



B03g  
Piperacks

SPA WNP Ingenieurs  
Constructieberekening  
7. Piperacks



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Yara Sluiskil - Project CCS



Plant Description

**Carbon Capture Storage Plant, Sluiskil**

Linde Project No.  
**3710 A3T8**

Client Project No.  
**16471**

Linde Project Code  
**Sluiskil**

Client Project Code  
**CACTUS**

Linde Doc. No.  
**0542FA4650 2001 N-CS 1003 (EN)**

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**16471-Y16-00010**

Client Revision  
**00**

**STRUCTURAL PRE-CALCULATION  
for PIPERACK SR0501**

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<b>Status</b>	<b>Issue</b>	<b>Date</b>	<b>Prepared</b>	<b>Reviewed</b>	<b>Approved</b>	<b>Remarks</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## CONTENT

<b>1. GENERAL DATA &amp; BASIS FOR DESIGN CALCULATIONS</b>	<b>5</b>
1.1 INTRODUCTION	5
1.2 REFERENCE DOCUMENTS	6
1.2.1 PROJECT SPECIFICATIONS	6
1.2.2 CODES & STANDARDS	6
1.2.3 REFERENCE DOCUMENTS	7
1.3 DESIGN CRITERIA	7
1.4 DESCRIPTION OF GEOMETRY	7
1.5 COMPUTERISED ANALYSIS CRITERIA	7
1.5.1 SUPPORT CONDITION	9
<b>2. PRIMARY LOAD CASES AND LOAD COMBINATIONS</b>	<b>11</b>
2.1 PRIMARY LOAD CASES	11
2.2 MAIN & SPECIAL LOAD COMBINATIONS	15
<b>3 DETAILED LOAD CALCULATIONS</b>	<b>16</b>
3.1 DEAD LOAD (L/C:10)	16
3.1.1 SELF WEIGHT OF STRUCTURE (L/C:101)	16
3.1.2 DEAD LOAD OF GRATING, HANDRAIL & LADDER (L/C:111)	17
3.2 LIVE LOAD (L/C:20)	18
3.2.1 LIVE LOAD ON SERVICE PLATFORMS (L/C:202)	18
3.3 EMPTY WEIGHT OF PIPING/EQUIPMENT/E&I (L/C:30)	19
3.3.1 EMPTY WEIGHT OF PIPING (UDL) (L/C:301)	19
3.3.2 EMPTY WEIGHT OF PIPING (CONC) (L/C:302)	19
3.3.3 EMPTY WEIGHT OF EQUIPMENT (L/C:321)	20
3.3.4 EMPTY WEIGHT OF CABLE TRAY (L/C:322)	21
3.4 OPERATING WEIGHT OF PIPING/EQUIPMENT/E&I (L/C:40)	22
3.4.1 OPERATING WEIGHT OF PIPING (UDL) (L/C:401)	22
3.4.2 OPERATING WEIGHT OF PIPING (CONC) (L/C:402)	22
3.4.3 OPERATING WEIGHT OF EQUIPMENT (L/C:411)	23
3.4.4 CABLE TRAY LOAD (L/C:420)	23
3.5 HYDROTEST WEIGHT OF PIPING/EQUIPMENT/E&I (L/C:50)	24
3.5.1 HYDROTEST WEIGHT OF PIPING (UDL) (L/C:501)	24
3.5.2 HYDROTEST WEIGHT OF PIPING (CONC) (L/C:502)	24
3.5.3 HYDROTEST WEIGHT OF EQUIPMENT (L/C:511)	24

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

3.6 WIND LOAD DUE TO SELF OBSTRUCTION IN -X DIRECTION (L/C:6110)	25
3.7 WIND LOAD DUE TO SELF OBSTRUCTION IN -Z DIRECTION (L/C:6310)	25
3.8 WIND LOAD IN +X DIRECTION (L/C: 61)	27
3.8.1 WIND LOAD ON STRUCTURE IN +X (E-W) DIRECTION (L/C:611)	27
3.8.2 WIND LOAD ON PIPING IN +X (E-W) DIRECTION (L/C:612)	27
3.8.3 WIND LOAD ON EQUIPMENT IN +X (E-W) DIRECTION (L/C:613)	28
3.8.4 WIND LOAD ON CABLE TRAYS IN +X (E-W) DIRECTION (L/C:614)	28
3.9 WIND LOAD IN +Z DIRECTION (L/C: 62)	
3.9.1 WIND LOAD ON STRUCTURE IN +Z (N-S) DIRECTION (L/C:621)	29
3.9.2 WIND LOAD ON PIPING IN +Z (N-S) DIRECTION (L/C:622)	29
3.9.3 WIND LOAD ON EQUIPMENT IN +Z (N-S) DIRECTION (L/C:623)	30
3.9.4 WIND LOAD ON CABLE TRAYS IN +Z (N-S) DIRECTION (L/C:624)	30
3.10 WIND LOAD IN -X DIRECTION (L/C: 63)	31
3.10.1 WIND LOAD ON STRUCTURE IN -X (W-E) DIRECTION (L/C:631)	31
3.10.2 WIND LOAD ON PIPING IN -X (W-E) DIRECTION (L/C:632)	31
3.10.3 WIND LOAD ON EQUIPMENT IN -X (W-E) DIRECTION (L/C:633)	32
3.10.4 WIND LOAD ON CABLE TRAYS IN -X (W-E) DIRECTION (L/C:634)	32
3.11 WIND LOAD IN -Z DIRECTION (L/C: 64)	33
3.11.1 WIND LOAD ON STRUCTURE IN -Z (S-N) DIRECTION (L/C:641)	33
3.11.2 WIND LOAD ON PIPING IN -Z (S-N) DIRECTION (L/C:642)	34
3.11.3 WIND LOAD ON EQUIPMENT IN -Z (S-N) DIRECTION (L/C:643)	34
3.11.4 WIND LOAD ON CABLE TRAYS IN -Z (S-N) DIRECTION (L/C:644)	34
3.12 PIPE THERMAL LOAD IN X (E-W) DIRECTION (L/C: 81)	35
3.13 PIPE THERMAL LOAD IN Z (N-S) DIRECTION (L/C: 82)	35
3.14 STEEL THERMAL LOAD ON STRUCTURE IN WARM DIRECTION (L/C: 85)	36
3.15 STEEL THERMAL LOAD ON STRUCTURE IN COLD DIRECTION (L/C: 86)	36
3.16 VERTICAL LOAD DUE TO TRAFFIC MOVEMENT	37
3.17 MINIMUM VERTICAL LOAD FOR BEAM DESIGN (L/C: 93)	37
3.18 SNOW LOAD ON STRUCTURE/PIPE/CABLE TRAY (SL) (L/C: 94)	39
3.19 BLAST LOADS	40
3.19.1 BLAST LOAD IN +X DIRECTION ON FIRST FRAME (L/C:961)	40
3.19.2 BLAST LOAD IN +X DIRECTION ON SECOND FRAME (L/C:962)	40
3.19.3 BLAST LOAD IN +X DIRECTION ON 3 <sup>RD</sup> FRAME (L/C:963)	41
3.19.4 BLAST LOAD IN +X DIRECTION ON 4 <sup>TH</sup> FRAME (L/C:964)	41

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

3.19.5 BLAST LOAD IN +X DIRECTION ON 5 <sup>TH</sup> FRAME (L/C:965)	42
3.19.6 BLAST LOAD IN +X DIRECTION ON 6 <sup>TH</sup> FRAME (L/C:966)	43
3.19.7 BLAST LOAD IN -X DIRECTION ON FIRST FRAME (L/C:971)	44
3.19.8 BLAST LOAD IN -X DIRECTION ON SECOND FRAME (L/C:972)	44
3.19.9 BLAST LOAD IN -X DIRECTION ON 3 <sup>RD</sup> FRAME (L/C:973)	45
3.19.10 BLAST LOAD IN -X DIRECTION ON 4 <sup>TH</sup> FRAME (L/C:974)	45
3.19.11 BLAST LOAD IN -X DIRECTION ON 5 <sup>TH</sup> FRAME (L/C:975)	46
3.19.12 BLAST LOAD IN -X DIRECTION ON 6 <sup>TH</sup> FRAME (L/C:976)	46
3.19.13 BLAST LOAD IN +Z DIRECTION (L/C:98)	47
3.19.14 BLAST LOAD IN -Z DIRECTION (L/C:99)	47
3.20 EARTHQUAKE LOAD	49
4 STATIC CHECK	50
5 MEMBER DESIGN AND POST PROCESSING	51
5.1 DESCRIPTION OF MEMBER DESIGN	51
5.2 DESIGN PARAMETERS	51
5.3 UTILIZATION RATIO	51
5.4 DEFLECTION / DRIFT CHECK	63
5.5 MEMBER SIZE	66
6 BASE PLATE DESIGN	77
7 ANCHOR BOLT DESIGN	84
8 PEDESTAL/PILE/PILE CAP DESIGN	87
8.1 PEDESTAL DESIGN	87
8.2 PILE LAYOUT (WITH REACTION, SETTLEMENT CHECK)	91
8.3 PILE CAP DESIGN	94
9 ANNEXURE A : WIND LOAD	101
10 ANNEXURE B : BLAST LOAD	105
11 ANNEXURE C : SNOW LOAD	109
12 ANNEXURE D : LOAD INPUT	111
13 ANNEXURE E : LOAD COMBINATION	116
14 ANNEXURE F : STAAD INPUT FOR SUPERSTRUCTURE ANALYSIS & DESIGN	121
15 ANNEXURE G : STAAD INPUT FOR SUBSTRUCTUREANALYSIS & DESIGN	187

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 1. GENERAL DATA & BASIS FOR DESIGN CALCULATIONS

### 1.1 INTRODUCTION

The Preliminary static calculation report consists of Analysis & Design of Superstructure & foundation of piperack SR0501 in the plant area.

This document forms the part of Basic FEED engineering for the project of “Carbon Capture Storage plant, Sluiskil CO2”.

The site is located in Industrial area of YARA Sluiskil. The industrial site is on the Ghent-Terneuzen channel on the opposite bank of the village of Sluiskil in the province of Zeeland in the Netherlands.

Dimensions, Geometry and the section sizes are as per this preliminary static calculation and subject to verification during further design stages.

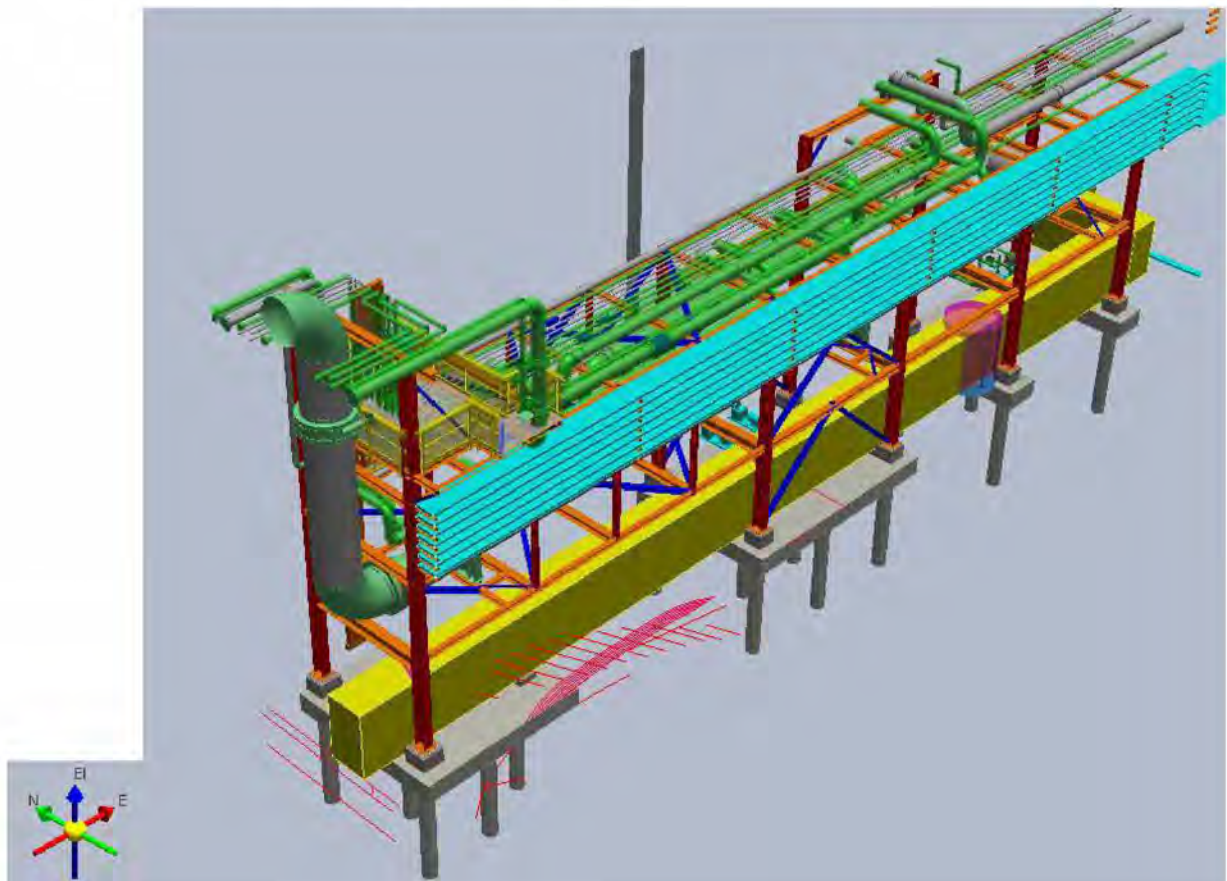


Figure 1.1: 3D model view of piperack SR0501

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 1.2 REFERENCE DOCUMENTS

### 1.2.1 PROJECT SPECIFICATIONS

Civil and steel structure related client specifications are listed as follows.

Owners document no.	Document number	Title
16471-B45-00005	-	APP 2 Att 5-Civil specification
16471-Y85-00001	&AE 0000 N-SP 1001 (EN)	Steel Structure and Civil Design basis & General description
16471-C02-00001	-	Appendix 2 att 1 annex 1 – Design Basis
16471-C50-00001	-	Appendix 2 att 1 annex 2 - Site specification

### 1.2.2 CODES & STANDARDS

Following codes and standards are used for the analysis & design of piperack.

Netherlands Standard: Issue Date	Title
NEN-EN 1990:2019	Basis of structural design
NEN-EN 1991-1-1:2009	Part 1-1: General actions - Densities, self-weight, imposed loads for buildings
NEN-EN 1991-1-3:2015	Part 1-3: General Actions - Snow loads
NEN-EN 1991-1-4:2010	Part 1-4: General Actions - Wind actions
NEN-EN 1991-1-7:2014	Part 1-7: General actions - Accidental actions
NEN-EN-1998-1:2005	Design of structures for earthquake resistance
NEN-EN 1993-1-1:2014	Design of Steel structures: General rules and rules for buildings
NEN-EN-1992-1-1:2016	Design of concrete structures: General rules and rules for buildings



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

Reference documents:

Sr. No.	Document number	Title
1	&AE 2001 N-ZD 1001 (EN)/16471-Y56-0006	Steel structure layout drawings PIPERACK SR0501 Isometric view & Level views
2	&AE 2001- N-ZD 1002 (EN)/16471-Y56-0012	Steel structure layout drawings PIPERACK SR0501 Elevations
3	&AE 2001 C-ZA 1001 (EN)/16471-Y56-00007	General arrangement drawings – Foundation/Piling CO2 liquification.

### 1.3 DESIGN CRITERIA

- \* All steel columns have pinned base plate connection at the bottom.
- \* The piperack is having moment frame in Lateral direction & braced frame in longitudinal direction.
- \* All steel members are designed as per NEN EN 1993-1-1:2014
- \* Additional horizontal load of value 0.5% of the vertical load (Dead Load + Live Load + Operating Load) is applied in both horizontal directions (X and Z) to take care of the imperfections of the columns.
- \* Lateral deflection check is carried out from nodal displacements.

### 1.4 DESCRIPTION OF GEOMETRY

- \* H.P.P elevation is +1.700 m N.A.P, which is considered as base datum +0.000m.
- \* Structures comprises of RCC pedestals upto EL+0.300m & steel structure from EL+0.300 to up levels.
- \* There are three pedestals which are upto the HPP level, and shall be used at the time of testing the 48" diameter of pipe that is resting at +3.700m level.
- \* The piperack SR0501 is 31m long, 4m wide & 8m high in the size.
- \* There is an additional platform of 4m length, 4m wide and 0.8m high from the main piperack level situated at grid 1 & 2.
- \* The piperack is supporting 48" diameter pipe at the first level +3.700m. At second level +5.000 20" diameter of pipes are supported. And at third main level +8.000, smaller bore pipes which are 2"/3" are supported.

### 1.5 COMPUTERISED ANALYSIS CRITERIA

- \* Three-dimensional mathematical model is analysed by using STAAD Pro CONNECT Edition 22.10.00.153 3D analysis model considers nodes at centre line of column and beam for simplicity.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* All the horizontal beam members are modelled at TOS level.

\* **For superstructure member and Base plate design - The structural steel columns are modelled up to EL (BOBP) In STAAD file as shown in figure 1.5.1.**

\* **For foundation design – Staad model used for Superstructure is updated by modelling pedestals (beam element), pile cap (finite element mesh) & piles (spring constants) as shown in figure 1.5.2.**

\* At some places Hangers, cantilever beams and brackets are not included in static model, but the reactions of the same are transferred to the main frame to get equivalent effect.

\* All other assumptions have been mentioned as and where applicable.

The general system of the computer model is with global axis system:

X = Horizontal axis in computer model along East - West direction.

Y = Vertical axis in computer model (positive upward direction)

Z = Horizontal axis in computer model along North - South direction.

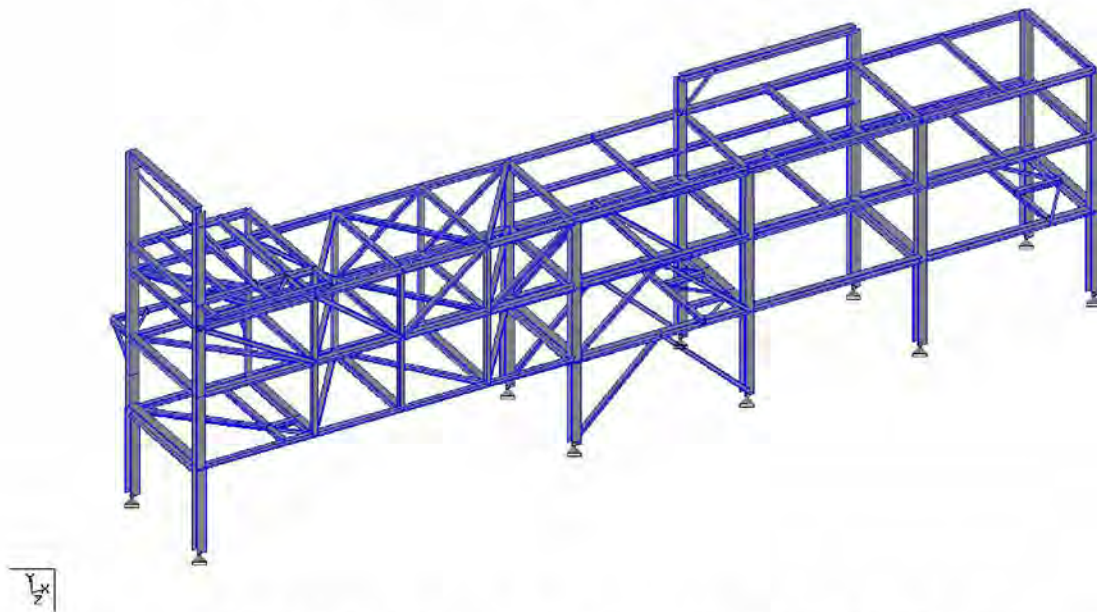


Figure 1.5.1: staad model (for superstructure member analysis & design)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

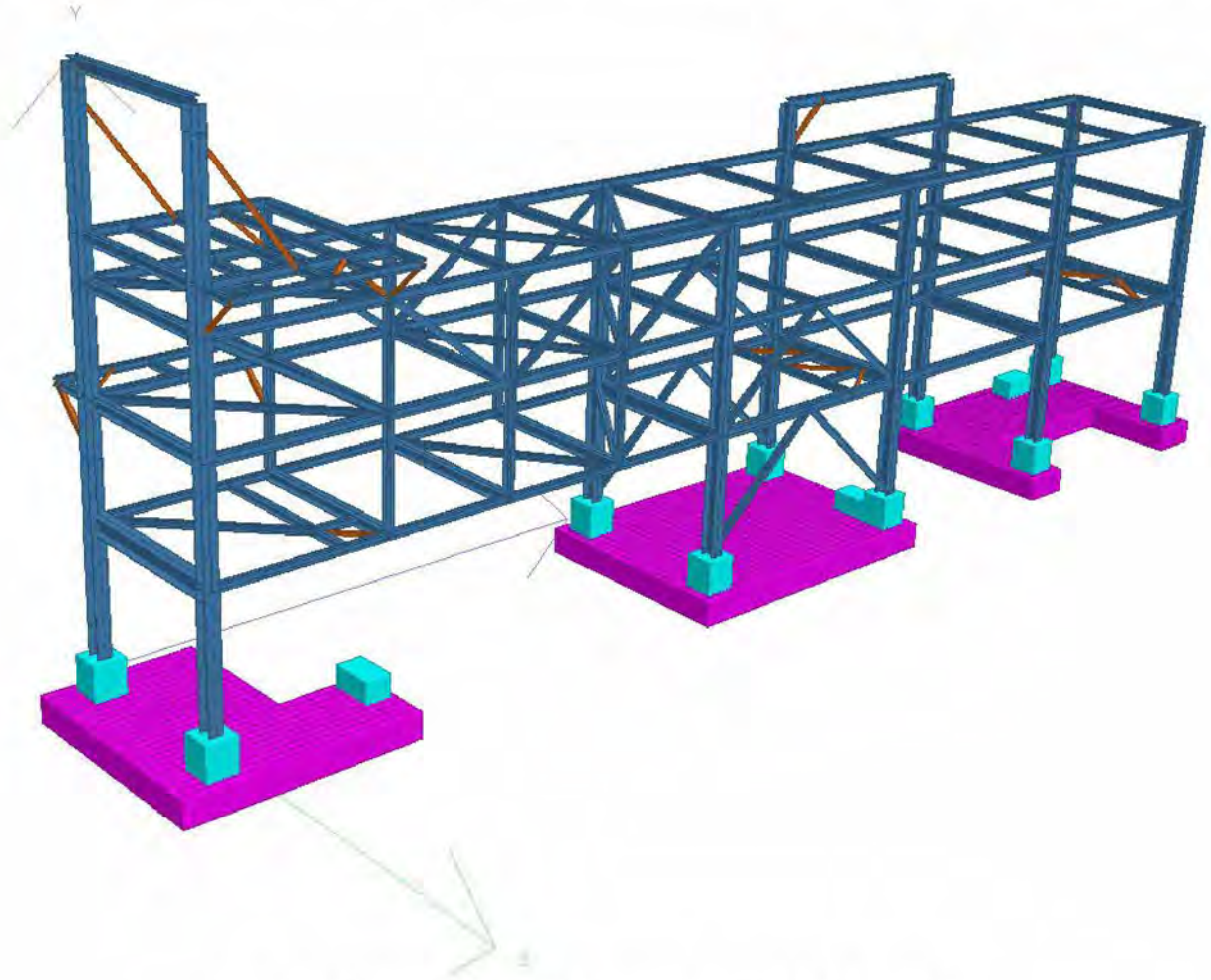


Figure 1.5.2: staad model (for substructure analysis & design)

#### 1.5.1 SUPPORT CONDITION

\* All supports are considered as pinned at the bottom of base plate level at EL+0.300m (see figure 1.5.1.1).

\* The spring constant are modelled at the location of piles (see figure 1.5.1.2).

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

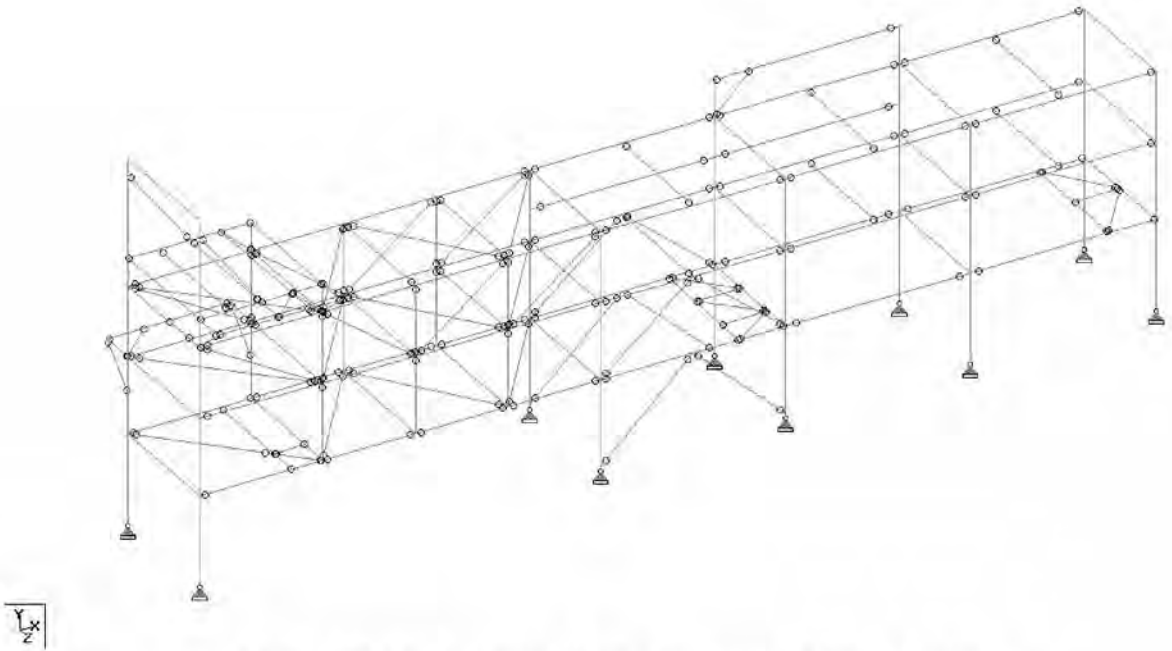


Figure 1.5.1.1: staad model (for superstructure analysis & design)

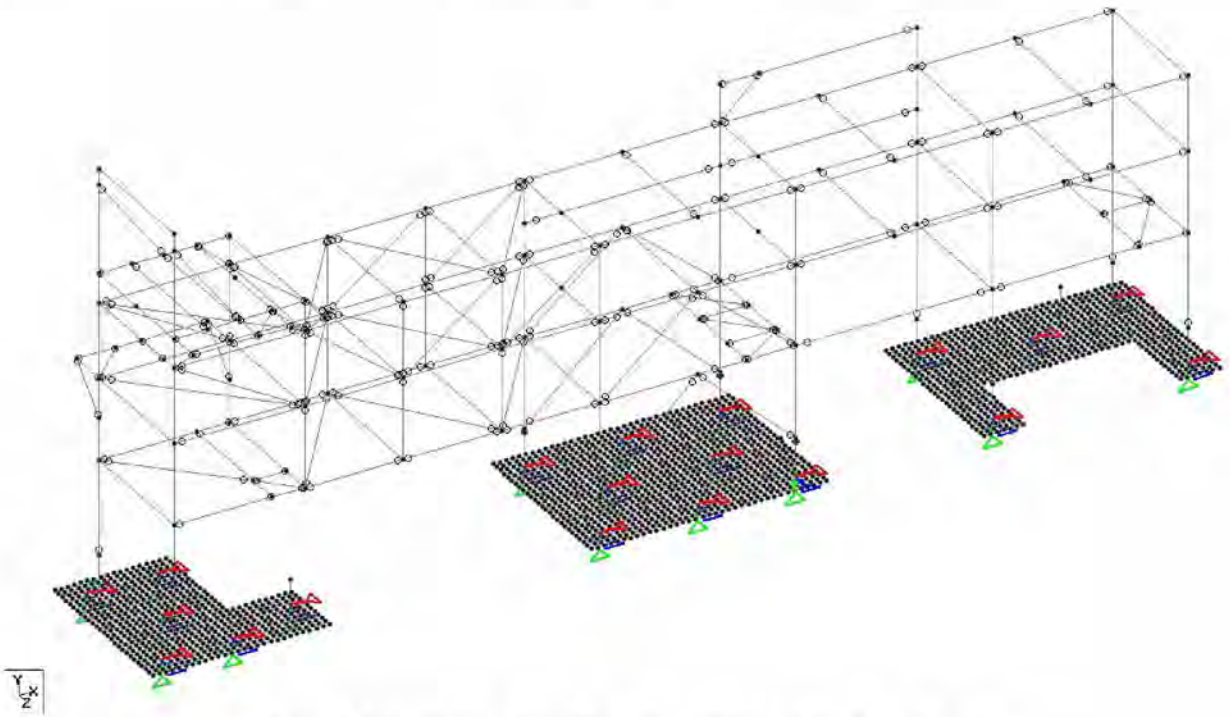


Figure 1.5.1.2: staad model (for substructure analysis & design)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 2. PRIMARY LOAD CASES AND LOAD COMBINATIONS

### 2.1 PRIMARY LOAD CASES

The piperack SR0501 is designed for the below Primary Load cases and for Load combinations.

<b>Basic Load Cases and Load Description</b>	
<b>Basic Load Case No</b>	<b>Load Description</b>
<b>STRUCTURAL DEAD LOAD</b>	
101	Modelled Structural/ Foundation Self Weight
102	Node/ Connection weight/Lifting Lug/ pad-eye weight
<b>100</b>	<b>Primary Structural Steel (Sum of LC 101 to 102)</b>
111	Grating/ Chequered plate /Equipment supports / Secondary platforms/ Staircase stringer /ladder /Handrail
112	Pipe Supports/ Monorails, runway beams, Material handling items
113	Rigging weight/Sea fastening/ lashing/ securing weights
<b>110</b>	<b>Secondary &amp; Tertiary Structural Steel ( Unmodeled Part) (Sum of LC 111 to 113)</b>
<b>120</b>	<b>Additional Load to Match the WCR Structural weight</b>
131	Painting load
132	Fire Proofing loads
<b>130</b>	<b>Miscellaneous Loads (Sum of LC 131 and LC 132)</b>
<b>140</b>	<b>Hook up Loads</b>
<b>10</b>	<b>Total Structural Dead Load (Sum of LC 100, 110, 120, 130,140,150)</b>
<b>LIVE LOADS</b>	
201	Open Area Live Loads/ operating Platforms (5 kN/m <sup>2</sup> )
202	Live Load on Service Platforms, pedestals, Walkways (3 kN/m <sup>2</sup> )
203	Live Load on Stairways (5kN/m <sup>2</sup> )
<b>20</b>	<b>Total Live Load (Sum of LC 201 to 203) ( LL)</b>
<b>Piping Dry Weights</b>	
301	Empty weight of pipe (UDL)/pipe area load
302	Empty weight of pipe valves, Supports (Point Load)
303	Empty weight of pipe valves, Supports on Hook up steel
<b>300</b>	<b>Piping Dry Weights (Sum of LC 301 to 303)</b>
<b>Mechanical Equipment Dry Weights</b>	

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

311	Equipment Dry Weight (> 5mT)
312	Equipment Dry Weight (<5 mT) /Area load
<b>310</b>	<b>Mechanical Dry Weights (Sum of LC 311 to 312)</b>
<b>Electrical Dry Weights</b>	
321	Electrical Equipment Dry Weight
322	Electrical Cables, Cable ducts/ trays
<b>320</b>	<b>Electrical Dry Weights (Sum of LC 321 to 322)</b>
<b>Instrumentation Dry Weights</b>	
331	Instrumentation Equipment Dry Weight
332	Instrumentation Cables, Cable ducts/ trays
<b>330</b>	<b>Instrumentation Dry Weights (Sum of LC 331 to 332)</b>
<b>30</b>	<b>Total Empty Weight of Piping/ Equipment/ E&amp;I (Sum of LC 300, 310, 320, 330)</b>
<b>Operating Pipe (Empty +Content) Weights (EQLO)</b>	
401	Operating weight of pipe (UDL)/ Area Load
402	Operating weight of pipe support (Point load)
<b>400</b>	<b>Operating Pipe Weights (Sum of LC 401 to 402)</b>
<b>Mechanical Equipment Operating Weights (Empty + Content)</b>	
411	Equipment Operating Weight (> 5mT)
412	Equipment Operating Weight (<5 mT)
<b>410</b>	<b>Mechanical Equipment Weights (Sum of LC 411 to 412)</b>
<b>Electrical Item Weight for Operating Condition</b>	
421	Electrical Equipment Weight/ Bulk Items/Cables, Cable ducts/ trays
<b>420</b>	<b>Electrical Item Weights in Operating Condition(LC 421)</b>
<b>Instrumentation Item Weights in Operating Condition</b>	
431	Instrumentation Equipment Weight/ Bulk Items/Cables, Cable ducts/ trays
<b>430</b>	<b>Instrumentation Item Weights in Operating Condition (LC 431)</b>
<b>40</b>	<b>Total Operating Weight of Piping/ Equipment/ E&amp;I (Sum of LC 400, 410, 420, 430)</b>
<b>Piping Hydrotest Weights</b>	
501	Hydrotest weight of piping (UDL)
502	Hydrotest weight of pipe supports (Point load)
<b>500</b>	<b>Piping Hydrotest Weights (Sum of LC 501 to 502)</b>
<b>Mechanical Equipment Hydrotest Weights</b>	
511	Equipment Hydrotest Weight (> 5mT)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

512	Equipment Hydrotest Weight (<5 mT)
<b>510</b>	<b>Mechanical Hydrotest Weights (Sum of LC 511 to 512)</b>
<b>50</b>	<b>Total Hydrotest Weight of Piping/ Equipment/ E&amp;I (Sum of LC 500, 510, 420, 430)</b>
<b>Wind loads due to structure self obstruction [W-E] -ve X direction</b>	
<b>6110</b>	Wind loads due to structure self obstruction [W-E] -ve X direction
<b>Wind loads due to structure self obstruction [S-N] -ve Z direction</b>	
<b>6310</b>	Wind loads due to structure self obstruction [S-N] -ve Z direction
<b>In-service Wind Load in +ve X-Direction [WLX:E-W]</b>	
611	Wind Load on Structure due to self obstruction in +ve X-(E-W) Direction
612	Wind load on Piping in +ve X-(E-W) Direction
613	Wind load on equipment +ve X-(E-W) Direction
614	Wind load on cable tray +ve X-(E-W) Direction
<b>61</b>	<b>Total Wind Load in +ve X-(E-W) Direction (LC 611+LC612+LC613+LC614)</b>
<b>In-service Wind Load in +ve Z-Direction [WLZ:N-S]</b>	
621	Wind Load on Structure due to self obstruction in +ve Z-(N-S) Direction
622	Wind load on Piping in +ve Z-(N-S) Direction
623	Wind load on equipment +ve Z-(N-S) Direction
624	Wind load on cable tray +ve Z-(N-S) Direction
<b>62</b>	<b>Total Wind Load in +ve Z-(N-S) Direction (LC 621+LC622+LC623+LC624)</b>
<b>In-service Wind Load in -ve X- Direction [WLX:W-E]</b>	
631	Wind Load on Structure due to self obstruction in -ve X-(W-E) Direction
632	Wind load on Piping in -ve X-(W-E) Direction
633	Wind load on equipment -ve X-(W-E) Direction
634	Wind load on cable tray -ve X-(W-E) Direction
<b>63</b>	<b>Total Wind Load in -ve X-(W-E) Direction (LC 631+LC632+LC633+LC634)</b>
<b>In-service Wind Load in -ve Z-Direction [WLZ:S-N]</b>	
641	Wind Load on Structure due to self obstruction in -ve Z-(S-N) Direction
642	Wind load on Piping in -ve Z-(S-N) Direction
643	Wind load on equipment -ve Z-(S-N) Direction
644	Wind load on cable tray -ve Z-(S-N) Direction
<b>64</b>	<b>Total Wind Load in -ve Z-(S-N) Direction (LC 641+LC642+LC643+LC644)</b>
<b>Thermal Load</b>	
<b>81</b>	<b>Piping Thermal Load In E-W Direction (FDN/GLOBAL DESIGN) (TLE)</b>

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

<b>82</b>	<b>Piping Thermal Load In N-S Direction (FDN/GLOBAL DESIGN) (TLN)</b>
<b>Friction Loads</b>	
<b>83</b>	<b>Pipe/Equipment Friction Load In E-W Direction (FLE)</b>
<b>84</b>	<b>Pipe/Equipment Friction Load In N-S Direction (FLN)</b>
<b>Structural Thermal Loads</b>	
<b>85</b>	<b>Structural Thermal Load on Structure in Warm Condition ( ENT+)</b>
<b>86</b>	<b>Structural Thermal Load on Structure in Cold Condition ( ENT-)</b>
<b>Local Wind Loads</b>	
<b>87</b>	<b>Local Wind Load on Pipe/Equipment in X -(E-W) Direction (Local Design) ( WindX<sub>Local</sub> )</b>
<b>88</b>	<b>Local Wind Load on Pipe/Equipment in Z -(N-S) Direction (Local Design) ( WindZ<sub>Local</sub> )</b>
<b>Local Piping Loads</b>	
<b>89</b>	<b>Local Pipe Horizontal Load in E-W Direction (Local Design) ( TLE<sub>Local</sub>)</b>
<b>90</b>	<b>Local Pipe Horizontal Load in N-S Direction (Local Design) (TLN<sub>Local</sub>)</b>
<b>Maintenance Load</b>	
<b>911</b>	Vertical Load Due to Crane, Monorail and Bundle Pull Loads
<b>912</b>	Horizontal Load Due to Crane, Monorail and Bundle Pull Loads
<b>91</b>	<b>Maintenance Load (Sum of LC 911 &amp; LC 912) (ML)</b>
<b>PSV Load</b>	
<b>92</b>	<b>Horizontal Loads of PSV (LOCAL DESIGN) ( PSV)</b>
<b>Minimum Vertical load</b>	
<b>93</b>	<b>Minimum Vertical Load For Beam Design ( V<sub>MIN</sub>)</b>
<b>Buoyancy load</b>	
<b>94</b>	<b>Snow Load</b>
<b>Notional Loads</b>	
<b>1001</b>	<b>Notional Load for Dead Load in X -(E-W) Direction (NLDE)</b>
<b>1002</b>	<b>Notional Load for Dead Load in Z -(N-S) Direction (NLDN)</b>
<b>1003</b>	<b>Notional Load for Empty Load of Piping &amp; Equipment in X-(E-W) (NLEE)</b>
<b>1004</b>	<b>Notional Load for Empty Load of Piping &amp; Equipment in Z-(N-S)(NLEN)</b>
<b>1005</b>	<b>Notional Load for Operating Load of Piping &amp; Equipmnt in X(E-W)(NLOE)</b>
<b>1006</b>	<b>Notional Load for Operating Load of Piping &amp; Equipmnt in Z(N-S)(NLON)</b>
<b>1007</b>	<b>Notional Load for Live Load in X -(E-W) Direction (NLLE)</b>
<b>1008</b>	<b>Notional Load for Live Load in Z -(N-S) Direction (NLLN)</b>



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 2.2 MAIN & SPECIAL LOAD COMBINATIONS

Refer annexure E for the detailed load combinations.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3 DETAILED LOAD CALCULATIONS

In the subsequent pages, figures for staad model (that together with substructure) for load application are included, only when there are any loads acting on the substructure. Else the picture of Superstructure staad file is included.

#### 3.1 DEAD LOAD (L/C:10)

##### 3.1.1 SELF WEIGHT OF STRUCTURE (L/C:101)

Dead load due to self weight of structure is applied using "SELFWEIGHT Y-1.15" command in the STAAD pro using density of 78.5 KN/cum for steel.

Selfweight of members is calculated automatically as per the member properties assigned to members and density provided.

This 15% additional selfweight is for taking into consideration of connection weight.

On the top of Raft, 200mm thick paving has been considered.

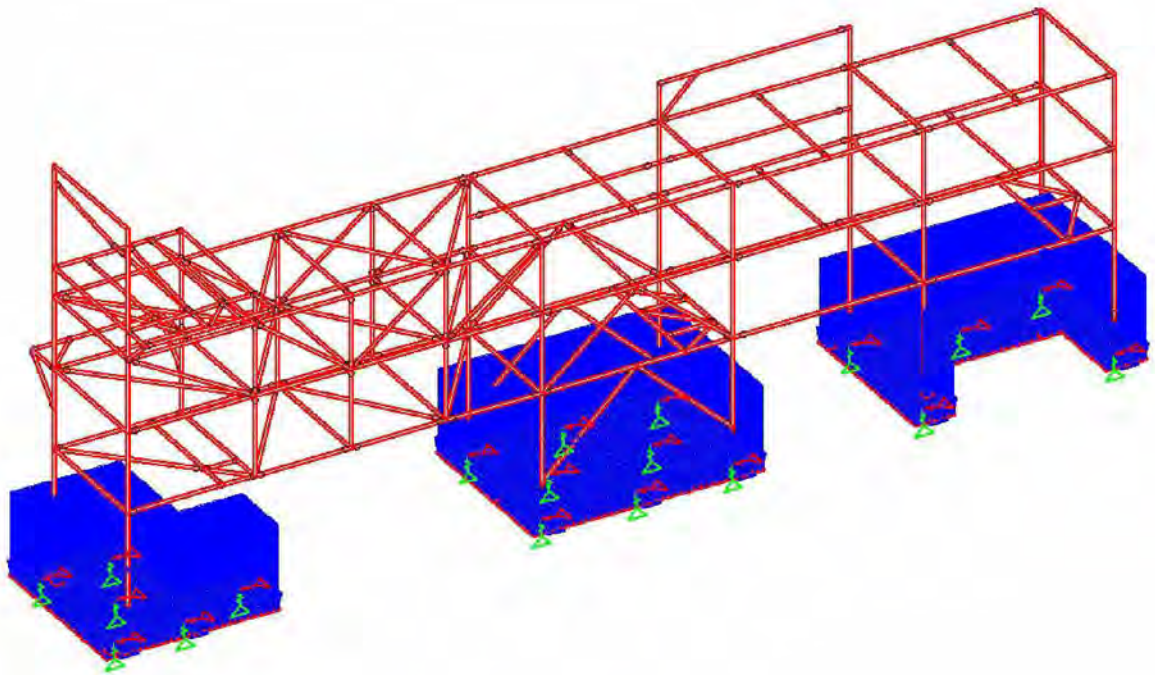


Figure 3.1.1.1: staad model (for superstructure analysis & design)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.1.2 DEAD LOAD OF GRATING, HANDRAIL & LADDER (L/C:111)

Dead load of 30mm thick GRP grating = 0.25 KN/m<sup>2</sup>

Dead load of handrail = 0.06 KN/m

Dead load of ladder = 0.10 KN/m

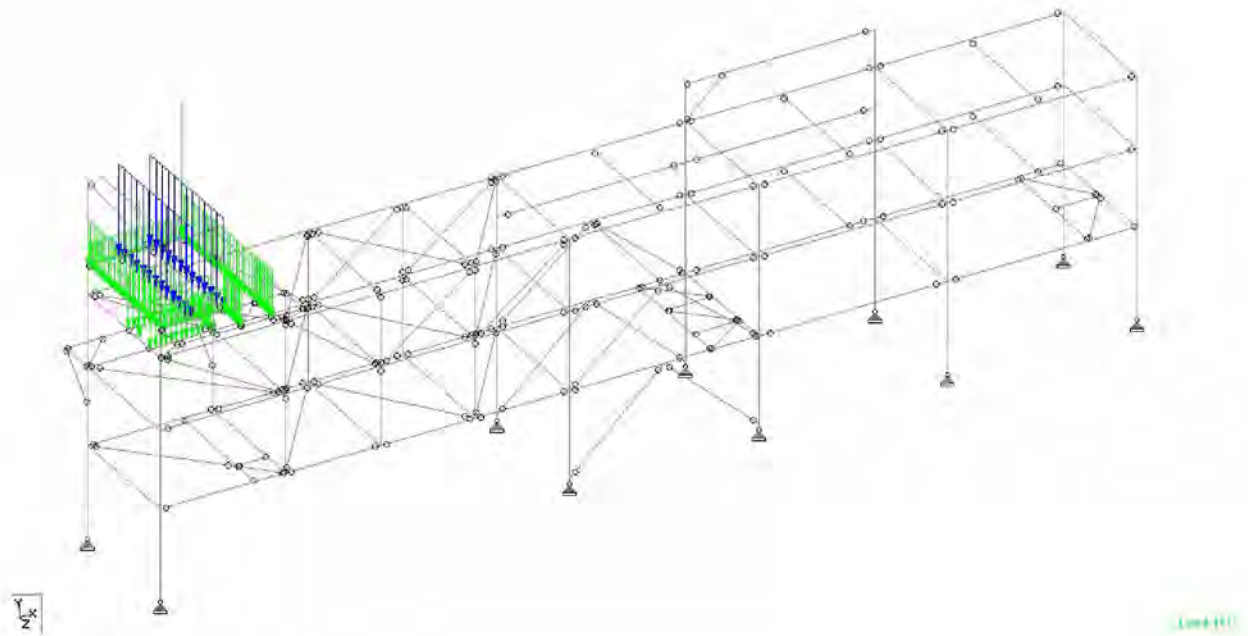


Figure 3.1.2.1 : Dead load of Grating, handrail, & Ladder

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.2 LIVE LOAD (L/C:20)

#### 3.2.1 LIVE LOAD ON SERVICE PLATFORMS (L/C:202)

Live load on the service platform applied as 3 KN/m<sup>2</sup> as per specification 10000-Y50-026.

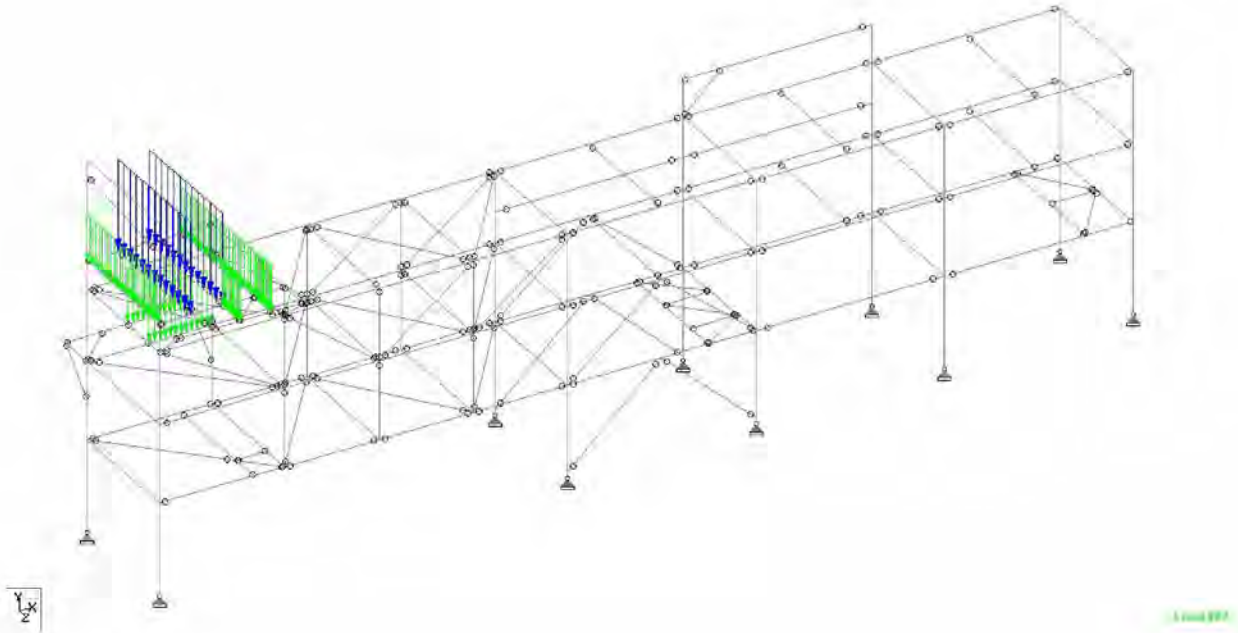


Figure 3.2.1.1 : Live load on Service platforms

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.3 EMPTY WEIGHT OF PIPING/EQUIPMENT/E&I (L/C:30)

#### 3.3.1 EMPTY WEIGHT OF PIPING (UDL) (L/C:301)

The Empty load of piping (UDL) is applied as per the Load input received. Refer annexure E.

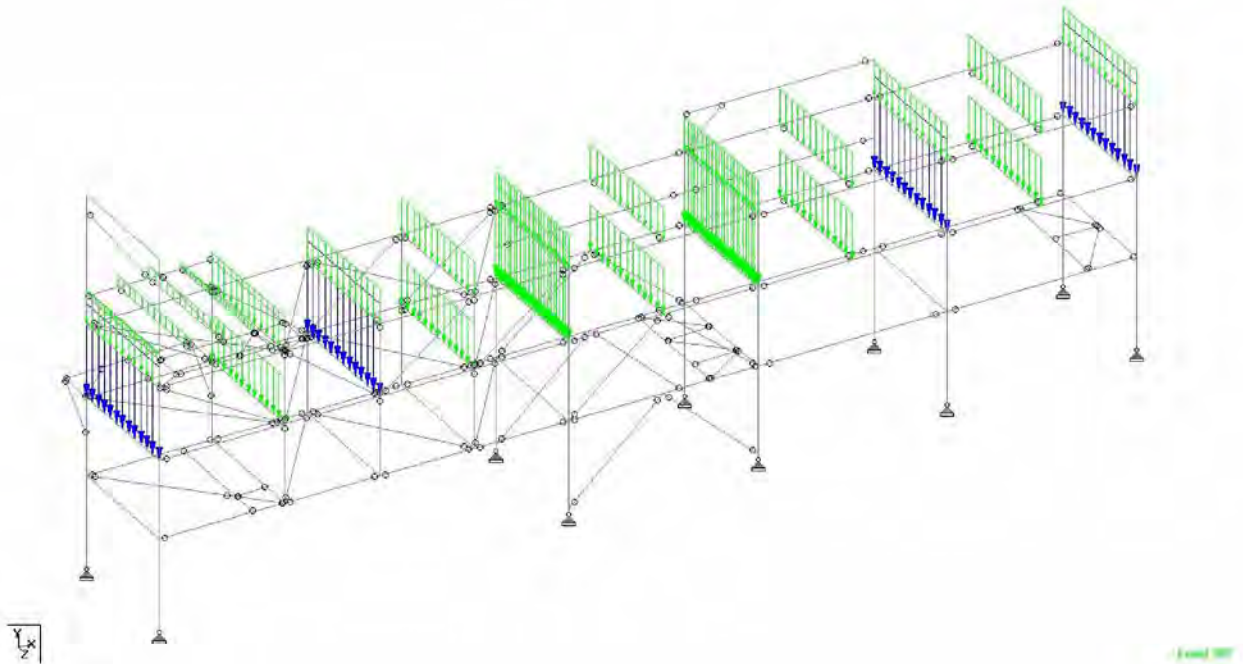


Figure 3.3.1.1 : Empty weight of piping (UDL)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.3.2 EMPTY WEIGHT OF PIPING (CONC) (L/C:302)

The Empty load of piping (CONC) is applied as per the Load input received. Refer Annexure

E.

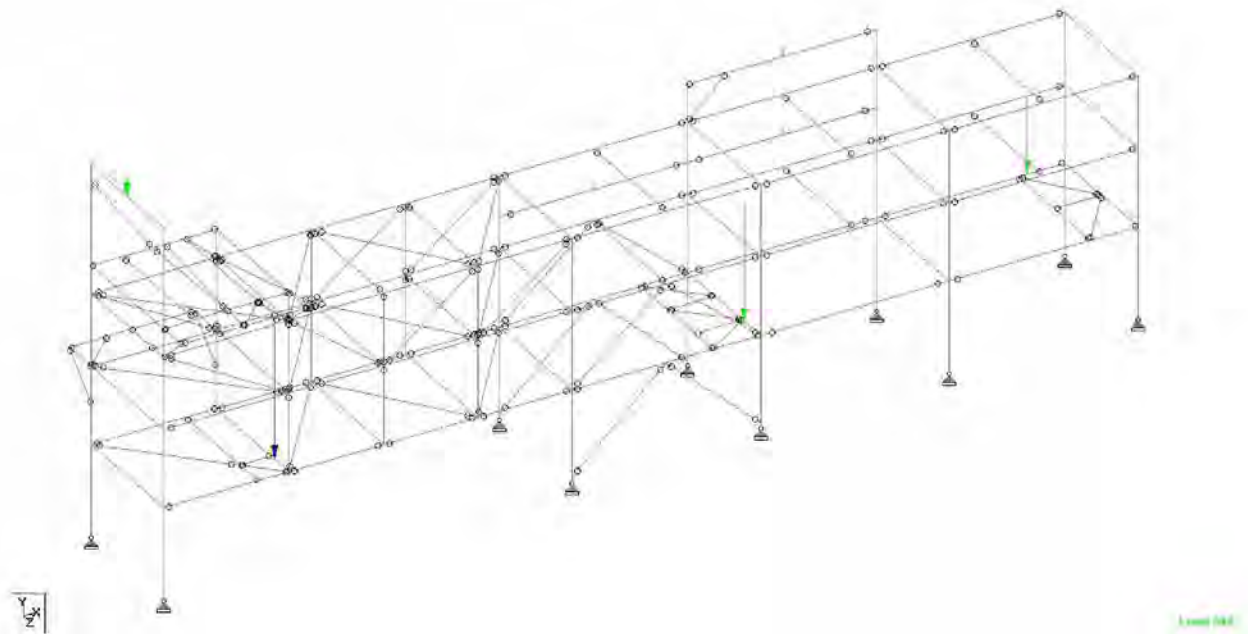


Figure 3.3.2.1 : Empty weight of piping (CONC)

### 3.3.3 EMPTY WEIGHT OF EQUIPMENT (L/C:311 & 312)

Not applicable

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.3.4 EMPTY WEIGHT OF CABLE TRAY (L/C:322)

The empty weight of cable trays considered as 1.3 KN/m.

There are total 7 cable trays attached to the column. The cable tray supports are not modelled. However the concerned loads were transferred to the supporting column with vertical load & the cantilever moments.

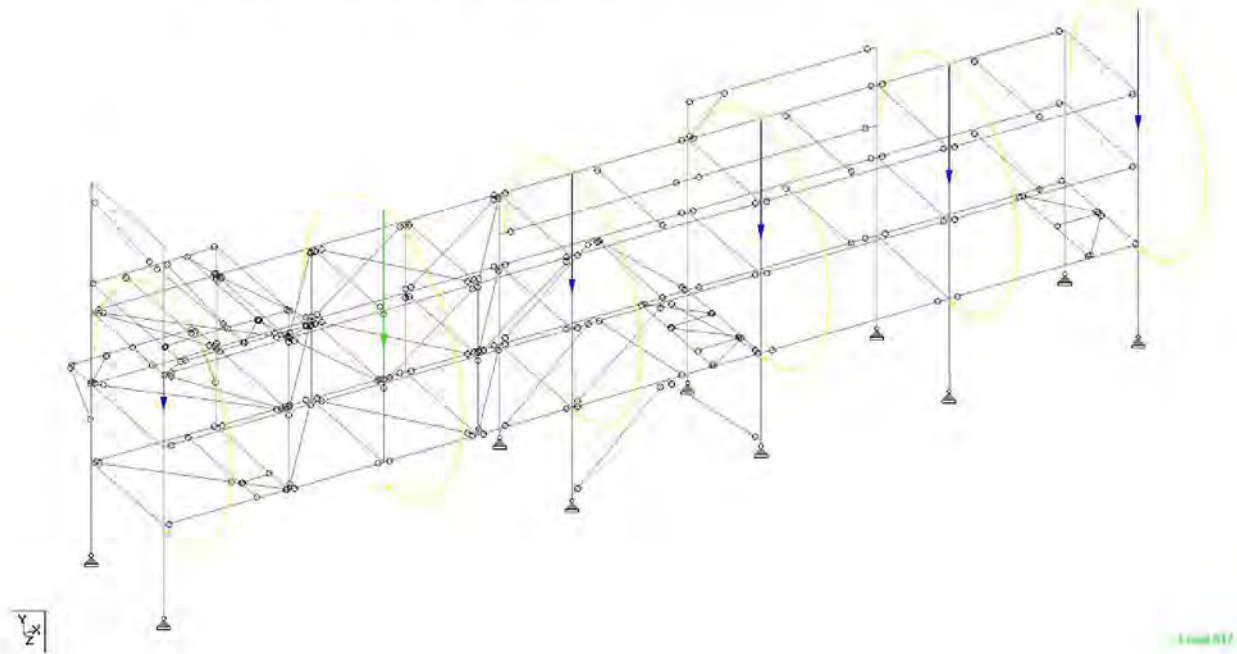


Figure 3.3.4.1 : Empty weight of Cable trays

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.4 OPERATING WEIGHT OF PIPING/EQUIPMENT/E&I (L/C:40)

#### 3.4.1 OPERATING WEIGHT OF PIPING (UDL) (L/C:401)

The Operating load of piping (UDL) is applied as per the Load inputs received. Refer Annexure E.

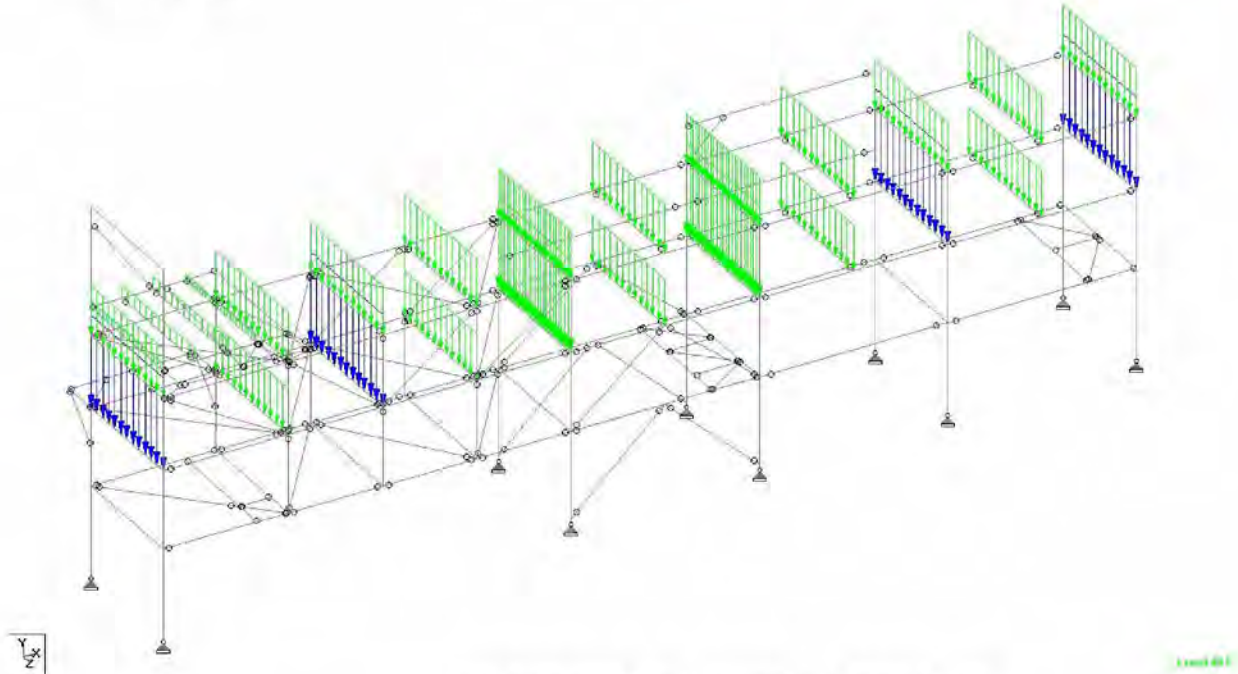


Figure 3.4.1.1 : Operating weight of piping (UDL)

#### 3.4.2 OPERATING WEIGHT OF PIPING (CONC) (L/C:402)

The Operating load of piping (CONC) is applied as per the Load inputs received. Refer annexure E.

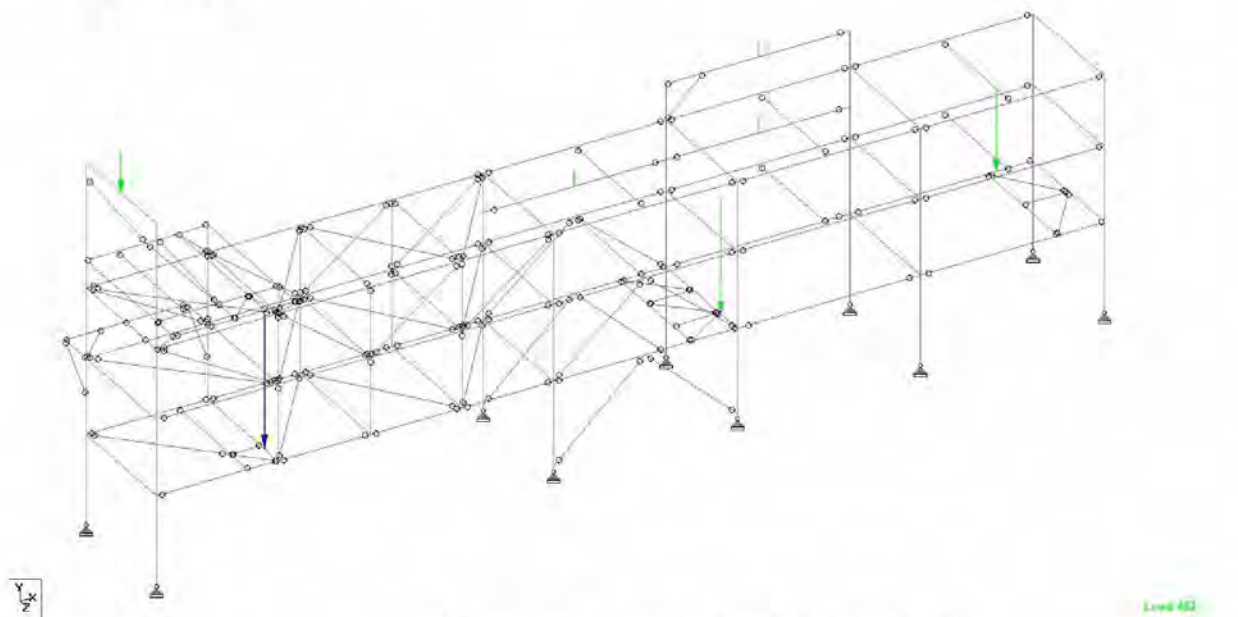


Figure 3.4.2.1 : Operating weight of piping (CONC)



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.4.3 OPERATING WEIGHT OF EQUIPMENT (L/C:411)

Not applicable

### 3.4.4 CABLE TRAY LOAD (L/C:420)

The operating weight of cable trays considered as 1.3 KN/m.

There are total 7 cable trays attached to the column. The cable tray supports are not modelled. However the concerned loads were transferred to the supporting column with vertical load & the cantilever moments.

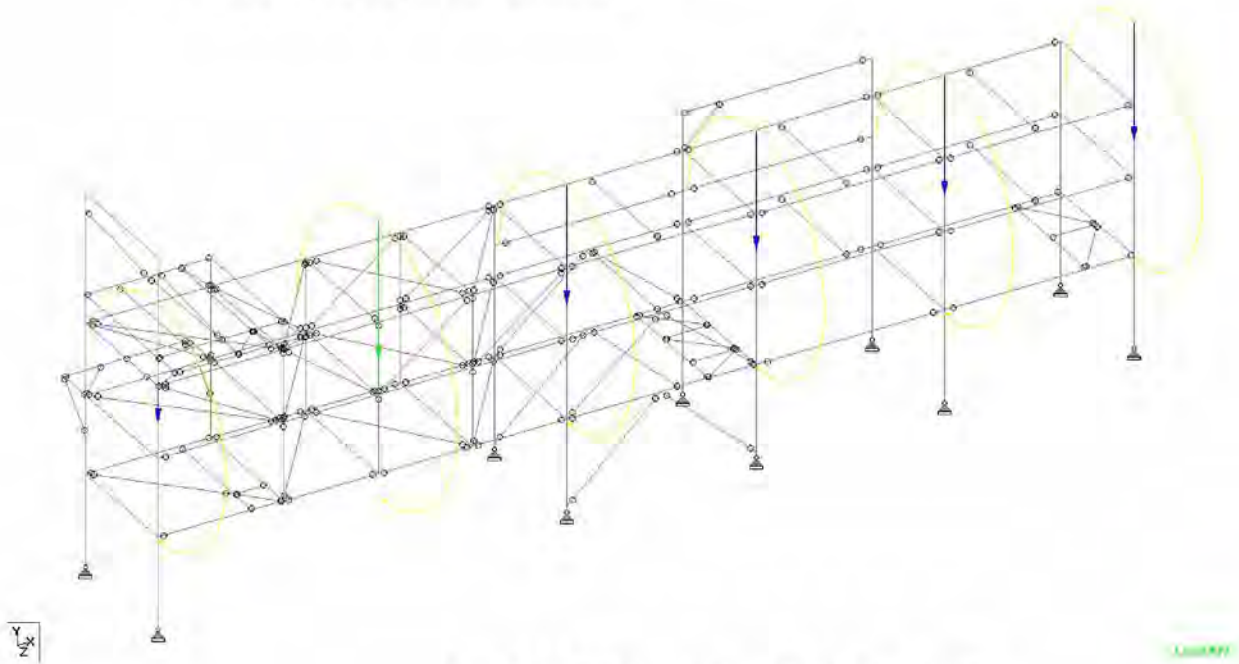


Figure 3.4.4.1 : Operating weight of Cable trays

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.5 HYDROTEST WEIGHT OF PIPING/EQUIPMENT/E&I (L/C:50)

#### 3.5.1 HYDROTEST WEIGHT OF PIPING (UDL) (L/C:501)

Not Applicable

#### 3.5.2 HYDROTEST WEIGHT OF PIPING (CONC) (L/C:502)

The Test load of piping (CONC) is applied as per the Load inputs received. Refer Annexure E.

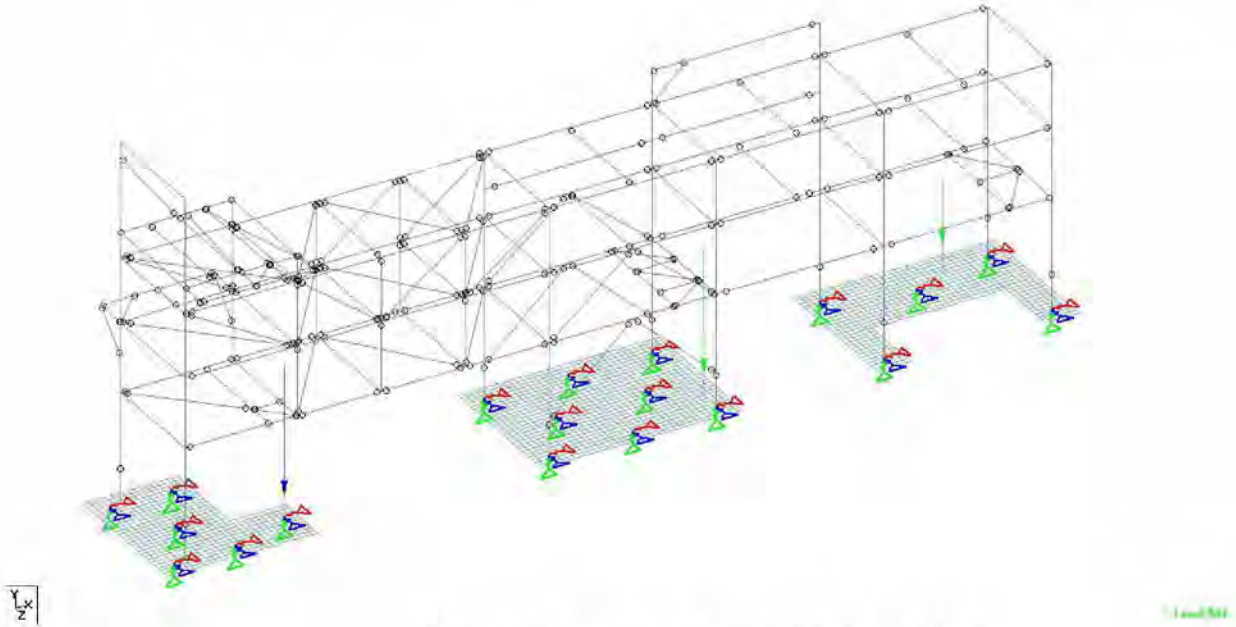


Figure 3.5.2.1 : Hydrotest weight of piping (CONC)

#### 3.5.3 HYDROTEST WEIGHT OF EQUIPMENT (L/C:511) ..... 28

Not Applicable

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.6 WIND LOAD DUE TO SELF OBSTRUCTION IN -X DIRECTION (L/C:6110)

Wind load is calculated as per Eurocode: EN-1991-1-4 as per 16741-C50-00001. This wind load on structure is applied due to self obstruction in -X direction.

As per document 16471-C50-00001, following parameter were used.

Wind zone II, wind speed = 27 m/s, Terrain type II,  $C_f=1.7$  for structural steel.

For Detailed calculation, refer Annexure A.

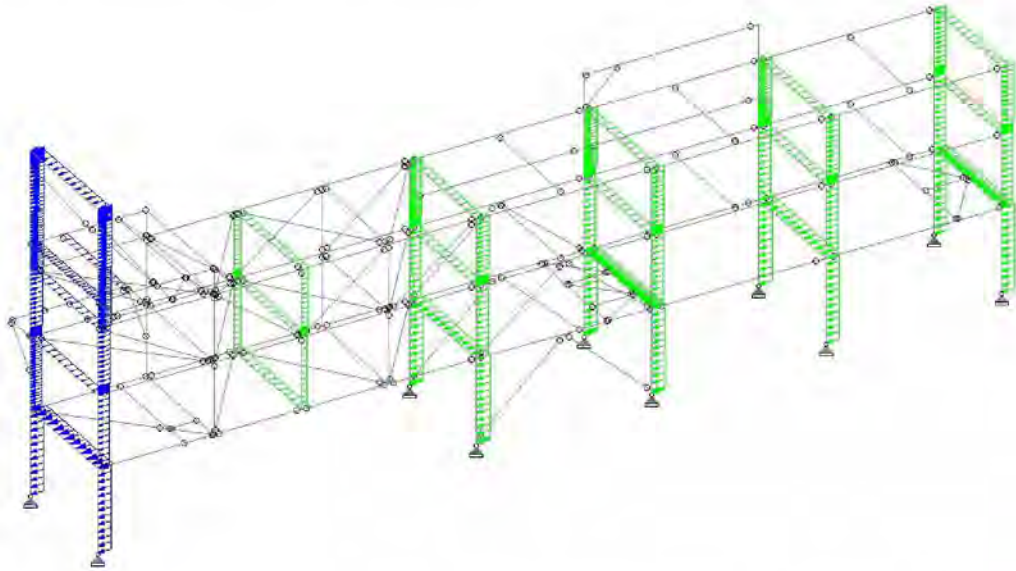


Figure 3.6.1 :Wind load (-X) due to self obstruction

### 3.7 WIND LOAD DUE TO SELF OBSTRUCTION IN -Z DIRECTION (L/C:6310)

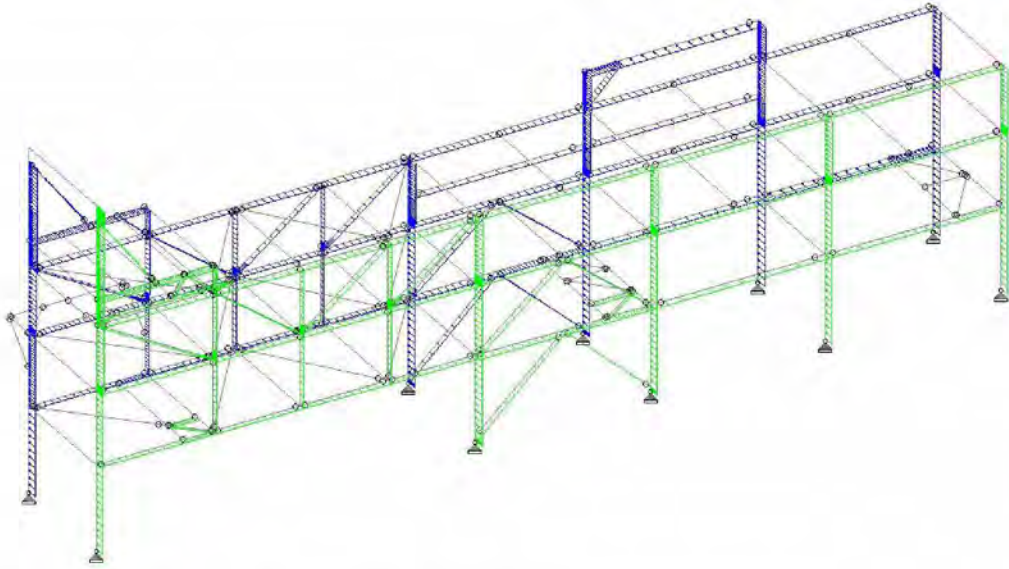
Wind load is calculated as per Eurocode: EN-1991-1-4. This wind load on structure is applied due to self obstruction in -Z direction.

As per document 16471-C50-00001, following parameter were used.

Wind zone II, wind speed = 27 m/s, Terrain type II,  $C_f=1.7$  for structural steel.

For Detailed calculation, refer Annexure A.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>



Load 8310

Figure 3.7.1 :Wind load (-Z) due to self obstruction

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.8 WIND LOAD IN +X DIRECTION (L/C: 61)

The wind load is applied on structure in +X direction (E-W) due to self obstruction of the structure, piping & Cable trays

**For detailed calculation refer annexure A.**

#### 3.8.1 WIND LOAD ON STRUCTURE IN +X (E-W) DIRECTION (L/C:611)

This is wind load on structure due to self obstruction in +X direction

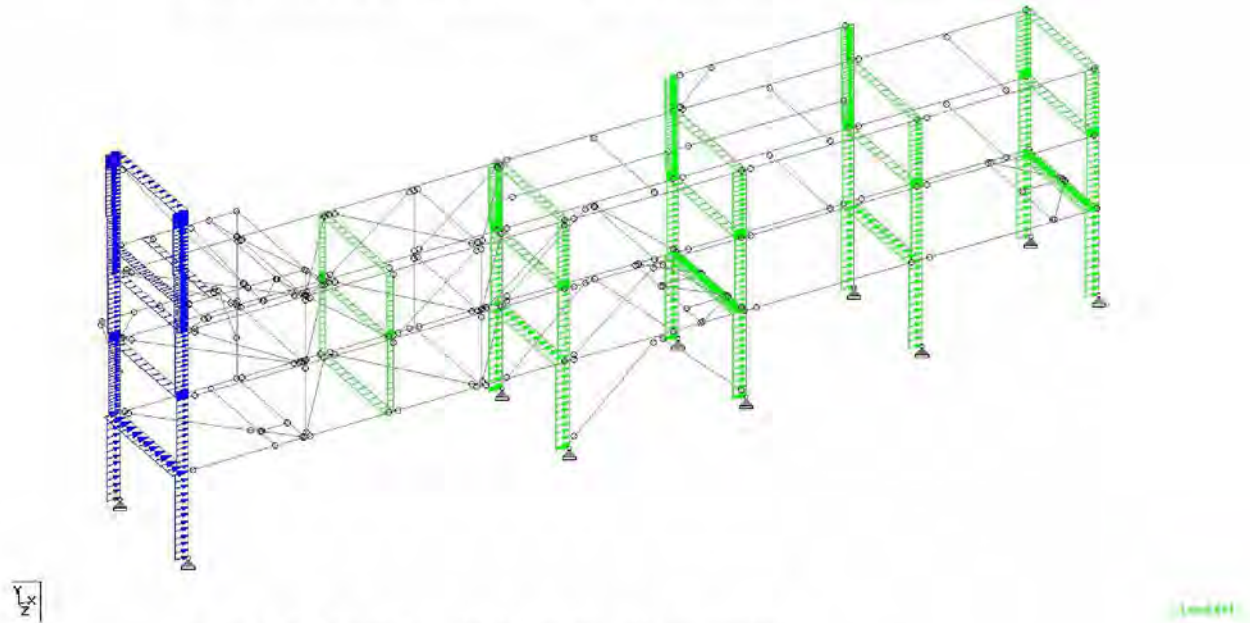


Figure 3.8.1.1 : Wind load (+X) due to self obstruction

#### 3.8.2 WIND LOAD ON PIPING IN +X (E-W) DIRECTION (L/C:612)

This wind load is applied on structure due to piping obstruction.

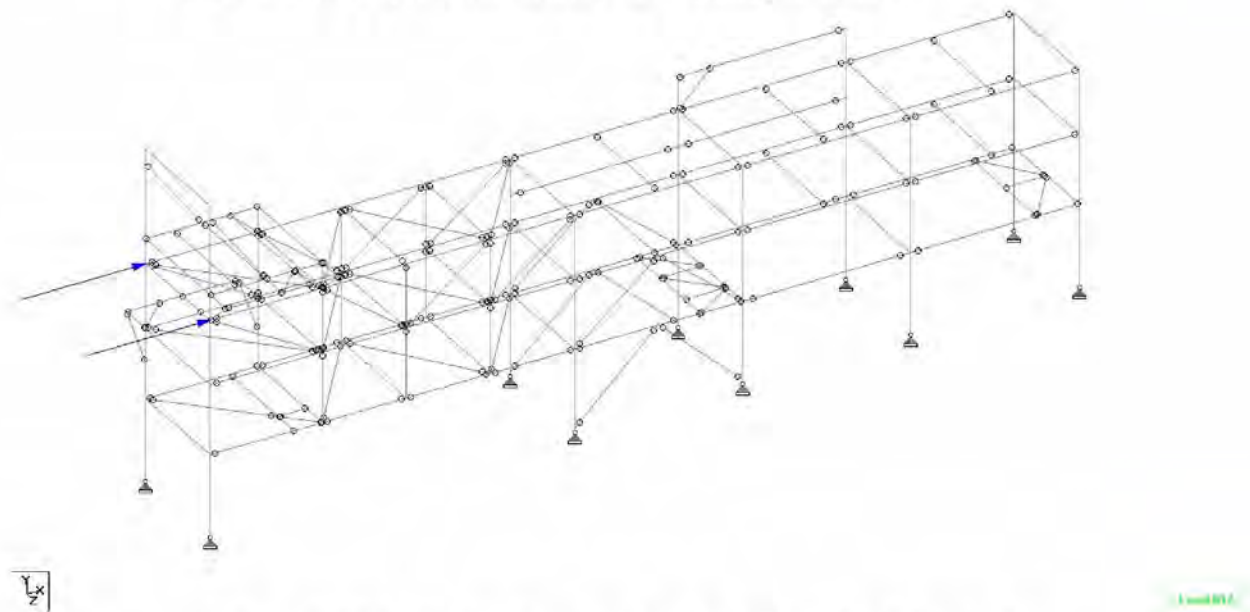


Figure 3.8.2.1 : Wind load on structure due to piping (in +X direction)

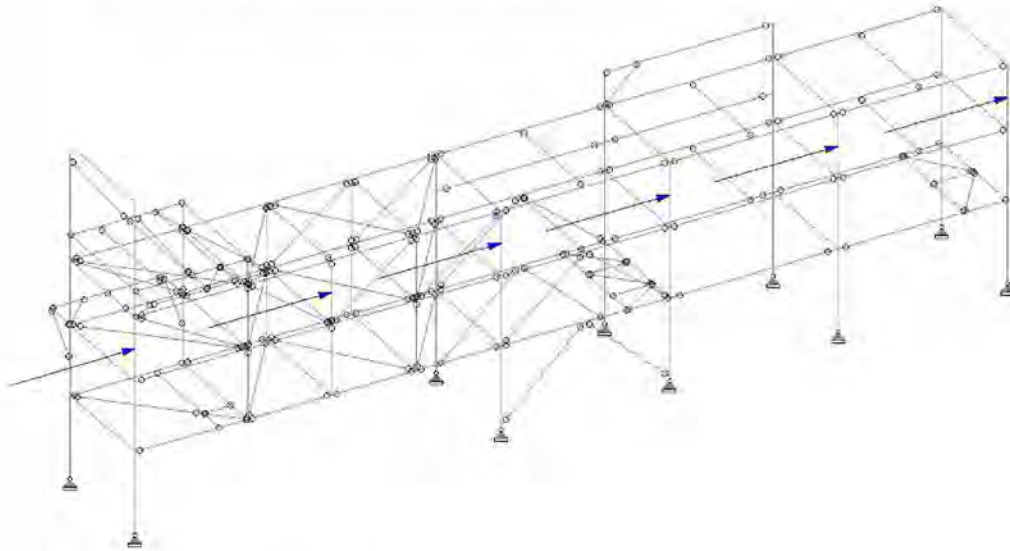
Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.8.3 WIND LOAD ON EQUIPMENT IN +X (E-W) DIRECTION (L/C:613)

Not applicable.

### 3.8.4 WIND LOAD ON CABLE TRAYS IN +X (E-W) DIRECTION (L/C:614)

This wind load is applied on the structure due to cable trays obstruction.



16471

Figure 3.8.4.1 : Wind load on structure due to cable trays (in +X direction)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.9 WIND LOAD IN +Z DIRECTION (L/C: 62)

The wind load is applied on structure in +Z direction (S-N) due to self obstruction of the structure, piping & Cable trays

**For detailed calculation refer annexure A.**

#### 3.9.1 WIND LOAD ON STRUCTURE IN +Z (N-S) DIRECTION (L/C:621)

This is wind load on structure due to self obstruction in +Z direction.

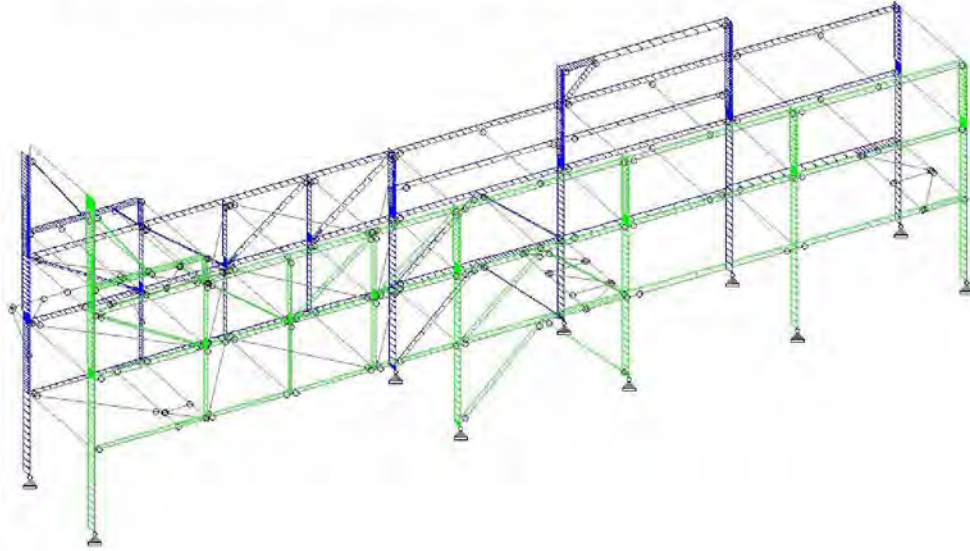


Figure 3.9.1.1 : Wind load on structure due to self-obstruction (in +Z direction)

#### 3.9.2 WIND LOAD ON PIPING IN +Z (N-S) DIRECTION (L/C:622)

This is wind load on structure due to piping obstruction in +Z direction.

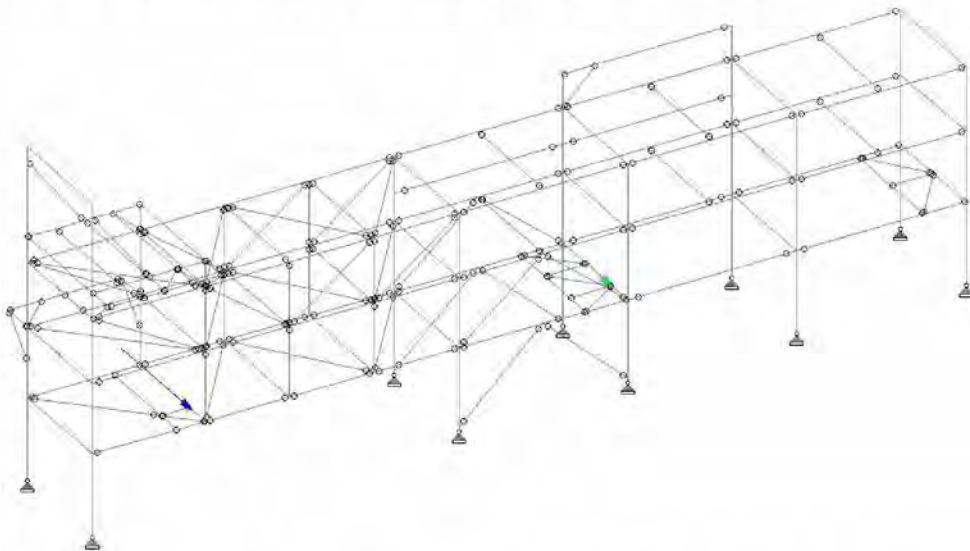


Figure 3.9.2.1 : Wind load on structure due to piping (in +Z direction)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.9.3 WIND LOAD ON EQUIPMENT IN +Z (N-S) DIRECTION (L/C:623)

Not applicable.

### 3.9.4 WIND LOAD ON CABLE TRAYS IN +Z (N-S) DIRECTION (L/C:624)

This is wind load on structure due to cable trays obstruction in +Z direction.

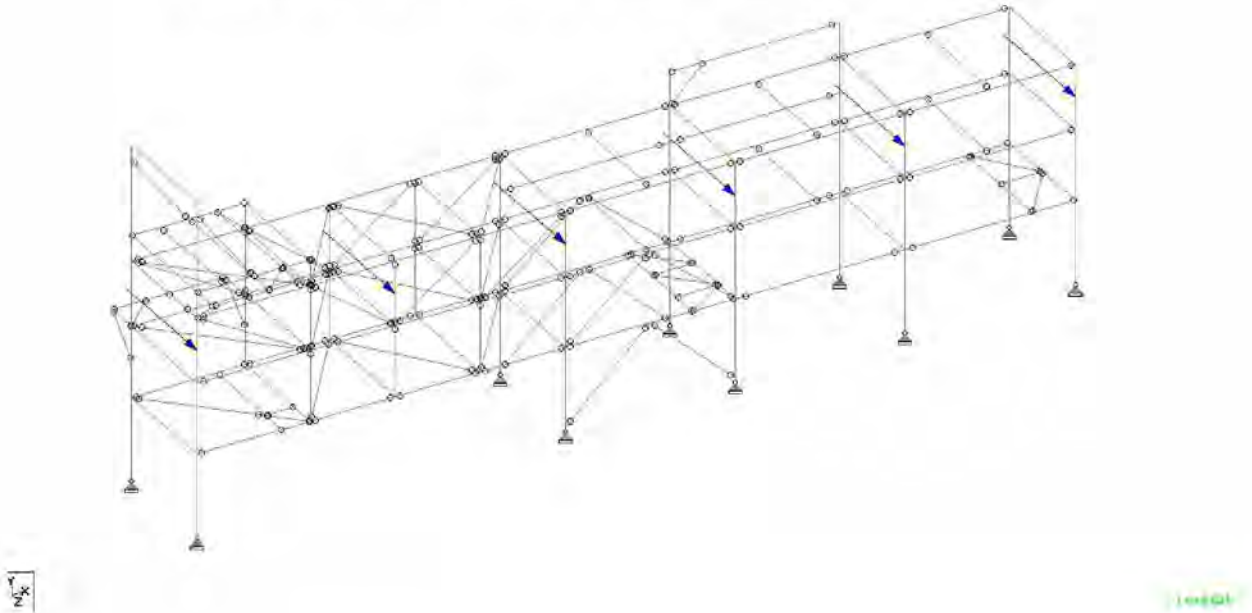


Figure 3.9.2.1 : Wind load on structure due to cable trays (in +Z direction)



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.10 WIND LOAD IN -X DIRECTION (L/C: 63)

The wind load is applied on structure in -X direction (W-E) due to self obstruction of the structure, piping & Cable trays.

This load would be similar load as +X direction, however applied in -ve direction.

#### 3.10.1 WIND LOAD ON STRUCTURE IN -X (W-E) DIRECTION (L/C:631)

This is wind load on structure due to self obstruction in -X direction

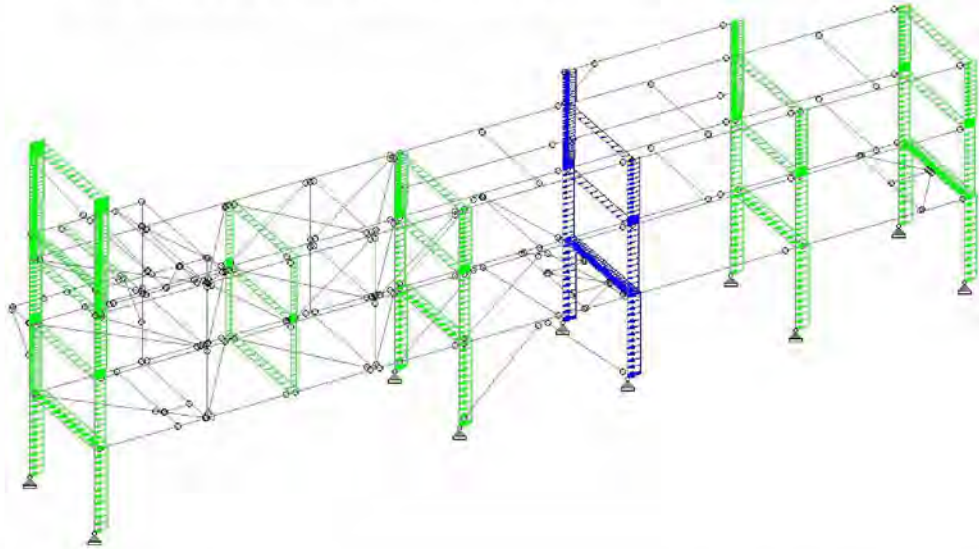


Figure 3.10.1.1 : Wind load on structure due to Self-Obstruction (in -X direction)

#### 3.10.2 WIND LOAD ON PIPING IN -X (W-E) DIRECTION (L/C:632)

This is wind load on structure due to piping obstruction in -X direction

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

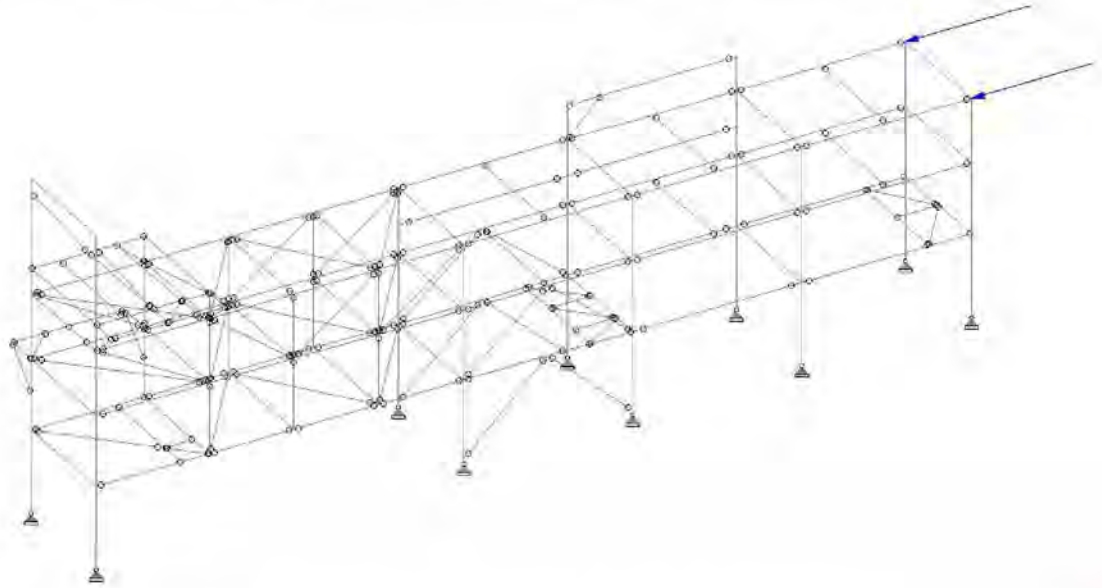


Figure 3.10.2.1 : Wind load on structure due to piping (in -X direction)

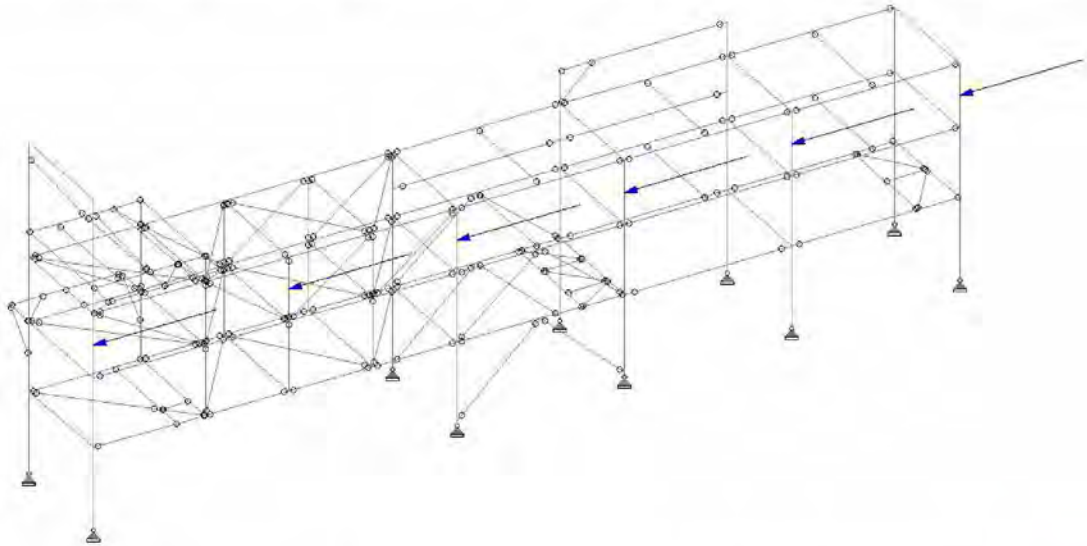
### 3.10.3 WIND LOAD ON EQUIPMENT IN -X (W-E) DIRECTION (L/C:633)

Not applicable

### 3.10.4 WIND LOAD ON CABLE TRAYS IN -X (W-E) DIRECTION (L/C:634)

This is wind load on structure due to cable tray obstruction in -X direction

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>



Load 634

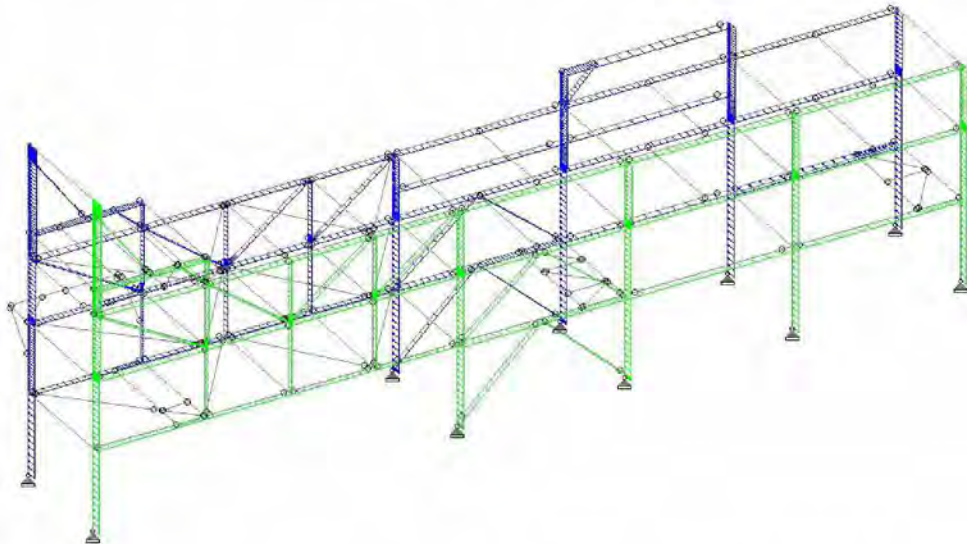
Figure 3.10.4.1 : Wind load on structure due to cable trays (in -X direction)

### 3.11 WIND LOAD IN -Z DIRECTION (L/C: 64)

The wind load is applied on structure in -Z direction (N-S) due to self obstruction of the structure, piping & Cable trays.

#### 3.11.1 WIND LOAD ON STRUCTURE IN -Z (N-S) DIRECTION (L/C:641)

This is wind load on structure due to self obstruction in -Z direction



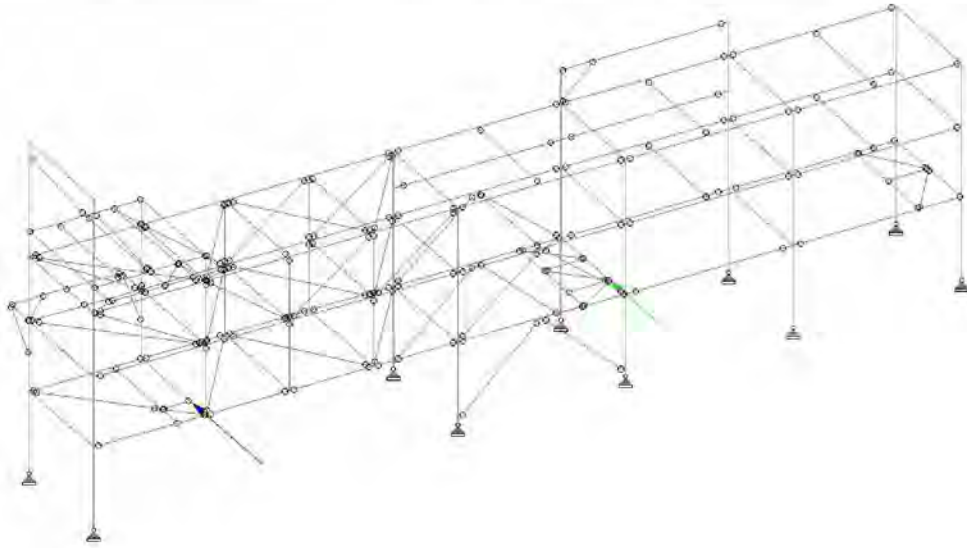
Load 641

Figure 3.11.1.1 : Wind load on structure due to self-obstruction (in -Z direction)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.11.2 WIND LOAD ON PIPING IN -Z (N-S) DIRECTION (L/C:642)

This is wind load on structure due to piping obstruction in -Z direction.



Link 814

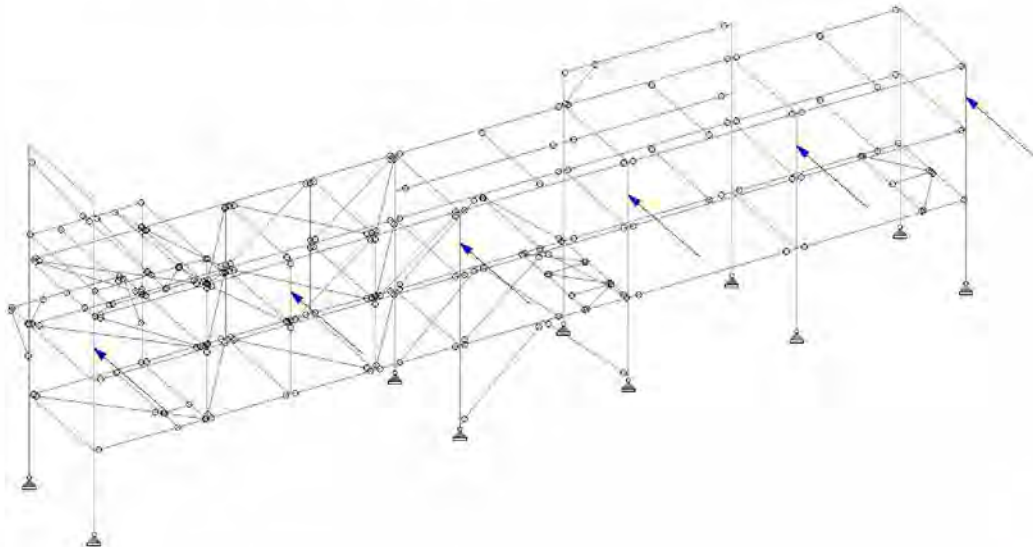
Figure 3.11.2.1 : Wind load on structure due to piping (in -Z direction)

### 3.11.3 WIND LOAD ON EQUIPMENT IN -Z (N-S) DIRECTION (L/C:643)

Not applicable

### 3.11.4 WIND LOAD ON CABLE TRAYS IN -Z (N-S) DIRECTION (L/C:644)

This is wind load on structure due to cabletray obstruction in -Z direction.



Link 814

Figure 3.11.4.1 : Wind load on structure due to Cable trays (in -Z direction)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.12 PIPE THERMAL LOAD IN X (E-W) DIRECTION (L/C: 81)

The load is applied as per the Load input received. See Annexure E.

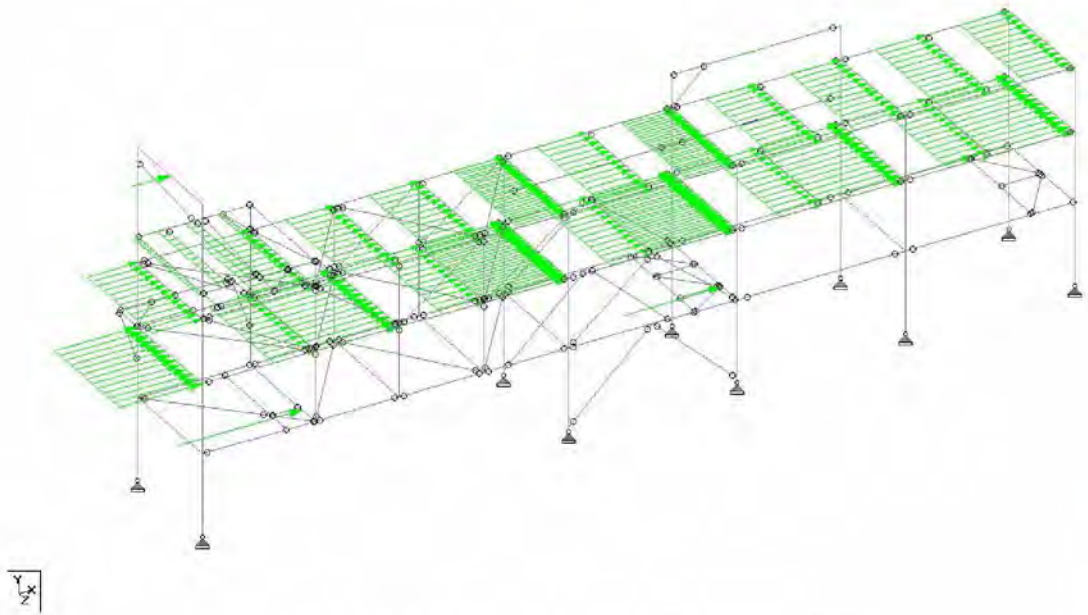


Figure 3.12.1 : Pipe thermal load (in +X direction)

### 3.13 PIPE THERMAL LOAD IN Z (N-S) DIRECTION (L/C: 82)

The load is applied as per the Load input received. See Annexure E.

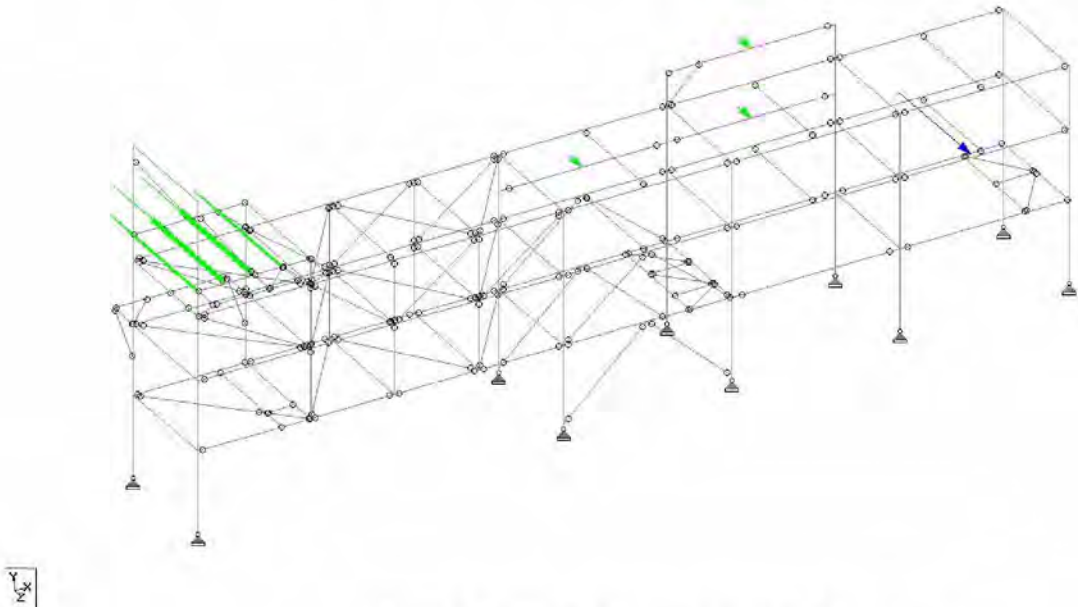


Figure 3.13.1 : Pipe thermal load (in +Z direction)

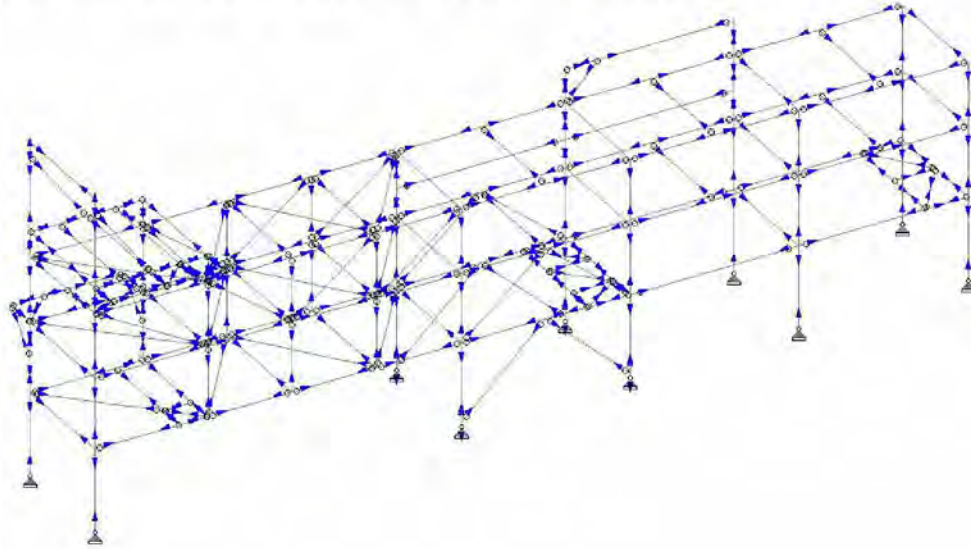
Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.14 STEEL THERMAL LOAD ON STRUCTURE IN WARM DIRECTION (L/C: 85)

Maximum ambient temperature = +40°C as per specification 16471-C50-00001.

The erection temperature of 10 Degree considered

The net load applied =  $40 - 10 = 30$  degree Celsius (+ve temperature)



Created By

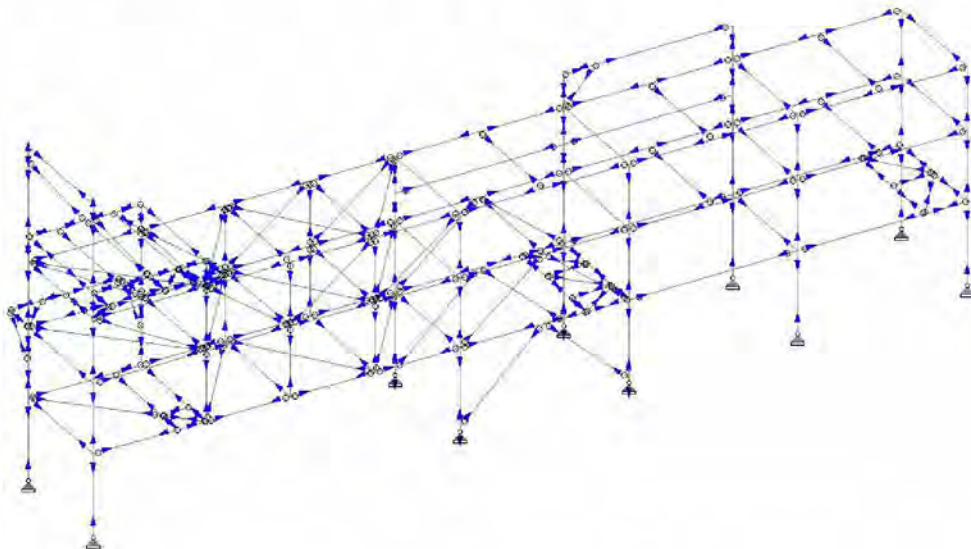
Figure 3.14.1 : Steel thermal load in Warm condition

### 3.15 STEEL THERMAL LOAD ON STRUCTURE IN COLD DIRECTION (L/C: 86)

Minimum ambient temperature = -20°C as per specification 16471-C50-00001.

The erection temperature of 10 Degree considered

The net load applied =  $-20 - 10 = -30$  degree Celsius (-ve temperature)



Created By

Figure 3.15.1 : Steel thermal load in cold condition

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.16 VERTICAL LOAD DUE TO TRAFFIC MOVEMENT

Traffic load of 20 KN/m<sup>2</sup> is applied as per the Load input received. Refer Annexure E for the load input.

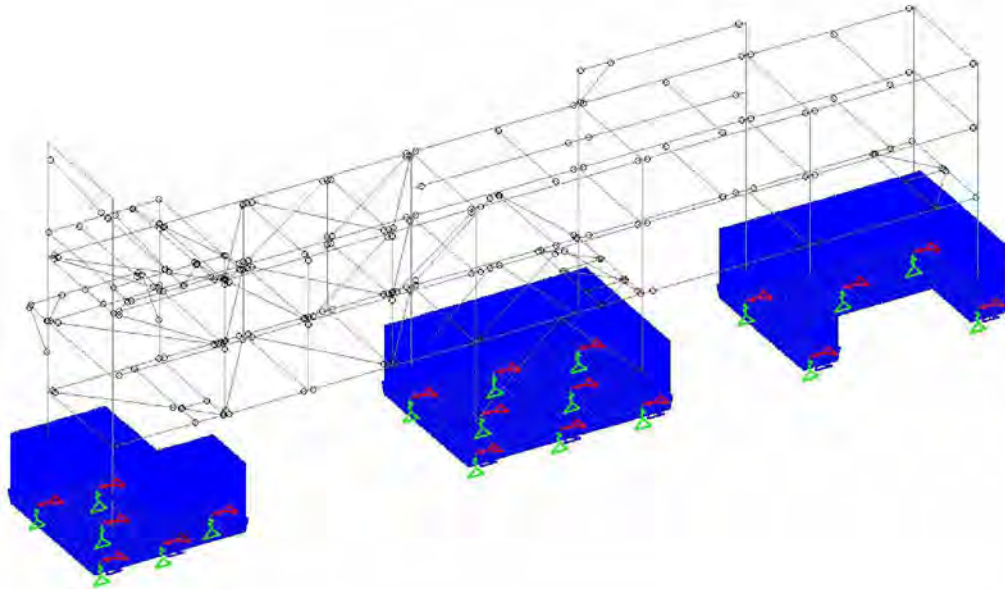


Figure 3.16.1 : Vertical Load due to Traffic movement

### 3.17 MINIMUM VERTICAL LOAD FOR BEAM DESIGN (L/C: 93)

The load of 10KN is applied to the members which do not carry any piping loads. However, these beams needs to be designed with this minimum load. Also, the load is considered at all grid columns as shown here in the figure below.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

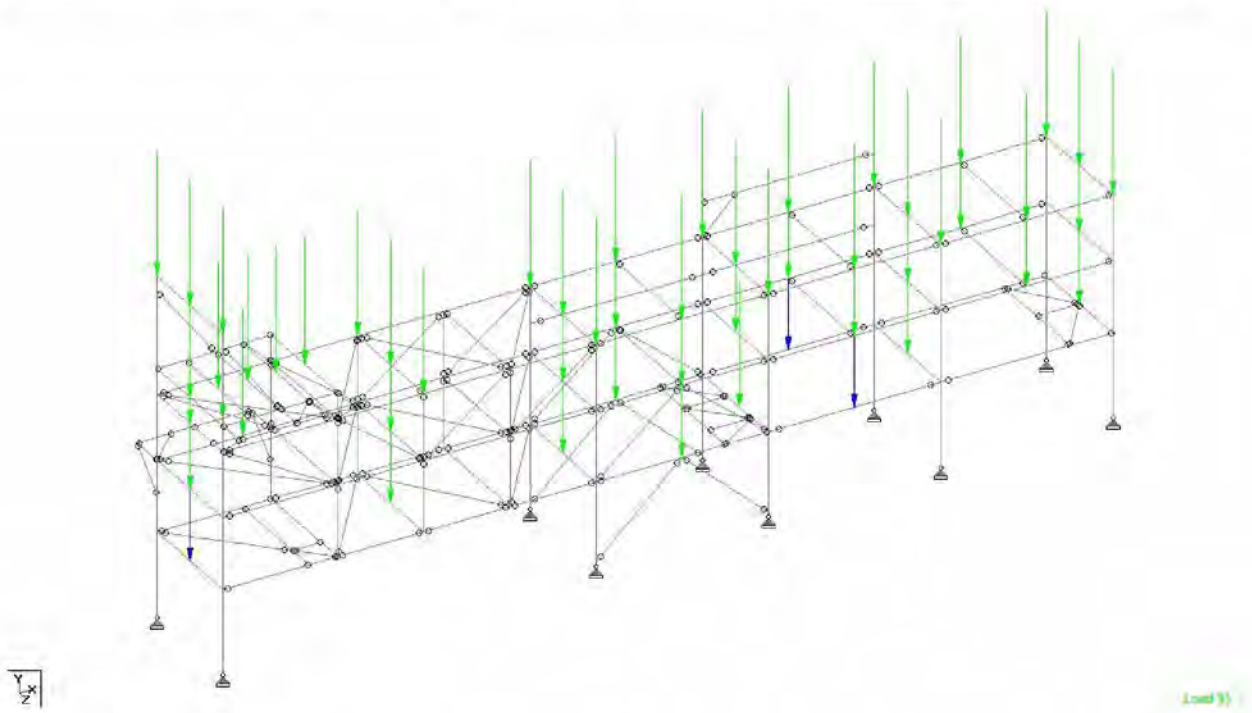


Figure 3.17.1 : Minimum Vertical Load for Beam design



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.18 SNOW LOAD ON STRUCTURE/PIPE/CABLE TRAY (SL) (L/C: 94)

As per specification 16471-C50-00001, 2.4.9 following parameters were considered.

Characteristic value of snow load =  $s_k = 0.7 \text{ KN/m}^2$

Exposure coefficient =  $C_e = 1$

Thermal coefficient =  $c_t = 1$

For detailed calculation refer Annexure D.

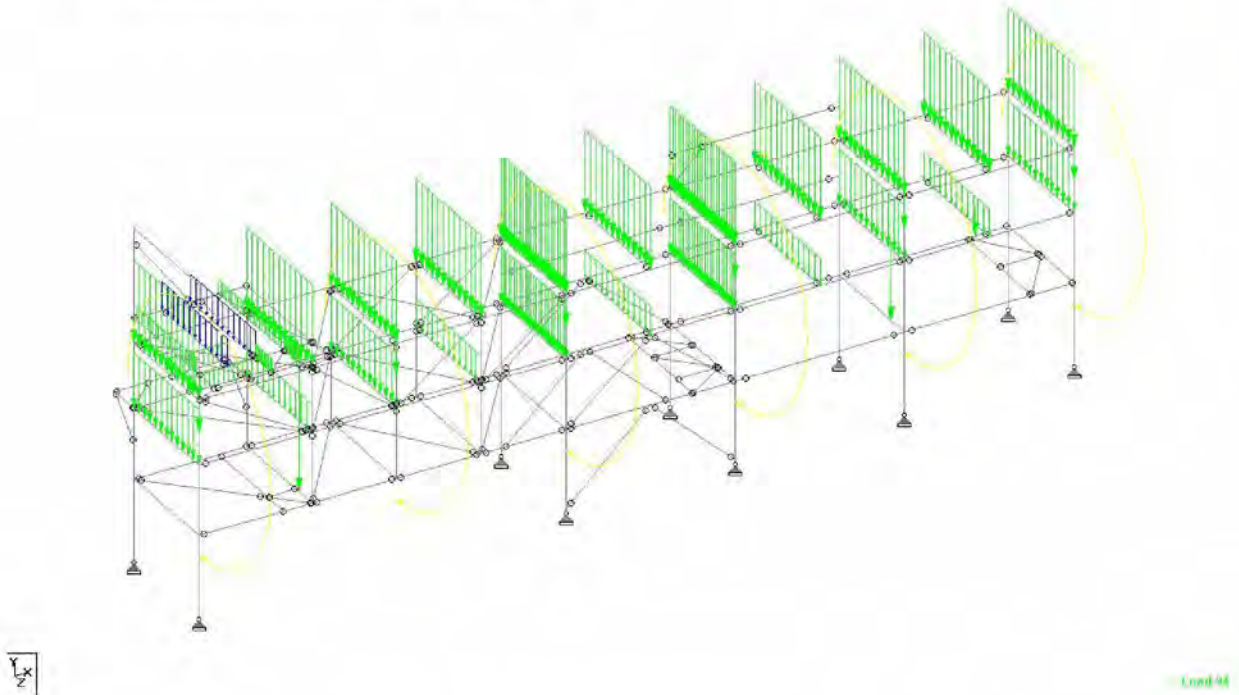


Figure 3.18.1 : Snow load on structure/pipe/cable trays

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.19 BLAST LOADS

In X direction (+Ve or -Ve, longitudinal direction) as the approach of blast wave is not at the same time at the different rows/axes, hence the blast load in X direction were applied frame wise, so to avoid too conservative results.

As per the received input, the Blast pressure = 30 mbar = 3 kN/m<sup>2</sup>,

Positive phase duration = 15 milli second.

For detailed calculation of blast load, refer Annexure C.

#### 3.19.1 BLAST LOAD IN +X DIRECTION ON FIRST FRAME (L/C:961)

The Blast load is applied on the first frame and on longitudinal frame as shown below.

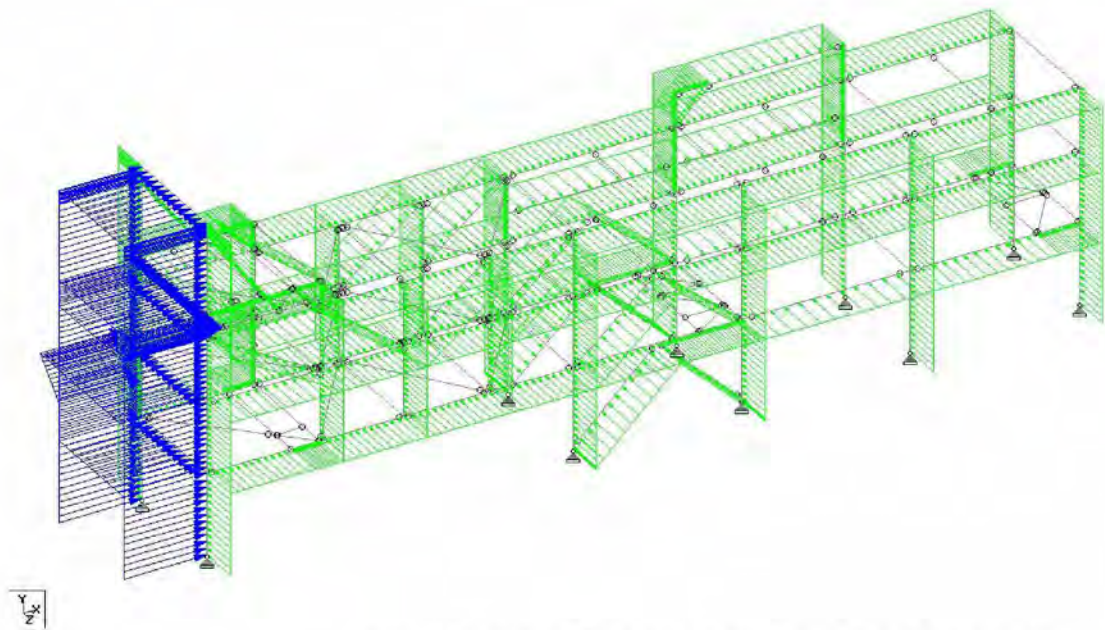


Figure 3.19.1.1 : Blast load on First frame (in +X direction)

#### 3.19.2 BLAST LOAD IN +X DIRECTION ON SECOND FRAME (L/C:962)

The Blast load is applied on the second frame and on longitudinal frame as shown below.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

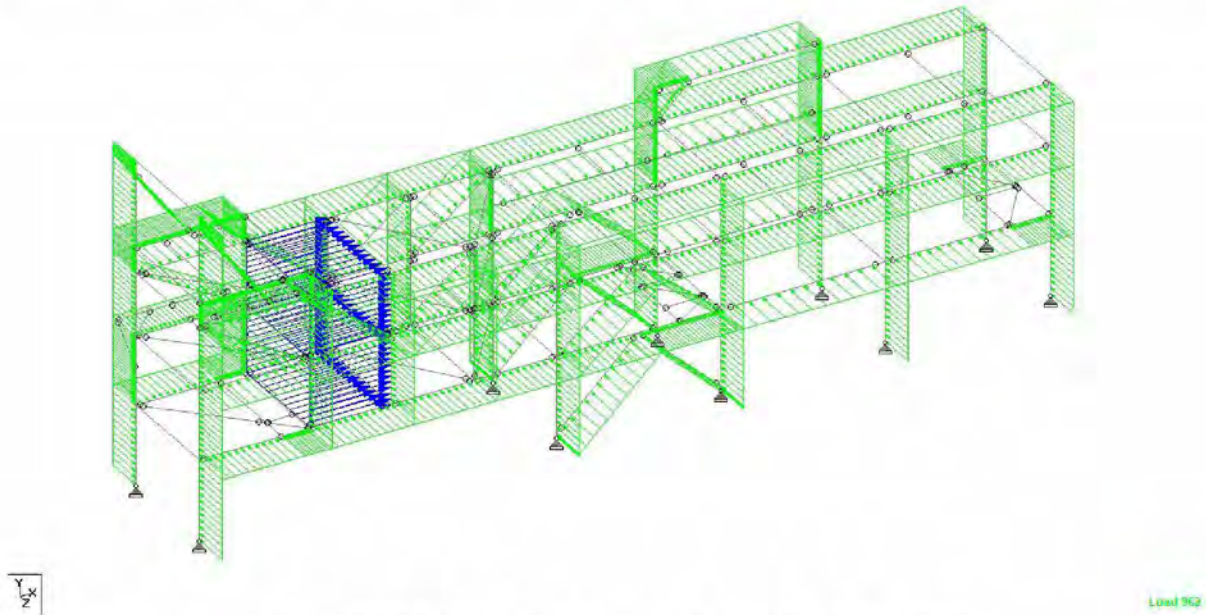


Figure 3.19.2.1 : Blast load on second frame (in +X direction)

### 3.19.3 BLAST LOAD IN +X DIRECTION ON 3<sup>RD</sup> FRAME (L/C:963)

The Blast load is applied on the third frame and on longitudinal frame as shown below. Here the Blast load on piping and cable tray is also applied in this load case.

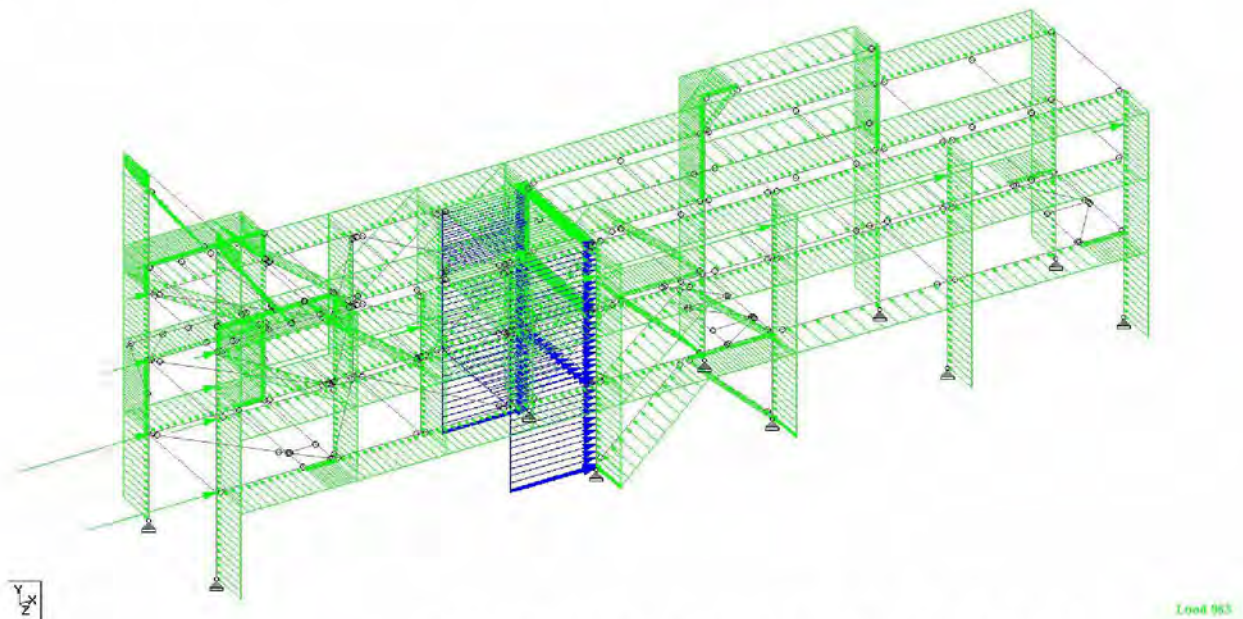


Figure 3.19.3.1 : Blast load on third frame (in +X direction)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.19.4 BLAST LOAD IN +X DIRECTION ON 4<sup>TH</sup> FRAME (L/C:964)

The Blast load is applied on the fourth frame and on longitudinal frame as shown below.

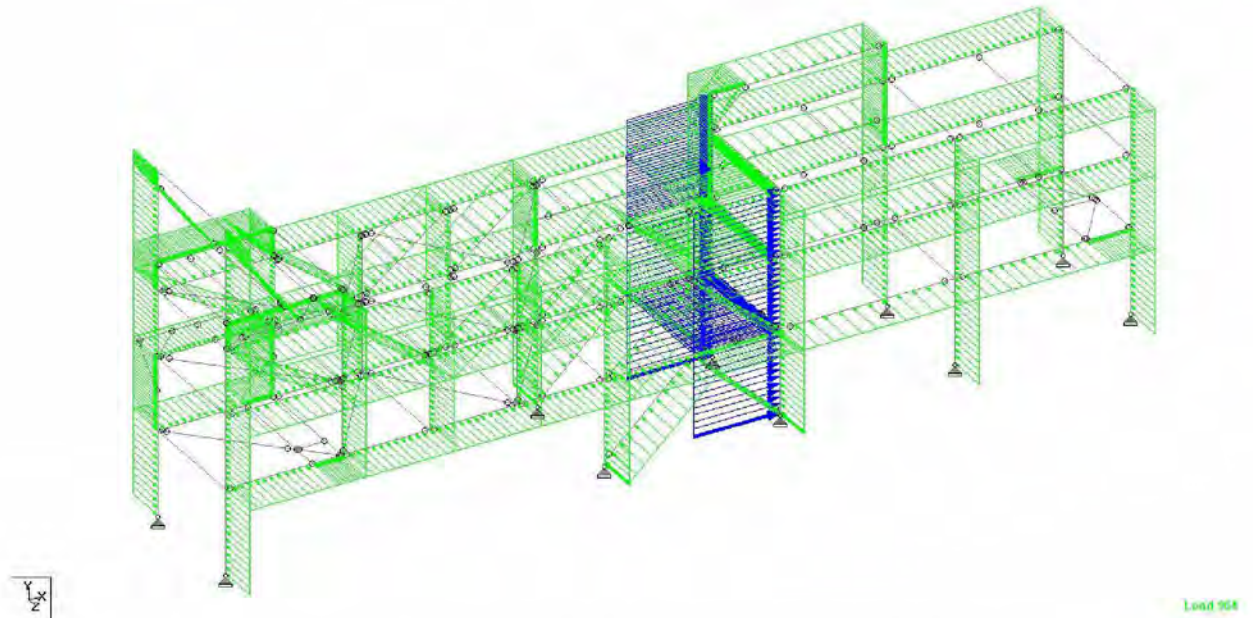


Figure 3.19.4.1 : Blast load on fourth frame (in +X direction)

### 3.19.5 BLAST LOAD IN +X DIRECTION ON 5<sup>TH</sup> FRAME (L/C:965)

The Blast load is applied on the fifth frame and on longitudinal frame as shown below.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

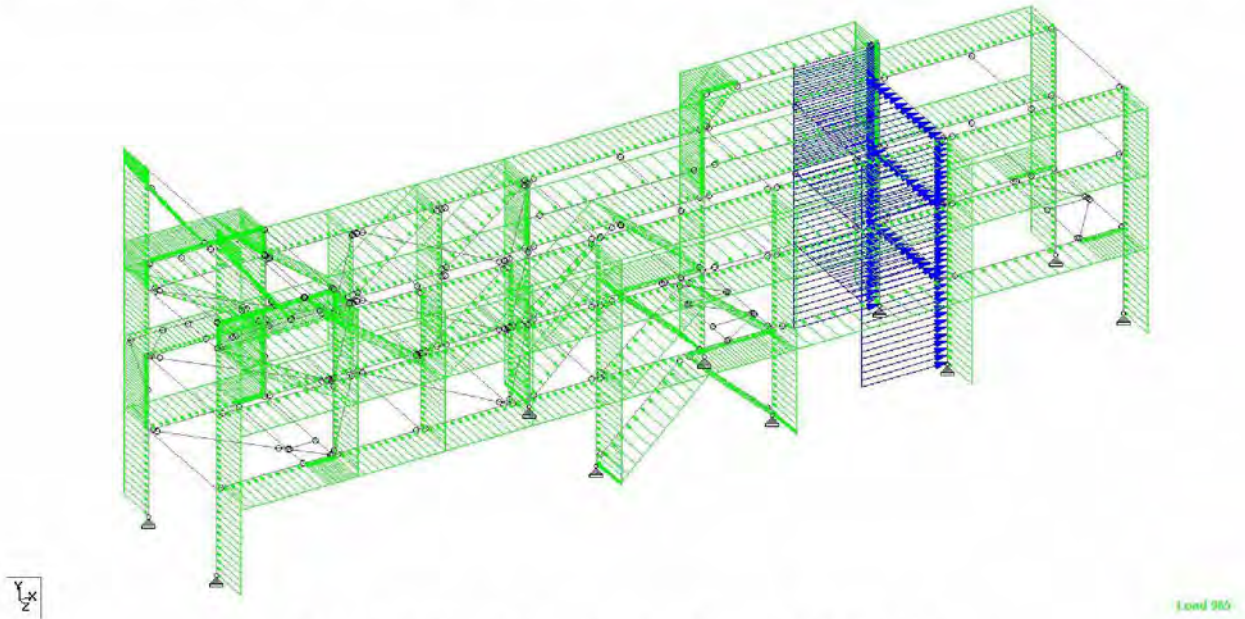


Figure 3.19.5.1 : Blast load on first frame (in +X direction)

### 3.19.6 BLAST LOAD IN +X DIRECTION ON 6<sup>TH</sup> FRAME (L/C:966)

The Blast load is applied on the sixth frame and on longitudinal frame as shown below.

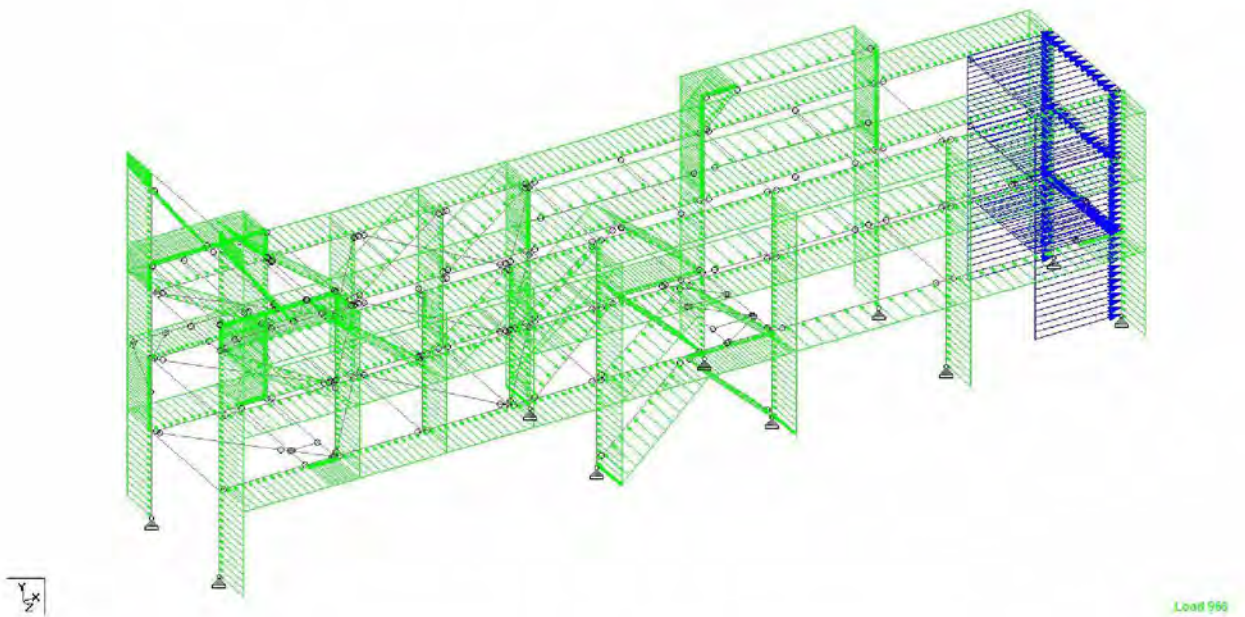


Figure 3.19.6.1 : Blast load on sixth frame (in +X direction)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.19.7 BLAST LOAD IN -X DIRECTION ON FIRST FRAME (L/C:971)

The Blast load is applied on the first frame and on longitudinal frame as shown below.

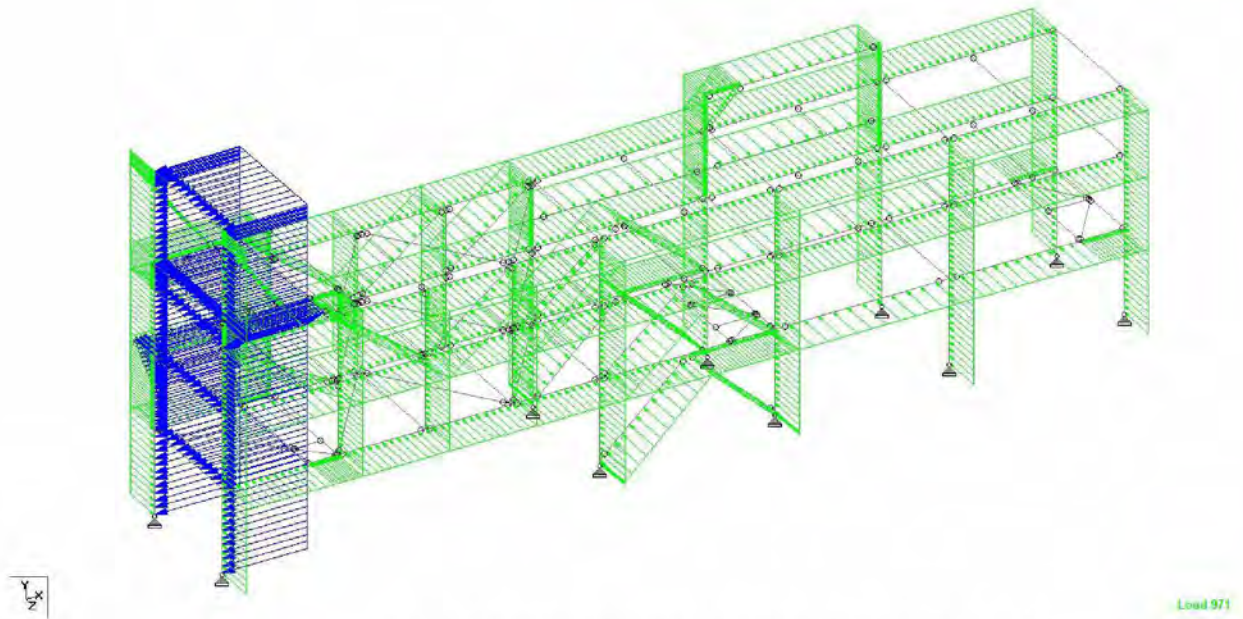


Figure 3.19.7.1 : Blast load on first frame (in -X direction)

### 3.19.8 BLAST LOAD IN -X DIRECTION ON SECOND FRAME (L/C:972)

The Blast load is applied on the second frame and on longitudinal frame as shown below.

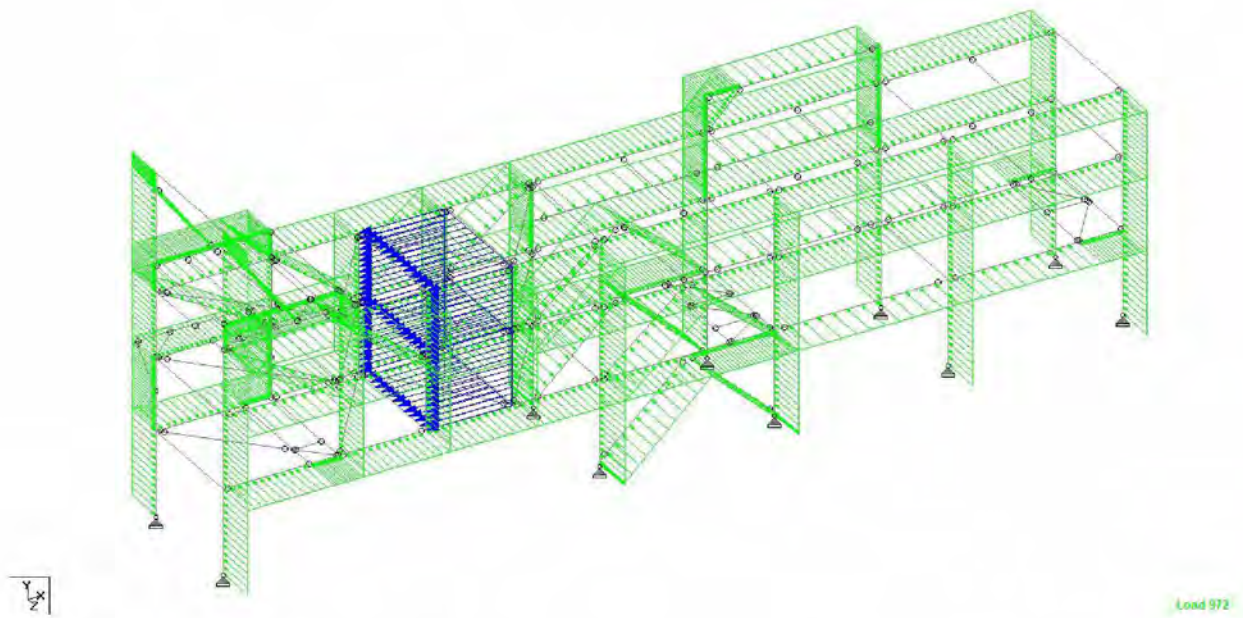


Figure 3.19.7.1 : Blast load on second frame (in -X direction)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.19.9 BLAST LOAD IN -X DIRECTION ON 3<sup>RD</sup> FRAME (L/C:973)

The Blast load is applied on the third frame and on longitudinal frame as shown below. Here the Blast load on piping and cable tray is also applied in this load case.

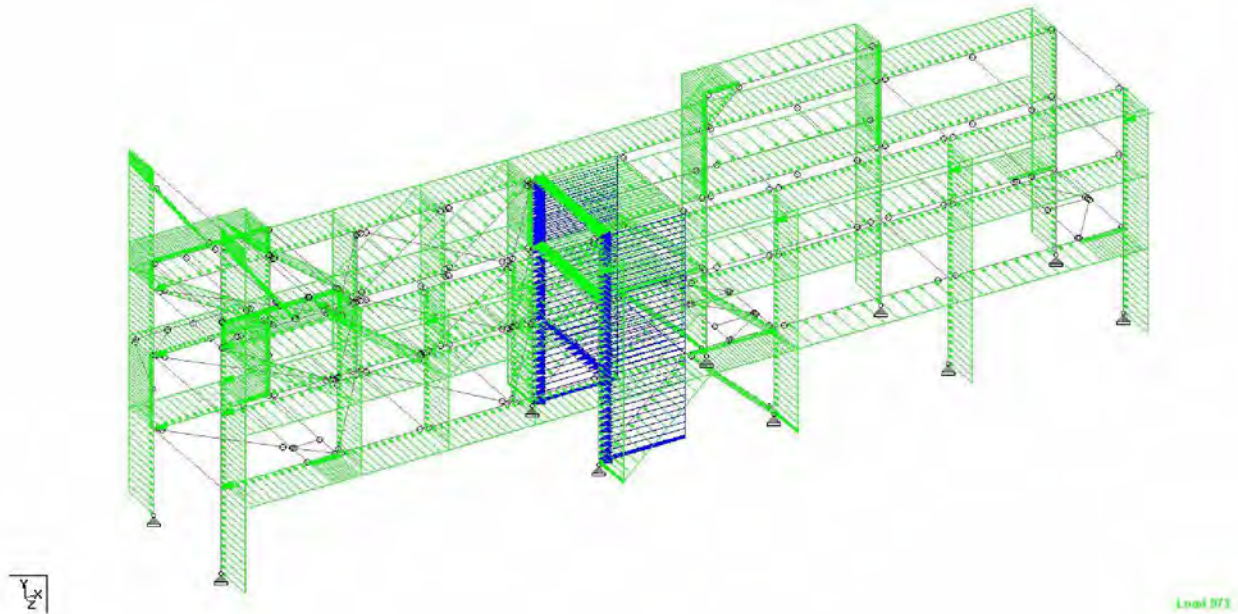


Figure 3.19.9.1 : Blast load on third frame (in -X direction)

### 3.19.10 BLAST LOAD IN -X DIRECTION ON 4<sup>TH</sup> FRAME (L/C

The Blast load is applied on the fourth frame and on longitudinal frame as shown below.

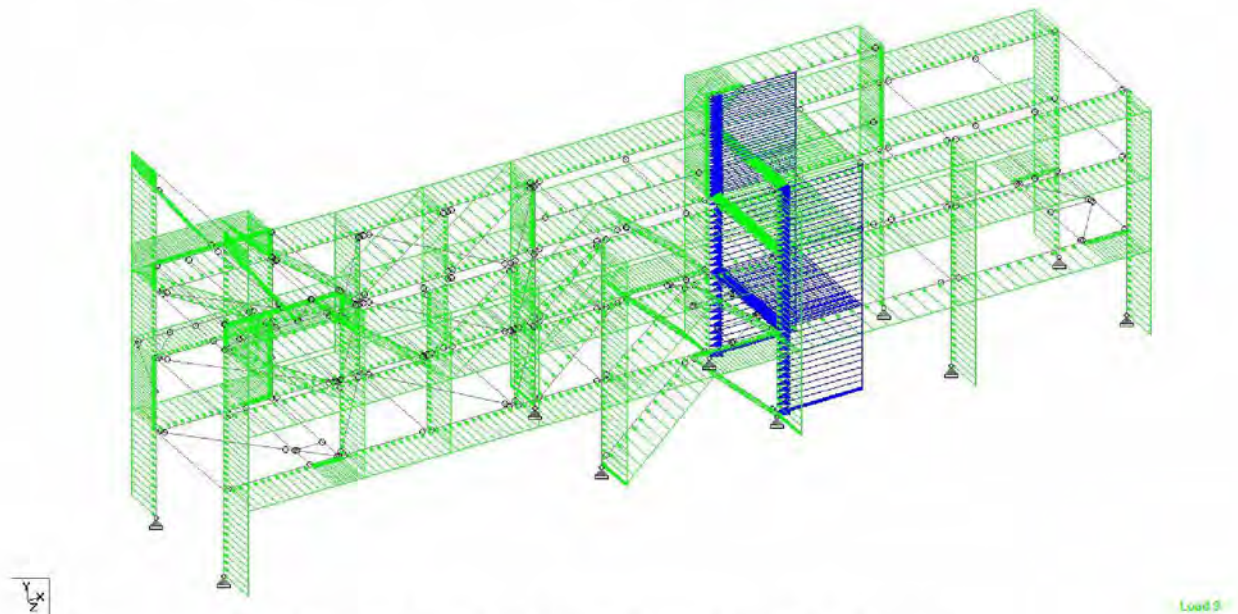


Figure 3.19.10.1 : Blast load on Fourth frame (in -X direction)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.19.11 BLAST LOAD IN -X DIRECTION ON 5<sup>TH</sup> FRAME (L/C:975)

The Blast load is applied on the fifth frame and on longitudinal frame as shown below.

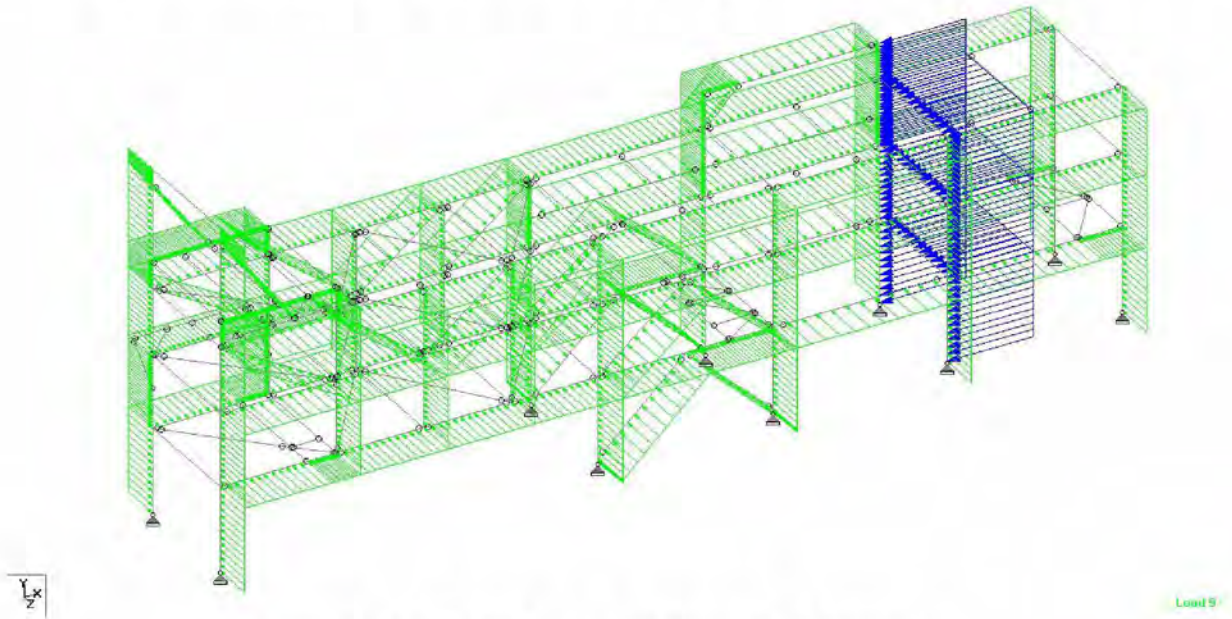


Figure 3.19.11.1 : Blast load on fifth frame (in -X direction)

### 3.19.12 BLAST LOAD IN -X DIRECTION ON 6<sup>TH</sup> FRAME (L/C:976)

The Blast load is applied on the sixth frame and on longitudinal frame as shown below.

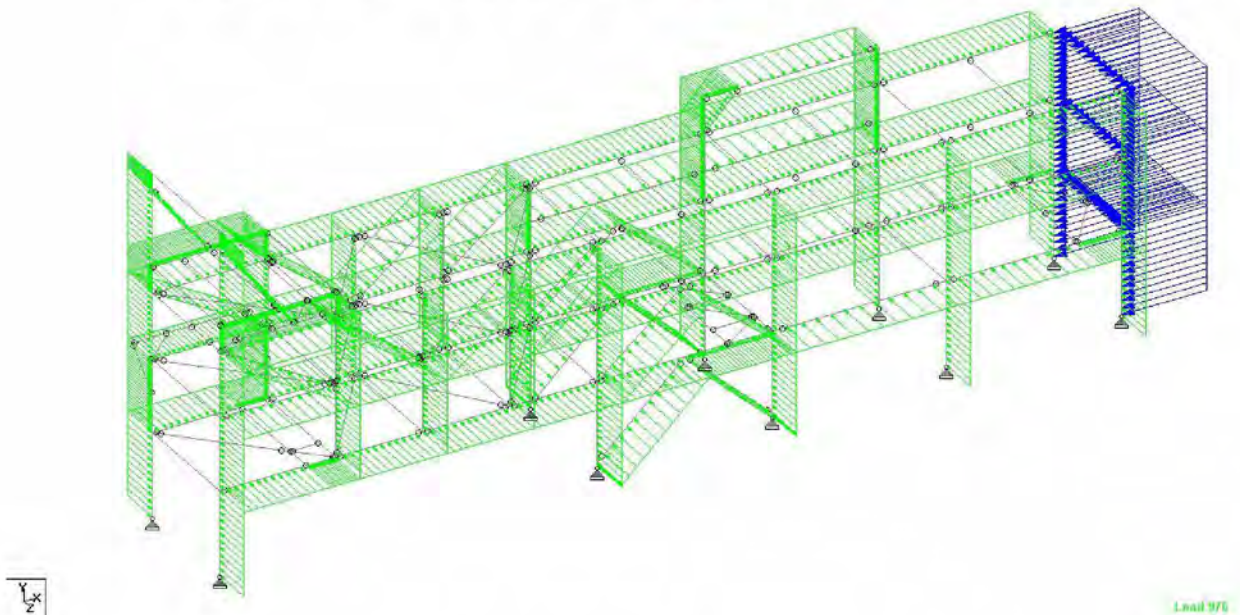


Figure 3.19.12.1 : Blast load on sixth frame (in -X direction)



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.19.13 BLAST LOAD IN +Z DIRECTION (L/C:98)

The blast load is applied on the lateral direction of the piperack together with the side frame. For detailed calculation, refer the annexure...

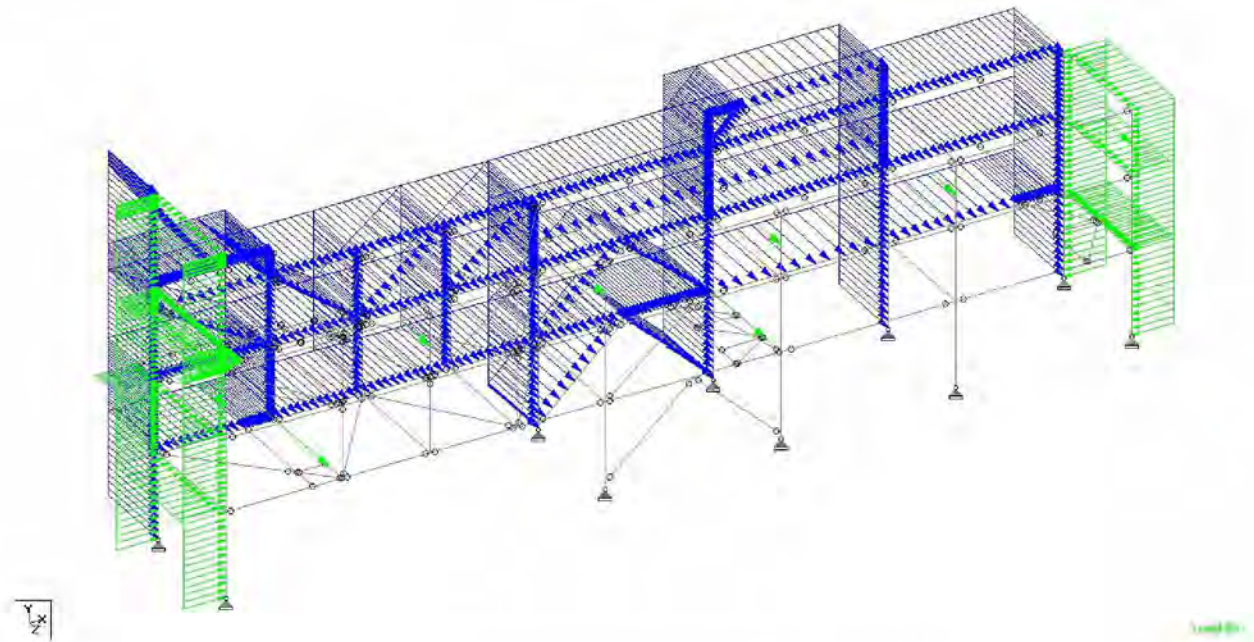


Figure 3.19.13.1 : Blast load in +Z direction

### 3.19.14 BLAST LOAD IN -Z DIRECTION (L/C:99)

The blast load is applied on the lateral direction of the piperack together with the side frame. For detailed calculation, refer the annexure...

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

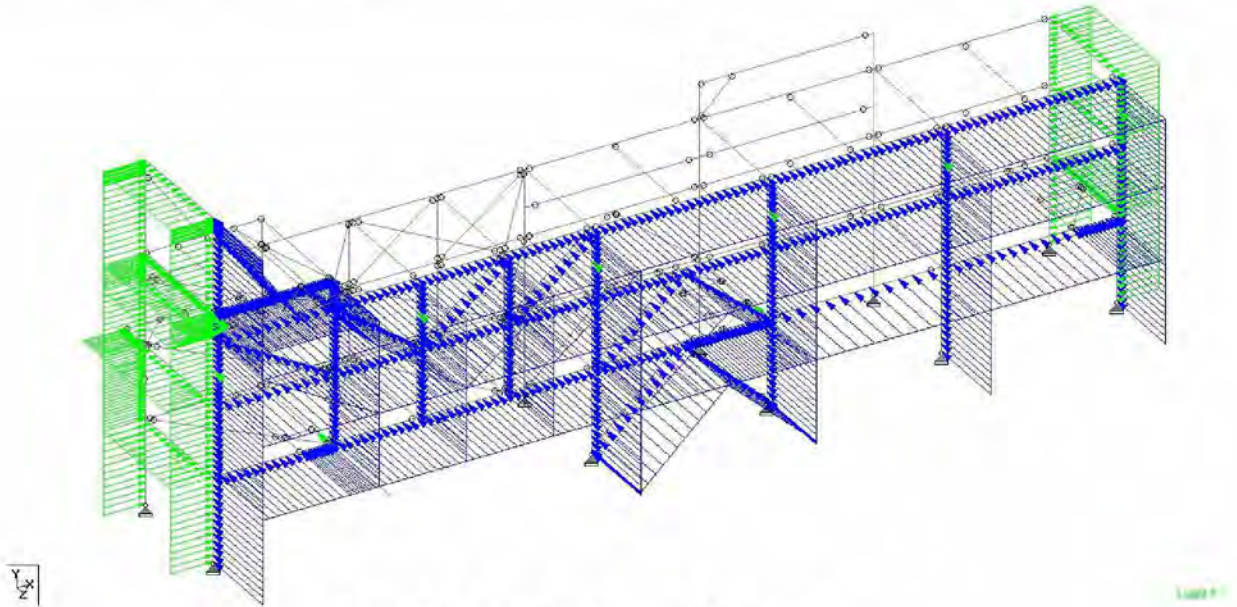


Figure 3.19.13.1 : Blast load in -Z direction

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 3.20 EARTHQUAKE LOAD

The Earthquake load was calculated as shown below.

As per Eurocode8

$$T = C_t \cdot H^{0.75} = 0.085 \cdot 7.7^{0.75} = 0.393 \dots \dots (4.6)$$

for type 2, and ground type D, as per table 3.3, the different values are

$$S = 1.8, T_a = 0.1, T_c = 0.3, T_D = 1.2,$$

$$\text{hence } T > T_c, T < T_D, \text{ hence } S_d(t) = a_g \cdot S \cdot 2.5 / q \cdot T_c / T \dots (3.15)$$

$$S_d(t) = 0.05 \cdot 1.8 \cdot 2.5 / q \cdot 0.3 / 0.393 \text{ (ag in terms of g, } a_g = 0.05)$$

$$q = q_0 \cdot k_w \dots (5.2.2.2)$$

$$q_0 = 3 \cdot a_0 / a_1 \dots \text{ table 5.1, } a_0 / a_1 = 1.2, k_w = 1,$$

$$q = 3 \cdot 1.2 \cdot 1 = 3.6,$$

$$S_d(t) = 0.05 \cdot 1.8 \cdot 2.5 / 3.6 \cdot 0.3 / 0.393 = 0.048 \dots \dots$$

$$\text{Base shear} = F_b = S_d(t) \cdot m \cdot \lambda$$

$$\lambda = 1, m \text{ is mass of the structure}$$

$$\text{Base shear} = 0.048 \cdot m \dots$$

means the base shear is 4.8 or say 5% of the mass.

$$\text{Weight of the structure} = 405 \text{ KN}$$

Seismic base shear =  $0.05 \cdot 405 = 20 \text{ KN}$ . This load is less than the wind load in X and in Z direction that were calculated as per Annexure A.

$$\text{Wind load in X direction} = 108 \text{ KN, Wind load in Z direction} = 235 \text{ kN}$$

**Hence Earthquake load is not applied to the structure.**

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

#### 4 STATIC CHECK

The below table provides the static check between the load applied Vs. the reactions produced.

Sr. No.	Load case	Type of load	Load calculated (in KN)	Load from Staad (kN)	Remark
1	101	Self weight		378.398	Vertical
2	111	Grating/ladder/handrail load	6.3	5.9	Vertical
3	202	Live load	46.2	46.2	Vertical
4	301	Empty weight of piping (udl)	408	416	Vertical
5	302	Empty weight of piping (Conc.)	195	195	Vertical
6	332	Empty weight of cable trays	336.7	336	Vertical
7	401	Operating weight of piping (udl)	810	830	Vertical
8	402	Operrating weight of piping (Conc.)	255	255	Vertical
9	420	Cable tray loads	336.7	336	Vertical
10	6110	Wind load on self obstruction (-X direction)	63.648	62	Horizontal
11	6310	Wind load on self obstruction (-Z direction)	95.2	106	Horizontal
12	612	Wind load on piping (X direction)	28	28	Horizontal
13	614	Wind load on cable trays (X direction)	17.4	17.4	Horizontal
14	622	Wind load on piping (X direction)	65.45	65.45	Horizontal
15	624	Wind load on cable trays (X direction)	66.24	66.24	Horizontal

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 5 MEMBER DESIGN AND POST PROCESSING

### 5.1 DESCRIPTION OF MEMBER DESIGN

Structural analysis and member design have been carried out using STAAD Pro connect series.

### 5.2 DESIGN PARAMETERS

Various parameters used in the design are defined in the staad input file. Refer annexure E & F.

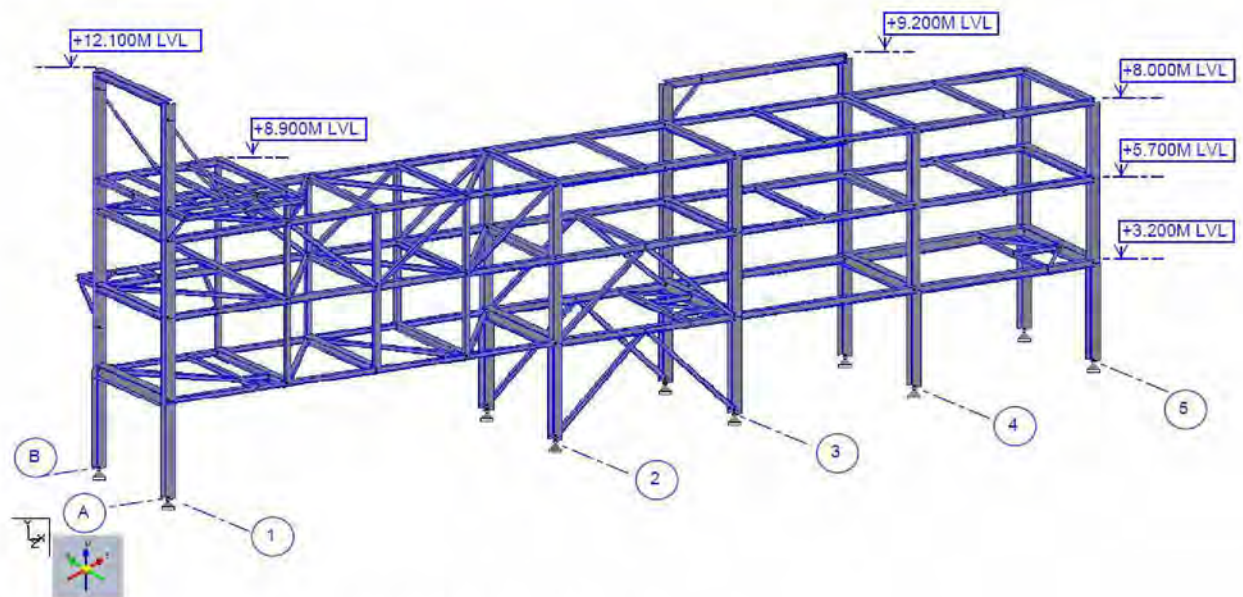
### 5.3 UTILIZATION RATIO

Utilization ratio for all members are within unity. For column (column no.1) at grid 1 the ratio is 1.01. This design case is with Blast condition. For Blast condition, design utilization is permitted with 10% increase i.e. 1.1.

So, Maximum utilization in column =  $1.01 < 1.10$ , hence safe

Maximum utilization in beam =  $0.951 < 1.10$ , hence safe.

Refer below 3D snap to identify the levels and the grids of the piperack.



Refer following snaps for the utilization ratios.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

Refer the subsequent pages for the utilization of members as per design loads.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

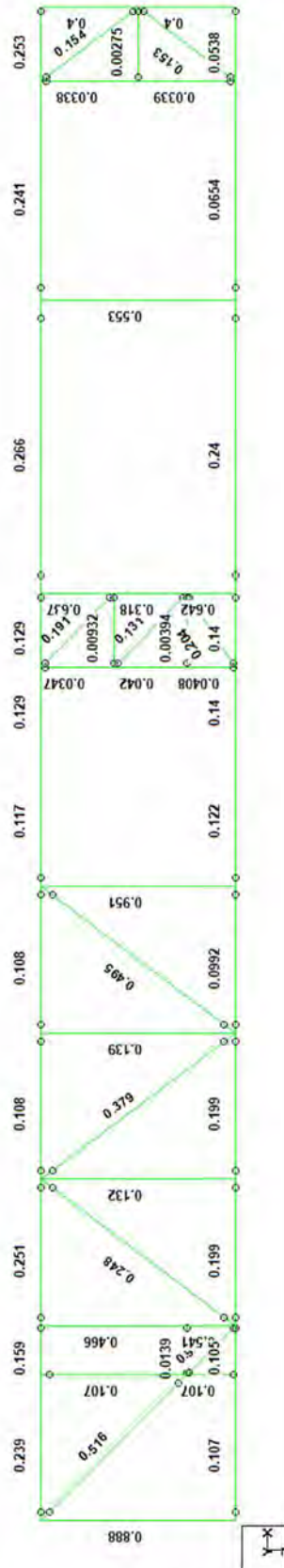


Figure 5.3.1 : Utilization ratio for members at +3.200m level

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

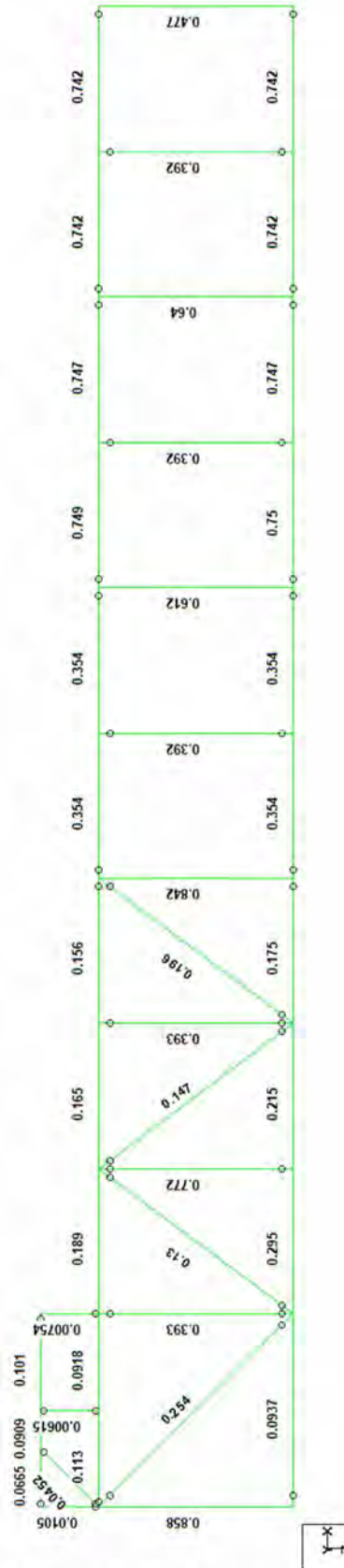


Figure 5.3.2 : Utilization ratio for members at +5.700m level



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

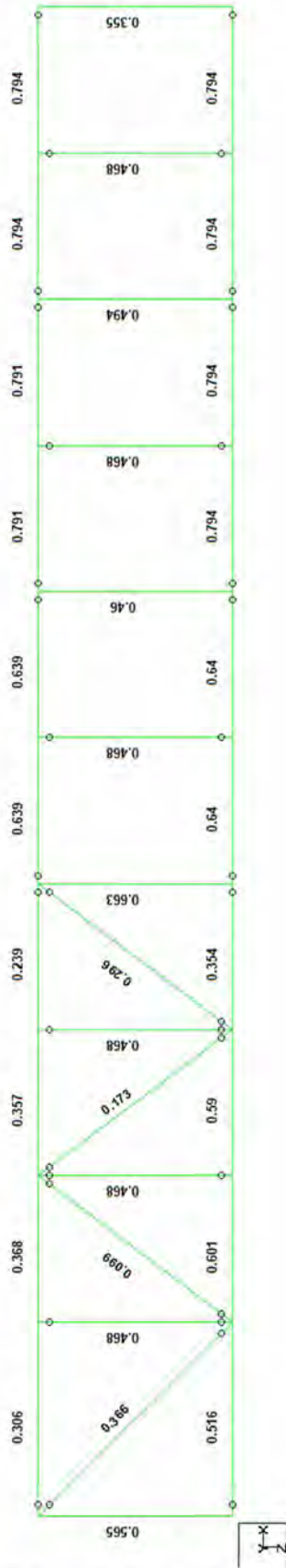


Figure 5.3.3 : Utilization ratio for members at +8.000m level

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>



Figure 5.3.4 : Utilization ratio for members at +8.900m level

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>



Figure 5.3.5 : Utilization ratio for members at grid 1

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

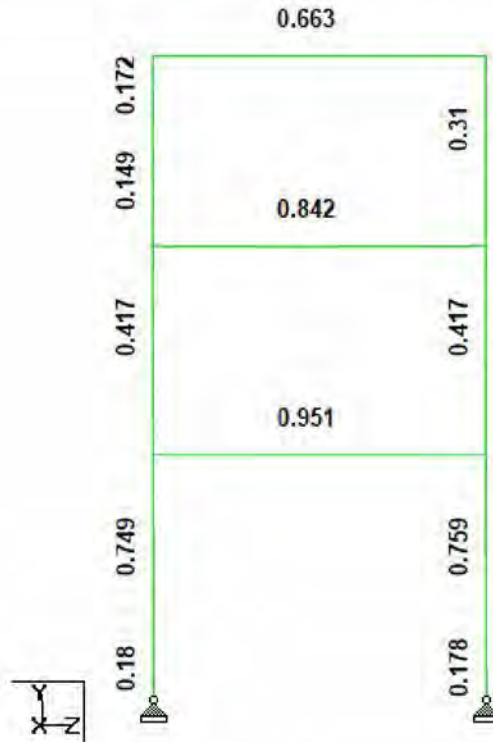


Figure 5.3.6 : Utilization ratio for members at grid 2

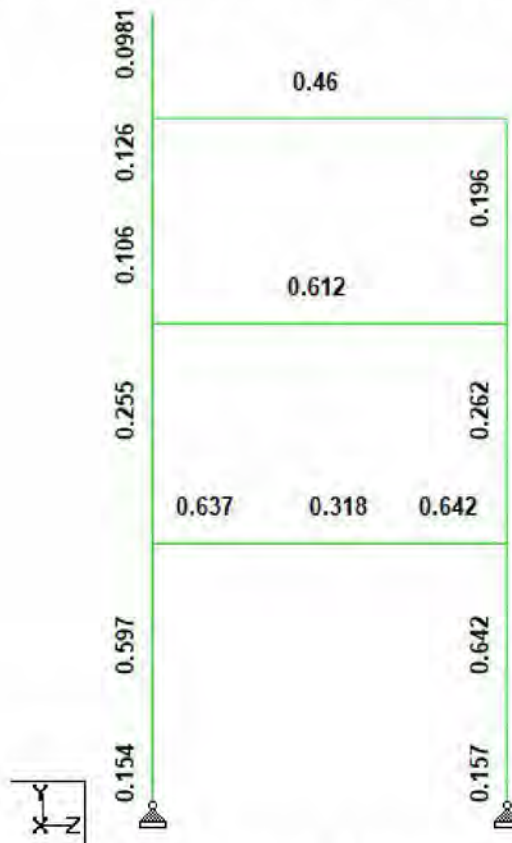


Figure 5.3.7 : Utilization ratio for members at grid 3

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

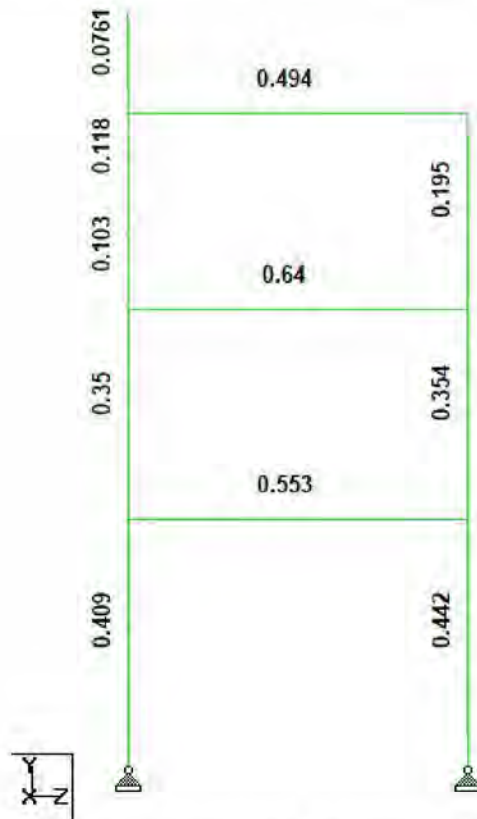


Figure 5.3.8 : Utilization ratio for members at grid 4

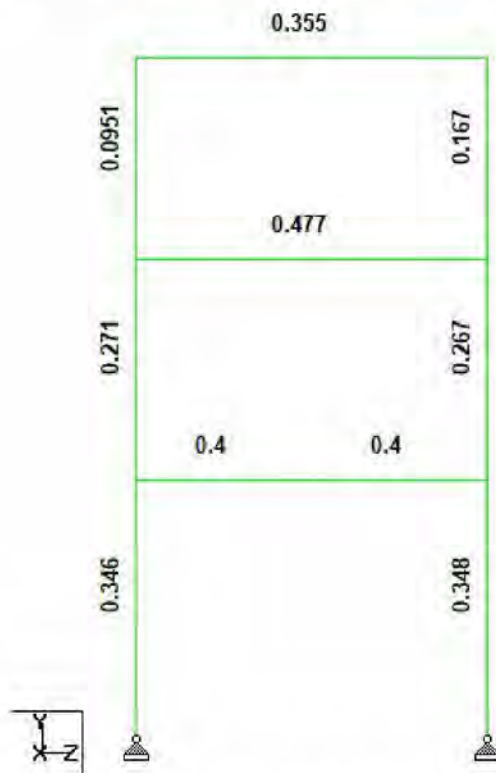


Figure 5.3.8 : Utilization ratio for members at grid 5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

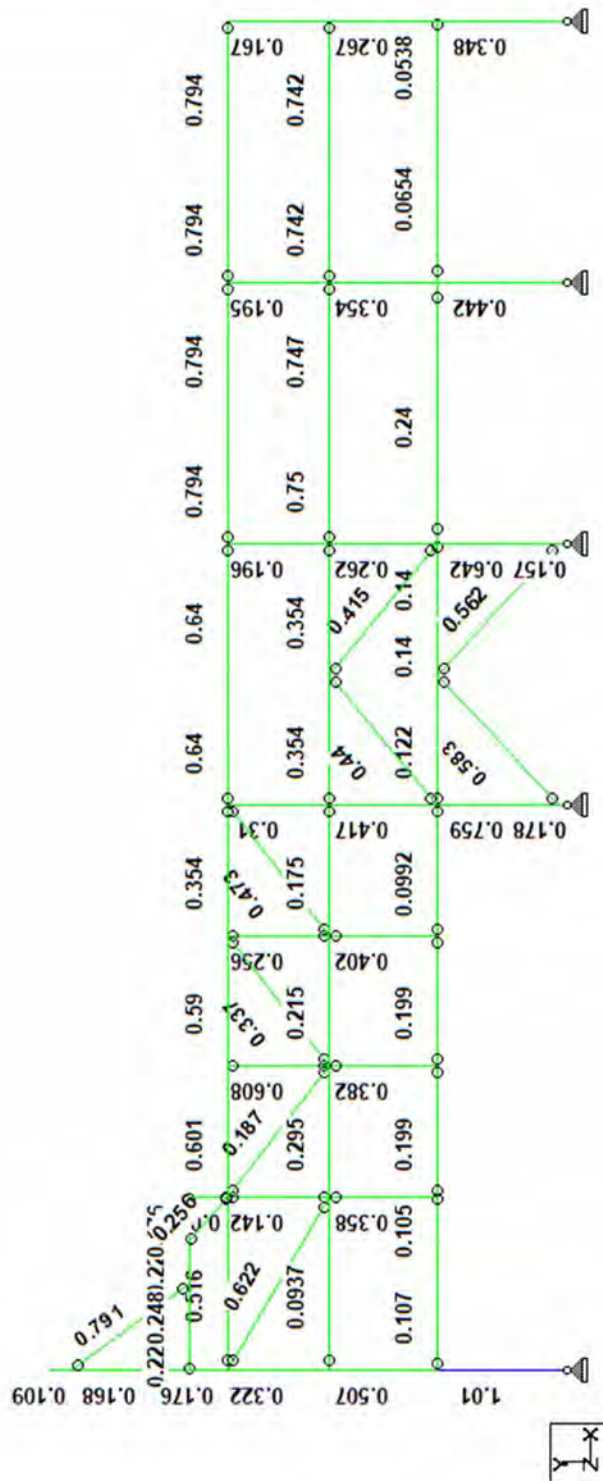


Figure 5.3.9 : Utilization ratio for members at grid A

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

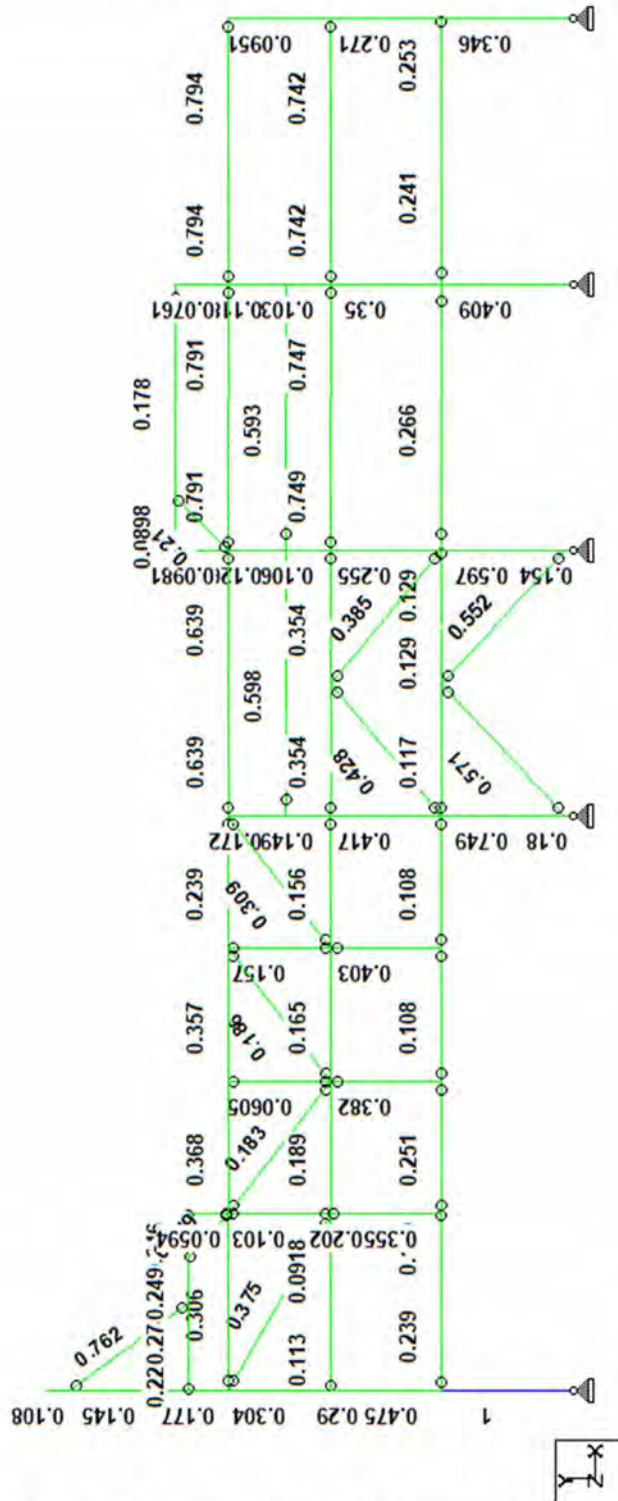


Figure 5.3.10 : Utilization ratio for members at grid B

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

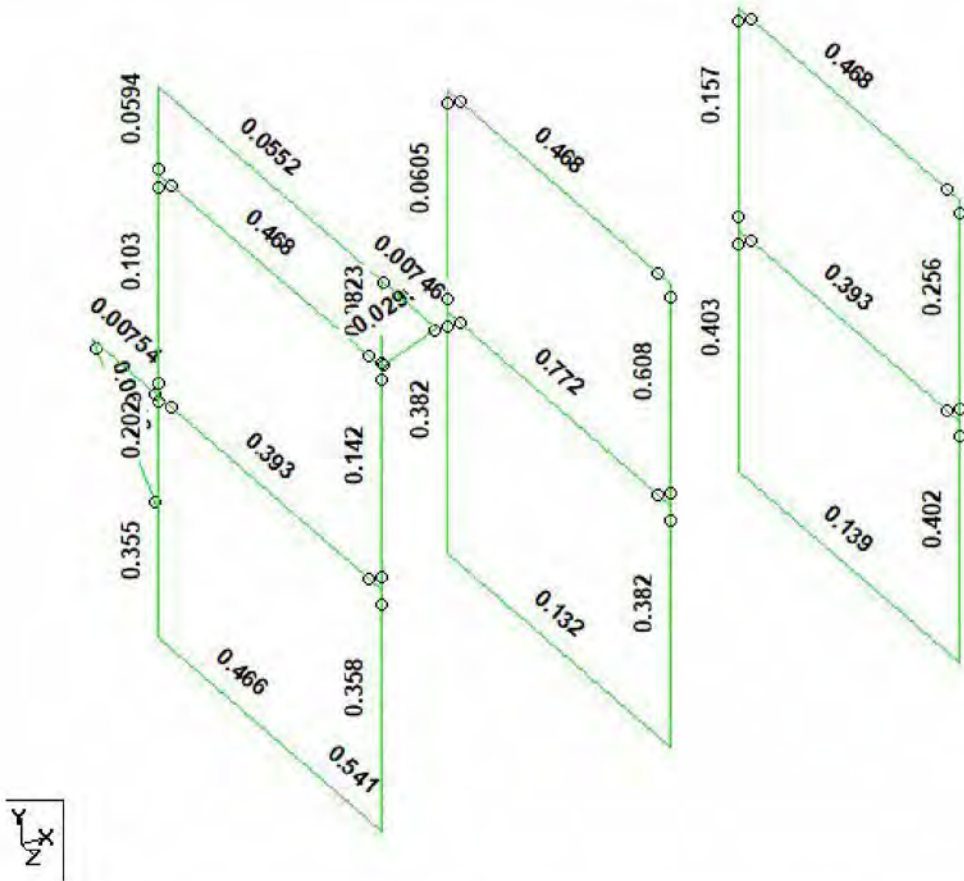


Figure 5.3.11 : Utilization ratio for intermediate members



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

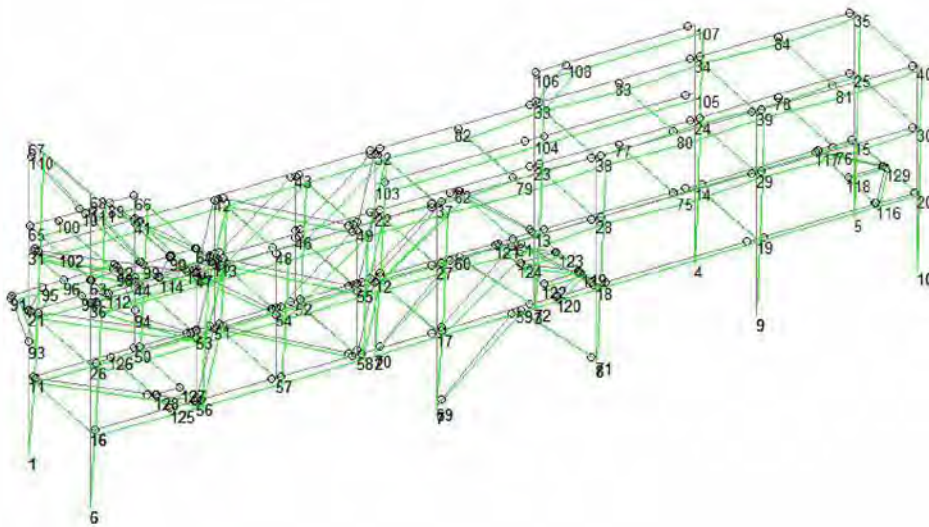
#### 5.4 DEFLECTION / DRIFT CHECK

**5.4.1 Lateral deflection:** The maximum deflection at the top of the column is 72.781mm at node no. 67 in LC 30173 which is a blast load combination. The limiting deflection would be H/200. Height of the column = 12100mm. As this is a blast load case, the limiting deflection value is increased by 25%. That means, H/200\*1.25. Hence

$$\text{limiting lateral deflection} = (12100/200) * 1.25 = 75.625\text{mm.}$$

As actual deflection = 72.781 < 75.625mm Hence it is safe.

Refer below snap from STAAD file. (The lateral deflection without blast load case are within limit of H/200, hence safe)



Piperack SR0501\_Sluiskil\_Superstructure\_Staad\_1.STD - Node Displacements:

	Node	L/C	Horizontal			Resultant	Rotational		
			X mm	Y mm	Z mm		rX rad	rY rad	rZ rad
Max X	68	30157	21.591	-7.390	-0.168	22.821	-0.000	-0.001	-0.004
Min X	40	30158	-11.771	-4.544	2.005	12.776	0.000	0.001	0.001
Max Y	91	30173	0.963	8.859	45.382	46.249	0.007	-0.001	0.000
Min Y	79	30158	-3.663	21.273	1.624	21.647	0.000	0.000	0.000
Max Z	67	30173	2.666	0.408	72.781	72.831	0.002	0.001	-0.001
Min Z	68	30174	2.588	0.410	-72.715	72.763	-0.002	-0.001	-0.001
Max rX	1	30173	0.000	0.000	0.000	0.000	0.012	-0.000	-0.000
Min rX	1	30174	0.000	0.000	0.000	0.000	-0.012	0.000	0.000
Max rY	68	30057	4.068	-0.961	3.260	5.284	-0.000	0.002	-0.002
Min rY	82	30174	0.076	-2.004	-62.861	62.893	-0.004	-0.003	0.000
Max rZ	6	30155	0.000	0.000	0.000	0.000	0.000	-0.000	0.004
Min rZ	95	30105	-2.480	-5.338	-0.203	6.809	-0.001	-0.000	-0.004
Max Rst	68	30173	3.968	-0.776	72.774	72.886	0.002	-0.000	-0.001

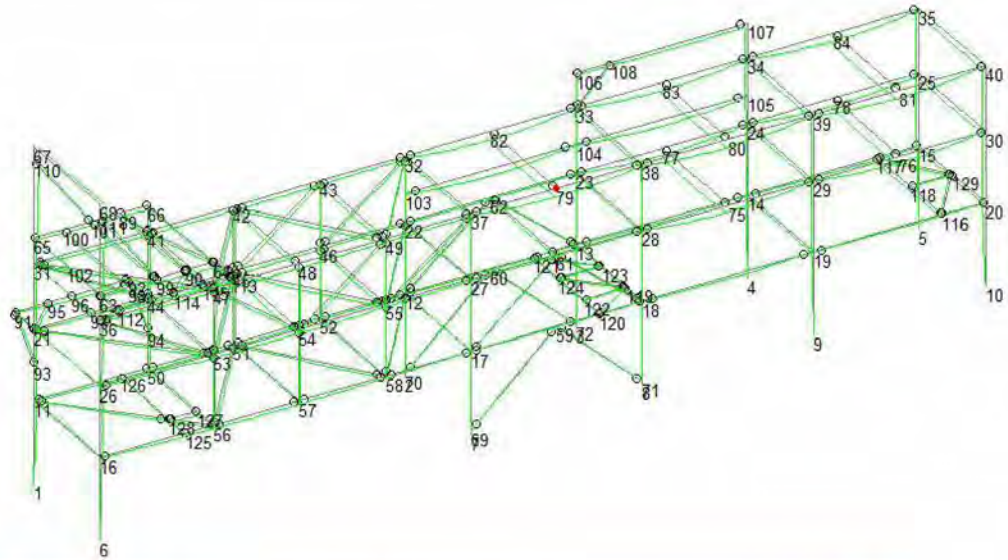
Level 30173: Displacement



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**5.4.2 Vertical deflection:** For vertical deflection in STAAD file, the required design parameters DFF & DJ1, DJ2 for the concerned beams are defined. The utilization ratio of all the beams are within unity. Hence they are safe. Here at below one manual calculation is shown.

The maximum vertical deflection = 21.273mm at node no. 79 in LC 30158. See the snap below.



Piperack SR0501\_Sluiskil\_Superstructure\_Staad\_1.STD - Node Displacements:

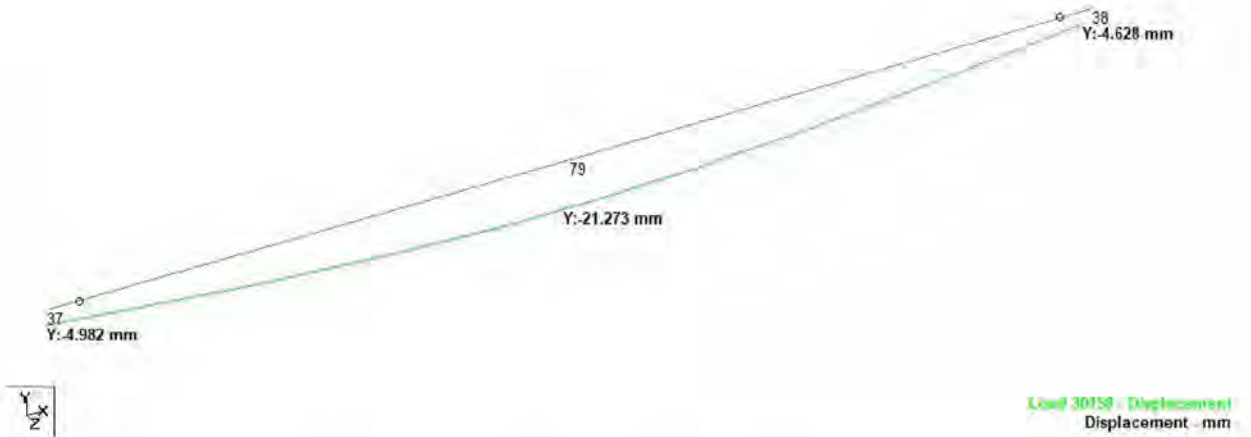
Summary

	Node	L/C	Horizontal			Resultant	Rotational		
			X mm	Y mm	Z mm		rX rad	rY rad	rZ rad
Max X	68	30157	21.591	-7.390	-0.168	22.821	-0.000	-0.001	-0.004
Min X	40	30158	-11.771	-4.544	2.005	12.776	0.000	0.001	0.001
Max Y	91	30173	0.963	8.859	45.382	46.249	0.007	-0.001	0.000
Min Y	79	30158	-3.663	-21.273	1.624	21.647	0.000	0.000	0.000
Max Z	67	30173	2.668	0.408	72.781	72.831	0.002	0.001	-0.001
Min Z	88	30174	2.588	0.410	-72.715	72.763	-0.002	-0.001	-0.001
Max rX	1	30173	0.000	0.000	0.000	0.000	0.012	-0.000	-0.000
Min rX	1	30174	0.000	0.000	0.000	0.000	-0.012	0.000	0.000
Max rY	68	30057	4.068	-0.861	3.260	5.284	-0.000	0.002	-0.002
Min rY	82	30174	0.076	-2.004	-62.861	62.893	-0.004	-0.003	0.000
Max rZ	6	30155	0.000	0.000	0.000	0.000	0.000	-0.000	0.004
Min rZ	95	30105	-2.480	-6.338	-0.203	6.809	-0.001	-0.000	-0.004
Max Rst	68	30173	3.968	-0.776	72.774	72.886	0.002	-0.000	-0.001

Y  
X  
Z

Load 30158 - Dis

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>



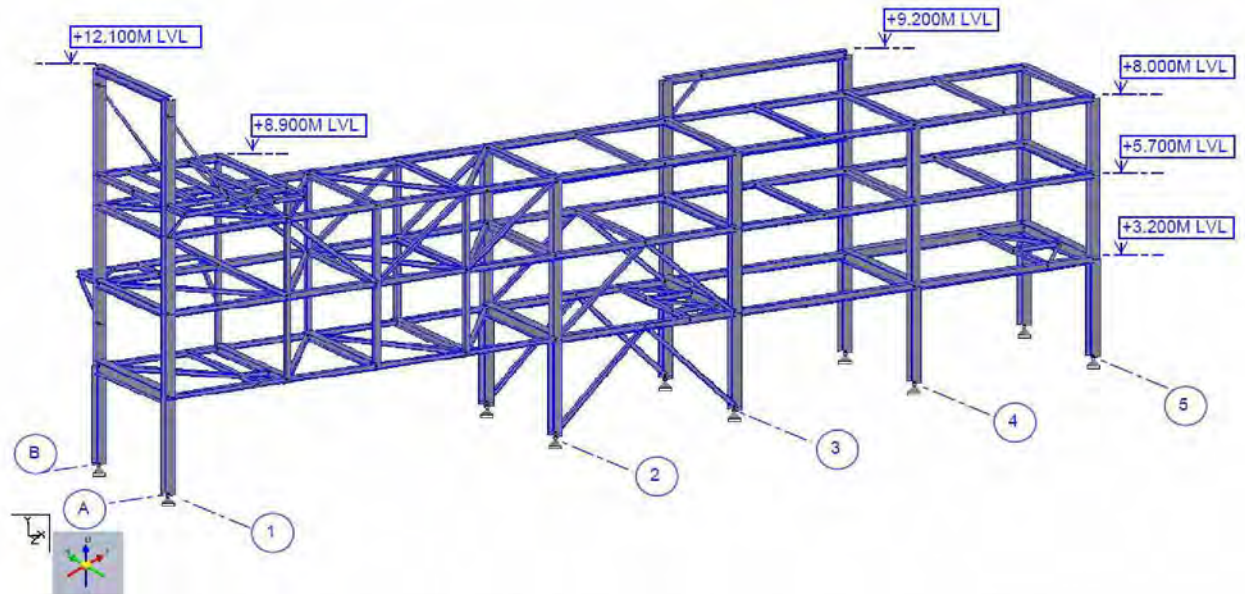
The deflection at the ends of the beams are 4.982 and 4.628mm (refer the snap above), hence net deflection at the centre of the beam =  $21.273 - ((4.982 + 4.628) / 2) = 16.47\text{mm}$ .

Limiting deflection =  $L/300 = 6000/300 = 20\text{mm}$ . As Actual deflection (16.47) < limiting deflection (20), hence it is safe.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 5.5 MEMBER SIZE

Refer below 3D snap to identify the levels and the grids of the piperack.



Refer following snaps from STAAD file for the member sizes of piperack SR0501.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

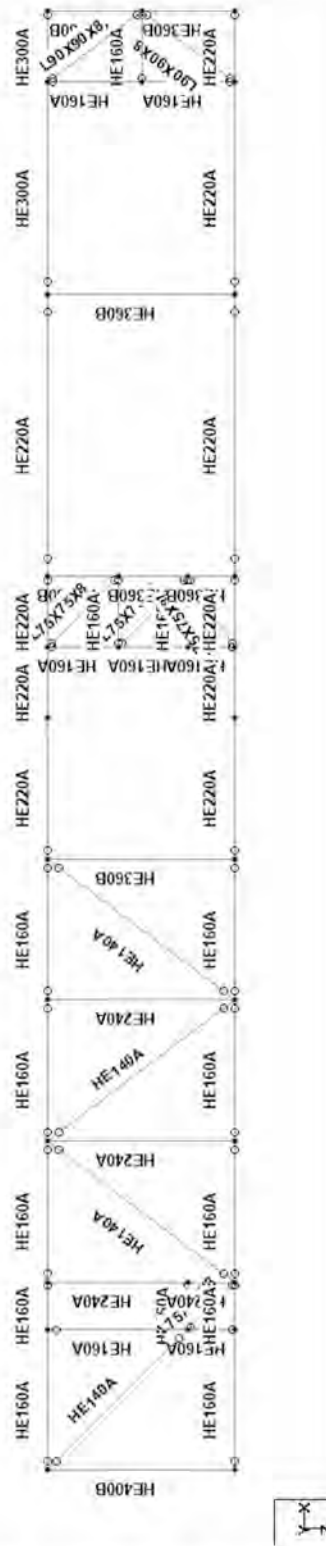


Figure 5.4.1 : member sizes at EL.3.200m level

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

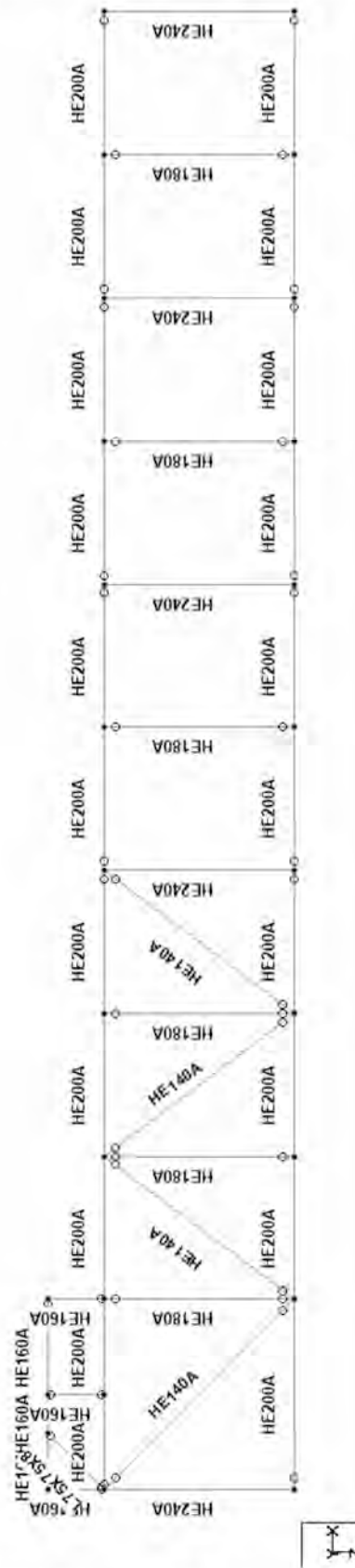


Figure 5.4.2 : member sizes at EL.5.700m level

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

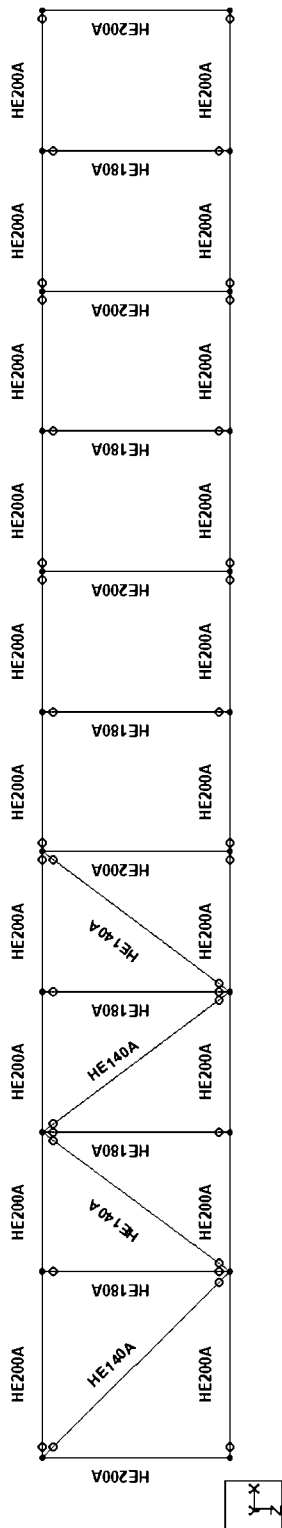


Figure 5.4.3 : member sizes at EL.8.000m level

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

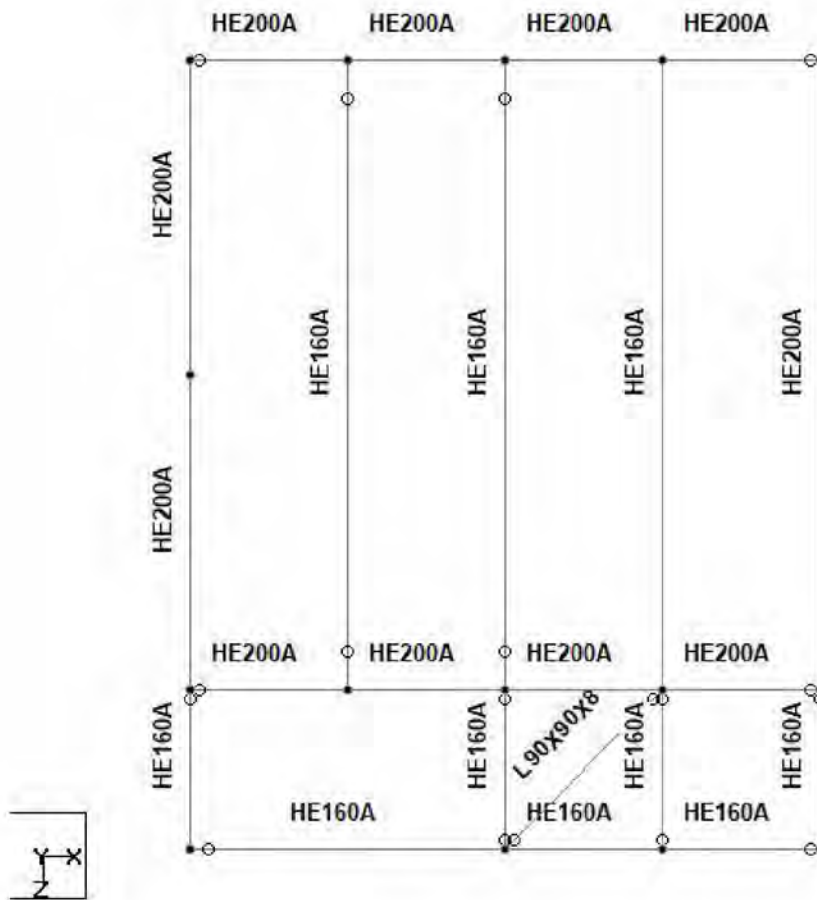


Figure 5.4.4 : member sizes at EL.8.900m level



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

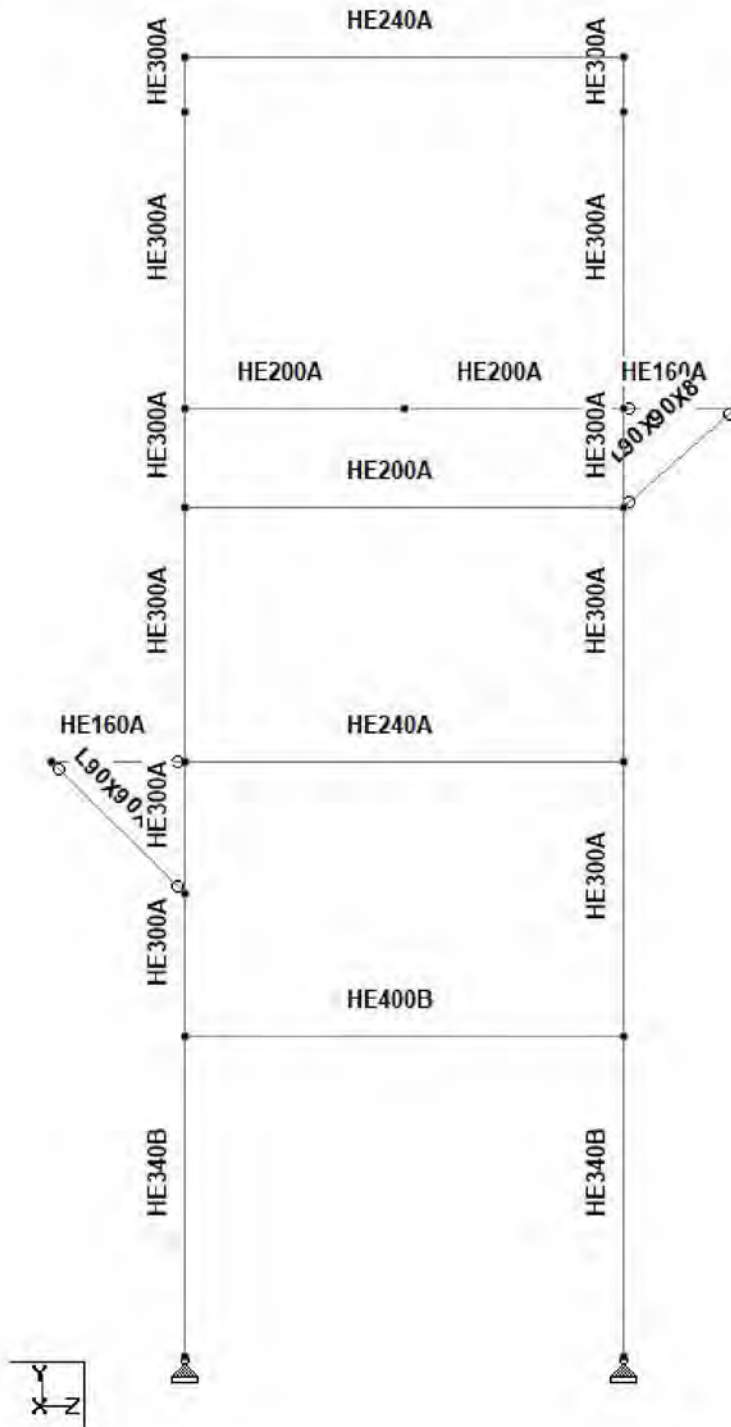


Figure 5.4.5 : member sizes at grid 1

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

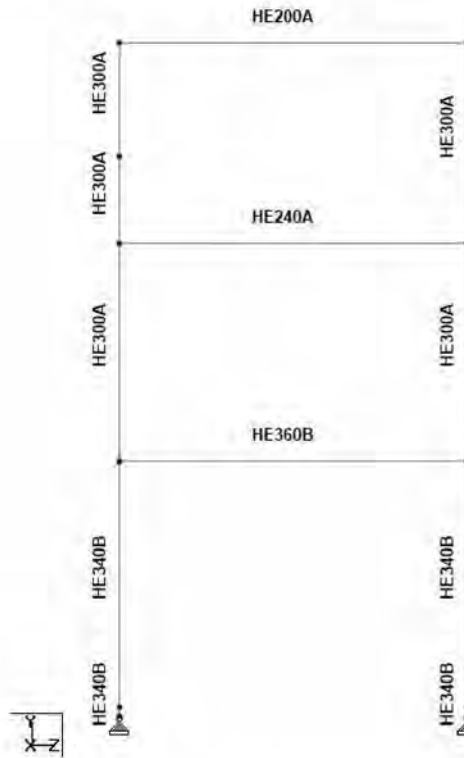


Figure 5.4.6 : member sizes at grid 2

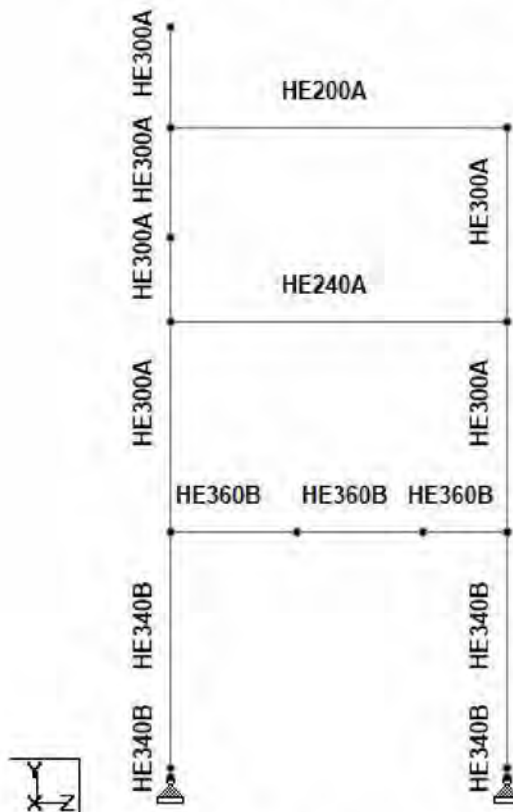


Figure 5.4.7 : member sizes at grid 3

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

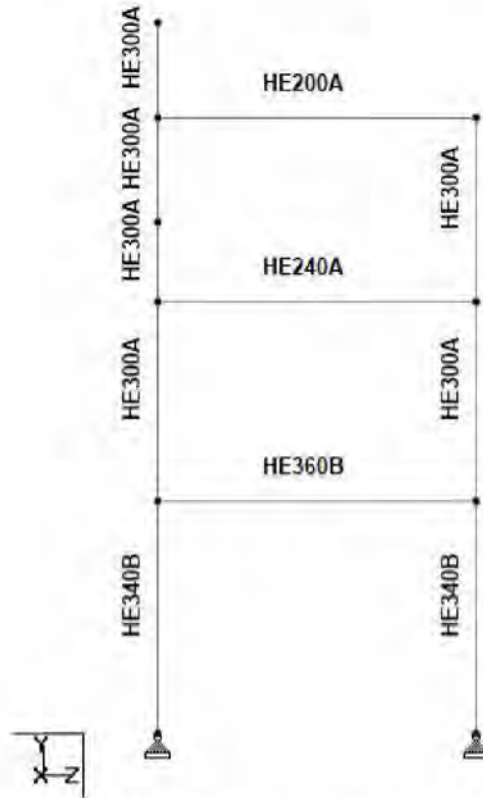


Figure 5.4.8 : member sizes at grid 4



Figure 5.4.9 : member sizes at grid 5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

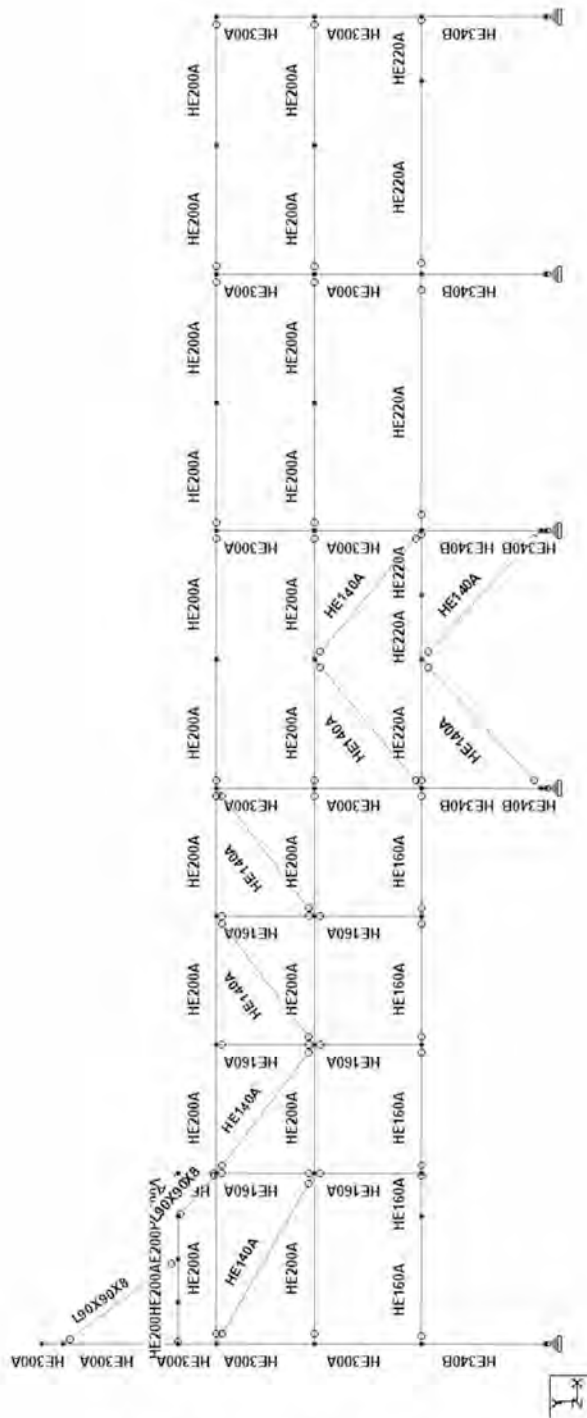


Figure 5.4.9 : member sizes at grid A

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

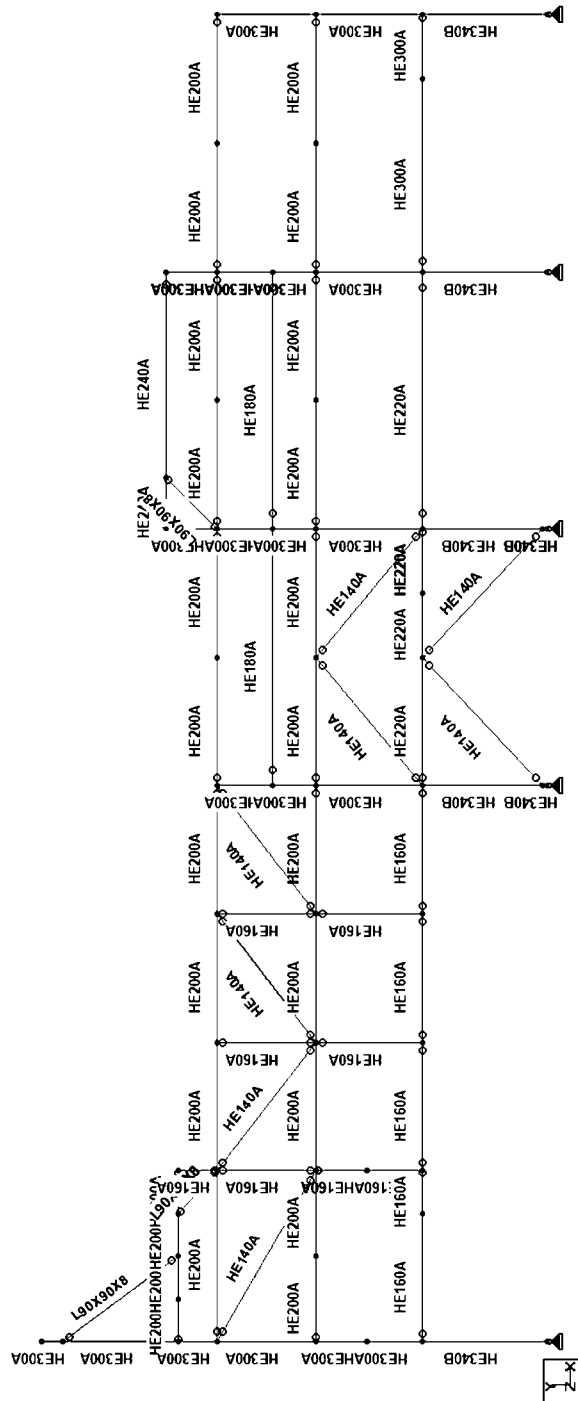


Figure 5.4.10 : member sizes at grid B

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

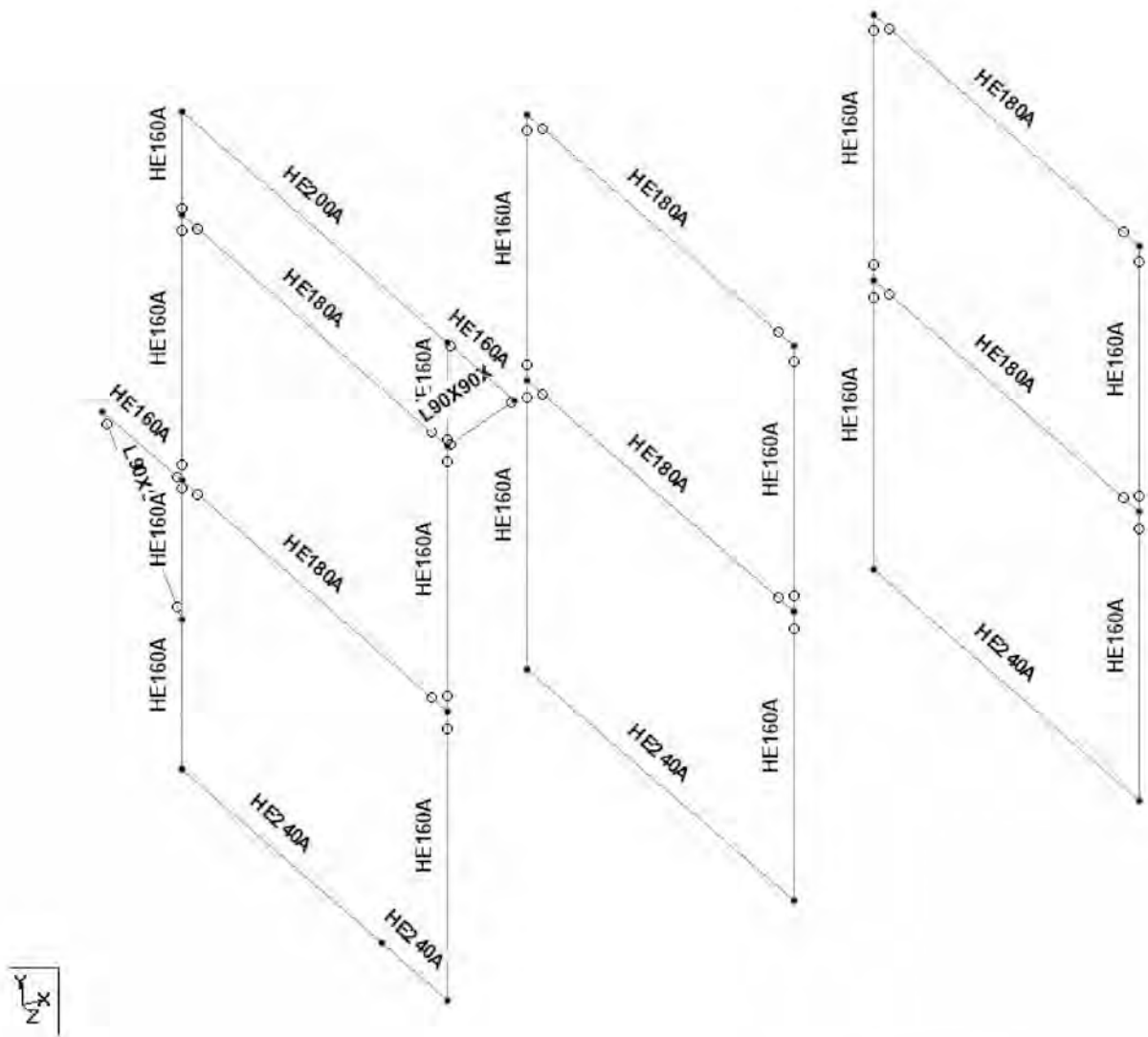


Figure 5.4.11 : member sizes at intermediate locations.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 6 BASE PLATE DESIGN

Base plate is designed as pinned. The maximum design forces for the design of the base plate are obtained from staad.

Piperack SR0501\_Sluiskil\_Superstructure\_Staad\_1.STD - Support Reactions:

All Summary Envelope

	Node	L/C	Horizontal			Moment		
			Fx kN	Fy kN	Fz kN	Mx kN-m	My kN-m	Mz kN-m
Max Fx	7	40143	<b>123.259</b>	580.840	-2.761	0.000	0.000	0.000
Min Fx	8	40141	<b>-110.489</b>	458.265	5.512	0.000	0.000	0.000
Max Fy	7	40142	71.539	<b>635.984</b>	-46.472	0.000	0.000	0.000
Min Fy	6	40218	-1.301	<b>-354.861</b>	153.098	0.000	0.000	0.000
Max Fz	6	40218	-1.301	-354.861	<b>153.098</b>	0.000	0.000	0.000
Min Fz	1	40217	<b>-2.900</b>	<b>-351.303</b>	<b>-153.902</b>	0.000	0.000	0.000
Max Mx	1	40001	7.837	87.787	5.372	<b>0.000</b>	0.000	0.000
Min Mx	1	40001	7.837	87.787	5.372	<b>0.000</b>	0.000	0.000
Max My	1	40001	7.837	87.787	5.372	0.000	<b>0.000</b>	0.000
Min My	1	40001	7.837	87.787	5.372	0.000	<b>0.000</b>	0.000
Max Mz	1	40001	7.837	87.787	5.372	0.000	0.000	<b>0.000</b>
Min Mz	1	40001	7.837	87.787	5.372	0.000	0.000	<b>0.000</b>

Table 6.1 Summary of forces for Base plate design

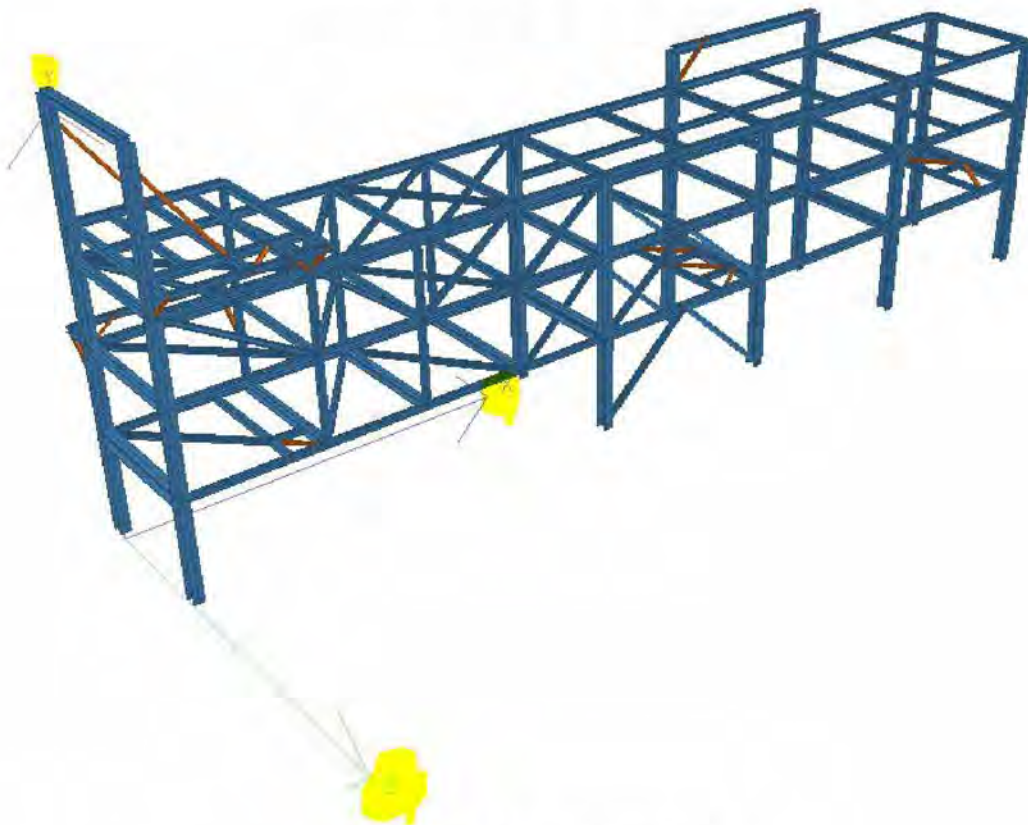


Figure 6.1 Staad directions

Maximum Vertical compression load = 635.984 say 640 kN

Maximum Vertical tension load = -354.861 say -355 kN

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

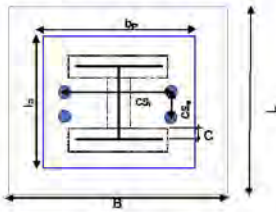
Maximum shear parallel to column flange = 123.259 say 125 kN

Maximum shear parallel to column web = 153.902 say 155 kN.

A typical base plate is designed for all the columns of the piperack with the forces mentioned above.



**Design of Base Plate (Pinned Support at Base - With Shear key):**



**Reference**  
 DIN EN 1993-1-1:2008  
 DIN EN 1993-1-8:2010  
 DIN EN 1992-1-1:2008  
 SCI-P398  
 SCI-P363

Structure No:	=	SR0501
Base Plate No:	=	BP1
Column on grid	=	for all

**Base Plate Details:**

Length of base plate ( $l_p$ )	=	500	mm	>=	440	mm	Clash free
Width of base plate ( $b_p$ )	=	600	mm	>=	550	mm	Clash free
Thickness of Base Plate ( $t_p$ )	=	25	mm				
Area of Base Plate Provided ( $A_{p0}$ )	=	300000	mm <sup>2</sup>				

**Utilization Ratios:**

Base plate in Compression	0.34
Base plate in Tension	0.40
Anchor Bolt in Tension	0.58
Shear Stub	0.37

**Pedestal Details:**

Length of Pedestal (L)	=	700	mm	>=	600	mm	Clash free
Width of base plate (B)	=	700	mm	>=	700	mm	Clash free
Area of Pedestal ( $A_p$ )	=	490000	mm <sup>2</sup>				

**Design Actions on Base Plate(ULS load combination):**

Max. Compressive Force ( $P_c$ )	=	640	kN
Max. Tensile Force ( $P_t$ )	=	-355	kN
Max. shear parallel to column flange ( $V_{edge}$ )	=	125	kN
Max. shear parallel to column web ( $V_{web}$ )	=	155	kN

**Structural steel Column Details:**

Column Section	=	HE 340 B	
Width of Flange (b)	=	300	mm
Depth of Column (h)	=	340	mm
Flange thickness (t)	=	21.5	mm
Web thickness ( $t_w$ )	=	12	mm
Root radius (r)	=	27	mm
Column Area ( $A_{col}$ )	=	17090	mm <sup>2</sup>
Column Perimeter ( $P_{col}$ )	=	1856	mm

**Material Strengths:**

Steel Grade for Base Plate Design	=	S235JR		
Yield Stress of Steel Plate ( $f_{yk}$ )	=	225	N/mm <sup>2</sup>	EN 10025-2, Table 7
Tensile Stress of Steel Plate ( $f_{tk}$ )	=	360	N/mm <sup>2</sup>	EN 10025-2, Table 7
Partial factor for steel ( $\gamma_{st}$ )	=	1.00		NEN EN 1993-1-1:2010, NA.2.15
Characteristic Strength of Concrete ( $f_{ck}$ )	=	30	N/mm <sup>2</sup>	
Coefficient taking account of long term effects on the compressive strength and of unfavourable effects resulting from the way the load is applied, $\alpha_{cc}$	=	1		NEN-EN 1992-1-1:2020, 3.1.6
Concrete Material Factor for Ultimate limit state, $\gamma_c$	=	1.5		NEN-EN 1992-1-1:2020, Table 2.1N
Design Compressive strength of concrete, $f_{cd} = \alpha_{cc} \cdot \gamma_{ck} / \gamma_c$	=	20		DIN EN 1992-1-1:2011, CL 3.1.6 (1)
Coefficient accounts for diffusion of the forces in the foundation, $\alpha$	=	1.5		Assumed Refer SCI_P358 page 241
Foundation joint material coefficient, $\beta_j$	=	0.87		DIN EN 1993-1-8:2010, CL 8.2.5 (7)
Joint Bearing strength at baseplate and concrete interface, $f_{jd} = \beta_j \cdot \alpha \cdot f_{cd}$	=	20	N/mm <sup>2</sup>	DIN EN 1993-1-8:2010, CL 6.2.5 (7)

**Anchor bolt Details:**

Material:	=	Grade S355		
Diameter of anchor bolt	=	30	mm	
Capacity of bolt in axial tension	=	152.14	kN	
Flange direction c/c distance between bolts, $CS_f$	=	350	mm	> 300 mm OK
Web direction c/c distance between bolts, $CS_w$	=	150	mm	< 300 mm NOT OK
No. of anchor bolts provided	=	4		
Edge Dist. From Base Plate (In Flange Dir.)	=	125	mm	> 70 mm OK
Edge Dist. From Pocket (In Flange Dir.)	=	50	mm	> 50 mm OK
Edge Dist. From Base Plate (In Web Dir.)	=	175	mm	> 70 mm OK
Edge Dist. From Pocket (In Web Dir.)	=	50	mm	> 50 mm OK
Shim Plate size	=	100	mm	
Distance of Shim from Column flange	=	23.5	mm	< 50 mm N.A
Distance of Shim from Column web	=	119	mm	> 50 mm OK

**Check for Anchor Bolts Tension Resistance:**

Tensile force on column	=	355	kN	
Tensile Force in each Anchor bolt	=	355	/	4 < 152.1 kN
	=	88.75	kN	
Utilization Ratio	=	0.58	<b>Anchor bolts are safe in tension</b>	

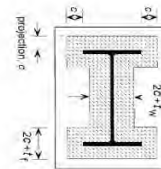
**1. Baseplate Design:**

**Required Area of Base plate:**

Self weight of the Baseplate, DL <sub>p</sub> =	0.6	kN
Area required (A <sub>p,req</sub> ) = (P <sub>c</sub> + DL <sub>p</sub> ) / f <sub>td</sub>	=	32029 mm <sup>2</sup> < Baseplate Area Provided, O.K

**Effective Area of Base plate:**

Maximum bearing width c	=	$t_p \cdot \left( \frac{f_{yb}}{3 \cdot f_{jd} \cdot \gamma_{M2}} \right) \cdot 0.5$	=	48.4	mm	DIN EN 1993-1-8:2010, CL 6.2.5(4)
Check for effective area overlap: (n - 2 * t) / 2 =	149	mm	> c , <b>No Overlap of Effective Area between flanges</b>			
Effective length of the base plate, L <sub>eff</sub> = h + 2 * c	=	437	mm	<	500	mm <b>OK</b>
Effective width of the base plate, B <sub>eff</sub> = bf + 2 * c	=	397	mm	<	600	mm <b>OK</b>
Effective bearing area of Base plate (A <sub>p,eff</sub> ) = 4 * c <sup>2</sup> + c * P <sub>col</sub> + A <sub>col</sub>	=	116318	mm <sup>2</sup>			



**Resistance in Compression:**

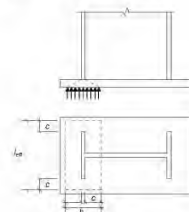
**A. Compressive Resistance of Baseplate:**

Design Compressive Resistance of Base plate, F <sub>C,Rd,1</sub> = f <sub>td</sub> * A <sub>p,eff</sub>	=	2326	kN
Design action on Base plate in compression, F <sub>01</sub> = (P <sub>c</sub> + DL <sub>p</sub> )	=	641	kN < 2326 kN <b>Satisfactory</b>

**B. Compressive Resistance of Concrete below Column Flange:**

Design Compressive Resistance of effective T-Stub flange, F <sub>C,Rd,2</sub> = f <sub>td</sub> * b <sub>eff</sub> * l <sub>eff</sub>	=	939.1	kN
Where, l <sub>eff</sub> = Effective length of Compression T-Stub = b <sub>f</sub> + 2 * c	=	396.82458	mm
b <sub>eff</sub> = Effective width of Compression T-Stub = t <sub>f</sub> + 2 * c	=	118.32458	mm
Design Compressive action in effective T-Stub, F <sub>d,2</sub> = P <sub>c</sub> / 2 =	=	320	kN < 939 kN <b>Satisfactory</b>

DIN EN 1993-1-8:2010, CL 6.2.5(3)



**Resistance in Tension:**

Design Resistance of baseplate T-stub in tension together with the associated anchor bolts, F<sub>T,Rd</sub> = 2 \* M<sub>p1,Rd</sub> / m

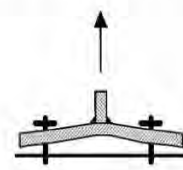
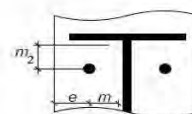
DIN EN 1993-1-8:2010, CL 6.2.4.1 (6), Table 6.2

Bending Moment, M<sub>p1,Rd</sub> = 0.25 \* l<sub>ten</sub> \* t<sub>p</sub> \* f<sub>p</sub> \* f<sub>yB</sub> / γ<sub>M2</sub>

DIN EN 1993-1-8:2010, Table 6.2

Where, l<sub>ten</sub> = Effective length of Tension T-Stub = MIN((2πm), (α m))

l <sub>ten</sub> =	1012	mm
M <sub>p1,Rd</sub> =	35.56	kN-m
m = (CS - l <sub>w</sub> - 2 s) / 2 =	161	mm
m <sub>2</sub> = (h - CS <sub>w</sub> - 2 t <sub>f</sub> - 2 s) / 2 =	65.5	mm
e = (b <sub>p</sub> - CS) / 2 =	126	mm
λ <sub>1</sub> = $\frac{m}{m + e}$	=	0.56
λ <sub>2</sub> = $\frac{m_2}{m + e}$	=	0.23



α = 8.00 Based on λ<sub>1</sub> and λ<sub>2</sub> from Figure 6.11 of DIN EN 1993-1-8:2010, Fig 6.11

F<sub>T,Rd</sub> = 2 \* M<sub>p1,Rd</sub> / m = 441.8 kN

No. of Anchor Bolts in effective T-Stub = 2

Design tensile action in effective T-Stub, F<sub>d</sub> = 177.5 kN < 441.8 kN **Satisfactory**

**Weld Design of Column and Base plate joint:**

DIN EN 1993-1-8:2010, CL 4.5.3.2 (6)

Weld leg length, s = 8 mm < t<sub>w</sub> = 12 mm **Satisfactory**

Weld throat, a = 0.707 \* s = 5.656 mm

Appropriate correlation factor, β<sub>w</sub> = #N/A

SCI-P398, Page 158

Partial safety factor for welded joint, γ<sub>M2</sub> = 1.30

DIN EN 1993-1-8:2010, CL 4.5.3.2 (6), Table 4.1

Ultimate Tensile Stress of the weaker part joined (f<sub>u</sub>) = 360 N/mm<sup>2</sup>

DNVGL-ST-N001, CL 5.9.8.4 (5)

Design Shear Strength of the weld, f<sub>w,d</sub> = (f<sub>u</sub> / √3) / (β<sub>w</sub> \* γ<sub>M2</sub>) = #N/A N/mm<sup>2</sup>

NEN-EN 1993-1-8:2010, CL 4.5.3.2 (6)

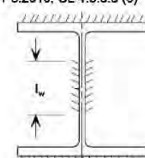
Length of weld along column web, l<sub>w,web</sub> = 2 \* (h - 2 \* t<sub>f</sub> - 2 \* r - 2 \* s) = 454 mm (Double Fillet Weld)

Length of weld along column flange, l<sub>w,flange</sub> = 2 \* b = 600 mm (Full Pen Weld)

DIN-EN 1993-1-8:2010, CL 4.5.3.3 (6)

Design throat area of weld along Column web, A<sub>w,web</sub> = a \* l<sub>w,web</sub> = 2567.82 mm<sup>2</sup>

Design throat area of weld along Column flange, A<sub>w,flange</sub> = t<sub>f</sub> \* l<sub>w,flange</sub> = 12900 mm<sup>2</sup>



**A. Weld Check for Directional Method**

τ <sub>⊥</sub> = Shear stress (in the plane of the throat) perpendicular to the axis of the weld	=	(V <sub>flange</sub> / A <sub>w,web</sub> ) + (V <sub>web</sub> / A <sub>w,flange</sub> ) =	60.7	N/mm <sup>2</sup>
τ <sub>∥</sub> = Shear stress (in the plane of the throat) parallel to the axis of the weld	=	(V <sub>flange</sub> / A <sub>w,flange</sub> ) + (V <sub>web</sub> / A <sub>w,web</sub> ) =	70.1	N/mm <sup>2</sup>
σ <sub>⊥</sub> = Normal stress perpendicular to the throat = P <sub>r</sub> / (A <sub>w,flange</sub> + A <sub>w,web</sub> ) =	22.95	N/mm <sup>2</sup> <	0.9 f <sub>u</sub> / γ <sub>M2</sub> =	249.2 N/mm <sup>2</sup> <b>Satisfactory</b>

$[\sigma_{\perp}^2 + 3 (\tau_{\perp}^2 + \tau_{\parallel}^2)]^{0.5} = 162$  N/mm<sup>2</sup> # f<sub>u</sub> / (β<sub>w</sub> \* γ<sub>M2</sub>) = #N/A N/mm<sup>2</sup> #N/A #N/A



**B. Shear Check for Column Web Weld:**

Design Resistance due to shear force,  $F_{w,Rd} = f_{w,d} \cdot A_{w,web} =$  #N/A kN DIN EN 1993-1-8, CL 4.5.3.3 (2)  
 Design Shear force,  $V_{Ed} =$  155 kN ### #N/A kN #N/A

**C. Shear Check for Column Flange weld:**

Column flanges shall be connected to baseplate with full penetration butt weld.

**2. Shear Stub:**

**Note :- Whole shear force is resisted by the shear stub.**

Shear stub Orientation w.r.t Main Column= **0**  
 Design value of shear parallel to stub web = 155 kN  
 Design value of shear parallel to stub flange = 125 kN  
 Shear Stub Section **HE 200 B**  
 I section Properties = 

Sh	200	mm
----	-----	----

Sb	200	mm
----	-----	----

Stw	9	mm
-----	---	----

Stf	15	mm
-----	----	----

Sr	18	mm
----	----	----

SA	7810	mm <sup>2</sup>
----	------	-----------------

  
 Depth of shear stub below base plate, ds = **200** mm  
 Thickness of groud, lg = **50** mm

**Shear Resistance of Stub web:**

Shear resisting area of stub,  $A_{w} = SA - 2 \cdot Sb \cdot Stf + (Stw + 2 \cdot Sr) \cdot Stf > \eta \cdot (Sh - 2 \cdot Stf) \cdot Stw$  DIN EN 1993-1-1:2010, CL 6.2.6 (3)  
 Where,  $\eta =$  1.0 NA to SS EN 1993-1-5:2009, NA 2.4  
 $A_w =$  2485 mm<sup>2</sup>

Design Shear Resistance of Stub web,  $V_{w,Rd} = A_w \cdot (f_{t,web} / \sqrt{3}) / \gamma_{M2}$  DIN EN 1993-1-1:2010, CL 6.2.6 (2)  
 Yield Stress of Steel Plate ( $f_{t,web}$ ) = 235 N/mm<sup>2</sup> EN 10025-2, Table 7  
 Tensile Stress of Steel Plate ( $f_{t,web}$ ) = 360 N/mm<sup>2</sup> EN 10025-2, Table 7  
 Design Shear Resistance of Stub web,  $V_{w,Rd} =$  357 kN > 155 kN **Satisfactory**

**Shear Resistance of Stub flanges:**

Shear resisting area of stub,  $A_{w} = SA - (Sh - 2 \cdot Stf) \cdot Stw =$  8280 mm<sup>2</sup> DIN EN 1993-1-1:2010, CL 6.2.6 (3)  
 Design Shear Resistance of Stub flanges,  $V_{w,Rd} = A_w \cdot (f_{t,web} / \sqrt{3}) / \gamma_{M2}$  DIN EN 1993-1-1:2010, CL 6.2.6 (2)  
 Yield Stress of Steel Plate ( $f_{t,web}$ ) = 235 N/mm<sup>2</sup> EN 10025-2, Table 7  
 Tensile Stress of Steel Plate ( $f_{t,web}$ ) = 360 N/mm<sup>2</sup> EN 10025-2, Table 7  
 Design Shear Resistance of Stub flanges,  $V_{w,Rd} =$  852 kN > 125 kN **Satisfactory**

**Weld Design of Base plate and Shear stub joint:**

**A. Shear Stub Web Weld**

Weld leg length, s = **8** mm < Stw = 9 mm **Satisfactory**  
 Weld throat, a = 0.707 \* s = 4.2 mm  
 Appropriate correlation factor,  $\beta_w =$  #N/A DIN EN 1993-1-8:2010, CL 4.5.3.2 (6), Table 4.1  
 Partial safety factor for welded joint,  $\gamma_{M2} =$  1.25 NEN-EN 1993-1-8:2011, CL 2.2(2)  
 Design Shear Strength of the weld,  $f_{w,d} = (f_u / \sqrt{3}) / (\beta_w \cdot \gamma_{M2}) =$  #N/A N/mm<sup>2</sup> DIN EN 1993-1-8:2010, CL 4.5.3.3 (3)  
 Effective length of weld in web of shear stub,  $l_{w,eff} = 2(Sh - 2 \cdot Stf - 2 \cdot Sr) =$  244 mm  
 Design Resistance due to shear force,  $F_{w,Rd} = f_{w,d} \cdot a \cdot l_{w,eff} =$  #N/A kN DIN EN 1993-1-8:2010, CL 4.5.3.3 (2)  
 Design Shear force,  $V_{Ed} =$  155 kN ### #N/A kN #N/A #N/A

**B. Shear Stub flanges Weld**

Weld leg length, s = **8** mm < Stf = 15 mm **Satisfactory**  
 Weld throat, a = 0.707 \* s = 4.2 mm  
 Appropriate correlation factor,  $\beta_w =$  0.80 DIN EN 1993-1-8:2010, CL 4.5.3.2 (6), Table 4.1  
 Partial safety factor for welded joint,  $\gamma_{M2} =$  1.25 NEN-EN 1993-1-8:2011, CL 2.2(2)  
 Design Shear Strength of the weld,  $f_{w,d} = (f_u / \sqrt{3}) / (\beta_w \cdot \gamma_{M2}) =$  207.85 N/mm<sup>2</sup> DIN-EN 1993-1-8:2010, CL 4.5.3.3 (3)  
 Effective length of weld in flange of shear stub,  $l_{w,eff} = ((Sb - 2a) + (Stw - 4a + 2Sr)) =$  319 mm  
 Design Resistance due to shear force,  $F_{w,Rd} = f_{w,d} \cdot a \cdot l_{w,eff} =$  281.28 kN DIN EN 1993-1-8:2010, CL 4.5.3.3 (2)  
 Design Shear force parallel to weld per flange,  $V_{EdF} =$  63 kN  
 Design Transverse force per flange,  $V_{EdT} = (M_{y,Ed} / (Sh - Stf)) + ((M_{z,Ed} / 2) / (Stw + 2 \cdot Sr + ((Sb - Stw - 2 \cdot Sr) / 2))) =$  169 kN DIN EN 1993-1-8:2010, CL 4.5.3.3 (6)  
 Design Shear force,  $V_{Ed} = \sqrt{V_{EdF}^2 + (V_{EdT} / K)^2} =$  151 kN < 281 kN **Satisfactory** DIN EN 1993-1-8:2010, CL 4.5.3.3 (8)  
 where K = 1.23 SCI-P363, Page A-44

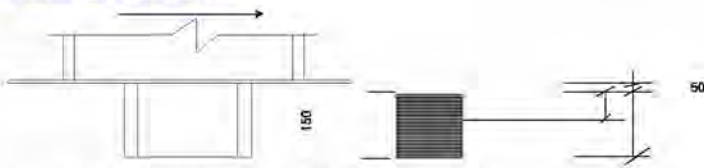
**Joint bearing resistance parallel to Shear stub web:**

Effective bearing area of Shear stub web ( $A_{w,b}$ ) =  $l_{w,eff} \cdot (ds - lg) =$  38800 mm<sup>2</sup>  
 Design Resistance of bearing at joint,  $F_{C,Rd,2} = f_{d,2} \cdot A_{w,b} =$  732 kN  
 Design value of bearing at joint,  $F_{Ed} =$  155 kN < 732 kN **Satisfactory**

**Joint bearing resistance parallel to Shear stub flanges:**

Effective bearing area of Shear stub web ( $A_{w,b}$ ) =  $l_{w,eff} \cdot (ds - lg) =$  47850 mm<sup>2</sup>  
 Design Resistance of bearing at joint,  $F_{C,Rd,3} = f_{d,3} \cdot A_{w,b} =$  957 kN  
 Design value of bearing at joint,  $F_{Ed} =$  125 kN < 957 kN **Satisfactory**

Interaction Ratio of shear stub:



Moment in shear lug @ major axis,	$M_{y,Ed} = 165 \times ( 75 + 50 ) = 19 \text{ kN-m}$	
Moment in shear lug @ minor axis,	$M_{z,Ed} = 125 \times ( 75 + 50 ) = 16 \text{ kN-m}$	
Plastic section modulus about major axis,	$W_{pl,y} = 542500 \text{ mm}^3$	
Plastic section modulus about minor axis,	$W_{pl,z} = 305800 \text{ mm}^3$	
Design Resistance for bending about major axis,	$M_{y,Rd} = W_{pl,y} \cdot f_{yTW} / \gamma_{M2} = 151 \text{ kN-m}$	DIN EN 1993-1-1:2010, CL 6.2.5 (2)
Design Resistance for bending about minor axis,	$M_{z,Rd} = W_{pl,z} \cdot f_{yTW} / \gamma_{M2} = 71.9 \text{ kN-m}$	DIN EN 1993-1-1:2010, CL 6.2.5 (2)
Compressive force on Shear stub, $N_{c,Ed} = (P_G + DL_p) \cdot SA / A_{c,stub} =$	43 kN	
Design Resistance of cross-section for uniform compression, $N_{c,Rd} = SA \cdot f_{yTW} / \gamma_{M0}$	1835 kN	DIN EN 1993-1-1:2010, CL 6.2.4 (2)
Interaction ratio = $\frac{N_{c,Ed}}{N_{c,Rd}} + \frac{M_{y,Ed}}{M_{y,Rd}} + \frac{M_{z,Ed}}{M_{z,Rd}} = 0.37 < 1$	<b>Satisfactory</b>	DIN EN 1993-1-1:2010, CL 6.2.1 (7)
Pocket Size Required For shear lug:	300 x 300 x 200 Deep	
Provide Pocket Size:	<b>250</b> x <b>250</b> x <b>200</b> Deep	

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

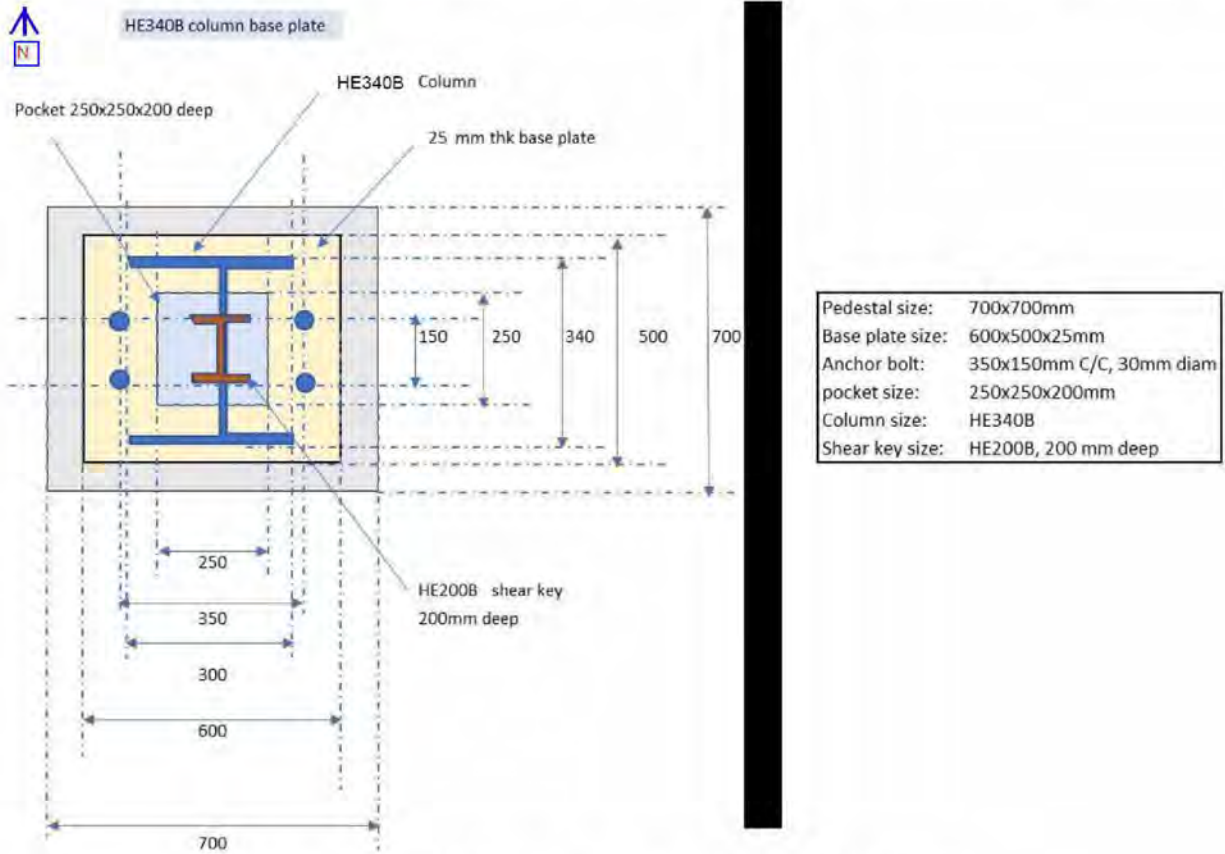


Figure 6.2: Base plate sketch (typical for all columns)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 7 ANCHOR BOLT DESIGN DESIGN

A typical anchor bolt is designed for the loads which were mentioned for the base plate design. Refer following pages for the design of the same.

**Design Resistance of Anchor Bolts with sleeve:**



**Reference**  
 EN 1993-1-1:2005  
 EN 1993-1-8:2005  
 EN 1992-1-1:2005  
 ETAG-001, Annex C

Column on grid = **for all grids**

**Anchor bolt Details:**

Material:	<b>S355JR</b>	for -10 to +300°C Temperature range
Bolt Class:	<b>8.8</b>	
Diameter of anchor bolt, $\phi$	= <b>30</b> mm	
Tensile stress Area, $A_s$	= <b>561</b> mm <sup>2</sup>	
Sleeve Diameter, $S_d$	= <b>208</b> mm	
Flange direction c/c distance between bolts, $CS_f$	= <b>350</b> mm	> 250 mm
Web direction c/c distance between bolts, $CS_w$	= <b>150</b> mm	< 250 mm
No. of anchor bolts provided	= <b>4</b>	
Edge distance from pedestal in Flange direction, $C_1$	= <b>175</b> mm	
Edge distance from pedestal in Web direction, $C_2$	= <b>275</b> mm	
Thickness of Base Plate ( $t_p$ )	= <b>25</b> mm	
Thickness of Sole Plate ( $t_s$ )	= <b>0</b> mm	
Thickness of Grout ( $t_g$ )	= <b>50</b> mm	
Projection of Anchor Bolt above ungrounded concrete	= <b>190</b> mm	< 190 mm

**OK**  
**NOT OK.....Refer following design. Anchor bolt with lesser spacing are safe.**

**OK**

**Pedestal Details:**

Length of Pedestal (L)	= <b>700</b> mm
Width of Pedestal (B)	= <b>700</b> mm
Height of Pedestal (H)	= <b>1100</b> mm

**Design Actions on Base Plate:**

Max. Compressive Force ( $F_c$ )	= <b>640</b> kN
Max. Tensile Force ( $F_T$ )	= <b>-355</b> kN
Max. shear parallel to column flange ( $V_{U1}$ )	= <b>125</b> kN
Max. shear parallel to column web ( $V_{U2}$ )	= <b>155</b> kN

**Material Strengths:**

Anchor Bolt Yield Strength ( $f_y$ )	= 640 N/mm <sup>2</sup>	EN 1993-1-8, Table 3.1
Anchor Bolt Ultimate Strength ( $f_{ub}$ )	= 800 N/mm <sup>2</sup>	EN 1993-1-8, Table 3.1
Partial safety factor for bolt ( $\gamma_{M2}$ )	= 1.25	NA to NEN 1993-1-8, 2.2
Partial safety factor for taking account of the installation safety of an anchor system ( $\gamma_2$ )	= 1.00	ETAG-001, Annex C - cl 3.2.2.1
Concrete Material Factor for Ultimate limit state, $\gamma_c$	= 1.5	NA to NEN 1992 1-1, Table 2.1N
Partial safety factor for concrete cone failure, $\gamma_{Mc} = \gamma_c * \gamma_2$	= 1.5	ETAG-001, Annex C - cl 3.2.2.1
Partial safety factor for pull-out failure, $\gamma_{Me} = \gamma_{Mc}$	= 1.5	ETAG-001, Annex C - cl 3.2.2.1
Partial safety factor for splitting failure, $\gamma_{Msp} = \gamma_{Mc}$	= 1.5	ETAG-001, Annex C - cl 3.2.2.1
Characteristic Cylindrical Strength of Concrete ( $f_{ck}$ )	= 30 N/mm <sup>2</sup>	ETAG-001, Annex C - cl 3.2.2.1
Characteristic Cube Strength of Concrete ( $f_{ck,cube}$ )	= 37 N/mm <sup>2</sup>	

**1. Steel Failure Resistance:**

Design Tensile Resistance of Anchor Bolt,  $N_{Rd,A} = 0.85 * k_2 * f_{ub} * A_s / \gamma_{M2} = 275$  kN  
 where,  $k_2 = 0.9$

EN 1993-1-8, cl 3.8.1 (3),  
 Table 3.4

Design tensile force in Anchor Bolt,  $N_{Ed} = 89$  kN < 275 kN **Satisfactory**



**2. Pull-out Failure Resistance:**

Design Resistance of Anchor Bolt in case of pull-out Failure,  $N_{Rd,p} = k_1 \cdot f_{tk} \cdot A_h / \gamma_{Mcp} = 192 \text{ kN}$

ETAG-001, Annex C - cl 5.2.2.3

Where,  $A_h = \text{Load bearing area of the head of the fastener} = \pi (\phi_h^2 - \phi^2) / 4 = 1336 \text{ mm}^2$   
 $\phi_h = \text{External Diameter of the anchor stud} = 51 \text{ mm}$   
 $\phi = \text{External Diameter of the anchor shaft} = 30 \text{ mm}$   
 $k_1 = \text{Coefficient dependent on concrete condition, for cracked concrete} = 7.2$



Design tensile force in Anchor Bolt,  $N_{Sd} = 89 \text{ kN} < 192 \text{ kN}$  **Satisfactory**

**3. Concrete Cone Failure Resistance:**

The characteristic resistance of Anchor Bolt in case of Concrete Cone Failure:  $N_{Rk,c} = N_{Rk,c}^0 \cdot \frac{A_{c,N}}{A_{c,N}^0} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec,N}$

EN 1992-1-1, cl 2.7 (1)

ETAG-001, Annex C - cl 5.2.2.4

Initial value of characteristic resistance  $N_{Rk,c}^0 = k_1 \cdot \sqrt{f_{ck,cube}} \cdot h_{ef}^{1.5} = 153 \text{ kN}$

where,  $k_1$  for cracked concrete = 7.2

$h_{ef} = \text{length of the anchor in concrete} = 230 \text{ mm}$

$S_{cr,N} = \text{Spacing for ensuring the transmission of the characteristic tensile resistance of a single anchor without spacing and edge effects in case of concrete cone failure} = 3 \cdot h_{ef} = 690 \text{ mm}$

$C_{cr,N} = \text{Edge distance for ensuring the transmission of the characteristic tensile resistance of a single anchor without spacing and edge effects in case of concrete cone failure} = 1.5 \cdot h_{ef} = 345 \text{ mm}$

$A_{c,N}^0 = \text{Area of concrete of an individual anchor with large spacing and edge distance at the concrete surface} = S_{cr,N} \cdot S_{cr,N} = 476100 \text{ mm}^2$

$A_{c,N} = \text{Actual area of concrete cone of the anchorage at the concrete surface, as the concrete cones of four anchor bolts are overlapping,}$

$A_{c,N} = (2 \cdot C_1 + CS) \cdot (2 \cdot C_2 + CS_w) = 490000 \text{ mm}^2$

$\psi_{s,N} = \text{factor accounts disturbance of the stresses in the concrete due to edges of the member, } (0.7 + 0.3 \cdot C / C_{cr,N}) \leq 1 = 0.9$

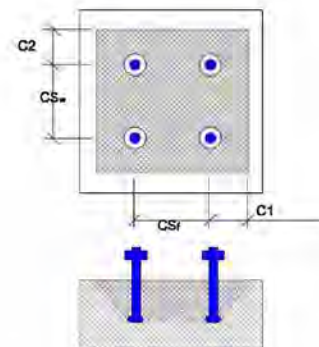
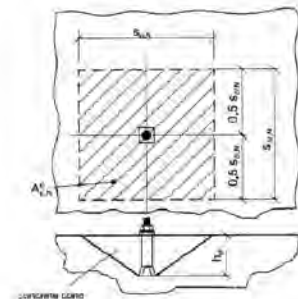
$\psi_{re,N} = \text{The shell spalling factor, accounts the effect of Reinforcement, } (0.5 + (h_{ef} / 200)) \leq 1 = 1.0$

$\psi_{ec,N} = \text{factor accounts group effect when different tension loads acting on the individual anchors of a group} = 1.0$

The characteristic resistance of Anchor Bolt in case of Concrete Cone Failure,  $N_{Rk,c} = 134 \text{ kN}$

Design resistance of Anchor Bolt in case of Concrete Cone Failure,  $N_{Rd,c} = N_{Rk,c} / \gamma_{Mc} = 89.32 \text{ kN}$

Design tensile force in Anchor Bolt,  $N_{Sd} = 89 \text{ kN} < 89 \text{ kN}$  **Satisfactory**



**4. Splitting Failure due to loading Resistance:**

The characteristic resistance of Anchor Bolt in case of Concrete Cone Failure:  $N_{Rk,sp} = N_{Rk,c}^0 \cdot \frac{A_{c,sp}}{A_{c,N}^0} \cdot \psi_{h,sp} \cdot \psi_{br,N} \cdot \psi_{ec,N} \cdot \psi_{cr,N}$

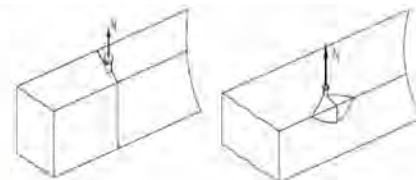
ETAG-001, Annex C - cl 5.2.2.6

where,  $\psi_{h,sp} = \text{factor to account for the influence of the actual member depth, H, on the splitting resistance for anchors} = (H/h_{ef})^{(2/3)} \leq 1.5 = 1.5$

The characteristic resistance of Anchor Bolt in case of Splitting Failure,  $N_{Rk,sp} = 201 \text{ kN}$

Design resistance of Anchor Bolt in case of Splitting Failure,  $N_{Rd,c} = N_{Rk,sp} / \gamma_{Mcp} = 134 \text{ kN}$

Design tensile force in Anchor Bolt,  $N_{Sd} = 89 \text{ kN} < 134 \text{ kN}$  **Satisfactory**





Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 8 PEDESTAL/PILE/PILE CAP DESIGN

### 8.1 PEDESTAL DESIGN

Refer below sketch as the layout of pedestal

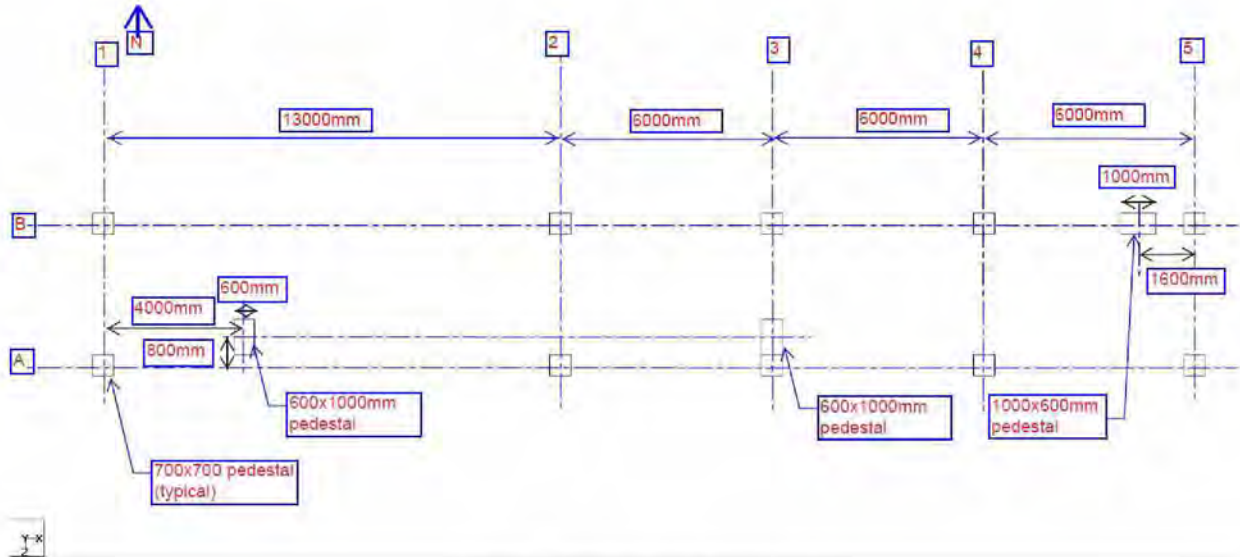


Figure 7.1.1 Pedestal layout

The pedestals are designed by using Advanced Concrete design. Refer following pages for the detailed calculation for the pedestal design.

Column/Wall : C1

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	164	40014	53.14	2.7	59.95	0.28	0.34	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C2

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	195	40045	119.09	88.66	-13.64	0.28	0.38	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C3

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	197	40047	-6.68	-102.4	-1.73	0.28	0.54	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C4

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	208	40058	19.53	7.59	30.96	0.28	0.15	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C5

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	208	40058	31.34	7.64	31.59	0.28	0.15	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C6

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	162	40012	46.76	1.98	-59.64	0.28	0.29	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C7

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
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2 TO 3	700 X 700	C35/45 : Fy500	211	40061	75.87	83.1	-13.59	0.28	0.38	12-T12	T8 @ 125 + T8 @ 225
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Column/Wall : C8

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	213	40063	31.93	-93.48	5.88	0.28	0.46	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C9

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	214	40064	52.8	7.38	-31.09	0.28	0.14	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C10

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
2 TO 3	700 X 700	C35/45 : Fy500	210	40060	50.76	-8.4	-31.83	0.28	0.15	12-T12	T8 @ 125 + T8 @ 225

Column/Wall : C17

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
1 TO 2	600 X 1000	C35/45 : Fy500	320	40170	220.15	-0.01	0.02	0.3	0.02	16-T12	T8 @ 125 + T8 @ 225

Column/Wall : C18

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
1 TO 2	600 X 1000	C35/45 : Fy500	320	40170	422.73	0.12	0.21	0.3	0.03	16-T12	T8 @ 125 + T8 @ 225

Column/Wall : C19

Level	Size (mm)	Material	LC	Analysis LC No	P (kN)	Mx (kNm)	My (kNm)	Pt (%)	Interaction Ratio	Main Reinforcement	Links
1 TO	600 X	C35/45 :	320	40170	422.73	0.14	0.23	0.3	0.03	16-T12	T8 @ 125 + T8 @

2	1000	Fy500										225
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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 8.2 PILE LAYOUT (WITH REACTION, SETTLEMENT CHECK)

As per the BGD soil report, section 5.2 & 5.3, the spring stiffness at the pile location is defined as 104000 kN/m as vertical spring & 3000 kN/m as horizontal spring.

Refer the snap below for the location of the piles (spring constants) that are provided in STAAD file for design of pile cap.

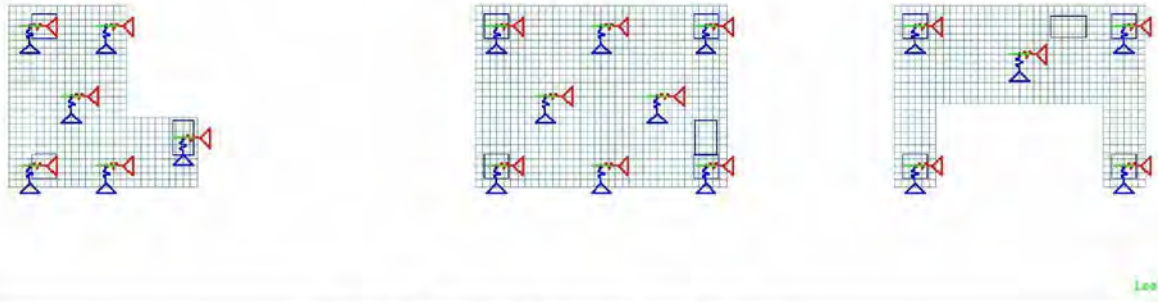


Figure 7.2.1: Spring modelled for piles

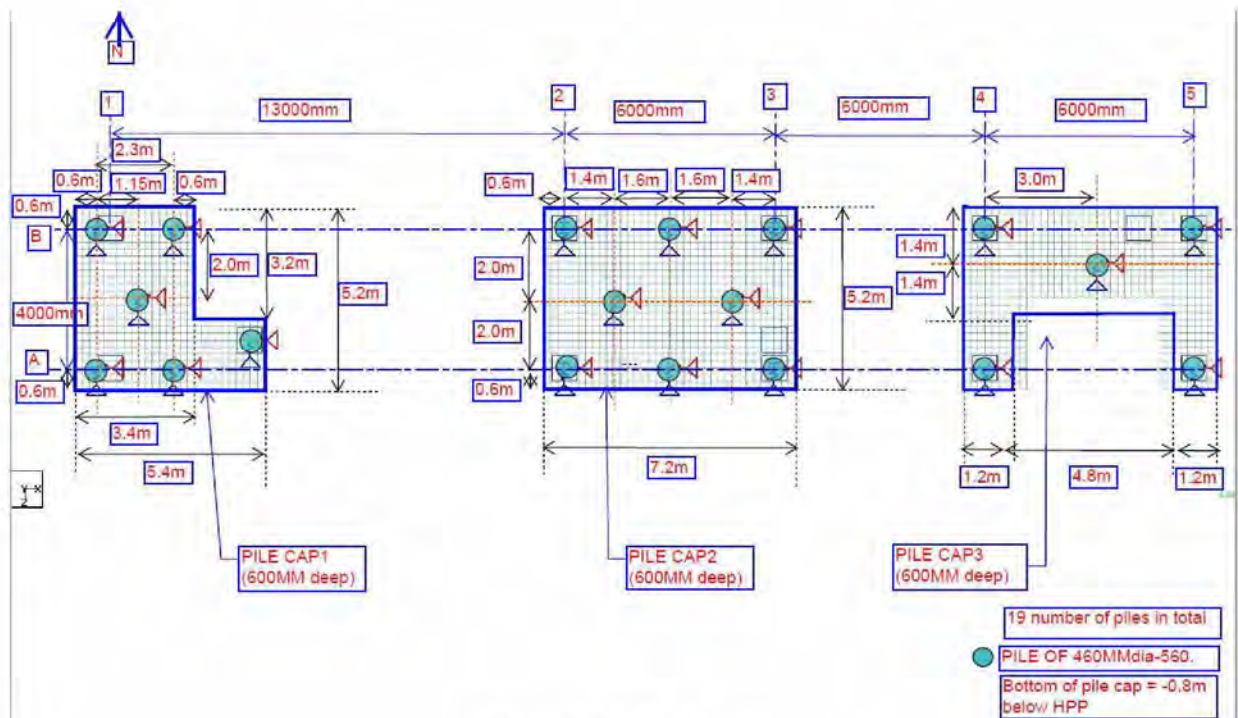


Figure 7.2.2: Pile layout

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

Total 19 number of dia. 460-560mm with 15m length piles are used in SR0501 piperack to cater the various loads.

Below are the maximum forces on the piles.

	Node	L/C	Horizontal Fx kN	Vertical Fy kN	Horizontal Fz kN	Moment Mx kN-m My kN-m Mz kN-m		
Max Fx	136	30117	35.318	442.618	-0.947	0.000	0.000	0.000
Min Fx	137	30115	-31.558	378.670	4.177	0.000	0.000	0.000
Max Fy	136	30116	23.863	471.155	-16.248	0.000	0.000	0.000
Min Fy	210	30174	20.669	-160.061	71.485	0.000	0.000	0.000
Max Fz	210	30174	20.669	-160.061	71.485	0.000	0.000	0.000
Min Fz	210	30173	-22.242	437.165	-71.386	0.000	0.000	0.000
Max Mx	131	30001	0.670	171.642	-0.190	0.000	0.000	0.000
Min Mx	131	30001	0.670	171.642	-0.190	0.000	0.000	0.000
Max My	131	30001	0.670	171.642	-0.190	0.000	0.000	0.000
Min My	131	30001	0.670	171.642	-0.190	0.000	0.000	0.000
Max Mz	131	30001	0.670	171.642	-0.190	0.000	0.000	0.000
Min Mz	131	30001	0.670	171.642	-0.190	0.000	0.000	0.000

Table 7.2.1: Support reactions at pile locations

Maximum compression force = 471 kN

Maximum Tension force = 160 kN

Maximum shear in X direction (E-W) = 35.318 kN

Maximum shear in Z direction (N-S) = 71.485 kN

The capacities of the piles as provided in the BGD soil report, section 4.1 are as follows.

For compression, characteristic pile capacity = 630 kN,

For tension, characteristic pile capacity = 450 kN

For shear, the pile capacity = 45 kN for 12.5mm displacement & 70 kN for 25mm displacement.

**a) Vertical compression:**

- The force of 471 kN is induced in the load case with wind.
- In Soil report, it is mentioned that there is no need to consider the group effect if the number of piles are less than 9, however group factor of 0.85 is considered..
- As Wind is a transient load case, 25% increase in the capacity as mentioned in the Soil report.

Capacity of the pile in compression =  $630 \times 0.85 \times 1.25 = 669.4 \text{ kN} > 471 \text{ kN}$ ... Hence safe.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**b) Vertical Tension:**

- The force of 160 kN is corresponding to the Blast load case.
- In Soil report, it is mentioned that there is no need to consider the group effect if the number of piles are less than 9, however group factor of 0.85 is considered..
- As Blast is a transient load case, 25% increase in the capacity as mentioned in the Soil report.

Capacity of the pile in tension =  $450 \times 0.85 \times 1.25 = 478 \text{ kN} > 160 \text{ kN} \dots$  Hence safe.

**c) Shear in X (E-W) direction:**

- The force of 35.318 kN is induced in the load case with wind.
- In Soil report, it is mentioned that there is no need to consider the group effect if the number of piles are less than 9, however group factor of 0.85 is considered..
- As wind is a transient load case, 25% increase in the capacity as mentioned in the Soil report.

Capacity of the pile in shear =  $45 \times 0.85 \times 1.25 = 47.81 \text{ kN} > 35 \text{ kN} \dots$  Hence safe.

**d) Shear in Z (N-S) direction:**

- The force of 71.485 kN is induced in the Blast load combination. Hence for blast case, the capacity of pile is considered as 70 kN, with 25mm displacement.
- In Soil report, it is mentioned that there is no need to consider the group effect if the number of piles are less than 9, however group factor of 0.85 is considered..
- As Blast is a transient load case, 50% increase in the capacity as mentioned in the Soil report.

Capacity of the pile in shear =  $70 \times 0.85 \times 1.5 = 74.375 \text{ kN} > 89 \text{ kN} \dots$  Hence safe.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

### 8.3 PILE CAP DESIGN

There are three pile caps provided for piperack SR0501 for the load transfer from superstructure. Refer snap below.

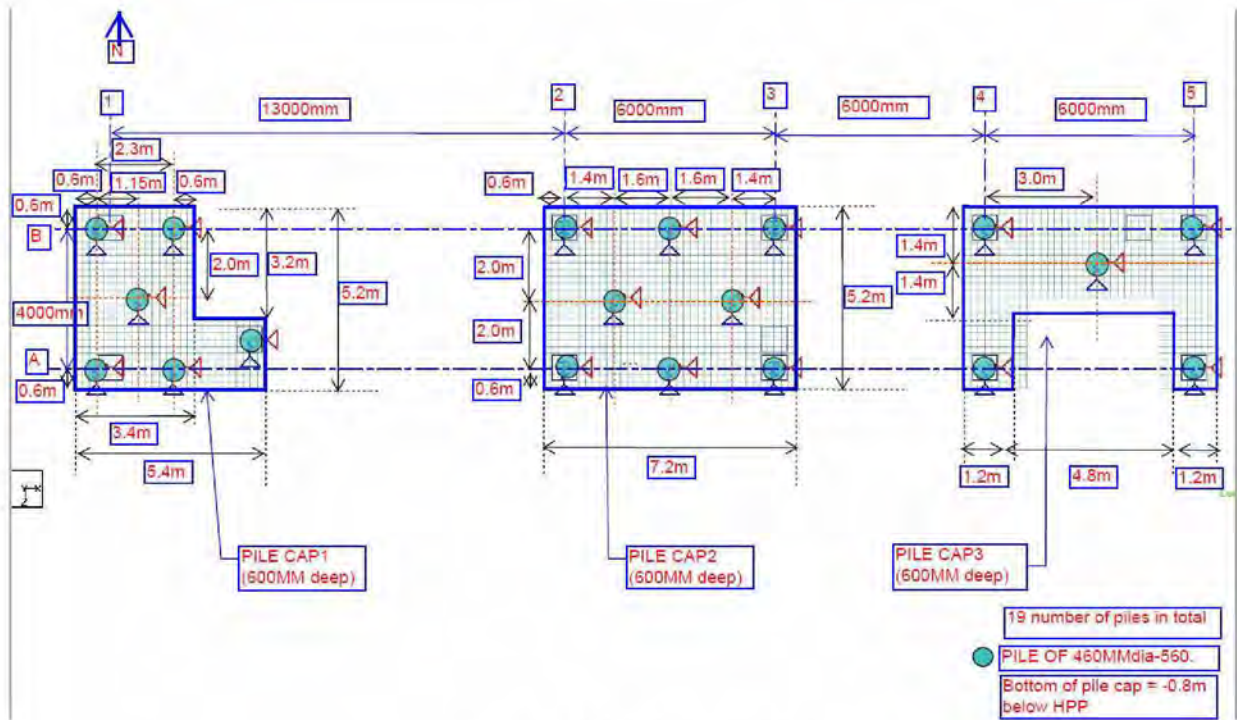


Figure 7.3.1: Pile cap layout



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

a) Bottom moments

	Plate	LIC	Shear		Membrane			Bending Moment			Bending Moment					
			SQX (local) kN/m <sup>2</sup>	SQY (local) kN/m <sup>2</sup>	SX (local) kN/m <sup>2</sup>	SY (local) kN/m <sup>2</sup>	SXY (local) kN/m <sup>2</sup>	Mx kN/m	My kN/m	Mxy kN/m	Mx1	My1	Mx2	My2	Mxd	Myd
Max Qx	436	40217	1303.287	932.816	-216.997	23.942	-174.17	-202.987	-158.691	-126.095	-76.89	-32.60	-102.79	-80.36	0.00	0.00
Min Qx	297	40218	-1317.92	-1518.737	-231.561	8.036	-229.76	-191.341	-149.494	-74.703	-116.64	-74.79	-154.01	-120.33	0.00	0.00
Max Qy	300	40218	-1312.779	962.63	-219.179	24.99	181.717	-206.542	-159.11	132.807	-73.74	-26.30	-95.69	-73.71	0.00	0.00
Min Qy	433	40217	1298.175	-1527.411	-227.421	11.441	235.499	-185.712	-142.15	80.73	-104.98	-61.42	-139.86	-107.06	0.00	0.00
Max Sx	386	40217	-326.991	363.54	328.408	62.698	-190.02	150.21	-109.508	-131.355	281.57	21.85	307.77	5.36	281.57	21.85
Min Sx	386	40218	-20.411	-136.764	-354.29	-72.63	208.735	-180.641	56.803	157.957	-22.68	214.76	258.60	194.92	0.00	194.92
Max Sy	438	40217	149.734	155.63	-12.112	168.42	0.211	-7.52	-121.773	-16.867	9.35	-104.91	-5.18	-83.94	-5.18	0.00
Min Sy	438	40218	-134.801	-304.059	12.786	-178.3	0.934	8.731	90.437	20.793	-29.52	111.23	13.51	139.96	29.52	111.23
Max Sxy	297	40217	1014.576	921.66	245.383	2.282	248.535	191.83	114.312	85.287	277.12	199.80	255.46	152.23	277.12	199.80
Min Sxy	433	40218	-1024.801	942.074	240.753	-2.877	-252.88	192.936	117.675	-80.316	273.25	197.99	247.75	151.11	273.25	197.99
Max Mx	436	40218	-999.836	-746.507	228.27	-30.08	183.427	195.283	105.929	142.989	338.27	249.92	386.49	211.63	338.27	249.92
Min Mx	300	40218	-1312.779	962.63	-219.179	24.99	181.717	-206.542	-159.11	132.807	-73.74	-26.30	-95.69	-73.71	0.00	0.00
Max My	1032	40138	-527.382	-553.081	36.525	41.201	71.124	53.017	171.988	-4.552	57.57	176.54	53.14	172.38	57.57	176.54
Min My	300	40218	-1312.779	962.63	-219.179	24.99	181.717	-206.542	-159.11	132.807	-73.74	-26.30	-95.69	-73.71	0.00	0.00
Max Mxy	386	40218	-20.411	-136.764	-354.29	-72.63	208.735	-180.641	56.803	157.957	-22.68	214.76	258.60	194.92	0.00	194.92
Min Mxy	367	40217	38.857	-124.967	-351.497	-77.34	-227.11	-184.179	44.156	-157.33	-26.85	201.49	376.40	178.55	0.00	178.55
															<b>338.27</b>	<b>249.92</b>

Mxb = Design moment along X-direction (for bottom rebar)

= 338.27 kNm/m (load case 40218 plate no. 436) Plates used for design are highlighted.

Myb = Design moment along Z-direction (for bottom rebar)

= 249.92 kNm/m (load case 40218 plate no. 436)

b) Top moments

	Plate	LIC	Shear		Membrane			Bending Moment			Bending Moment					
			SQX (local) kN/mm <sup>2</sup>	SQY (local) kN/mm <sup>2</sup>	SX (local) kN/mm <sup>2</sup>	SY (local) kN/mm <sup>2</sup>	SXY (local) kN/mm <sup>2</sup>	Mx kN/m	My kN/m	Mxy kN/m	Mx1	My1	Mx2	My2	Mxd	Myd
Max Qx	436	40217	1303.287	932.816	-216.997	23.942	-174.17	-202.987	-158.691	-126.095	-329.08	-284.79	-303.18	-237.02	-329.08	-284.79
Min Qx	297	40218	-1317.92	-1518.737	-231.561	8.036	-229.76	-191.341	-149.494	-74.703	-266.04	-224.20	-228.67	-178.66	-266.04	-224.20
Max Qy	300	40218	-1312.779	962.63	-219.179	24.99	181.717	-206.542	-159.11	132.807	-339.35	-291.92	-317.39	-244.51	-339.35	-291.92
Min Qy	433	40217	1298.175	-1527.411	-227.421	11.441	235.499	-185.712	-142.15	80.73	-266.44	-222.88	-231.56	-177.24	-266.44	-222.88
Max Sx	386	40217	-326.991	363.54	328.408	62.698	-190.02	150.21	-109.508	-131.355	18.85	-240.86	-7.35	-224.37	0.00	-224.37
Min Sx	386	40218	-20.411	-136.764	-354.29	-72.63	208.735	-180.641	56.803	157.957	-338.60	-101.15	-619.89	-81.32	-338.60	-101.15
Max Sy	438	40217	149.734	155.63	-12.112	168.42	0.211	-7.52	-121.773	-16.867	-24.39	-138.84	-9.86	-159.80	-24.39	-138.84
Min Sy	438	40218	-134.801	-304.059	12.786	-178.3	0.934	8.731	90.437	20.793	-12.06	59.64	3.95	40.92	3.95	0.00
Max Sxy	297	40217	1014.576	921.66	245.383	2.282	248.535	191.83	114.312	85.287	106.54	29.03	128.20	76.39	0.00	0.00
Min Sxy	433	40218	-1024.801	942.074	240.753	-2.877	-252.88	192.936	117.675	-80.316	112.62	37.36	138.12	84.24	0.00	0.00
Max Mx	436	40218	-999.836	-746.507	228.27	-30.08	183.427	195.283	106.929	142.989	52.29	-36.06	4.07	2.23	0.00	2.23
Min Mx	300	40218	-1312.779	962.63	-219.179	24.99	181.717	-206.542	-159.11	132.807	-339.35	-291.92	-317.39	-244.51	-339.35	-291.92
Max My	1032	40138	-527.382	-553.081	36.525	41.201	71.124	53.017	171.988	-4.552	48.47	167.44	52.90	171.60	0.00	0.00
Min My	300	40218	-1312.779	962.63	-219.179	24.99	181.717	-206.542	-159.11	132.807	-339.35	-291.92	-317.39	-244.51	-339.35	-291.92
Max Mxy	386	40218	-20.411	-136.764	-354.29	-72.63	208.735	-180.641	56.803	157.957	-338.60	-101.15	-619.89	-81.32	-338.60	-101.15
Min Mxy	367	40217	38.857	-124.967	-351.497	-77.34	-227.11	-184.179	44.156	-157.33	-341.51	-113.17	-744.75	-80.24	-341.51	-113.17
															<b>-341.51</b>	<b>-291.92</b>

Mxt = Design moment along Z-direction (for top rebar)

= 341.51 kNm/m (load case 40217 plate no. 367)

Myt = Design moment along X-direction (for top rebar)

= 291.92 kNm/m (load case 40218 plate no. 300)

Table 7.3.1: Plate stress results from FEM analysis

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

	Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kN-m	My kN-m	Mz kN-m
Max Fx	279	40142.0	136.0	639.2	-68.127	-46.936	0.002	52.3	-75.7
Min Fx	119	40135.0	36.0	-461.7	-0.68	0	-0.001	0.0	0.0
Max Fy	55	40218.0	11.0	-59.4	303.249	1.488	0.157	0.0	600.9
Min Fy	55	40217.0	16.0	62.2	-301.74	-1.511	-0.161	0.0	596.6
Max Fz	277	40218.0	135.0	-325.3	8.163	160.761	0.006	-176.2	8.9
Min Fz	276	40217.0	130.0	-315.9	11.247	-161.003	-0.006	176.4	12.4
Max Mx	55	40218.0	11.0	-59.4	303.249	1.488	0.157	0.0	600.9
Min Mx	55	40217.0	11.0	62.2	-293.16	1.489	-0.161	0.0	-592.8
Max My	276	40217.0	130.0	-315.9	11.247	-161.003	-0.006	176.4	12.4
Min My	277	40218.0	135.0	-325.3	8.163	160.761	0.006	-176.2	8.9
Max Mz	55	40218.0	11.0	-59.4	303.249	1.488	0.157	0.0	600.9
Min Mz	55	40218	16	-59.353	294.669	-1.513	0.157	0.003	-595.335

Table 7.3.2: Design forces from pedestal for punching shear check

	Node	L/C	Horizontal Fx kN	Vertical Fy kN	Horizontal Fz kN	Moment Mx kN-m	My kN-m	Mz kN-m
Max Fx	136	40143.0	49.3	558.6	-1.126	0	0	0.0
Min Fx	137	40141.0	-43.7	455.1	6.002	0	0	0.0
Max Fy	136	40142.0	29.6	600.8	-25.582	0	0	0.0
Min Fy	3130	40217.0	24.5	-136.4	-45.672	0	0	0.0
Max Fz	210	40218.0	20.9	-126.4	71.594	0	0	0.0
Min Fz	210	40217.0	-22.4	471.1	-71.516	0	0	0.0
Max Mx	131	40001.0	-0.1	141.0	-0.171	0	0	0.0
Min Mx	131	40001.0	-0.1	141.0	-0.171	0	0	0.0
Max My	131	40001.0	-0.1	141.0	-0.171	0	0	0.0
Min My	131	40001.0	-0.1	141.0	-0.171	0	0	0.0
Max Mz	131	40001.0	-0.1	141.0	-0.171	0	0	0.0
Min Mz	131	40001	-0.147	140.972	-0.171	0	0	0

Table 7.3.3: Design forces at piles for Punching shear check

**Design of Foundation by FEM for EN 1992 1-1 For Footing Slab / Pile cap**



**References :**

- 1) VOID
- 2) EN 1992 Part 1-1: General Rules and rules for Buildings (Including NA to SS EN 1992 Part 1-1)
- 3) EN 1992 Part 1-2: General Rules Structural Fire design (Including NA to SS EN 1992 Part 1-2)

**1) Basic Input data:**

Cylindrical compressive strength of concrete,  $f_{ck}$  =  
 Yield strength of steel (Grade of steel),  $f_{yk}$  =  
 Depth of Pile Cap, D =  
 Width of Column in X Direction,  $l_x$   
 Width of Column in Y Direction,  $l_y$   
 Diameter / width of pile in X direction  $d_{px}$   
 Diameter / width of pile in Y direction  $d_{py}$   
 Embedment of Pile inside pilecap  $s_1$   
 Axial tensile strength of concrete  $f_{ctm}$

35	N/mm <sup>2</sup>
500	N/mm <sup>2</sup>
600	mm
700	mm
700	mm
450	mm
460	mm
75	mm
2.8	N/mm <sup>2</sup>

**2) Design Input Data:**

Max net bending moment at bottom of pile cap in X direction,  $M_{x,bot}$   
 Max net bending moment at bottom of pile cap in Y direction,  $M_{y,bot}$   
 Max net bending moment at top of pile cap in X direction,  $M_{x,top}$   
 Max net bending moment at top of pile cap in Y direction,  $M_{y,top}$   
 Maximum net Shear force at top of pile cap in X direction,  $N_{Ed,x}$   
 Maximum net Shear force at top of pile cap in Y direction,  $N_{Ed,y}$   
 Maximum net Vertical Load at top of Pile cap  $N_{Ed}$   
 Maximum net Shear force at top of pile head in X direction,  $N_{Ed,x}$   
 Maximum net Shear force at top of pile head in Y direction,  $N_{Ed,y}$   
 Maximum net Vertical reaction from Pile  $N_{Edp}$

338	kN-m
250	kN-m
342	kN-m
292	kN-m
303	kN
161	kN
639	kN
50	kN
72	kN
601	kN

Clear cover for bottom bars,  $C_{db}$   
 Clear cover for top bars,  $C_{dt}$   
 Clear cover for side bars,  $C_{ds}$   
 Minimum diameter of bar  $\phi$

75	mm
50	mm
50	mm
10	mm

As per Clause 9.8.1(3) of Ref 2

Bar diameter to be provided @  
 At bottom in X direction,  $d_{db,x}$   
 At top in X direction,  $d_{dt,x}$   
 At bottom in Y direction,  $d_{db,y}$   
 At top in Y direction,  $d_{dt,y}$

Bar Dia	Spacing	
20	@ 150	mm c/c
20	@ 150	mm c/c
20	@ 150	mm c/c
20	@ 150	mm c/c

Check For Diameter of bar for main tensile reinforcement  $\phi$  as per Clause 9.8.1(3) of Ref 2

Diameter of Bar provided  $\phi$  = 20 mm O.K.

Check For Spacing of reinforcement at tension reinforcement as per Cl. 9.3.1.1 (3) of ref-2

Allowable maximum spacing of tension reinforcement in Slabs / Pile cap

$S_{max}$  Pile cap = min. of the following:

For Principal (Main) reinforcement =  $3D \leq 400$  mm For Secondary (Distribution) reinforcement =  $3.5D \leq 450$  mm

In areas with concentrated loads or areas of maximum moment the above values of  $S_{max}$  become respectively:

For Principal (Main) reinforcement =  $2D \leq 200$  mm For Secondary (Distribution) reinforcement =  $3D \leq 400$  mm

$S_{max} = 200.0$  mm O.K.

(As per Clause 9.3.1.1 (3) of ref 2

**3) Design of Slabs / Pile Cap :**

**3.1 Effective depth of Slabs / Pile Cap,  $Def_f$ :**

For bottom rebars,

Def<sub>f</sub> in X direction =  $Def_{fx} = D - C_{db} - d_{top}/2 =$

515 mm

Def<sub>f</sub> in Y direction =  $Def_{fy} = D - C_{db} - d_{top}/2 =$

495 mm

For top rebars,

Def<sub>f</sub> in X direction =  $Def_{tx} = D - C_{dt} - d_{bot}/2 =$

540 mm

Def<sub>f</sub> in Y direction =  $Def_{ty} = D - C_{dt} - d_{bot}/2 =$

520 mm

**3.2 Calculations for Effective depth of Slabs / Pile Cap,  $d_1$  and  $d_2$  : (considering Balanced Section - Singly reinforced Section)**

Check for  $D_{req} d_1 = D/2 \sqrt{1 - 3.53 \cdot K}$  where  $K = Mu / (f_{ck} \cdot b \cdot d^2)$

$K = 0.0385$   $d_1 = 580.00$  mm

Check for  $D_{req} d_2 = 0.9 \cdot D$   $d_2 = 540$  mm

Governing Effective Depth  $Def_{fx}$  and  $Def_{fy}$  = 495.00 mm

Governing Effective Depth  $Def_{tx}$  and  $Def_{ty}$  = 520.00 mm

**3.3 Area of Reinforcement required  $A_{s,req}$ :**

$A_{s,req}$  (required) =  $Mu / (f_{yk} \cdot D_{req})$

$\%P_t$  (required) =  $A_{s,req} \cdot 100 / (b \cdot X \cdot Def_f)$

As per Clause 9.2.1 (1) of ref 2 Longitudinal reinforcement shall not be less than

$A_{s,min} = (0.26 \cdot b \cdot Def_f) \cdot (f_{ctd} / f_{yk})$  Total required minimum longitudinal reinforcement  $A_{s,min} = 746.46$  mm<sup>2</sup>/m

$A_{s,min} = 0.0013 \cdot b \cdot D$  For each top & Bottom Reinforcement  $A_{s,min} = 780$  mm<sup>2</sup>/m

$A_{s,max} = 0.04 A_c$  Where  $A_c$  is the area of concrete cross section  $A_{s,max} = 24000$  mm<sup>2</sup>/m

**3.4 Reinforcement at bottom of Slabs / Pile cap in X direction :**

$A_{sxb}$  (required) =  $M_{sxb}/(f_{yk} \cdot Deff_b)$  = 1369.697 mm<sup>2</sup>/m  
 Check for  $A_{sxb}$  (required) = 1369.697 mm<sup>2</sup>/m  
 $A_{sxb}$  (provided) = 2093.333 mm<sup>2</sup>/m **OK**

**3.5 Reinforcement at bottom of Slabs / Pile cap in Y direction :**

$A_{syt}$  (required) =  $M_{syt}/(f_{yk} \cdot Deff_b)$  = 1010.101 mm<sup>2</sup>/m  
 Check for  $A_{syt}$  (required) = 1010.101 mm<sup>2</sup>/m  
 $A_{syt}$  (provided) = 2093.333 mm<sup>2</sup>/m **OK**

**3.6 Reinforcement at top of Slabs / Pile cap in X direction :**

$A_{stx}$  (required) =  $M_{stx}/(f_{yk} \cdot Deff_t)$  = 1315.385 mm<sup>2</sup>/m  
 Check for  $A_{stx}$  (required) = 1315.385 mm<sup>2</sup>/m  
 $A_{stx}$  (provided) = 2093.333 mm<sup>2</sup>/m **OK**

**3.7 Reinforcement at top of Slabs / Pile cap in Y direction :**

$A_{sty}$  (required) =  $M_{sty}/(f_{yk} \cdot Deff_t)$  = 1123.077 mm<sup>2</sup>/m  
 Check for  $A_{sty}$  (required) = 1123.077 mm<sup>2</sup>/m  
 $A_{sty}$  (provided) = 2093.333 mm<sup>2</sup>/m **OK**

**3.8a Check for one way shear in X Direction :**

Comparison of Design Value of applied Shear Force  $V_{Ed}$  with the Design Shear Resistance of the cross section without reinforcement  $V_{Rd,c}$  in N/mm<sup>2</sup> as per Clause 6.2.1(3) and 8.2.2 of Ref 2

$V_{Rd,c} = [C_{Rd,c} \cdot k \cdot (100 \cdot \rho_s \cdot f_{ck})^{1/3} + k_1 \cdot \sigma_{cp}] \cdot b_w \cdot Deff_x$  KN However, shear is checked in terms of stress (N/mm<sup>2</sup>) in place of kN as below as the STAAD output gives shear in terms of stress.

$V_{Rd,c}$  (Minimum) =  $(V_{min} + k_1 \cdot \sigma_{cp}) \cdot b_w \cdot Deff_x$  KN However, shear is checked in terms of stress (N/mm<sup>2</sup>) in place of kN as below as the STAAD output gives shear in terms of stress.

Where:  $f_{ck}$  is in N/mm<sup>2</sup>,

$k = 1 + \sqrt{200/Deff_x} \leq 2.0 = 1.636$

$k_1 = A_8 \text{ per NA to SS EN 1992-1-1:2008} = 0.150$

$\rho_s = A_{sxb}/(b_w \cdot Deff_x) \leq 0.02 = 0.003$

$\sigma_{cp} = 0.2 \cdot f_{cd} = 3.96667 \text{ N/mm}^2$

where  $f_{cd}$  is design compressive strength of Concrete =  $(\alpha_{cc} \cdot f_{ck})/\gamma_c = 19.8333 \text{ N/mm}^2$

where  $\alpha_{cc}$  and  $\gamma_c$  are coefficients as defined in Clause 3.1.6 of ref 2.

$\alpha_{cc} = 0.85 \quad \gamma_c = 1.5$

Refer Clause 3.1.6(1)P of ref 2

$C_{Rd,c} = 0.18/\sqrt{\gamma_c} = 0.12$

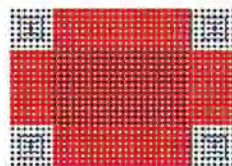
$v_{min} = 0.035 \cdot k^{2/3} \cdot f_{ck}^{1/3} = 0.453$

$V_{Rd,c} =$  Design Shear Resistance of the Cross section without reinforcement = 1.2288 N/mm<sup>2</sup>

$V_{Rd,c} =$  Minimum Design Shear Resistance of the Cross Section = 1.0480 N/mm<sup>2</sup>

**Check for one way shear in X direction**

Plate strips considered for one way shear in X direction from STAAD model.



$\frac{V_{Ed}}{b_w}$

Actual Design Value of applied Shear Force  $V_{Ed}$  = 0.622 N/mm<sup>2</sup> **OK**

**3.8b Check for one way shear in Y Direction :**

Comparison of Design Value of applied Shear Force  $V_{Ed}$  with the Design Shear Resistance of the cross section without reinforcement  $V_{Rd,c}$  in N/mm<sup>2</sup> as per Clause 6.2.1(3) and 8.2.2 of Ref 2

$V_{Rd,c} = [C_{Rd,c} \cdot k \cdot (100 \cdot \rho_s \cdot f_{ck})^{1/3} + k_1 \cdot \sigma_{cp}] \cdot b_w \cdot Deff_y$  KN However, shear is checked in terms of stress (N/mm<sup>2</sup>) in place of kN as below as the STAAD output gives shear in terms of stress.

$V_{Rd,c}$  (Minimum) =  $(V_{min} + k_1 \cdot \sigma_{cp}) \cdot b_w \cdot Deff_y$  KN However, shear is checked in terms of stress (N/mm<sup>2</sup>) in place of kN as below as the STAAD output gives shear in terms of stress.

Where:  $f_{ck}$  is in N/mm<sup>2</sup>,

$k = 1 + \sqrt{200/Deff_y} \leq 2.0 = 1.636$

$k_1 =$  Coefficient for Abrasion Class XM1 = 0.150

$\rho_s = A_{syt}/(b_w \cdot Deff_y) \leq 0.02 = 0.004$

$\sigma_{cp} = 0.2 \cdot f_{cd} = 3.96667 \text{ N/mm}^2$

where  $f_{cd}$  is design compressive strength of Concrete =  $(\alpha_{cc} \cdot f_{ck}) / \gamma_c = 19.8333 \text{ N/mm}^2$   
 where  $\alpha_{cc}$  and  $\gamma_c$  are coefficients as defined in Clause 3.1.6 of ref 2.

$\alpha_{cc} = 0.85$        $\gamma_c = 1.5$

Refer Clause 3.1.6(1)P of ref 2

$$C_{Rd,c} = 0.18 / \gamma_c = 0.12$$

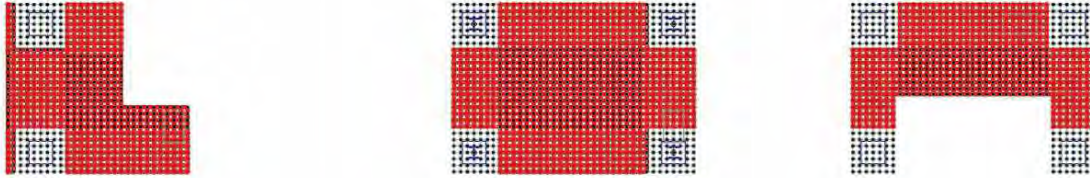
$$v_{min} = 0.035 \cdot k^{2/3} \cdot f_{ck}^{1/2} = 0.453$$

$$V_{Rd,c} = \text{Design Shear Resistance of the Cross section without reinforcement} = 1.5634 \text{ N/mm}^2$$

$$V_{Rd,c} = \text{Minimum Design Shear Resistance of the Cross Section} = 1.0480 \text{ N/mm}^2$$

**Check for one way shear in Y direction**

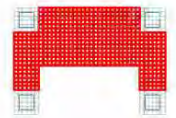
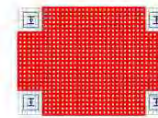
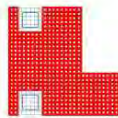
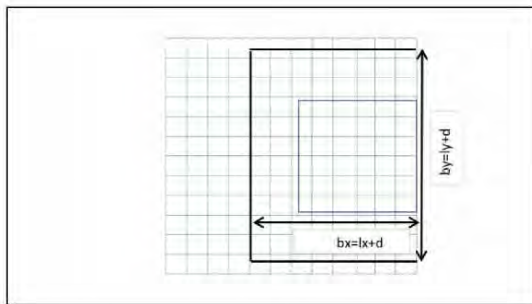
Plate strips considered for one way shear in Y direction from STAAD model.



Local 181

Actual Design Value of applied Shear Force  $V_{Ed}$  = 0.817 N/mm<sup>2</sup>      **OK**

**3.9a Check for Punching shear in slabs / Pile cap from Column :**



Punching shear resistance of slabs / pile caps without shear reinforcement as per Cl 6.4.4 ref 2

$$V_{Rd,c} = [C_{Rd,c} \cdot k \cdot (100 \cdot \rho_l \cdot f_{ck})^{1/3} + k_1 \cdot \sigma_{cp}] \text{ in N/mm}^2$$

Where Values for  $C_{Rd,c}$ ,  $v_{min}$ ,  $k$ ,  $f_{ck}$  remain same as in 3.8a and 3.8b above

$$k_1 = \text{As per NA to SS EN 1992-1-1 : 2008} = 0.1$$

$$\rho_l = \text{SQRT}(\rho_{lx} \cdot \rho_{ly}) \leq 0.02$$

$$\rho_{lx} = A_{sxd} / (b_x \cdot D_{effx}) \leq 0.02 = 0.002 \quad \text{where } b_x = \text{width of Column } l_x + 2(2 \cdot D_{effx}) = 2780 \text{ mm}$$

Refer Cl 6.4.2 of ref 2

$$\rho_{ly} = A_{sxd} / (b_y \cdot D_{effy}) \leq 0.02 = 0.002 \quad \text{where } b_y = \text{width of Column } l_y + 2(2 \cdot D_{effy}) = 2780 \text{ mm}$$

Refer Cl 6.4.2 of ref 2

$\sigma_{cx}$ ,  $\sigma_{cy}$  = Normal Concrete Stresses in the critical sections in X and Y directions (in N/mm<sup>2</sup>, positive if compression)

$N_{Edx}$ ,  $N_{Edy}$  = Longitudinal forces across the full bay for internal columns and the longitudinal force across the control section for edge columns. The force may be from a load action

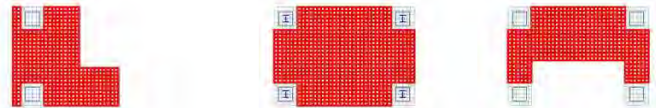
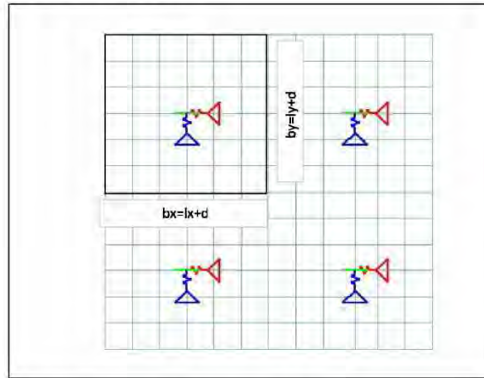
$$\sigma_{cx} = N_{Edx} / A_{cx} = 0.2202 \text{ N/mm}^2 \quad \sigma_{cy} = N_{Edy} / A_{cy} = 0.1114 \text{ N/mm}^2$$

$$\sigma_{cp} = (\sigma_{cx} + \sigma_{cy}) / 2 = 0.1658 \text{ N/mm}^2$$

$$V_{Rd,c} = 4.586 \text{ N/mm}^2$$

$$V_{Ed,c} = N_{Ed} / ((2b_x + 2b_y) \cdot D_{eff}) = 0.1105 \text{ N/mm}^2 \quad \text{OK}$$

**3.9b Check for Punching shear in slabs / Pile cap from Piles (Internal) :**



Punching shear resistance of slabs / pile caps without shear reinforcement as per Cl 6.4.4 ref 2

$$V_{Rd,c} = [C_{Rd,c} \cdot k \cdot (100 \cdot \rho_l \cdot f_{ck})^{1/3} + k_1 \cdot \sigma_{cp}] \quad \text{in N/mm}^2$$

Where Values for  $C_{Rd,c}$ ,  $v_{min}$ ,  $k$ ,  $f_{ck}$  remain same as in 3.8a and 3.8b above

$$k_1 = \text{As per NA to SS EN 1992-1-1 : 2008} = 0.1$$

$$\rho_l = \text{SQRT}(\rho_{s,x} \cdot \rho_{s,y}) \leq 0.02$$

$$\rho_{lx} = A_{srd}/(b_x \cdot Deff_x) \leq 0.02 = 0.002 \quad \text{where } b_x = \text{width of pile } d_{px} + 2(2 \cdot Deff_{pb}) = 2430 \text{ mm}$$

Refer Cl 6.4.2 of ref 2

$$\rho_{ly} = A_{srd}/(b_y \cdot Deff_y) \leq 0.02 = 0.002 \quad \text{where } b_y = \text{width of pile } d_{py} + 2(2 \cdot Deff_{pb}) = 2430 \text{ mm}$$

Refer Cl 6.4.2 of ref 2

$\sigma_{cx}, \sigma_{cy}$  = Normal Concrete Stresses in the critical sections in X and Y directions (in N/mm<sup>2</sup>, positive if compression)

$N_{Ed,ox}, N_{Ed,oy}$  = Longitudinal forces across the full bay for internal columns and the longitudinal force across the control section for edge columns. The force may be from a load action

$$\sigma_{cx} = N_{Ed,ox}/A_{cx} = 0.0416 \text{ N/mm}^2 \quad \sigma_{cy} = N_{Ed,oy}/A_{cy} = 0.0570 \text{ N/mm}^2$$

$$\sigma_{cp} = (\sigma_{cx} + \sigma_{cy})/2 = 0.0493 \text{ N/mm}^2$$

$$V_{Rd,c} = 4.585 \text{ N/mm}^2$$

$$V_{Ed,c} = N_{Ed,ox}/((2b_x + 2b_y) \cdot Deff) = 0.1249 \text{ N/mm}^2$$

**OK**

Summary for Maximum Pedestal Load from STAAD for Punching shear						
	Beam	L/C	Node	Fx kN	Fy kN	Fz kN
Max Fx	279	40142	136	639.21	-68.13	-46.94
Min Fx	119	40135	36	-461.68	-0.68	0.00
Max Fy	55	40218	11	-59.35	303.25	1.49
Min Fy	55	40217	16	62.25	-301.74	-1.51
Max Fz	277	40218	135	-325.34	8.16	160.76
Min Fz	276	40217	130	-315.87	11.25	-161.00
Max Mx	55	40218	11	-59.35	303.25	1.49
Min Mx	55	40217	11	62.25	-293.16	1.49
Max My	276	40217	130	-315.87	11.25	-161.00
Min My	277	40218	135	-325.34	8.16	160.76
Max Mz	55	40218	11	-59.35	303.25	1.49
Min Mz	55	40218	16	-59.35	294.67	-1.51

Summary for Maximum Pile reaction from STAAD for Punching shear					
	Node	L/C	Horizontal	Vertical	Horizontal
			Fx kN	Fy kN	Fz kN
Max Fx	136	40143	49.3	558.6	-1.1
Min Fx	137	40141	-43.7	455.1	6.0
Max Fy	136	40142	29.6	600.8	-25.6
Min Fy	3130	40217	24.5	-136.4	-45.7
Max Fz	210	40218	20.9	-126.4	71.6
Min Fz	210	40217	-22.4	471.1	-71.5
Max Mx	131	40001	-0.1	141.0	-0.2
Min Mx	131	40001	-0.1	141.0	-0.2
Max My	131	40001	-0.1	141.0	-0.2
Min My	131	40001	-0.1	141.0	-0.2
Max Mz	131	40001	-0.1	141.0	-0.2
Min Mz	131	40001	-0.1	141.0	-0.2

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 9. ANNEXURE A: WIND LOAD

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**Wind Pressure Calculation as per EN 1991-1-4 and NA to NEN EN 1991-1-4**

Terrain Category	<b>2</b>		<i>Table NB. 3-4.1 NEN EN 1991-1-4</i>
Fundamental Basic Wind Velocity $V_{b0}$	<b>27.00</b>	m/s	<i>Table NB. 1 NEN EN 1991-1-4</i>
Directional Factor ( $C_{dir}$ )	<b>1</b>		<i>clause 4.2 (2P) NEN EN 1991-1-4 - NB</i>
Seasonal Factor ( $C_{season}$ )	<b>1</b>		<i>clause 4.2 (2P) NEN EN 1991-1-4 - NB</i>
Basic Wind velocity $V_b = V_{b0} \times C_{dir} \times C_{season}$	<b>27</b>	m/s	<i>clause 4.2 EN 1991-1-4</i>
Orographic Factor $C_o$	<b>1</b>		<i>clause 4.3.3 EN 1991-1-4 - NB</i>
$Z_0$	<b>0.2</b>	m	<i>Table NB. 3-4.1 NEN EN 1991-1-4</i>
Air Density $\rho$	<b>1.25</b>	kg/m <sup>3</sup>	<i>clause 4.5 NEN EN 1991-1-4 - NB</i>
$k_r = 0.19 (Z_0/0.05)^{0.07}$	<b>0.2094</b>		
Maximum Structure Height	<b>50</b>	m	
Turbulence factor $k_t$	<b>1</b>		<i>clause 4.4 NEN EN 1991-1-4 - NB</i>
Terrain roughness			
$C_r$ - Roughness Factor	$k_r \times \ln(z/z_0)$		<i>equ. 4.4 EN 1991-1-4</i>
$V_m$ - Mean Wind Velocity	$C_r \times C_o \times V_b$		<i>equ. 4.3 EN 1991-1-4</i>
$I_v$ - Turbulence Intensity	$k_t / (C_o \times \ln(z/z_0))$		<i>equ. 4.7 EN 1991-1-4</i>
$q_p$ - Peak Velocity Pressure	$(1+7 \times I_v) \times 0.5 \times \rho \times V_m^2$		<i>equ. 4.8 EN 1991-1-4</i>

Height z (m)	$C_r$	$V_m$ (m/s)	$I_v$ (m/s)	$q_p$ (N/m <sup>2</sup> )	$q_p$ (kN/m <sup>2</sup> )
6	0.71	19.23	0.29	707	0.71
8	0.77	20.85	0.27	787	0.79
10	0.82	22.11	0.26	853	0.85
12	0.86	23.14	0.24	907	0.91
14	0.889	24.02	0.24	954	0.95
16	0.917	24.77	0.23	996	1.00
18	0.942	25.44	0.22	1033	1.03
20	0.964	26.03	0.22	1067	1.07
25	1.011	27.29	0.21	1141	1.14
30	1.049	28.32	0.20	1202	1.20
35	1.081	29.20	0.19	1255	1.25
40	1.109	29.95	0.19	1301	1.30
50	1.156	31.21	0.18	1381	1.38

Structural Factor  $C_s C_d$  shall be determined as per EN 1991-1-4 section 6.3.1 and Annex C of NEN 1991-1-4 NB.



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

Wind load in X direction (Longitudinal direction of the piperack)

i) Wind load on self obstruction area with  $C_f = 1.7$

ii) Wind load on piping =

as per section 10.3, & YARA A-PC 10000-Y50-00026, the horizontal load

H<sub>tot</sub> shall be provided as HS (or HWL or HE)+ HA (longitudinal direction)

H<sub>s</sub> stability force = 1.5 % of the weight of the structure and the operating - loads of the pipes.

weight of the structure = 405kN, operating piping weight = 1437 kN.

LC101-self weight of structure, LC40-operating load

hence  $H_s = 1.5/100*(405+1437) = 27.63\text{KN} \dots\dots\dots(1)$

HWL = longitudinal wind force =  $0.3*(DP+HB)*p_w*L$

DP=1.2, HB=0.2m, P<sub>w</sub>=0.8KN/m<sup>2</sup>, L=31m (total length of the piperack considered),

hence HWL =  $0.3*(1.2+0.2)*0.8*31 = 10.416 \text{ kN} \dots\dots\dots@2.7\text{m level}$

(so per joint,  $10.416/2 = 5.25 \text{ kN}$ )

HWL =  $0.3*(0.3+0.2)*0.8*31 = 3.72 \text{ kN} \dots\dots\dots@5.7\text{m level}$

(so per joint,  $3.72/2 = 1.86 \text{ kN}$ )

HWL =  $0.3*(0.05+0.2)*0.8*31 = 1.86 \text{ kN} \dots\dots\dots& 7.0\text{m level}$

(so per joint,  $1.86/2 = 0.93 \text{ kN}$ )

total =  $10.416+3.72+1.86 = 15.996 \text{ KN} \dots\dots\dots(2)$

the governing is 27.63 KN, this load is applied at top level

to have the more effect on the structure.

load =  $28/2 = 14 \text{ KN}$ , applied at two nodes.

iii) Wind load on cable trays:

the cable tray gallery height = 2.65m, width of the cables=0.8m,

the wind pressure = 0.8 KN/m<sup>2</sup>,  $c_f=1.7$

hence load on cables trays considering fully cladded =  $2.65*0.8*0.8*1.7=2.9\text{KN}$ ,

this load is applied to the column where the cable trays are attached.

torsional force due to this wind on cables not considered as, the beams would be restrained by the cables.

iv) Wind load in equipment: Not applicable

Wind load in Z direction (Transverse direction of the piperack)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

i) Wind load on self obstruction area with  $C_f = 1.7$

ii) Wind load on pipings:

Load at +3.200m level

$H_{wp} = DP + w \cdot \tan(10) = 1.2 + (1.2 \cdot \tan(10)) = 1.4\text{m}$  contributory height for load,

with  $c_f = 0.8$  of pipe,  $0.8 \text{ KN/m}^2$  as wind pressure as per calculation,  $L = 20\text{m}$

length of the pipe, load1 (L01.01) =  $0.8 \cdot 1.4 \cdot 0.8 \cdot 24 = 21.5 \text{ kN}$ ,

for 15m length, load2 (L01.02) =  $0.8 \cdot 1.4 \cdot 0.8 \cdot 15 = 13.5 \text{ kN}$

Load at +5.700m level

$H_{wp} = DP + w \cdot \tan(10) = 0.4 + (4 \cdot \tan(10)) = 1.1\text{m}$  contributory height for load,

with  $c_f = 0.8$  of pipe,  $0.8 \text{ KN/m}^2$  as wind pressure as per calculation,

load at the main grid beam =  $0.8 \cdot 1.1 \cdot 0.8 \cdot (2/3 \cdot 6) = 2.82 \text{ KN} \dots$

applied at the centre of the beam

load at intermediate beam =  $0.8 \cdot 1.1 \cdot 0.8 \cdot 1/3 \cdot 6 = 1.41 \text{ KN} \dots$

applied at the centre of the beam

Load at +8.000m level

$H_{wp} = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8\text{m}$  contributory height for load,

with  $c_f = 0.8$  of pipe,  $0.8 \text{ KN/m}^2$  as wind pressure as per calculation,

load at the main grid beam =  $0.8 \cdot 0.8 \cdot 0.8 \cdot 3 = 1.55 \text{ KN} \dots$

applied at the centre of the beam

Load at 12.100m level

$H_{wp} = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8\text{m}$  contributory height for load,

with  $c_f = 0.8$  of pipe,  $0.9 \text{ KN/m}^2$  as wind pressure as per calculation,

load at the main grid beam =  $0.8 \cdot 0.9 \cdot 0.8 \cdot 3 = 1.75 \text{ KN} \dots$  applied at the centre of the beam

iii) Wind load on cable trays:

the second level is clad with cable tray,

with  $c_f = 1.7$ , height =  $2.3\text{m}$ , wind pressure =  $0.8 \text{ kN/m}^2$ , cable tray span =  $6\text{m}$ ,

$c_f$  is not considered as whole area is considered.

load =  $2.3 \cdot 0.8 \cdot 6 = 11.04 \text{ kN}$  applied at the supporting location of the cable trays.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 10. ANNEXURE – B: BLAST LOAD

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

The Blast load was calculated as per ASCE guidelines, and applied similar to wind load on structure.

Blast load on upward direction & end face are not applied. This is to ensure that the load shall not be too conservative.

Reference: ASCE-"Design of Blast Resistant Buildings for Petrochemical Facilities" (Referred here as ASCE-BLAST)

**1. Blast Load Parameters**

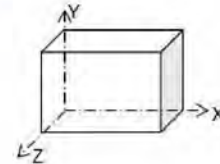
Over Pressure,  $P_{so} = 3 \text{ kPa} = 3 \text{ kN/m}^2$  Cl. 12.1.3 -BGS-CU-033  
 Positive Duration,  $t_d = 15 \text{ ms} = 0.015 \text{ s}$  Cl. 12.1.3 -BGS-CU-033

**2. Shock Wave Parameters**

Velocity,  $U = 345(1+0.0083P_{so})^{0.5} = 349.3 \text{ m/s}$  Eq. 3.5 ASCE-BLAST  
 Wave Length,  $L_w = t_d U = 5.239 \text{ m}$  Eq. 3.6 ASCE-BLAST  
 Peak dynamic wind pressure,  $q_o = 0.0032P_{so}^2 = 0.03 \text{ kN/m}^2$  Eq. 3.4 ASCE-BLAST

**3. Building dimensions**

Length along X-axis =  $L_x = 31 \text{ m}$   
 Length along Z-axis =  $L_z = 4 \text{ m}$   
 Height along Y-axis =  $L_y = 8 \text{ m}$

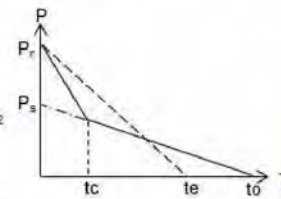


**4. Blast load in + Z direction**

Width of building,  $B = L_x = 31 \text{ m}$   
 Length of Building,  $L = L_z = 4 \text{ m}$   
 Height of Building,  $H = L_y = 8 \text{ m}$

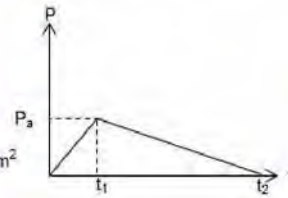
**Front Wall Loading**

Reflection Coefficient,  $C_r = (2 + 0.0073P_{so}) = 2.02$  Eq. 3.3 ASCE-BLAST  
 Reflected Pressure,  $P_r = C_r P_{so} = 6.07 \text{ kN/m}^2$  Eq. 3.2 ASCE-BLAST  
 Clearing Distance,  $S = \text{Minimum of } (H, B/2) = 8 \text{ m}$  Eq. 3.8 ASCE-BLAST  
 Reflected Overpressure Clearing Time,  $t_c = 3S/U = 0.069 \text{ s}$  Eq. 3.8 ASCE-BLAST  
 Drag Coefficient for front wall,  $C_d = 1.0$  Eq. 3.7 ASCE-BLAST  
 Stagnation Pressure,  $P_s = P_{so} + C_d q_o = 3.0288 \text{ kN/m}^2$  Eq. 3.9 ASCE-BLAST  
 Effective Pressure Impulse,  $I_{eff} = 0.5(P_r - P_s)t_c + 0.5P_s t_d = 0.13 \text{ kN/m}^2\text{-s}$  Eq. 3.10 ASCE-BLAST  
 Effective Duration,  $t_e = 2I_{eff} / P_r = 0.042 \text{ s}$



**Side Wall Loading**

Side wall is designed as one-way, spanning vertically.  
 Hence consider, Length,  $L = 1 \text{ m}$   
 Therefore  $L_w/L = 5.239$   
 Equivalent Load Factor, From Figure 3.9 of ASCE,  $C_e = 1.0$   
 Drag Coefficient for front wall,  $C_d = -0.4$   
 Side wall Pressure,  $P_a = C_e P_{so} + C_d q_o = 2.99 \text{ kN/m}^2$   
 The Rise Time,  $t_1 = L/U = 0.0029 \text{ s}$   
 Positive Time Duration,  $t_2 = t_1 + t_d = 0.0179 \text{ s}$



**Roof Loading**

Roof slab is one way with span =  $4.0 \text{ m}$   
 Hence consider, Length,  $L = 8 \text{ m}$   
 Therefore  $L_w/L = 0.65$   
 Equivalent Load Factor, From Figure 3.9 of ASCE,  $C_e = 0.9$   
 Drag Coefficient for front wall,  $C_d = -0.4$   
 Equivalent Peak overPressure,  $P_a = C_e P_{so} + C_d q_o = 2.54 \text{ kN/m}^2$   
 The Rise Time,  $t_1 = L/U = 0.023 \text{ s}$   
 Positive Time Duration,  $t_2 = t_1 + t_d = 0.038 \text{ s}$

Figure 3.9 of ASCE-BLAST  
 Sec 3.3.3 ASCE-BLAST  
 Eq. 3.11 ASCE-BLAST  
 Figure 3.8 of ASCE-BLAST  
 Figure 3.8 of ASCE-BLAST

Figure 3.9 of ASCE-BLAST  
 Sec 3.3.3 ASCE-BLAST  
 Eq. 3.11 ASCE-BLAST  
 Figure 3.8 of ASCE-BLAST  
 Figure 3.8 of ASCE-BLAST

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

5. Blast load in + X direction

Width of building,  $B = L_z = 4$  m  
Length of Building,  $L = L_x = 31$  m  
Height of Building,  $H = L_y = 8$  m

Front Wall Loading

Reflection Coefficient,  $C_r = (2 + 0.0073P_{so}) = 2.02$  Eq. 3.3 ASCE-BLAST  
Reflected Pressure,  $P_r = C_r P_{so} = 6.07$  kN/m<sup>2</sup> Eq. 3.3 ASCE-BLAST  
Clearing Distance,  $S = \text{Minimum of } (H, B/2) = 2$  m Eq. 3.8 ASCE-BLAST  
Reflected Overpressure Clearing Time,  $t_c = 3S/U = 0.017$  s Eq. 3.8 ASCE-BLAST  
Drag Coefficient for front wall,  $C_d = 1.0$  Sec 3.3.3 ASCE-BLAST  
Stagnation Pressure,  $P_s = P_{so} + C_d q_o = 3.0288$  kN/m<sup>2</sup> Eq. 3.7 ASCE-BLAST  
Effective Pressure Impulse,  $I_w = 0.5(P_r - P_s)t_c + 0.5P_s t_d = 0.05$  kN/m<sup>2</sup>-s Eq. 3.9 ASCE-BLAST  
Effective Duration,  $t_e = 2t_w / P_r = 0.016$  s Eq. 3.10 ASCE-BLAST

Side Wall Loading

Side wall is designed as one-way, spanning vertically.  
Hence consider, Length,  $L = 1$  m = 1 m  
Therefore  $L_w/L = 5.239$  Figure 3.9 of ASCE-BLAST  
Equivalent Load Factor, From Figure 3.9 of ASCE,  $C_e = 1.0$  Sec 3.3.3 ASCE-BLAST  
Drag Coefficient for front wall,  $C_d = -0.4 = -0.4$  Eq. 3.11 ASCE-BLAST  
Side wall Pressure,  $P_s = C_e P_{so} + C_d q_o = 2.99$  kN/m<sup>2</sup> Figure 3.8 of ASCE-BLAST  
The Rise Time,  $t_r = L/U = 0.0029$  s Figure 3.8 of ASCE-BLAST  
Positive Time Duration,  $t_2 = t_1 + t_d = 0.0179$  s

**Blast load in X direction:**

**Blast load on structure**

The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
load on frame =  $cf * 0.25 * 6.07 = 2.58$ , cf is ignored as load was provided to lateral direction also.  
final load =  $0.25 * 6.07 = 1.518$  say 1.52 KN/m

The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>, this is at side frames.

load on frame =  $cf * 0.25 * 3 = 1.275$ , cf is ignored  
final load =  $0.25 * 3 = 0.75$  KN/m

as per section 10.3, & YARA A-PC 10000-Y50-00026, the horizontal load Blast load on pipes in longitudinal direction would be calculated as...

HWL = longitudinal wind force =  $0.3 * (DP + HB) * pw * L$   
 $DP = 1.2$ ,  $HB = 0.2$ m,  $Pw = 6.07$ KN/m<sup>2</sup>,  $L = 31$ m (total length of the piperack considered),  
hence  $HWL = 0.3 * (1.2 + 0.2) * 6.07 * 31 = 79.031$  kN.....@2.7m level  
(so per joint,  $79.031/2 = 39.516$  kN)  
 $HWL = 0.3 * (0.3 + 0.2) * 6.07 * 31 = 28$  kN.....@5.7m level  
(so per joint,  $28.226/2 = 14.113$  kN)  
 $HWL = 0.3 * (0.05 + 0.2) * 6.07 * 31 = 14.113$  kN.....& 7.0m level  
(so per joint,  $14.113/2 = 7.056$  kN)

the cable tray gallery height = 2.00m, width of the cables=0.8m,  
the Blast pressure = 6.07 KN/m<sup>2</sup>,  $cf = 1.7$ , 1 if whole area is considered  
hence load on cables trays considering fully cladded =  $2 * 0.8 * 6.07 * 1 = 9.712$ KN  
this load is applied to the column where the cable trays are attached.  
torsional force due to this wind on cables not considered as, the beams would be restrained by the cables.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**Blast load in Z direction:**

the blast load is considered as the wind load application.

as per the excel, the front face pressure = 6.07 KN/m<sup>2</sup>

the side face pressure = 3 KN/m<sup>2</sup>

the back face load is not applied.

for member size of 0.25m, the load = CF\*6.07\*0.25

CF=1.7, LOAD = 2.58 KN/m, cf is ignored as load was provided to lateral direction also.

final load = 0.25\*6.07 = 1.518 say 1.52 KN/m

\* Load at +3.200m level

blast load on big pipe:

Hwp = DP+w.tan(10) = 1.2 + (1.2\*tan(10)) = 1.4m contributory height for load,

with cf=0.8 of pipe, 6.07 KN/m<sup>2</sup> as wind pressure as per calculation, L=20m

length of the pipe, load1 (L01.01) = 0.8\*1.4\*6.07\*18 = 122 kN, (length reduced)

for 13m length, load2 (L01.02) = 0.8\*1.4\*6.07\*13 = 88 kN (length reduced)

\* Load at +5.700m level

Hwp = DP+w.tan(10) = 0.4 + (4\*tan(10)) = 1.1m contributory height for load,

with cf=0.8 of pipe, 6.07 KN/m<sup>2</sup> as blast pressure as per calculation,

load at the main grid beam = 0.8\*1.1\*6.07\*(2/3\*6) = 21.366 KN...

applied at the centre of the beam

load at intermediate beam = 0.8\*1.1\*6.07\*1/3\*6 = 10.683 KN...

applied at the centre of the beam

\* Load at +8.000m level

Hwp = DP+w.tan(10) = 0.1 + (4\*tan(10)) = 0.8m contributory height for load,

with cf=0.8 of pipe, 6.07 KN/m<sup>2</sup> as blast pressure as per calculation,

load at the main grid beam = 0.8\*0.8\*6.07\*3 = 11.654 KN...

applied at the centre of the beam

\* Load at 12.100m level

Hwp = DP+w.tan(10) = 0.1 + (4\*tan(10)) = 0.8m contributory height for load,

with cf=0.8 of pipe, 6.07 KN/m<sup>2</sup> as blast pressure as per calculation,

load at the main grid beam = 0.8\*6.07\*0.8\*3 = 11.654 KN...

applied at the centre of the beam

\* blast load on cable trays

the second level is clad with cable tray,

with cf=1.7, height = 2.3m, blast pressure = 6.07 kN/m<sup>2</sup>, cable tray span=6m,

cf is not required to be considered as full area is considered.

load = 2.3\*6.07\*6 = 83.766 kN applied at the supporting location of the cable trays.

the above method was too conservative. The cable trays are of 0.1m deep.

there are total 7 number of cable trays. With 6m C/C distances (span),

shape factor = 1.7 as individual cable trays are considered.

load = 0.1\*6.07\*7\*1.7\*6 = 43.34 KN.

load on side frame, blast pressure = 3 KN/m<sup>2</sup>.

average depth of beam/column = 0.25m

cf = 1.7, load = 1.7\*3\*0.25 = 1.275 KN/m, cf is ignored

final load = 0.25\*3 = 0.75 KN/m

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 11. ANNEXURE C: SNOW LOAD

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

snow load as per 16471-C50-00001\_published,  
characteristic value of snow load,  $S_k = 0.7 \text{ KN/m}^2$ , Exposure coefficient= $C_e=1$ ,

Thermal coefficient =  $c_t = 1$ ,

as per EN-1991-1-3/NA, (m) snow load shape coefficient for 0 degree roof = 0.8,  
the same value would be used for cable tray, grating floor & the big pipe.

load =  $m \cdot c_e \cdot c_t \cdot s_k = 0.8 \cdot 1 \cdot 1 \cdot 0.7 = 0.56 \text{ KN/m}^2$

**Snow load on grating:**

load on grating = with 1.0m width, load =  $1 \cdot 0.56 = 0.56$  say 0.6 KN/m applied -  
at grating supporting beams at internal beams

this is applied to all grating supporting beams at level +8.900

loads at external beams =  $0.6/2 = 0.3 \text{ KN/m}$

**Snow load on cable trays:**

load on cable tray = for the top layer = 0.6 KN/m, load for 6.0m span = 3.6KN,

load at all other cable trays would be considered 50% =  $0.5 \cdot 3.6 = 1.8 \text{ kN}$ ,

total load =  $3.6 + (6 \cdot 1.8) = 14.4 \text{ KN}$ , moment =  $14.4 \cdot 0.4 = 5.76 \text{ KN.m}$

**snow load on piping:**

At +5.700 level, snow load = 0.6 KN/m<sup>2</sup>, 50% reduction considered as +8.0 piping,  
is covered with 100% snow load, hence lower piping levels where considered  
with 50% reduction of the load.

load =  $0.5 \cdot 0.6 = 0.3 \text{ KN/m}^2$

load at main grid transverse beam =  $2/3 \cdot 6 \cdot (0.3 \text{ KN/m}^2) = 1.2 \text{ KN/m}$ , (for 6m span)

load at intermediate beam =  $1/3 \cdot 6 \cdot (0.3 \text{ KN/m}^2) = 0.6 \text{ KN/m}$ , (for 6m span)

load at +8.0m level, snow load = 0.6 KN/m<sup>2</sup>,

load for 3m span =  $0.6 \cdot 3 = 1.8 \text{ KN/m}$ , applied at all beams considering,

snow at +2.7m level,

snow load = 0.6 KN/m<sup>2</sup>, diameter of pipe = 1.22m,

load =  $0.6 \cdot 1.22 = 0.732 \text{ kN/m}$

for 25m span, load =  $0.732 \cdot 25 = 18.3 \text{ KN}$ , for

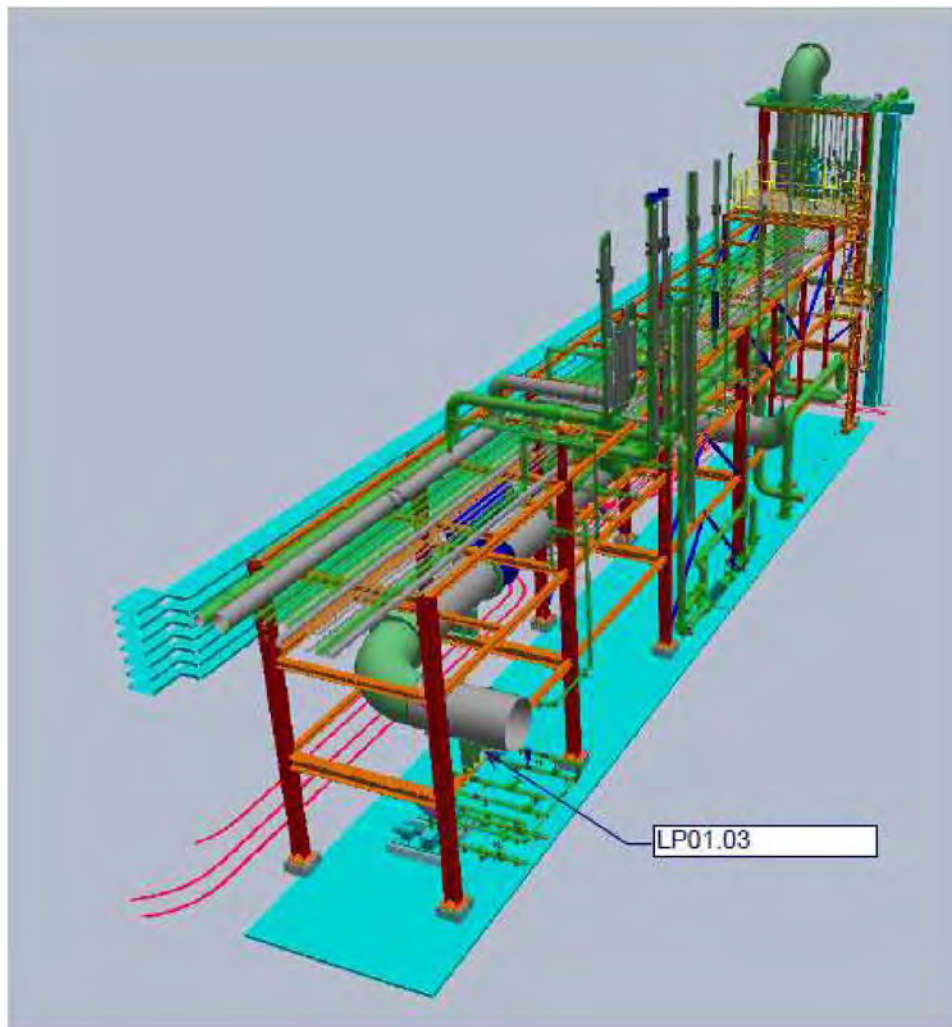
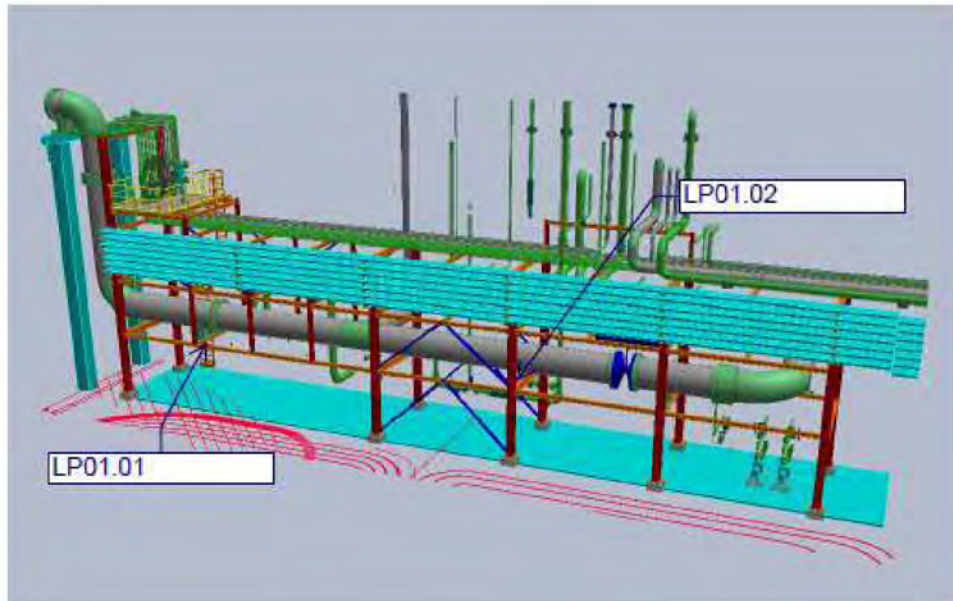
16m span, load =  $0.732 \cdot 16 = 11.7 \text{ kN}$ , and for 6m span, load =  $0.732 \cdot 6 = 4.4 \text{ kN}$ .



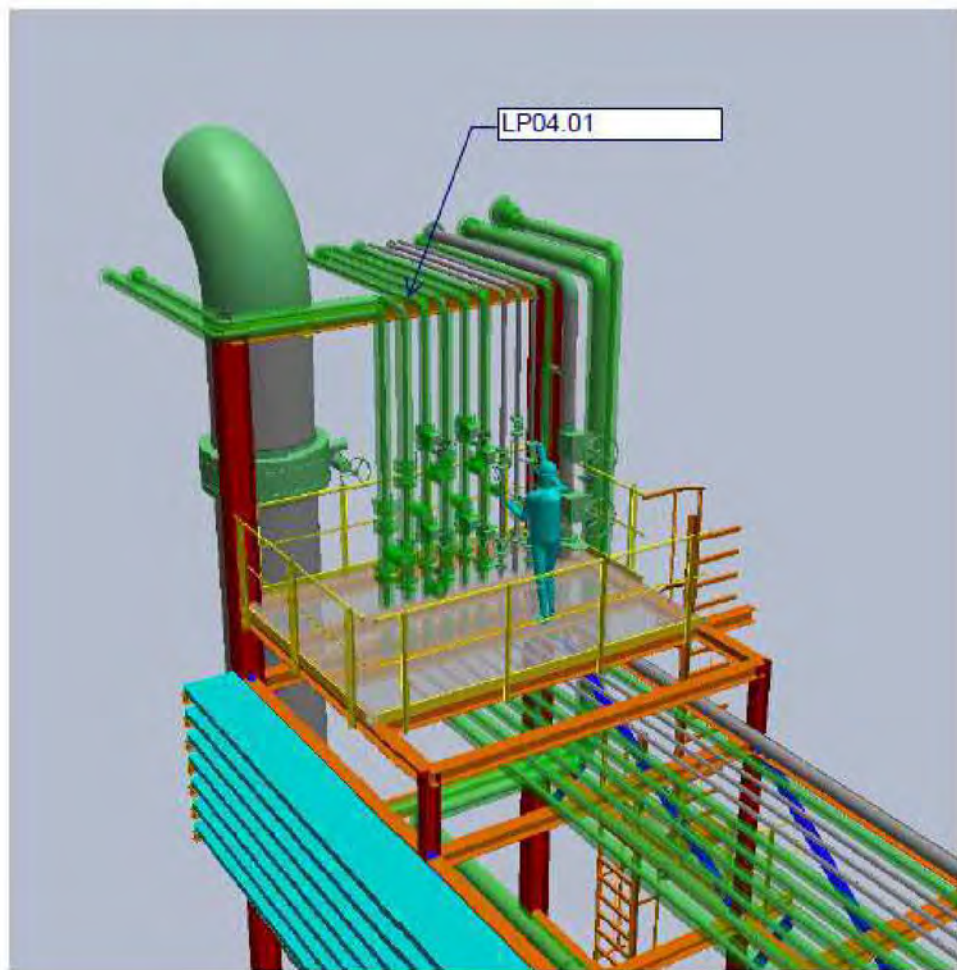
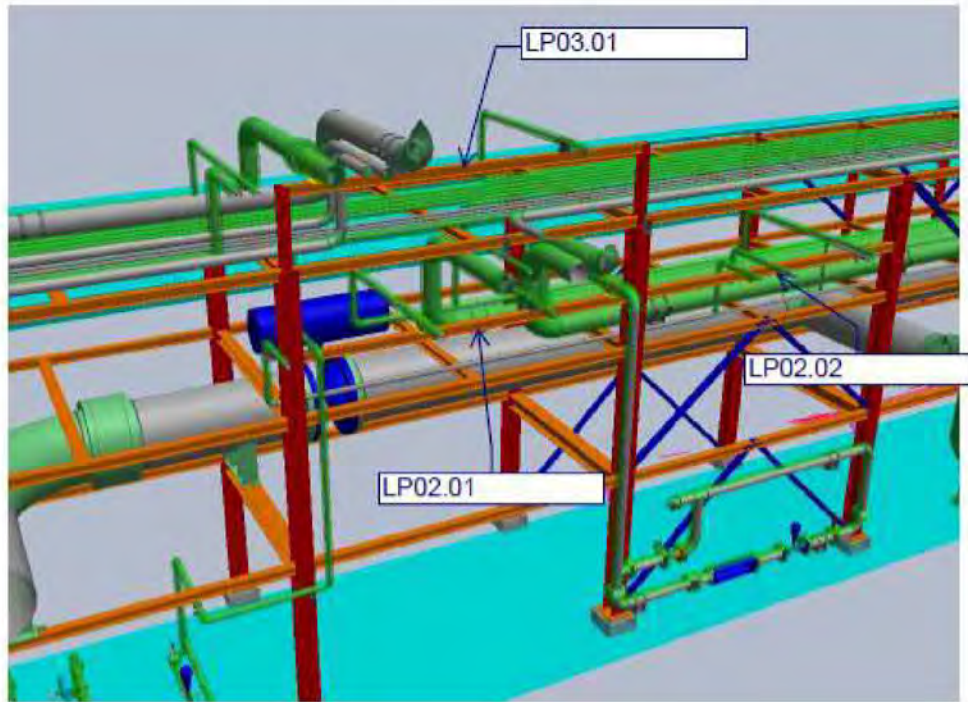
Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 12. ANNEXURE D: LOAD INPUTS

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>



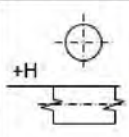

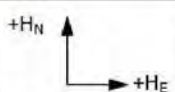
Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**CONCENTRATED LOADS (LOCATION SEE DRAWING)**

LOADS RESULTING FROM CONNECTED PIPING ARE INCLUDED

	MARKED LOAD POINT NO. OR EQP NO.						GLOBAL (X' - MARK)	REMARKS
		VERTICAL LOAD			HORIZONTAL LOAD			
ELEVATION [m]		V <sub>D</sub> [KN]	V <sub>O</sub> [KN]	V <sub>T</sub> [KN]	H <sub>N</sub> [KN]	H <sub>E</sub> [KN]		
+3.200	L01.01	+ 70.0	+ 80.0		wind only	+/-25,0	X	48" - CAJR01
+3.200	L01.02	+ 60.0	+ 70.0		wind only	+/-20	X	48" - CAJR01
+3.200	L01.03	+ 40.0	+ 50.0		+/-15	+/-15	X	48" - CAJR01
+6.700	LP02.01	+ 5.0	+ 10.0		+/-3	+/-3	X	
+6.700	LP02.02	+ 5.0	+ 10.0		+/-3	+/-3	X	
+9.200	LP03.01	+ 5.0	+ 10.0		+/-3	+/-3	X	
+12.100	LP04.01	+ 10.0	+ 25.0		only wind	+/-8	X	

**AREA LOADS (AS MARKED IN THE DRAWING)**

LEVEL	PIPING LOADS					LIVE LOADS VERTICAL	CONCENTRATED LOAD	REMARKS
	VERTICAL			HORIZONTAL				
ELEVATION [m]	g <sub>R</sub> [kN/m <sup>2</sup> ]	p <sub>R</sub> [kN/m <sup>2</sup> ]	q <sub>R</sub> [kN/m <sup>2</sup> ]	h <sub>N</sub> [kN/m <sup>2</sup> ]	h <sub>E</sub> [kN/m <sup>2</sup> ]	q [kN/m <sup>2</sup> ]	P [KN]	
+5.700	+ 2.0	+ 3.5		only wind	+/-0,5			
+8.000	+ 1.0	+ 2.5		only wind	+/-0,4			
+8.900	+ 1.0	+ 2.0		+/-0,2	+/-0,2	+ 3.0	+ 10.0	Walkway platform, movable single load, applied on area with grating only
Cabletrays								acc. to YARA Specification
Explosion Load								acc. to YARA Specification

NOTE 1 : CONSIDER CABLE TRAY SUPPORTING PORTION FULLY OCCUPIED

V<sub>D</sub> = DEAD LOAD (EMPTY WEIGHT WITH INSULATION AND ATTACHMENTS)

V<sub>O</sub> = OPERATING LOAD (V<sub>D</sub> + OPERATING, FILLING WITH OPERATING MEDIUM)

V<sub>T</sub> = PRESSURE TEST LOAD (V<sub>D</sub> + FILLING WITH WATER)

H<sub>N</sub> / H<sub>E</sub> = HORIZONTAL LOAD IN OPERATION (N=NORTH, E=EAST) FOR LOCAL DESIGN IF NOT MARKED AS GLOBAL

g<sub>R</sub> = DEAD LOAD - PIPELINE

p<sub>R</sub> = LIVE LOAD + g<sub>R</sub>

q<sub>R</sub> = TEST LOAD = g<sub>R</sub> + PRESSURE TEST LOAD (WITHOUT INSULATION)

h<sub>N</sub> = PIPE THRUST NORTH

h<sub>E</sub> = PIPE THRUST SOUTH

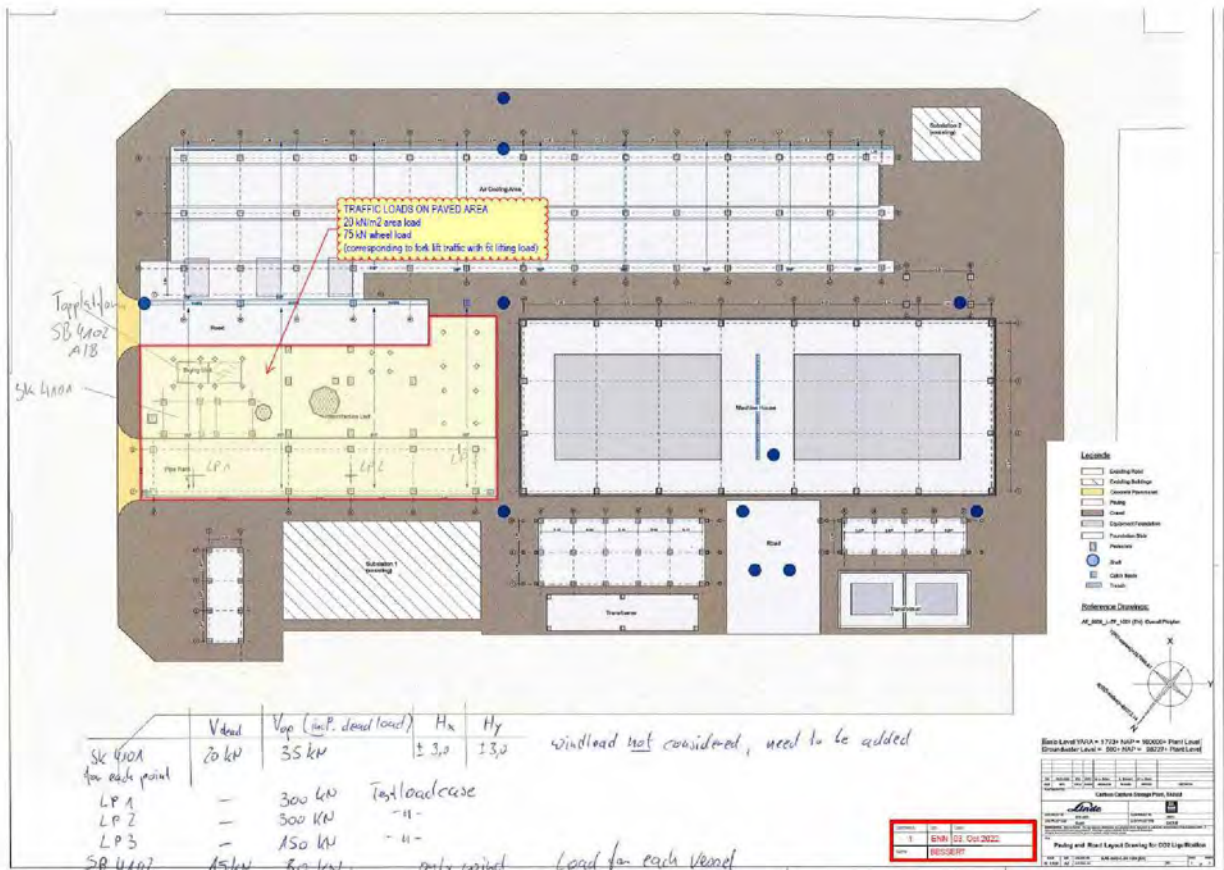
q = LIVE LOAD IN AREAS WITH GRATING

P = CONCENTRATED SINGLE LIVE LOAD ON PLATFORM FOR LOCAL DESIGN

0501

SINGLE LOADS, WHICH ARE PLACED IN ADDITION TO AREA LOADS, ARE REDUCED WITH THE OVERLAPPING AREA LOAD. ALL OTHER LOADS SHALL BE ADDED DIRECTLY TO THE DRAWING AT THEIR ASSUMED POSITION WITH VALUES

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 13. ANNEXURE E: LOAD COMBINATIONS

COMBINED BARS ON CONCRETE CLASS 3-CCS  
 SLS LOAD COMBINATIONS FOR MEMBER DESIGN OF STEEL STRUCTURES

Element	Type (SL, CL, PL)	Location	Dirn	Ref	Load Case												Member											
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20				
Beam 101-1	SL	101-1	Dirn	101-1	1.2D	1.2																						
					1.2D+0.5W	1.2			0.5																			
					1.2D+0.5W+0.4L	1.2			0.5	0.4																		





**Accounting period: 01/01/2015 to 31/12/2015**

**Accounting period: 01/01/2016 to 31/12/2016**

Account			2015		2016		2017		2018		2019		2020		2021		2022		2023		2024		2025		2026		2027		2028		2029		2030		2031		2032		2033		2034		2035					
Code	Description	Unit	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change	Balance	Change						
1.001	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...		
1.002	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

Table with multiple columns (likely columns 1-30) and rows. The table contains numerical data and some text labels, possibly representing structural analysis results or load data. The rows are grouped into sections labeled '1', '2', and '3'.

SLS Comb. No.	ULS Comb. No.	Load Combinations	Remark	DL	LL	BL+X	BL-X	BL+Z	BL-Z
30161	40205	1.0DL+1.0LL+1.0BL+X	First frame as primary frame	1.0	1.0	1.0			
30162	40206	1.0DL+1.0LL+1.0BL+X	Second frame as primary frame	1.0	1.0	1.0			
30163	40207	1.0DL+1.0LL+1.0BL+X	Third frame as primary frame	1.0	1.0	1.0			
30164	40208	1.0DL+1.0LL+1.0BL+X	Fourth frame as primary frame	1.0	1.0	1.0			
30165	40209	1.0DL+1.0LL+1.0BL+X	Fifth frame as primary frame	1.0	1.0	1.0			
30166	40210	1.0DL+1.0LL+1.0BL+X	Sixth frame as primary frame	1.0	1.0	1.0			
30167	40211	1.0DL+1.0LL+1.0BL-X	First frame as primary frame	1.0	1.0		1.0		
30168	40212	1.0DL+1.0LL+1.0BL-X	Second frame as primary frame	1.0	1.0		1.0		
30169	40213	1.0DL+1.0LL+1.0BL-X	Third frame as primary frame	1.0	1.0		1.0		
30170	40214	1.0DL+1.0LL+1.0BL-X	Fourth frame as primary frame	1.0	1.0		1.0		
30171	40215	1.0DL+1.0LL+1.0BL-X	Fifth frame as primary frame	1.0	1.0		1.0		
30172	40216	1.0DL+1.0LL+1.0BL-X	Sixth frame as primary frame	1.0	1.0		1.0		
30173	40217	1.0DL+1.0LL+1.0BL+Z		1.0	1.0			1.0	
30174	40218	1.0DL+1.0LL+1.0BL-Z		1.0	1.0				1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

## 14. ANNEXURE F: STAAD INPUT FILE FOR SUPERSTRUCTURE ANALYSIS & DESIGN

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

STAAD SPACE

START JOB INFORMATION

ENGINEER DATE 07-Sep-22

JOB NAME SR0501 (piperack)

JOB NO X

JOB REV 00 FOR STRUCTURAL DESIGN

JOB PART STATUS E

ENGINEER NAME KHUSHAL PATEL

CHECKER NAME MURTHY KOLLEPARA

APPROVED NAME JIGNESH SHAH

\*SET NL1050

END JOB INFORMATION

INPUT WIDTH 79

UNIT METER KN

JOINT COORDINATES

1 0 0.300001 0; 2 13 0.300001 0; 3 19 0.300001 0; 4 25 0.300001 0;  
5 31 0.300001 0; 6 0 0.300001 4; 7 13 0.300001 4; 8 19 0.300001 4;  
9 25 0.300001 4; 10 31 0.300001 4; 11 0 3.2 0; 12 13 3.2 0; 13 19 3.2 0;  
14 25 3.2 0; 15 31 3.2 0; 16 0 3.2 4; 17 13 3.2 4; 18 19 3.2 4; 19 25 3.2 4;  
20 31 3.2 4; 21 0 5.7 0; 22 13 5.7 0; 23 19 5.7 0; 24 25 5.7 0; 25 31 5.7 0;  
26 0 5.7 4; 27 13 5.7 4; 28 19 5.7 4; 29 25 5.7 4; 30 31 5.7 4; 31 0 8 0;  
32 13 8 0; 33 19 8 0; 34 25 8 0; 35 31 8 0; 36 0 8 4; 37 13 8 4; 38 19 8 4;  
39 25 8 4; 40 31 8 4; 41 4 8 0; 42 7 8 0; 43 10 8 0; 44 4 5.7 0; 45 7 5.7 0;  
46 10 5.7 0; 47 4 8 4; 48 7 8 4; 49 10 8 4; 50 4 3.2 0; 51 7 3.2 0;  
52 10 3.2 0; 53 4 5.7 4; 54 7 5.7 4; 55 10 5.7 4; 56 4 3.2 4; 57 7 3.2 4;  
58 10 3.2 4; 59 16 3.2 4; 60 16 3.2 0; 61 16 5.7 4; 62 16 5.7 0; 63 0 8.9 4;  
64 4 8.9 4; 65 0 8.9 0; 66 4 8.9 0; 67 0 12.1 0; 68 0 12.1 4; 69 13 0.400001 4;  
70 13 0.400001 0; 71 19 0.400001 4; 72 19 0.400001 0; 75 22 5.7 4; 76 28 5.7 4;  
77 22 5.7 0; 78 28 5.7 0; 79 16 8 4; 80 22 8 4; 81 28 8 4; 82 16 8 0;  
83 22 8 0; 84 28 8 0; 89 3 8.9 0; 90 3 8.9 4; 91 0 5.7 -1.2; 92 4 5.7 -1.2;  
93 0 4.5 0; 94 4 4.5 0; 95 1.2 5.7 -1.2; 96 2 5.7 -1.2; 97 2 5.7 0; 98 1 8.9 4;  
99 2 8.9 4; 100 1 8.9 0; 101 2 8.9 0; 102 0 8.9 2; 103 13 6.7 0; 104 19 6.7 0;  
105 25 6.7 0; 106 19 9.2 0; 107 25 9.2 0; 108 20.2 9.2 0; 110 0 11.6 0;  
111 0 11.6 4; 112 0 8.9 5; 113 4 8.9 5; 114 2 8.9 5; 115 3.00001 8.9 5;  
116 29.5 3.2 4; 117 29.5 3.2 0; 118 29.5 3.2 2; 119 19 3.2 3.00001;  
120 17.5 3.2 4; 121 17.5 3.2 0; 122 17.5 3.2 3.00001; 123 19 3.2 1.5;  
124 17.5 3.2 1.5; 125 3 3.2 4; 126 3 3.2 0; 127 4 3.2 3.00001;  
128 3 3.2 3.00001; 129 31 3.2 2;

MEMBER INCIDENCES

1 6 16; 2 16 26; 3 26 36; 4 1 11; 5 11 93; 6 21 31; 7 7 69; 8 17 27; 9 27 37;  
10 2 70; 11 12 22; 12 22 103; 13 8 71; 14 18 28; 15 28 38; 16 3 72; 17 13 23;  
18 23 104; 19 9 19; 20 19 29; 21 29 39; 22 4 14; 23 14 24; 24 24 105; 25 10 20;  
26 20 30; 27 30 40; 28 5 15; 29 15 25; 30 25 35; 31 16 125; 32 17 59; 33 18 19;  
34 19 116; 35 11 126; 36 12 60; 37 13 14; 38 14 117; 39 26 53; 40 27 61;  
41 28 75; 42 29 76; 43 21 97; 44 22 62; 45 23 77; 46 24 78; 47 36 47; 48 37 79;  
49 38 80; 50 39 81; 51 31 41; 52 32 82; 53 33 83; 54 34 84; 55 11 16; 56 21 26;  
57 31 36; 58 12 17; 59 22 27; 60 32 37; 61 13 123; 62 23 28; 63 33 38;  
64 14 19; 65 24 29; 66 34 39; 67 15 129; 68 25 30; 69 35 40; 70 41 42;  
71 42 43; 72 43 32; 73 44 45; 74 45 46; 75 46 22; 76 47 48; 77 48 49; 78 49 37;  
79 50 51; 80 51 52; 81 52 12; 82 53 54; 83 54 55; 84 55 27; 85 56 57; 86 57 58;  
87 58 17; 88 56 53; 89 53 47; 90 57 54; 91 54 48; 92 58 55; 93 55 49; 94 50 94;  
95 44 41; 96 51 45; 97 45 42; 98 52 46; 99 46 43; 100 50 127; 101 44 53;  
102 41 47; 103 42 48; 104 43 49; 105 45 54; 106 46 55; 107 59 120; 108 60 121;  
109 61 28; 110 62 23; 111 69 59; 112 71 59; 113 70 60; 114 72 60; 115 17 61;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

116 18 61; 117 12 62; 118 13 62; 119 53 36; 120 54 47; 121 54 49; 122 55 37;  
123 44 31; 124 45 41; 125 45 43; 126 46 32; 127 63 98; 128 65 100; 129 65 102;  
130 66 64; 131 36 63; 132 47 64; 133 31 65; 134 41 66; 135 67 68; 136 65 110;  
137 63 111; 138 69 17; 139 70 12; 140 71 18; 141 72 13; 148 62 61; 149 75 29;  
150 76 30; 151 77 24; 152 78 25; 153 79 38; 154 80 39; 155 81 40; 156 82 33;  
157 83 34; 158 84 35; 159 77 75; 160 78 76; 161 82 79; 162 83 80; 163 84 81;  
176 89 66; 177 90 64; 178 89 41; 179 90 47; 180 93 21; 181 94 44; 182 21 91;  
183 44 92; 184 91 95; 185 91 93; 186 92 94; 187 95 96; 188 95 21; 189 96 92;  
190 97 44; 191 96 97; 192 98 99; 193 99 90; 194 100 101; 195 101 89;  
196 100 98; 197 101 99; 198 89 90; 199 102 63; 202 103 32; 203 104 33;  
204 105 34; 205 103 104; 206 104 105; 207 33 106; 208 34 107; 209 106 108;  
210 108 107; 211 33 108; 212 42 49; 213 42 47; 214 53 45; 215 45 55; 216 49 32;  
217 47 31; 218 55 22; 219 53 21; 221 110 67; 222 111 68; 223 111 99;  
224 110 101; 229 51 57; 230 52 58; 235 63 112; 236 64 113; 237 36 112;  
238 47 113; 239 112 114; 240 114 115; 241 115 113; 242 99 114; 243 90 115;  
244 114 90; 245 116 20; 246 117 15; 247 117 118; 248 118 116; 249 117 129;  
250 129 116; 251 119 18; 252 120 18; 253 121 13; 254 121 124; 255 122 120;  
256 122 119; 257 123 119; 258 124 122; 259 124 123; 260 121 123; 261 124 119;  
262 119 120; 263 125 56; 264 126 50; 265 127 56; 266 126 128; 267 128 125;  
268 128 127; 269 128 56; 270 11 128; 271 56 51; 272 51 58; 273 58 12;  
274 129 20; 275 118 129;

**START GROUP DEFINITION**

**MEMBER**

BEAMS 31 TO 87 100 TO 110 127 TO 130 135 148 TO 163 176 177 182 TO 184 187 -  
189 TO 199 205 206 209 210 229 230 235 236 239 TO 242 245 TO 248 251 TO 259 -  
263 TO 268 274 275

**END GROUP DEFINITION**

**MEMBER RELEASE**

31 TO 54 79 TO 81 85 TO 87 89 91 93 95 97 99 101 TO 106 111 TO 128 132 134 -  
148 159 TO 163 178 179 182 TO 186 188 191 196 197 205 206 209 211 TO 219 -  
223 224 235 TO 239 242 TO 244 247 249 250 254 256 259 TO 262 266 268 TO 273 -  
275 START MY MZ

33 37 72 75 78 TO 81 84 TO 93 95 TO 99 101 TO 106 109 TO 126 148 TO 163 176 -  
177 TO 179 181 185 186 188 189 191 196 197 205 206 210 TO 219 223 224 237 -  
238 241 TO 246 248 TO 250 252 253 255 256 259 TO 264 267 TO 273 -  
275 END MY MZ

**DEFINE MATERIAL START**

**ISOTROPIC STEEL**

E 2.1e+08

POISSON 0.3

DENSITY 78.5

ALPHA 1.2e-05

DAMP 0.03

TYPE STEEL

STRENGTH FY 355000 FU 470000 RY 1.5 RT 1.2

G 8.1e+07

**END DEFINE MATERIAL**

**MEMBER PROPERTY EUROPEAN**

1 4 7 10 13 16 138 TO 141 TABLE ST HE340B

56 59 62 65 68 100 135 209 210 229 230 265 TABLE ST HE240A

178 179 185 186 211 223 224 237 238 244 249 250 TABLE ST L90X90X8

31 35 79 TO 81 85 TO 99 132 134 181 TO 184 187 189 191 196 TO 198 235 236 -  
239 TO 243 247 248 254 TO 256 258 259 263 264 266 TO 268 -

275 TABLE ST HE160A

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

32 TO 34 36 37 107 108 245 252 253 TABLE ST HE220A  
111 TO 126 212 TO 219 270 TO 273 TABLE ST HE140A  
101 TO 106 148 159 TO 163 205 206 TABLE ST HE180A  
39 TO 54 57 60 63 66 69 TO 78 82 TO 84 109 110 127 TO 130 149 TO 158 176 177 -  
190 192 TO 195 199 TABLE ST HE200A  
38 246 TABLE ST HE300A  
58 61 251 257 TABLE ST HE360B  
19 22 25 28 TABLE ST HE340B  
64 67 274 TABLE ST HE360B  
2 3 5 6 8 9 11 12 14 15 17 18 20 21 23 24 26 27 29 30 131 133 136 137 180 -  
202 TO 204 207 208 221 222 TABLE ST HE300A  
188 260 TO 262 269 TABLE ST L75X75X8  
55 TABLE ST HE400B  
CONSTANTS  
BETA 90 MEMB 1 TO 30 88 TO 99 131 TO 134 136 TO 141 180 181 202 TO 204 207 -  
208 221 222  
BETA 45 MEMB 178 179 185 186 188 211 223 224 249 250 260 TO 262 269  
MATERIAL STEEL ALL  
SUPPORTS  
1 TO 10 PINNED  
\*\*\*  
\*\*\*-----  
\*----- WIND LOAD DEFINITION -----  
\*\*\*-----  
DEFINE WIND LOAD  
TYPE 1 WIND 1  
INT 0.71 0.79 0.85 0.91 HEIG 6 8 10 12  
\*\*\*PRESSURE VS INTENSITY TO BE CONSIDERED FROM DESIGN BASIS  
\*\*\*-----  
LOAD 101 MODELLED STRUCTURAL/ FOUNDATION SELF WEIGHT  
\*\*\*-----  
SELFWEIGHT Y -1.15  
SELFWEIGHT Y -1.15 LIST 198  
SELFWEIGHT Y -1.15 LIST 63  
SELFWEIGHT Y -1.15 LIST 60  
SELFWEIGHT Y -1.15 LIST 62  
SELFWEIGHT Y -1.15 LIST 59  
\*\*\*-----  
LOAD 102 NODE/ CONNECTION WEIGHT/LIFTING LUG/ PAD-EYE WEIGHT  
\*\*\*-----  
LOAD 100 PRIMARY STRUCTURAL STEEL (SUM OF LC 101 TO 102)  
\*\*\*-----  
REPEAT LOAD  
101 1.0 102 1.0  
\*\*\*-----  
LOAD 111 GRATING/ CHEQUERED PLATE /EQUIPMENT SUPPORTS / SECONDARY  
PLATFORMS/  
\*Staircase stringer /ladder /Handrail  
\* as per procorr mail with 'GRP weights' dated 27 Sept 2022  
\*\*\*\*GRATING LOAD  
\* grating dead load = 0.25 KN/m<sup>2</sup>, for span of 1.0m, the load would be = 0.25\*1 =0.25kN/m  
\* this is applied to internal beams, and 0.125 KN/m applied to external beam  
\* at level +8.900  
MEMBER LOAD

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

196 197 UNI GY -0.25  
129 199 242 243 UNI GY -0.125  
198 UNI GY -0.125 2 4  
198 UNI GY -0.125 0 2

\*  
\* grating dead load = 0.25KN/m<sup>2</sup>, for span of 1.2m, and as the load is shared by  
\* two beams, load = 0.25\*1.2/2 = 0.15 KN/m, this is applied at level +5.700

MEMBER LOAD

189 190 UNI GY -0.15

\*  
\* Handrail load = 0.06 KN/m applied at the gating floor beams  
127 TO 129 183 189 190 192 194 195 199 UNI GY -0.06

\*  
\* Ladder load = 0.10kN/m, length of the ladder = 6m  
\* load = 0.10\*6 = 0.6 KN, applied at the location where ladder supports..

JOINT LOAD

89 FY -0.6

MEMBER LOAD

191 CON GY -0.6

\*  
\*\*\*\*SECONDARY BEAMS WEIGHT  
\*\*\*\*HANDRAIL WEIGHT\*\*\*0.25KN/M

\*\*\*-----  
LOAD 112 PIPE SUPPORTS/ MONORAILS, RUNWAY BEAMS, MATERIAL HANDLING ITEMS

\*\*\*-----  
LOAD 113 RIGGING WEIGHT/SEA FASTENING/ LASHING/ SECURING WEIGHTS

\*\*\*-----  
LOAD 110 SECONDARY & TERTIARY STRUCTURAL STEEL (UNMODELED PART)

\*(Sum of LC 111 to 113)

\*\*\*-----

REPEAT LOAD

111 1.0 112 1.0 113 1.0

\*\*\*-----

LOAD 120 ADDITIONAL LOAD TO MATCH THE WCR STRUCTURAL WEIGHT

\*\*\*-----

\*\*\*-----

LOAD 131 PAINTING LOAD

\*\*2% OF MODELLED STRUCTURAL STEEL WEIGHT CAN BE CONSIDERED AS AN EARLY ESTIMATE

\*\*\*-----

LOAD 132 FIRE PROOFING LOADS

\*\*\*-----

\*\*\*-----

LOAD 130 MISCELLANEOUS LOADS (SUM OF LC 131 AND LC 132)

\*\*\*-----

REPEAT LOAD

131 1.0 132 1.0

\*\*\*-----

LOAD 140 HOOK UP LOADS

\*\*\*-----

LOAD 10 TOTAL STRUCTURAL DEAD LOAD (SUM OF LC 100, 110, 120, 130,140)

\*\*\*-----

REPEAT LOAD

100 1.0 110 1.0 120 1.0 130 1.0 140 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*-----

**LOAD 201 OPEN AREA LIVE LOADS/ OPERATING PLATFORMS (5 KN/M2)**

\*\*\*-----

**\*\*\*\*LIVE LOAD ON MAIN OPERATING FLOOR**

\*\*\*-----

**LOAD 202 LIVE LOAD ON SERVICE PLATFORMS, PEDESTALS, WALKWAYS (3 KN/M2)**

**\*\*\*\*LIVE LOAD ON GRATING**

\* Live load = 3 KN/m<sup>2</sup>, for span of 1.0m, the load would be = 3\*1 =3kN/m

\* this is applied to internal beams, and for external beams = 3/2 = 1.5 KN/m

\* at level +8.900

**MEMBER LOAD**

196 197 UNI GY -3

129 199 242 243 UNI GY -1.5

198 UNI GY -1.5 2 4

198 UNI GY -1.5 0 2

\*

\* live load = 3KN/m<sup>2</sup>, for span of 1.2m, and as the load is shared by

\* two beams, load = 3\*1.2/2 = 1.8 KN/m, this is applied at level +5.700

**MEMBER LOAD**

189 190 UNI GY -1.8

\*\*\*-----

**LOAD 203 LIVE LOAD ON STAIRWAYS (5KN/M2)**

\*\*\*-----

**LOAD 204 LIVE LOADS ON STORAGE AREAS (LAYDOWN) (7.5 KN/M2)**

\*\*\*-----

**LOAD 20 TOTAL LIVE LOAD (SUM OF LC 201 TO 204) ( LL)**

\*\*\*-----

**REPEAT LOAD**

201 1.0 202 1.0 203 1.0 204 1.0

\*\*\*-----

**LOAD 301 EMPTY WEIGHT OF PIPE (UDL)/PIPE AREA LOAD**

\* Loads are from the Load input file "Loads table SR0501"

\* Loads at +5.700m level = gR = 2 KN/m<sup>2</sup>

**MEMBER LOAD**

\* load at main grid transverse beam = 2/3\*6\*(2) = 8 KN/m, (for 6m span)

56 65 68 105 UNI GY -8

62 UNI GY -8 2 4

62 UNI GY -8 0 2

59 UNI GY -8 2 4

59 UNI GY -8 0 2

\* load at intermediate beam = 1/3\*6\*(2 kN/m<sup>2</sup>) = 4 KN/m, (for 6m span)

101 106 148 159 160 UNI GY -4

\*

\* Loads at +8.000m level = gR = 1 KN/m<sup>2</sup>

\* load for 3m span = 1\*3 = 3 kN/m, applied at all beams considering,

\* that these small bore lines would be supported by all beams.

57 66 69 102 TO 104 161 TO 163 UNI GY -3

63 UNI GY -3 2 4

63 UNI GY -3 0 2

60 UNI GY -3 2 4

60 UNI GY -3 0 2

\*

\* Loads at +8.900m level = gR = 1 KN/m<sup>2</sup>

\* load for 1m span at internal beams = 1\*1 = 1 kN/m



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* loads at external beams = 1/2 = 0.5KN/m

MEMBER LOAD

196 197 UNI GY -1  
129 199 UNI GY -0.5  
198 UNI GY -0.5 2 4  
198 UNI GY -0.5 0 2

\*

\*\*\*-----

\*\*\*-----

LOAD 302 EMPTY WEIGHT OF PIPE VALVES, SUPPORTS (POINT LOAD)

\* As per the load mentioned in the load input file "Load table SR0501".

MEMBER LOAD

\* load at +3.200, L01.01 = 70 KN (48"-CAJR01)  
265 CON GY -70 0.199994  
\* load at +3.200, L01.02 = 60 KN (48"-CAJR01)  
251 CON GY -60 0.0999939  
\* load at +3.200, L01.03 = 40 KN (48"-CAJR01)  
246 CON GY -40 0.299999  
\* load at +6.700, L02.01 = 5 KN  
206 CON GY -5  
\* load at +6.700, L02.02 = 5 KN  
205 CON GY -5  
\* load at +9.200, L03.01 = 5 KN  
210 CON GY -5 1.8  
\* load at +12.100, L04.01 = 10 KN  
135 CON GY -10

\*\*\*-----

LOAD 303 EMPTY WEIGHT OF PIPE VALVES, SUPPORTS ON HOOK UP STEEL

\*\*\*-----

LOAD 300 PIPING DRY WEIGHTS (SUM OF LC 301 TO 303)

\*\*\*-----

REPEAT LOAD

301 1.0 302 1.0 303 1.0

\*\*\*-----

LOAD 311 EQUIPMENT DRY WEIGHT (> 10MT)

\*\*\*-----

\*\*\*-----

LOAD 312 EQUIPMENT DRY WEIGHT (<10 MT) /AREA LOAD

\*\*\*-----

LOAD 310 MECHANICAL DRY WEIGHTS (SUM OF LC 311 TO 312)

\*\*\*-----

REPEAT LOAD

311 1.0 312 1.0

\*\*\*-----

LOAD 321 ELECTRICAL EQUIPMENT DRY WEIGHT

\*\*\*-----

LOAD 322 ELECTRICAL CABLES, CABLE DUCTS/ TRAYS

\*\*\*-----

LOAD 320 ELECTRICAL DRY WEIGHTS (SUM OF LC 321 TO 322)

\*\*\*-----

REPEAT LOAD

321 1.0 322 1.0

\*\*\*-----

LOAD 331 INSTRUMENTATION EQUIPMENT DRY WEIGHT

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*-----

**LOAD 332 INSTRUMENTATION CABLES, CABLE DUCTS/ TRAYS**

- \* load of 600mm wide cables trays = 1.3 KN/m as per 10000-Y50-026
- \* (&YARA A-PC 1000-Y50-00026)
- \* the cable tray loads were applied at main/secondary column directly with the
- \* magnitude mentioned below.
- \* total number of cable trays= 7
- \* total point load =  $1.3*7*6 = 54.6$  KN
- \* moment at the end of the cable tray support =  $54.6*0.4 = 21.84$  KN.m
- \* for 7m span point load =  $1.3*7*7 = 63.7$  kN, moment =  $63.7*0.4 = 25.5$  Kn.m

**MEMBER LOAD**

3 9 15 21 27 CON GY -54.6  
3 9 15 21 27 CMOM GX 21.84  
\*

**MEMBER LOAD**

91 CON GY -63.7  
91 CMOM GX 25.5

\*\*\*-----

**LOAD 330 INSTRUMENTATION DRY WEIGHTS (SUM OF LC 331 TO 332)**

\*\*\*-----

**REPEAT LOAD**

331 1.0 332 1.0

\*\*\*-----

**LOAD 30 TOTAL EMPTY WEIGHT OF PIPING/ EQUIPMENT/ E&I**

\*(Sum of LC 300,310,320,330)(EQE)

\*\*\*-----

**REPEAT LOAD**

300 1.0 310 1.0 320 1.0 330 1.0

\*\*\*-----

**LOAD 401 OPERATING WEIGHT OF PIPE (UDL)/ AREA LOAD**

\*\*

\* Loads are from the Load input file "Loads table SR0501"

\* Loads at +5.700m level = pR = 3.5 KN/m<sup>2</sup>

**MEMBER LOAD**

\* load at main grid transverse beam =  $2/3*6*(3.5) = 14$  KN/m, (for 6m span)

56 65 68 105 UNI GY -14  
62 UNI GY -14 2 4  
62 UNI GY -14 0 2  
59 UNI GY -14 2 4  
59 UNI GY -14 0 2

\* load at intermediate beam =  $1/3*6*(2 \text{ kN/m}^2) = 7$  KN/m, (for 6m span)

101 106 148 159 160 UNI GY -7

\*

\* Loads at +8.000m level = pR = 2.5 KN/m<sup>2</sup>

\* load for 3m span =  $2.5*3 = 7.5$  kN/m, applied at all beams considering,

\* that these small bore lines would be supported by all beams.

57 66 69 102 TO 104 161 TO 163 UNI GY -7.5  
63 UNI GY -7.5 2 4  
63 UNI GY -7.5 0 2  
60 UNI GY -7.5 2 4  
60 UNI GY -7.5 0 2

\*

\* Loads at +8.900m level = pR = 2 KN/m<sup>2</sup>

\* load for 1m span at internal beams=  $2*1 = 2$  kN/m

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* loads at external beams =  $2/2 = 1$  KN/m

**MEMBER LOAD**

196 197 UNI GY -2

129 199 UNI GY -1

198 UNI GY -1 2 4

198 UNI GY -1 0 2

\*

\*\*\*-----

\*\*\*-----

**LOAD 402 OPERATING WEIGHT OF PIPE SUPPORT (POINT LOAD)**

\* As per the load mentioned in the load input file "Load table SR0501".

**MEMBER LOAD**

\* load at +3.200, L01.01 = 80 KN (48"-CAJR01)

265 CON GY -80 0.199994

\* load at +3.200, L01.01 = 70 KN (48"-CAJR01)

251 CON GY -70 0.0999939

\* load at +3.200, L01.01 = 50 KN (48"-CAJR01)

246 CON GY -50 0.299999

\* load at +6.700, L02.01 = 10 KN

206 CON GY -10

\* load at +6.700, L02.02 = 10 KN

205 CON GY -10

\* load at +9.200, L03.01 = 10 KN

210 CON GY -10 1.8

\* load at +12.100, L04.01 = 25 KN

135 CON GY -25

\*\*\*-----

**LOAD 400 OPERATING PIPE WEIGHTS (SUM OF LC 401 TO 402)**

\*\*\*-----

**REPEAT LOAD**

401 1.0 402 1.0

\*\*\*-----

**LOAD 411 EQUIPMENT OPERATING WEIGHT (> 10MT)**

\*\*\*-----

**REPEAT LOAD**

311 1.15

\*\*\*-----

**LOAD 412 EQUIPMENT OPERATING WEIGHT (<10 MT)**

\*\*\*-----

**LOAD 410 MECHANICAL EQUIPMENT WEIGHTS (SUM OF LC 411 TO 412)**

\*\*\*-----

**REPEAT LOAD**

411 1.0 412 1.0

\*\*\*-----

**LOAD 421 ELECTRICAL EQUIPMENT WEIGHT/ BULK ITEMS/CABLES, CABLE DUCTS/ TRAYS**

\*\*\*-----

**LOAD 420 ELECTRICAL ITEM WEIGHTS IN OPERATING CONDITION(LC 421)**

\* load of 600mm wide cables trays = 1.3 KN/m as per 10000-Y50-026

\* (&YARA A-PC 1000-Y50-00026)

\* the cable tray loads were applied at main/secondary column directly with the

\* magnitude mentioned below.

\* total number of cable trays= 7

\* total point load =  $1.3 * 7 * 6 = 54.6$  KN

\* moment at the end of the cable tray support =  $54.6 * 0.4 = 21.84$  KN.m

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* for 7m span point load =  $1.3 \times 7 \times 7 = 63.7$  kN, moment =  $63.7 \times 0.4 = 25.5$  Kn.m

MEMBER LOAD

3 9 15 21 27 CON GY -54.6

3 9 15 21 27 CMOM GX 21.84

\*

MEMBER LOAD

91 CON GY -63.7

91 CMOM GX 25.5

\*

\*\*\*-----

REPEAT LOAD

421 1.0

\*\*\*-----

LOAD 431 INSTRUMENTATION EQUIPMENT WEIGHT/BULK ITEMS/CABLES,CABLE DUCTS/TRAYS

\*\*\*-----

LOAD 430 INSTRUMENTATION ITEM WEIGHTS IN OPERATING CONDITION (LC 431)

\*\*\*-----

REPEAT LOAD

431 1.0

\*\*\*-----

LOAD 40 TOTAL OPERATING WEIGH OF PIPING/EQUIPMENT/E&I

\*(Sum of LC 400,410,420,430)(EQLO)

\*\*\*-----

REPEAT LOAD

400 1.0 410 1.0 420 1.0 430 1.0

\*\*\*-----

LOAD 501 HYDROTEST WEIGHT OF PIPING (UDL)

\*\*\*-----

LOAD 502 HYDROTEST WEIGHT OF PIPE SUPPORTS (POINT LOAD)

\*\*

\* The loads are not applicable here.

\*\*\*-----

LOAD 500 PIPING HYDROTEST WEIGHTS (SUM OF LC 501 & LC 502)

\*\*\*-----

REPEAT LOAD

501 1.0 502 1.0

\*\*\*-----

LOAD 511 EQUIPMENT HYDROTEST WEIGHT (> 10MT)

\*\*\*-----

LOAD 512 EQUIPMENT HYDROTEST WEIGHT (<10 MT)

\*\*\*-----

LOAD 510 MECHANICAL HYDROTEST WEIGHTS (SUM OF LC 511 & LC 512)

\*\*\*-----

REPEAT LOAD

511 1.0 512 1.0

\*\*\*-----

LOAD 50 TOTAL HYDROTEST WEIGH OF PIPING/EQUIPMENT/E&I

\*(Sum of LC 500,510,420,430)(EQLT)

\*\*\*-----

REPEAT LOAD

500 1.0 510 1.0 420 1.0 430 1.0

\*\*\*-----

LOAD 6110 WIND LOADS DUE TO STRUCTURE SELF OBSTRUCTION [W-E] -VE X DIRECTION

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*

WIND LOAD X -1.7 TYPE 1 XR -1 1 YR 0 13 ZR 0 4 OPEN  
WIND LOAD X -1.7 TYPE 1 XR 6 8 YR 0 8 ZR 0 4 OPEN  
WIND LOAD X -1.7 TYPE 1 XR 12 14 YR 0 8 ZR 0 4 OPEN  
WIND LOAD X -1.7 TYPE 1 XR 18 20 YR 0 10 ZR 0 4 OPEN  
WIND LOAD X -1.7 TYPE 1 XR 24 26 YR 0 10 ZR 0 4 OPEN  
WIND LOAD X -1.7 TYPE 1 XR 30 32 YR 0 8 ZR 0 4 OPEN

\*

\*\*\*-----  
\*\*\*-----

LOAD 6310 WIND LOADS DUE TO STRUCTURE SELF OBSTRUCTION [S-N] -VE Z DIRECTION

\*

\* (as per calculation, the wind load on frame is with  $cf=1.8$  on both the frames)  
\* as per &YARA A-PC 100000-Y50-00026, 10.2 - factor for longitudinal frame -  
\* - would be 1.7.

WIND LOAD Z -1.7 TYPE 1 XR 0 31 YR 0 13 ZR -1 1 OPEN  
WIND LOAD Z -1.7 TYPE 1 XR 0 31 YR 0 13 ZR 3 5 OPEN

\*

\*\*\*-----

\*\*\*\*\* the comparison of wind with earthquake load...

\* As per Eurocode8  
\*  $T=Ct.H^{3/4} = 0.085*7.7^{0.75} = 0.393..... (4.6)$   
\* for type 2, and ground type D, as per table 3.3, the different values are  
\*  $S=1.8, Ta=0.1, Tc=0.3, TD=1.2,$   
\* hence  $T > Tc, T < TD,$  hence  $Sd(t) = ag.S.2.5/q*Tc/T... (3.15)$   
\*  $Sd(t) = 0.05*1.8*2.5/q*0.3/0.393$  (ag in terms of g,  $ag=0.05$ )  
\*  $q = qo*kw...(5.2.2.2)$   
\*  $qo = 3.ao/a1... table 5.1, ao/a1=1.2, kw=1,$   
\*  $q = 3*1.2*1 = 3.6,$   
\*  $Sd(t) = 0.05*1.8*2.5/3.6*0.3/0.393 = 0.048 .....$   
\* Base shear =  $Fb = Sd(t)*m*lemda$   
\*  $lemda = 1, m$  is mass of the structure  
\* Base shear =  $0.048*m....$   
\* means the base shear is 4.8 or say 5% of the mass

\*

\* the wind load in both the direction are coming more than this seismic.  
\* hence seismic load will not govern and hence not applied...

\*\*\*-----

LOAD 611 WIND LOAD ON STR. DUE TO SELF OBSTRUCTION IN +VE X-(E-W) DIRECTION

\*\*\*\*\* as per calculation, the wind load on first frame is with  $cf=1.7$  factor,  
\*\*\*\*\* wind load on all other frames =  $cf=0.64.$

WIND LOAD X 1.7 TYPE 1 XR -1 1 YR 0 13 ZR 0 4 OPEN  
WIND LOAD X 1.7 TYPE 1 XR 6 8 YR 0 8 ZR 0 4 OPEN  
WIND LOAD X 1.7 TYPE 1 XR 12 14 YR 0 8 ZR 0 4 OPEN  
WIND LOAD X 1.7 TYPE 1 XR 18 20 YR 0 10 ZR 0 4 OPEN  
WIND LOAD X 1.7 TYPE 1 XR 24 26 YR 0 10 ZR 0 4 OPEN  
WIND LOAD X 1.7 TYPE 1 XR 30 32 YR 0 8 ZR 0 4 OPEN

\*\*\*-----

\*\*\*-----

LOAD 612 WIND LOAD ON PIPING IN +VE X-(E-W) DIRECTION

\*

\*\*\*\* as per section 10.3, &YARA A-PC 10000-Y50-00026, the horizontal load  
\* Htot shall be provided as HS (or HWL or HE)+ HA (longitudinal direction)  
\* A) Hs stability force = 1.5 % of the weight of the structure and the operating -

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* - loads of the pipes.  
\* weight of the structure = 405kN, operating piping weight = 1437 kN.  
\* LC101-self weight of structure, LC40-operating load  
\*\*\*\*\* hence  $H_s = 1.5/100*(405+1437) = 27.63\text{KN}$ ,  
\* -----  
\* HWL = longitudinal wind force =  $0.3*(DP+HB)*pw*L$   
\*  $DP=1.2$ ,  $HB=0.2\text{m}$ ,  $Pw=0.8\text{KN/m}^2$ ,  $L=31\text{m}$  (total length of the piperack considered),  
\*\*\*\*\* hence  $HWL = 0.3*(1.2+0.2)*0.8*31 = 10.416\text{ kN}.....@2.7\text{m level}$   
\*\*\*\*\* (so per joint,  $10.416/2 = 5.25\text{ kN}$ )  
\*\*\*\*\*  $HWL = 0.3*(0.3+0.2)*0.8*31 = 3.72\text{ kN}.....@5.7\text{m level}$   
\*\*\*\*\* (so per joint,  $3.72/2 = 1.86\text{ kN}$ )  
\*\*\*\*\*  $HWL = 0.3*(0.05+0.2)*0.8*31 = 1.86\text{ kN}.....\& 7.0\text{m level}$   
\*\*\*\*\* (so per joint,  $1.86/2 = 0.93\text{ kN}$ )  
\*\*\* total =  $10.416+3.72+1.86 = 15.996\text{ KN}$ ,  
\* \* -----  
\*\*\*\* the governing is 27.63 KN, this load is applied at top level  
\* to have the more effect on the structure.  
\* load =  $28/2 = 14\text{ KN}$ , applied at two nodes.

**JOINT LOAD**

31 36 FX 14

\*\*\* -----  
\*\*\* -----

**LOAD 613 WIND LOAD ON EQUIPMENT +VE X-(E-W) DIRECTION**

\*\*\* -----  
\*\*\* -----

**LOAD 614 WIND LOAD ON CABLE TRAY +VE X-(E-W) DIRECTION**

\* the cable tray gallery height = 2.65m, width of the cables=0.8m,  
\* the wind pressure = 0.8 KN/m<sup>2</sup>,  $cf=1.7$   
\* hence load on cables trays considering fully cladded =  $2.65*0.8*0.8*1.7=2.9\text{KN}$ ,  
\* this load is applied to the column where the cable trays are attached.  
\* torsional force due to this wind on cables not considered as, the beams would  
\* be restrained by the cables.

**MEMBER LOAD**

3 9 15 21 27 91 CON GX 2.9

\*\*\* -----  
\*\*\* -----

**LOAD 61 TOTAL WIND LOAD IN +VE X-(E-W) DIRECTION (LC 611)**

\*\*\* -----  
\*\*\* -----

**REPEAT LOAD**

611 1.0 612 1.0 613 1.0 614 1.0

\*\*\* -----  
\*\*\* -----

**LOAD 621 WIND LOAD ON STRUCTURE DUE TO SELF OBSTRUCTION IN +VE Z-(N-S) DIR**

\* (as per calculation, the wind load on frame is with  $cf=1.8$  on both the frames)  
\* as per &YARA A-PC 100000-Y50-00026, 10.2 - factor for longitudinal frame -  
\* - would be 1.7.

WIND LOAD Z 1.7 TYPE 1 XR 0 31 YR 0 12 ZR -1 1 OPEN

WIND LOAD Z 1.7 TYPE 1 XR 0 31 YR 0 13 ZR 3.5 4.5 OPEN

\*\*\* -----  
\*\*\* -----

**LOAD 622 WIND LOAD ON PIPING IN +VE Z-(N-S) DIRECTION**

\* Load at +3.200m level  
\* wind load on big pipe:  
\*  $H_{wp} = DP+w.tan(10) = 1.2 + (1.2*tan(10)) = 1.4\text{m}$  contributory height for load,  
\* with  $cf=0.8$  of pipe, 0.8 KN/m<sup>2</sup> as wind pressure as per calculation,  $L=20\text{m}$   
\* length of the pipe, load1 (L01.01) =  $0.8*1.4*0.8*20 = 17.92\text{ kN}$ ,

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* for 15m length, load2 (L01.02) =  $0.8 \times 1.4 \times 0.8 \times 15 = 13.5$  kN

MEMBER LOAD

265 CON GZ 17.92 0.199994

251 CON GZ 13.5 0.0999939

\* Load at +5.700m level

\* Hwp =  $DP + w \cdot \tan(10) = 0.4 + (4 \cdot \tan(10)) = 1.1$ m contributory hight for load,

\* with cf=0.8 of pipe, 0.8 KN/m2 as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \times 1.1 \times 0.8 \times (2/3 \times 6) = 2.82$  KN...

\* applied at the centre of the beam

MEMBER LOAD

56 65 68 105 CON GZ 2.82

\*

\* load at intermediate beam =  $0.8 \times 1.1 \times 0.8 \times 1/3 \times 6 = 1.41$  KN...

\* applied at the centre of the beam

MEMBER LOAD

101 106 148 159 160 CON GZ 1.41

\*

\* Load at +8.000m level

\* Hwp =  $DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8$ m contributory hight for load,

\* with cf=0.8 of pipe, 0.8 KN/m2 as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \times 0.8 \times 0.8 \times 3 = 1.55$  KN...

\* applied at the centre of the beam

MEMBER LOAD

57 66 69 102 TO 104 161 TO 163 CON GZ 1.55

\*

\* Load at 12.100m level

\* Hwp =  $DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8$ m contributory hight for load,

\* with cf=0.8 of pipe, 0.9 KN/m2 as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \times 0.9 \times 0.8 \times 3 = 1.75$  KN...

\* applied at the centre of the beam

MEMBER LOAD

135 CON GZ 1.75

\*\*\*

\*\*\*

LOAD 623 WIND LOAD ON EQUIPMENT +VE Z-(N-S) DIRECTION

\*\*\*

\*\*\*

LOAD 624 WIND LOAD ON CABLE TRAY +VE Z-(N-S) DIRECTION

\*the second level is cladde with cable tray,

\* with cf=1.7, height = 2.3m, wind pressure = 0.8 kN/m2, cable tray span=6m,

\* cf isnot considered as whole area is considered.

\* load =  $2.3 \times 0.8 \times 6 = 11.04$  kN applied at the supporting location of the cable

\* trays.

MEMBER LOAD

3 9 15 21 27 91 CON GZ 11.04

\*\*\*

LOAD 62 TOTAL WIND LOAD IN +VE Z-(N-S) DIRECTION (LC 621)

\*\*\*

REPEAT LOAD

621 1.0 622 1.0 623 1.0 624 1.0

\*\*\*

LOAD 631 WIND LOAD ON STRUCTURE DUE TO SELF OBSTRUCTION IN -VE X-(W-E) DIR

\*\*\*\* as per calculation, the wind load on frame is with cf=1.7 on both the frames

WIND LOAD -X -1.7 TYPE 1 XR 30 32 YR 0 8 ZR 0 4 OPEN

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

WIND LOAD -X -1.7 TYPE 1 XR 24 26 YR 0 10 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR 18 20 YR 0 10 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR 12 14 YR 0 8 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR 6 8 YR 0 8 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR -1 1 YR 0 13 ZR 0 4 OPEN

\*\*\*-----  
\*\*\*-----

**LOAD 632 WIND LOAD ON PIPING IN -VE X-(W-E) DIRECTION**

\*  
\*\*\*\* as per section 10.3, &YARA A-PC 10000-Y50-00026, the horizontal load  
\* Htot shall be provided as HS (or HWL or HE)+ HA (longitudinal direction)  
\* A) Hs stability force = 1.5 % of the weight of the structure and the operating -  
\* - loads of the pipes.  
\* weight of the structure = 405kN, operating piping weight = 1437 kN.  
\* LC101-self weight of structure, LC40-operating load  
\*\*\*\*\* hence Hs = 1.5/100\*(405+1437) = 27.63KN,  
\*-----  
\* HWL = longitudinal wind force = 0.3\*(DP+HB)\*pw\*L  
\* DP=1.2, HB=0.2m, Pw=0.8KN/m2, L=31m (total length of the piperack considered),  
\*\*\*\*\* hence HWL = 0.3\*(1.2+0.2)\*0.8\*31 = 10.416 kN.....@2.7m level  
\*\*\*\*\* (so per joint, 10.416/2 = 5.25 kN)  
\*\*\*\*\* HWL = 0.3\*(0.3+0.2)\*0.8\*31 = 3.72 kN.....@5.7m level  
\*\*\*\*\* (so per joint, 3.72/2 = 1.86 kN)  
\*\*\*\*\* HWL = 0.3\*(0.05+0.2)\*0.8\*31 = 1.86 kN.....& 7.0m level  
\*\*\*\*\* (so per joint, 1.86/2 = 0.93 kN)  
\*\*\* total = 10.416+3.72+1.86 = 15.996 KN,  
\* \*-----

\*\*\*\* the governing is 27.63 KN, this load is applied at top level.

\* load = 28/2 = 14 KN, applied at two nodes.

**JOINT LOAD**

35 40 FX -14

\*\*\*-----  
\*\*\*-----

**LOAD 633 WIND LOAD ON EQUIPMENT -VE X-(W-E) DIRECTION**

\*\*\*-----  
\*\*\*-----

**LOAD 634 WIND LOAD ON CABLE TRAY -VE X-(W-E) DIRECTION**

\*the cable tray gallery height = 2.65m, width of the cables=0.8m,  
\* the wind pressure = 0.8 KN/m2, cf=1.7  
\* hence load on cables trays considering fully cladded = 2.65\*0.8\*0.8\*1.7=2.9KN,  
\* this load is applied to the column where the cable trays are attached.  
\* torsional force due to this wind on cables not considered as, the beams would  
\* be restrained by the cables.

**MEMBER LOAD**

3 9 15 21 27 91 CON GX -2.9

\*\*\*-----  
\*\*\*-----

**LOAD 63 TOTAL WIND LOAD IN -VE X-(W-E) DIRECTION (LC 631)**

\*\*\*-----  
\*\*\*-----

**REPEAT LOAD**

631 1.0 632 1.0 633 1.0 634 1.0

\*\*\*-----  
\*\*\*-----

**LOAD 641 WIND LOAD ON STRUCTURE DUE TO SELF OBSTRUCTION IN -VE Z-(S-N) DIR**

\* (as per calculation, the wind load on frame is with cf=1.8 on both the frames)  
\* as per &YARA A-PC 100000-Y50-00026, 10.2 - factor for longitudinal frame -



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* - would be 1.7.

WIND LOAD -Z -1.7 TYPE 1 XR 0 31 YR 0 13 ZR -1 1 OPEN

WIND LOAD -Z -1.7 TYPE 1 XR 0 32 YR 0 13 ZR 3.5 4.5 OPEN

\*\*\*-----

\*\*\*-----

LOAD 642 WIND LOAD ON PIPING IN -VE Z-(S-N) DIRECTION

\* Load at +3.200m level

\* wind load on big pipe:

\*  $Hwp = DP + w \cdot \tan(10) = 1.2 + (1.2 \cdot \tan(10)) = 1.4m$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $0.8 \text{ KN/m}^2$  as wind pressure as per calculation,  $L=20m$

\* length of the pipe, load1 (L01.01) =  $0.8 \cdot 1.4 \cdot 0.8 \cdot 20 = 17.920 \text{ kN}$ ,

\* for 15m length, load2 (L01.02) =  $0.8 \cdot 1.4 \cdot 0.8 \cdot 15 = 13.5 \text{ kN}$

MEMBER LOAD

265 CON GZ -17.92 0.199994

251 CON GZ -13.5 0.0999939

\* Load at +5.700m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.4 + (4 \cdot \tan(10)) = 1.1m$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $0.8 \text{ KN/m}^2$  as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 1.1 \cdot 0.8 \cdot (2/3 \cdot 6) = 2.82 \text{ KN}...$

\* applied at the centre of the beam

MEMBER LOAD

56 65 68 105 CON GZ -2.82

\*

\* load at intermediate beam =  $0.8 \cdot 1.1 \cdot 0.8 \cdot 1/3 \cdot 6 = 1.41 \text{ KN}...$

\* applied at the centre of the beam

MEMBER LOAD

101 106 148 159 160 CON GZ -1.41

\*

\* Load at +8.000m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8m$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $0.8 \text{ KN/m}^2$  as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 0.8 \cdot 0.8 \cdot 3 = 1.55 \text{ KN}...$

\* applied at the centre of the beam

MEMBER LOAD

57 66 69 102 TO 104 161 TO 163 CON GZ -1.55

\*

\* Load at 12.100m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8m$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $0.9 \text{ KN/m}^2$  as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 0.9 \cdot 0.8 \cdot 3 = 1.75 \text{ KN}...$

\* applied at the centre of the beam

MEMBER LOAD

135 CON GZ -1.75

\*

\*\*\*-----

\*\*\*-----

LOAD 643 WIND LOAD ON EQUIPMENT -VE Z-(S-N) DIRECTION

\*\*\*-----

\*\*\*-----

LOAD 644 WIND LOAD ON CABLE TRAY -VE Z-(S-N) DIRECTION

\*the second level is claddd with cable tray,

\* with  $cf=1.7$ , height = 2.3m, wind pressure =  $0.8 \text{ kN/m}^2$ , cable tray span=6m,

\*  $cf$  isnot used as whole area is considered for the area calculation.

\* load =  $1.7 \cdot 2.3 \cdot 0.8 \cdot 6 = 11.040 \text{ kN}$  applied at the supporting location of the cable

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* trays.

**MEMBER LOAD**

3 9 15 21 27 91 CON GZ -11.04

\*\*\*-----

**LOAD 64 TOTAL WIND LOAD IN -VE Z-(S-N) DIRECTION (LC 641)**

\*\*\*-----

**REPEAT LOAD**

641 1.0 642 1.0 643 1.0 644 1.0

\*\*\*-----

**LOAD 81 PIPING THERMAL LOAD IN E-W DIRECTION (FDN/GLOBAL DESIGN) (TLE)**

\*\*\*\*\* Load applied are as per "Load table SR 0501"\*\*\*\*\*

**MEMBER LOAD**

\* Load at +3.200 level, L01.01 = 25 KN (48"- CAJR01)

265 CON GX 25 0.199994

\* Load at +3.200 level, L01.02 = 20 KN (48"- CAJR01)

251 CON GX 20 0.0999939

\* Load at +3.200 level, L01.01 = 25 KN (48"- CAJR01)

246 CON GX 15 0.299999

\* Load at +6.700 level, L02.01 = 3 KN

206 CON GX 3

\* Load at +6.700 level, L02.02 = 3 KN

205 CON GX 3

\* Load at +9.200 level, L03.01 = 3 KN

210 CON GX 3 1.8

\* Load at +12.100 level, L04.01 = 3 KN

135 CON GX 8

\* Load at +5.700m level, hE=0.5 KN/m<sup>2</sup>

\* load at main grid transverse beam =  $2/3 * 6 * (0.5) = 2$  KN/m, (for 6m span),

\* load at intermediate beam =  $1/3 * 6 * (0.5 \text{ kN/m}^2) = 1$  KN/m, (for 6m span),

56 65 68 105 UNI GX 2

62 UNI GX 2 2 4

62 UNI GX 2 0 2

59 UNI GX 2 2 4

59 UNI GX 2 0 2

101 106 148 159 160 UNI GX 1

\*

\* Loads at +8.000m level = hE = 0.4 KN/m<sup>2</sup>

\* load for 3m span =  $0.4 * 3 = 1.2$  kN/m, applied at all beams considering,

\* that these small bore lines would be supported by all beams.

57 66 69 102 TO 104 161 TO 163 UNI GX 1.2

63 UNI GX 1.2 2 4

63 UNI GX 1.2 0 2

60 UNI GX 1.2 2 4

60 UNI GX 1.2 0 2

\*

\* Loads at +8.900m level = hE = 0.2 KN/m<sup>2</sup>

\* load for 1m span at internal beams =  $0.2 * 1 = 0.2$  kN/m

\* loads at external beams =  $0.2 / 2 = 0.1$  KN/m

**MEMBER LOAD**

196 197 UNI GX 0.2

129 199 UNI GX 0.1

198 UNI GX 0.1 2 4

198 UNI GX 0.1 0 2

\*\*\*-----

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*-----

**LOAD 82 PIPING THERMAL LOAD IN N-S DIRECTION (FDN/GLOBAL DESIGN) (TLN)**

\*

- \* Load applied are as per "Load table SR 0501"
- \* 12" pipe considered at +5.700 level, hence load = 3 KN/m<sup>2</sup>
- \* load at main grid transverse beam =  $2/3 * 6 * (3) = 12$  KN/m, (for 6m span),
- \* with 0.3 factor, load =  $0.3 * 12 = 3.6$  kN/m
- \* load at intermediate beam =  $1/3 * 6 * (3 \text{ kN/m}^2) = 6$  KN/m, (for 6m span),
- \* with 0.3 factor, load =  $0.3 * 6 = 1.8$  kN
- \* (0.3 factor is friction coefficient between steel to steel)

**MEMBER LOAD**

\*\*\*\*\*59 62 65 105 164 166 UNI GZ 3.6

\*\*\*\*\*106 148 159 UNI GZ 1.8

\* Load at +3.200 level, L01.03 = 15 KN (48"- CAJR01)

246 CON GZ 15 0.299999

\* Load at +6.700 level, L02.01 = 3 KN

206 CON GZ 3

\* Load at +6.700 level, L02.02 = 3 KN

205 CON GZ 3

\* Load at +9.200 level, L03.01 = 3 KN

210 CON GZ 3 1.8

\*

\* Loads at +8.900m level = hE = 0.2 KN/m<sup>2</sup>

\* load for 1m span at internal beams =  $0.2 * 1 = 0.2$  kN/m

\* load at external beam =  $0.2 / 2 = 0.1$  KN/m

**MEMBER LOAD**

196 197 UNI GZ 0.2

129 199 UNI GZ 0.1

198 UNI GZ 0.1 2 4

198 UNI GZ 0.1 0 2

\*\*\*-----

\*\*\*-----

**LOAD 83 PIPE/EQUIPMENT FRICTION LOAD IN E-W DIRECTION (FLE)**

\*

- \* the big pipe load assumed = 5 KN/m, for 25m span, load =  $5 * 25 = 125$  KN, for
- \* 16m span, load =  $5 * 16 = 80$  kN,
- \* factor 0.3 is considered, load =  $0.3 * 125 = 37.5$  kN, &  $0.3 * 80 = 24$  kN,
- \*(0.3 factor is friction coefficient between steel to steel)

\*

\* 12" pipe considered at +5.700 level, hence load = 3 KN/m<sup>2</sup>

\* load at main grid transverse beam =  $2/3 * 6 * (3) = 12$  KN/m, (for 6m span)

\* with  $0.3 * 0.5 = 0.15$  factor, load =  $0.15 * 12 = 1.8$  KN/m

\* load at intermediate beam =  $1/3 * 6 * (3 \text{ kN/m}^2) = 6$  KN/m, (for 6m span)

\* with  $0.3 * 0.5 = 0.15$  factor, load =  $0.15 * 6 = 0.9$  kN/m

\* (0.3 factor is friction coefficient between steel to steel & 0.5 as per 4.2.2

\* of &YARA A PC 10000 Y50 00026)

\* load for smaller dia. at +8.0m level is considered as 1.5 KN/m<sup>2</sup>

\* load for 3m span =  $1.5 * 3 = 4.5$  kN/m<sup>2</sup>, applied at all beams considering,

\* that the these small bore lines would be supported by all beams.

\* with load =  $0.3 * 0.5 = 0.15$ , load =  $4.5 * 0.15 = 0.675$

\* (0.3 factor is friction coefficient between steel to steel & 0.5 as per 4.2.2

\* of &YARA A PC 10000 Y50 00026)

\*\*\*-----

**LOAD 84 PIPE/EQUIPMENT FRICTION LOAD IN N-S DIRECTION (FLN)**

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*

\* the big pipe load assumed = 5 KN/m, for 6m span, load = 5\*6 = 30kN.,

\* factor = 0.3 considered, load = 0.3\*30 = 9KN

\*

\* load for smaller dia. at +8.0m level is considered as 1.5 KN/m<sup>2</sup>

\* load for 3m span = 1.5\*3 = 4.5 kN/m<sup>2</sup>, applied at all beams considering,

\* that the these small bore lines would be supported by all beams.

\* with factor 0.3\*0.5 = 0.15, load = 0.15\*4.5 = 0.675 kN/m

\* (0.3 factor is friction coefficient between steel to steel & 0.5 as per 4.2.2

\* of &YARA A PC 10000 Y50 00026)

\*

\*\*\*-----

LOAD 85 STEEL THERMAL LOAD ON STRUCTURE IN WARM CONDITION (ENT+)

\* as per 16471-C50-00001-published 2.4.2.2, maximum temperature=40degreeC,

\* consider the erection temperature = 10degree, net = 40-10 = 30

TEMPERATURE LOAD

1 TO 58 61 64 TO 141 148 TO 163 176 TO 197 199 202 TO 219 221 TO 224 229 230 -

235 TO 275 TEMP 30

\*\*\*-----

\*\*\*-----

LOAD 86 STEEL THERMAL LOAD ON STRUCTURE IN COLD CONDITION (ENT-)

\* as per 16471-C50-00001-published 2.4.2.2, minimum temperature=-20degreeC,

\* consider the erection temperature = 10degree, net = 10-(-20) = 30(-)

TEMPERATURE LOAD

1 TO 58 61 64 TO 141 148 TO 163 176 TO 197 199 202 TO 219 221 TO 224 229 230 -

235 TO 275 TEMP -30

\*\*\*-----

\*\*\*-----

LOAD 87 LOCAL WIND LOAD ON PIPE/EQUIPMENT IN X -(E-W) DIRECTION (LOCAL DESIGN

\*\*\*-----

LOAD 88 LOCAL WIND LOAD ON PIPE/EQUIPMENT IN Z -(N-S) DIRECTION (LOCAL DESIGN)

\*\*\*-----

LOAD 89 LOCAL PIPE HORIZONTAL LOAD IN E-W DIRECTION (LOCAL DESIGN) (TLELOCAL)

\*\*\*-----

LOAD 90 LOCAL PIPE HORIZONTAL LOAD IN N-S DIRECTION (LOCAL DESIGN) (TLNLOCAL)

\*\*\*-----

LOAD 911 VERTICAL LOAD DUE TO CRANE, MONORAIL AND BUNDLE PULL LOADS

\*\*\*-----

LOAD 912 HORIZONTAL LOAD DUE TO CRANE, MONORAIL AND BUNDLE PULL LOADS

\*\*\*-----

LOAD 91 MAINTENANCE LOAD (SUM OF LC 911 & LC 912) (ML)

\*\*\*-----

REPEAT LOAD

911 1.0 912 1.0

\*\*\*-----

LOAD 92 HORIZONTAL LOADS OF PSV (LOCAL DESIGN) (PSV)

\*\*\*-----

LOAD 93 MINIMUM VERTICAL LOAD FOR BEAM DESIGN (VMIN)

\*

\* consider 10KN load at the centre of all longitudinal beams for the member

\* design.

\* also load at top of the main grid column of 10 KN (as contingency load)

\* applied for member design.

\* at +3.20m level, load for member design

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**MEMBER LOAD**

33 37 55 CON GY -10

\*\*\*\*\*38 CON GY -10 4.49975

\*\*\*\*\*34 CON GY -10 4.49975

**JOINT LOAD**

59 60 102 129 FY -10

\*

\* at +5.70m level, load for member design

**JOINT LOAD**

61 62 75 TO 78 FY -10

\*

\* at +8.0m level, load for member design

42 48 79 TO 84 FY -10

32 TO 35 37 TO 40 67 68 FY -10

**MEMBER LOAD**

56 TO 60 62 TO 66 68 69 103 105 130 135 189 190 196 TO 198 229 257 CON GY -10

\*\*\*-----

**LOAD 94 SNOW LOAD (SL)**

\* snow load as per 16471-C50-00001\_published,

\* characteristic value of snow load,  $S_k = 0.7 \text{ KN/m}^2$ , Exposure coefficient= $C_e=1$ ,

\* Thermal coefficient =  $c_t = 1$ ,

\* as per EN-1991-1-3/NA, (m) snow load shape coefficient for 0 degree roof = 0.8,

\* the same value would be used for cable tray, grating floor & the big pipe.

\* load =  $m \cdot c_e \cdot c_t \cdot s_k = 0.8 * 1 * 1 * 0.7 = 0.56 \text{ KN/m}^2$

\*\*

\* load on grating = with 1.0m width, load =  $1 * 0.56 = 0.56$  say 0.6 KN/m applied -

\* - at grating supporting beams at internal beams

\* this is applied to all grating supporting beams at level +8.900

\* loads at external beams =  $0.6/2 = 0.3 \text{ KN/m}$

**MEMBER LOAD**

196 197 UNI GY -0.6

129 199 242 243 UNI GY -0.3

198 UNI GY -0.3 2 4

198 UNI GY -0.3 0 2

\* two beams, load =  $0.6 * 1.2/2 = 0.36 \text{ KN/m}$ , this is applied at level +5.700

**MEMBER LOAD**

189 190 UNI GY -0.36

\*\*

\* load on cable tray = for the top layer = 0.6 KN/m, load for 6.0m span = 3.6KN,

\* load at all other cable trays would be considered 50% =  $0.5 * 3.6 = 1.8 \text{ kN}$ ,

\* total load =  $3.6 + (6 * 1.8) = 14.4 \text{ KN}$ , moment =  $14.4 * 0.4 = 5.76 \text{ KN.m}$

**MEMBER LOAD**

3 9 15 21 27 91 CON GY -14.4

3 9 15 21 27 91 CMOM GX 5.76

\*\*

\* snow load on piping

\* At +5.700 level, snow load = 0.6 KN/m<sup>2</sup>, 50% reduction considered as +8.0piping - ,

\* is covered with 100% snow load, hence lower piping levels where considered

\* with 50% reduction of the load.

\* load =  $0.5 * 0.6 = 0.3 \text{ KN/m}^2$

\* load at main grid transverse beam =  $2/3 * 6 * (0.3 \text{ KN/m}^2) = 1.2 \text{ KN/m}$ , (for 6m span)

\* load at intermediate beam =  $1/3 * 6 * (0.3 \text{ kN/m}^2) = 0.6 \text{ KN/m}$ , (for 6m span)

\*

\* load at +8.0m level, snow load = 0.6 KN/m<sup>2</sup>,

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* load for 3m span =  $0.6 \times 3 = 1.8$  KN/m, applied at all beams considering,

**MEMBER LOAD**

56 65 68 105 UNI GY -1.2

62 UNI GY -1.2 2 4

62 UNI GY -1.2 0 2

59 UNI GY -1.2 2 4

59 UNI GY -1.2 0 2

101 106 148 159 160 UNI GY -0.6

\*

57 66 69 102 TO 104 161 TO 163 UNI GY -1.8

63 UNI GY -1.8 2 4

63 UNI GY -1.8 0 2

60 UNI GY -1.8 2 4

60 UNI GY -1.8 0 2

\*

\* snow at +2.7m level,

\* snow load =  $0.6$  KN/m<sup>2</sup>, diameter of pipe =  $1.22$ m,

\* load =  $0.6 \times 1.22 = 0.732$  kN/m

\* for 25m span, load =  $0.732 \times 25 = 18.3$  KN, for

\* 16m span, load =  $0.732 \times 16 = 11.7$  kN, and for 6m span, load =  $0.732 \times 6 = 4.4$ kN.

**MEMBER LOAD**

265 CON GY -18.3 0.199994

64 CON GY -11.7 3.2

246 CON GY -4.4 0.299999

\*

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*LOAD 96 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

\*\*\*\*\* Blast load on structure

\*\*\*\*\* The size (thickness) is considered as  $0.25$ m, with blast load of  $6.07$  KN/m<sup>2</sup>

\*\*\*\*\* load on frame =  $cf \times 0.25 \times 6.07 = 2.58$

\*\*\*\*\*MEMBER LOAD

\*\*\*\*\*1 TO 30 55 TO 69 90 91 96 97 103 105 129 131 133 135 TO 141 164 TO 167 180 -

\*\*\*\*\*182 185 199 202 TO 204 207 208 221 222 229 235 237 251 257 274 UNI GX 2.58

\*\*\*\*\*

\*\*\*\*\* The size (thickness) is considered as  $0.25$ m, with blast load of  $3$  KN/m<sup>2</sup>,

\*\*\*\*\* this is at side frames.

\*\*\*\*\* load on frame =  $cf \times 0.25 \times 3 = 1.275$

\*\*\*\*\*

\*\*\*\*\*4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -

\*\*\*\*\*70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -

\*\*\*\*\*136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -

\*\*\*\*\*224 246 253 264 UNI GZ 1.275

\*\*\*\*\*1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -

\*\*\*\*\*76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -

\*\*\*\*\*140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -1.275

\* on front face and the  $3$  KN/m<sup>2</sup> at the side faces.

\*

\*\*\*\* as per section 10.3, &YARA A-PC 10000-Y50-00026, the horizontal load

\*\* Blast load on pipes in longitudinal direction would be calculated as...

\*\* \*-----

\*\* HWL = longitudinal wind force =  $0.3 \times (DP+HB) \times pw \times L$

\*\* DP= $1.2$ , HB= $0.2$ m, Pw= $6.07$ KN/m<sup>2</sup>, L= $31$ m (total length of the piperack considered),

\*\*\*\*\* hence HWL =  $0.3 \times (1.2+0.2) \times 6.07 \times 31 = 79.031$  kN.....@ $2.7$ m level

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\* (so per joint,  $79.031/2 = 39.516$  kN)  
 \*\*\*\*\* HWL =  $0.3*(0.3+0.2)*6.07*31 = 28$  kN.....@5.7m level  
 \*\*\*\*\* (so per joint,  $28.226/2 = 14.113$  kN)  
 \*\*\*\*\* HWL =  $0.3*(0.05+0.2)*6.07*31 = 14.113$  kN.....& 7.0m level  
 \*\*\*\*\* (so per joint,  $14.113/2 = 7.056$  kN)

\*\*\*\*\*  
 \*\* \*-----

**\*JOINT LOAD**

\*11 16 FX 39.516  
 \*21 26 FX 14.113  
 \*31 36 FX 7.056  
 \*\*

\*\*the cable tray gallery height = 2.65m, width of the cables=0.8m,  
 \*\* the Blast pressure = 6.07 KN/m<sup>2</sup>, cf=1.7  
 \*\* hence load on cables trays considering fully cladded =  $2.65*0.8*6.07*1.7=21.876$ KN  
 \*\* this load is applied to the column where the cable trays are attached.  
 \*\* torsional force due to this wind on cables not considered as, the beams would  
 \*\* be restrained by the cables.

**\*MEMBER LOAD**

\*3 9 15 21 27 91 CON GX 21.876

\*\*\*\*\*  
 \*\*\*\*\*

\*\*

**LOAD 961 LOADTYPE None TITLE BLAST LOAD +X DIRECTION**

\* Blast load on structure  
 \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
 \* load on frame =  $cf*0.25*6.07 = 2.58$ , cf is ignored as load was provided to  
 \* lateral direction also.  
 \* final load =  $0.25*6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

1 TO 6 55 TO 57 129 131 133 135 TO 137 180 182 185 199 221 222 235 -  
 237 UNI GX 1.52

\*

\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,  
 \* this is at side frames.  
 \* load on frame =  $cf*0.25*3 = 1.275$ , cf is ignored  
 \* final load =  $0.25*3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
 70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
 136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
 224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
 76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
 140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
 \*\*\*\*\*

**LOAD 962 LOADTYPE None TITLE BLAST LOAD +X DIRECTION**

\* Blast load on structure  
 \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
 \* load on frame =  $cf*0.25*6.07 = 2.58$ , cf is ignored as load was provided to  
 \* lateral direction also.  
 \* final load =  $0.25*6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

90 91 96 97 103 105 229 UNI GX 1.52

- \*
- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m
- \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
\*\*\*\*\*

LOAD 963 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to
- \* lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

7 TO 12 58 138 139 202 UNI GX 1.52

60 UNI GX 1.52 2 4  
60 UNI GX 1.52 0 2  
59 UNI GX 1.52 2 4  
59 UNI GX 1.52 0 2

- \*
- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m
- \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*this load is applied\*\*\*\*\*

\*\* as per section 10.3, & YARA A-PC 10000-Y50-00026, the horizontal load

\* Blast load on pipes in longitudinal direction would be calculated as...

\* \*-----

- \* HWL = longitudinal wind force =  $0.3 \cdot (DP + HB) \cdot pw \cdot L$
- \* DP=1.2, HB=0.2m, Pw=6.07KN/m<sup>2</sup>, L=31m (total length of the piperack considered),
- \* hence HWL =  $0.3 \cdot (1.2 + 0.2) \cdot 6.07 \cdot 31 = 79.031$  kN.....@2.7m level
- \* (so per joint,  $79.031/2 = 39.516$  kN)
- \* HWL =  $0.3 \cdot (0.3 + 0.2) \cdot 6.07 \cdot 31 = 28$  kN.....@5.7m level
- \* (so per joint,  $28.226/2 = 14.113$  kN)
- \* HWL =  $0.3 \cdot (0.05 + 0.2) \cdot 6.07 \cdot 31 = 14.113$  kN.....& 7.0m level
- \* (so per joint,  $14.113/2 = 7.056$  kN)

JOINT LOAD



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

11 16 FX 39.516  
21 26 FX 14.113  
31 36 FX 7.056

- \*
- \*the cable tray gallery height = 2.00m, width of the cables=0.8m,
- \* the Blast pressure = 6.07 KN/m<sup>2</sup>, cf=1.7, 1 if whole area is considered
- \* hence load on cables trays considering fully cladded = 2\*0.8\*6.07\*1=9.712KN
- \* this load is applied to the column where the cable trays are attached.
- \* torsional force due to this wind on cables not considered as, the beams would
- \* be restrained by the cables.

MEMBER LOAD

3 9 15 21 27 91 CON GX 9.712

\*\*\*\*\*  
\*\*\*

LOAD 964 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame = cf\*0.25\*6.07 = 2.58, cf is ignored as load was provided to
- \* lateral direction also.
- \* final load = 0.25\*6.07 = 1.518 say 1.52 KN/m

MEMBER LOAD

13 TO 18 61 140 141 203 207 251 257 UNI GX 1.52  
63 UNI GX 1.52 2 4  
63 UNI GX 1.52 0 2  
62 UNI GX 1.52 2 4  
62 UNI GX 1.52 0 2

- \*
- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame = cf\*0.25\*3 = 1.275, cf is ignored
- \* final load = 0.25\*3 = 0.75 KN/m
- \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75  
1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
\*\*\*\*\*

LOAD 965 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame = cf\*0.25\*6.07 = 2.58, cf is ignored as load was provided to
- \* lateral direction also.
- \* final load = 0.25\*6.07 = 1.518 say 1.52 KN/m

MEMBER LOAD

19 TO 24 64 TO 66 204 208 UNI GX 1.52

- \*
- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame = cf\*0.25\*3 = 1.275, cf is ignored
- \* final load = 0.25\*3 = 0.75 KN/m

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
\*\*\*\*\*

LOAD 966 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to
- \* lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

25 TO 30 67 TO 69 274 UNI GX 1.52

\*

- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
\*\*\*

\*\*\*\*\*

\*\*\*\*\*LOAD 97 LOADTYPE None TITLE BLAST LOAD - X DIRECTION

- \*\*\*\*\* Blast load on structure
- \*\*\*\*\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \*\*\*\*\* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$

\*\*\*\*\*MEMBER LOAD

\*\*\*\*\*1 TO 30 55 TO 69 90 91 96 97 103 105 129 131 133 135 TO 141 164 TO 167 180 -  
\*\*\*\*\*182 185 199 202 TO 204 207 208 221 222 229 235 237 251 257 -  
\*\*\*\*\*274 UNI GX -2.58

\*\*\*\*\*

- \*\*\*\*\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \*\*\*\*\* this is at side frames.
- \*\*\*\*\* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$

\*\*\*\*\*

\*\*\*\*\*4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
\*\*\*\*\*70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
\*\*\*\*\*136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
\*\*\*\*\*224 246 253 264 UNI GZ 1.275

\*\*\*\*\*1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
\*\*\*\*\*76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
\*\*\*\*\*140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -1.275

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\* on front face and the 3 KN/m2 at the side faces.

\*\*\*\*\*

\*\*\*\*\* as per section 10.3, & YARA A-PC 10000-Y50-00026, the horizontal load

\*\*\*\*\* Blast load on pipes in longitudinal direction would be calculated as...

\*\*\*\*\* \*

\*\*\*\*\* HWL = longitudinal wind force =  $0.3 \cdot (DP+HB) \cdot P_w \cdot L$

\*\*\*\*\* DP=1.2, HB=0.2m, Pw=6.07KN/m2, L=31m (total length of the piperack considered),

\*\*\*\*\* hence HWL =  $0.3 \cdot (1.2+0.2) \cdot 6.07 \cdot 31 = 79.031$  kN.....@2.7m level

\*\*\*\*\* (so per joint,  $79.031/2 = 39.516$  kN)

\*\*\*\*\* HWL =  $0.3 \cdot (0.3+0.2) \cdot 6.07 \cdot 31 = 28$  kN.....@5.7m level

\*\*\*\*\* (so per joint,  $28.226/2 = 14.113$  kN)

\*\*\*\*\* HWL =  $0.3 \cdot (0.05+0.2) \cdot 6.07 \cdot 31 = 14.113$  kN.....& 7.0m level

\*\*\*\*\* (so per joint,  $14.113/2 = 7.056$  kN)

\*\*\*\*\*

\*\*\*\*\* \*

\*\*\*\*\*JOINT LOAD

\*\*\*\*\*15 20 FX -39.516

\*\*\*\*\*15 20 25 30 FX -14.113

\*\*\*\*\*35 40 FX -7.056

\*\*\*\*\*

\*\*\*\*\*the cable tray gallery height = 2.65m, width of the cables=0.8m,

\*\*\*\*\* the Blast pressure = 6.07 KN/m2, cf=1.7

\*\*\*\*\* hence load on cables trays considering fully cladded =  $2.65 \cdot 0.8 \cdot 6.07 \cdot 1.7 = 21.876$ KN

\*\*\*\*\* this load is applied to the column where the cable trays are attached.

\*\*\*\*\* torsional force due to this wind on cables not considered as, the beams would

\*\*\*\*\* be restrained by the cables.

\*\*\*\*\*MEMBER LOAD

\*\*\*\*\*3 9 15 21 27 91 CON GX -21.876

\*\*\*\*\*

\*\*

LOAD 971 LOADTYPE None TITLE BLAST LOAD -X DIRECTION

\* Blast load on structure

\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m2

\* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to

\* lateral direction also.

\* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

1 TO 6 55 TO 57 129 131 133 135 TO 137 180 182 185 199 221 222 235 -

237 UNI GX -1.52

\*

\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m2,

\* this is at side frames.

\* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored

\* final load =  $0.25 \cdot 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -

70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -

136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -

224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -

76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -

140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*

\*\*\*\*\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

LOAD 972 LOADTYPE None TITLE BLAST LOAD -X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

90 91 96 97 103 105 229 UNI GX -1.52

- \*
- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m
- \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
\*\*\*\*\*

LOAD 973 LOADTYPE None TITLE BLAST LOAD -X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

7 TO 12 58 138 139 202 UNI GX -1.52

60 UNI GX -1.52 2 4  
60 UNI GX -1.52 0 2  
59 UNI GX -1.52 2 4  
59 UNI GX -1.52 0 2

- \*
- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m
- \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*this load is applied\*\*\*\*\*

- \*\* as per section 10.3, & YARA A-PC 10000-Y50-00026, the horizontal load
- \* Blast load on pipes in longitudinal direction would be calculated as...

\* \*-----\*

- \* HWL = longitudinal wind force =  $0.3 \cdot (DP + HB) \cdot pw \cdot L$
- \* DP=1.2, HB=0.2m, Pw=6.07KN/m<sup>2</sup>, L=31m (total length of the piperack considered),

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* hence HWL =  $0.3 \times (1.2 + 0.2) \times 6.07 \times 31 = 79.031$  kN.....@2.7m level  
\* (so per joint,  $79.031/2 = 39.516$  kN)  
\* HWL =  $0.3 \times (0.3 + 0.2) \times 6.07 \times 31 = 28$  kN.....@5.7m level  
\* (so per joint,  $28.226/2 = 14.113$  kN)  
\* HWL =  $0.3 \times (0.05 + 0.2) \times 6.07 \times 31 = 14.113$  kN.....& 7.0m level  
\* (so per joint,  $14.113/2 = 7.056$  kN)

**JOINT LOAD**

11 16 FX -39.516  
21 26 FX -14.113  
31 36 FX -7.056

\*  
\*the cable tray gallery height = 2.00m, width of the cables=0.8m,  
\* the Blast pressure = 6.07 KN/m<sup>2</sup>, cf=1.7, 1 if whole area is considered  
\* hence load on cables trays considering fully cladded =  $2 \times 0.8 \times 6.07 \times 1 = 9.712$ KN  
\* this load is applied to the column where the cable trays are attached.  
\* torsional force due to this wind on cables not considered as, the beams would  
\* be restrained by the cables.

**MEMBER LOAD**

3 9 15 21 27 91 CON GX -9.712

\*\*\*\*\*  
\*\*\*

**LOAD 974 LOADTYPE None TITLE BLAST LOAD -X DIRECTION**

\* Blast load on structure  
\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
\* load on frame =  $cf \times 0.25 \times 6.07 = 2.58$ , cf is ignored as load was provided to  
\* lateral direction also.  
\* final load =  $0.25 \times 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

13 TO 18 61 140 141 203 207 251 257 UNI GX -1.52  
63 UNI GX -1.52 2 4  
63 UNI GX -1.52 0 2  
62 UNI GX -1.52 2 4  
62 UNI GX -1.52 0 2

\*  
\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,  
\* this is at side frames.  
\* load on frame =  $cf \times 0.25 \times 3 = 1.275$ , cf is ignored  
\* final load =  $0.25 \times 3 = 0.75$  KN/m  
\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75  
1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
\*\*\*\*\*

**LOAD 975 LOADTYPE None TITLE BLAST LOAD -X DIRECTION**

\* Blast load on structure  
\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
\* load on frame =  $cf \times 0.25 \times 6.07 = 2.58$ , cf is ignored as load was provided to  
\* lateral direction also.  
\* final load =  $0.25 \times 6.07 = 1.518$  say 1.52 KN/m

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**MEMBER LOAD**

19 TO 24 64 TO 66 204 208 UNI GX -1.52

\*

- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
\*\*\*\*\*

**LOAD 976 LOADTYPE None TITLE BLAST LOAD -X DIRECTION**

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to
- \* lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

25 TO 30 67 TO 69 274 UNI GX -1.52

\*

- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*

**LOAD 98 LOADTYPE None TITLE BLAST LOAD +Z DIRECTION**

- \* the blast load is considered as the wind load application.
- \* as per the excel, the front face pressure = 6.07 KN/m<sup>2</sup>
- \* the side face pressure = 3 KN/m<sup>2</sup>
- \* the back face load isnot applied.
- \* for member size of 0.25m, the load =  $CF \cdot 6.07 \cdot 0.25$
- \*  $CF=1.7$ , LOAD = 2.58 KN/m, cf is ignored as load was provided to
- \* lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 1.52

\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* Load at +3.200m level

\* blast load on big pipe:

\*  $Hwp = DP + w \cdot \tan(10) = 1.2 + (1.2 \cdot \tan(10)) = 1.4m$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $6.07 \text{ KN/m}^2$  as wind pressure as per calculation,  $L=20m$

\* length of the pipe, load1 (L01.01) =  $0.8 \cdot 1.4 \cdot 6.07 \cdot 18 = 122 \text{ kN}$ , (length reduced)

\* for 13m length, load2 (L01.02) =  $0.8 \cdot 1.4 \cdot 6.07 \cdot 13 = 88 \text{ kN}$  (length reduced)

MEMBER LOAD

265 CON GZ 122 0.199994

251 CON GZ 88 0.0999939

\* Load at +5.700m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.4 + (4 \cdot \tan(10)) = 1.1m$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $6.07 \text{ KN/m}^2$  as blast pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 1.1 \cdot 6.07 \cdot (2/3 \cdot 6) = 21.366 \text{ KN}$ ...

\* applied at the centre of the beam

MEMBER LOAD

56 65 68 105 CON GZ 21.366

\*

\* load at intermediate beam =  $0.8 \cdot 1.1 \cdot 6.07 \cdot 1/3 \cdot 6 = 10.683 \text{ KN}$ ...

\* applied at the centre of the beam

MEMBER LOAD

101 106 148 159 160 CON GZ 10.683

\*

\* Load at +8.000m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8m$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $6.07 \text{ KN/m}^2$  as blast pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 0.8 \cdot 6.07 \cdot 3 = 11.654 \text{ KN}$ ...

\* applied at the centre of the beam

MEMBER LOAD

57 66 69 102 TO 104 161 TO 163 CON GZ 11.654

\*

\* Load at 12.100m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8m$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $6.07 \text{ KN/m}^2$  as blast pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 6.07 \cdot 0.8 \cdot 3 = 11.654 \text{ KN}$ ...

\* applied at the centre of the beam

MEMBER LOAD

135 CON GZ 11.654

\*

\* blast load on cable trays

\* the second level is clad with cable tray,

\* with  $cf=1.7$ , height = 2.3m, blast pressure =  $6.07 \text{ kN/m}^2$ , cable tray span = 6m,

\*  $cf$  is not required to be considered as full area is considered.

\* load =  $2.3 \cdot 6.07 \cdot 6 = 83.766 \text{ kN}$  applied at the supporting location of the cable

\* trays.

\*\*\*

\*\* the above method was too conservative. The cable trays are of 0.1m deep.

\*\* there are total 7 number of cable trays. With 6m C/C distances (span),

\*\* shape factor = 1.7 as individual cable trays are considered.

\*\* load =  $0.1 \cdot 6.07 \cdot 7 \cdot 1.7 \cdot 6 = 43.34 \text{ KN}$ .

MEMBER LOAD

\*\*\*\*\*3 9 15 21 27 91 CON GZ 83.766

3 9 15 21 27 91 CON GZ 43.34

\*

\* load on side frame, blast pressure =  $3 \text{ KN/m}^2$ .

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* avergae depth of beam/column = 0.25m  
\* cf = 1.7,  
\* load =  $1.7 \times 3 \times 0.25 = 1.275$  KN/m, cf is ignored  
\* final load =  $0.25 \times 3 = 0.75$  KN/m  
1 TO 6 55 TO 57 129 131 133 135 TO 137 180 182 199 221 222 235 237 UNI GX 0.75  
25 TO 30 67 TO 69 274 UNI GX -0.75  
\*\*\*\*\*  
LOAD 99 LOADTYPE None TITLE BLAST LOAD -Z DIRECTION  
\* the blast load is considered as the wind load application.  
\* as per the excel, the front face pressure = 6.07 KN/m2  
\* the side face pressure = 3 KN/m2  
\* the back face load isnot applied.  
\* for member size of 0.25m, the load =  $cf \times 6.07 \times 0.25$   
\* cf = 1.7, load = 2.58 KN/m, cf is ignored as load was provided to  
\* lateral direction also.  
\* final load =  $0.25 \times 6.07 = 1.518$  say 1.52 KN/m  
MEMBER LOAD  
1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -1.52  
\*  
\* Load at +3.200m level  
\* blast load on big pipe:  
\* Hwp =  $DP + w \cdot \tan(10) = 1.2 + (1.2 \cdot \tan(10)) = 1.4$ m contributory hight for load,  
\* with cf=0.8 of pipe, 6.07 KN/m2 as wind pressure as per calculation, L=20m  
\* length of the pipe, load1 (L01.01) =  $0.8 \times 1.4 \times 6.07 \times 18 = 122$  kN,  
\* for 15m length, load2 (L01.02) =  $0.8 \times 1.4 \times 6.07 \times 13 = 88$  kN  
MEMBER LOAD  
265 CON GZ -122 0.199994  
251 CON GZ -88.976 0.0999939  
\* Load at +5.700m level  
\* Hwp =  $DP + w \cdot \tan(10) = 0.4 + (4 \cdot \tan(10)) = 1.1$ m contributory hight for load,  
\* with cf=0.8 of pipe, 6.07 KN/m2 as blast pressure as per calculation,  
\* load at the main grid beam =  $0.8 \times 1.1 \times 6.07 \times (2/3 \times 6) = 21.366$  KN...  
\* applied at the centre of the beam  
MEMBER LOAD  
56 65 68 105 CON GZ -21.366  
\*  
\* load at intermediate beam =  $0.8 \times 1.1 \times 6.07 \times 1/3 \times 6 = 10.683$  KN...  
\* applied at the centre of the beam  
MEMBER LOAD  
101 106 148 159 160 CON GZ -10.683  
\*  
\* Load at +8.000m level  
\* Hwp =  $DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8$ m contributory hight for load,  
\* with cf=0.8 of pipe, 6.07 KN/m2 as blast pressure as per calculation,  
\* load at the main grid beam =  $0.8 \times 0.8 \times 6.07 \times 3 = 11.654$  KN...  
\* applied at the centre of the beam  
MEMBER LOAD  
57 66 69 102 TO 104 161 TO 163 CON GZ -11.654  
\*  
\* Load at 12.100m level  
\* Hwp =  $DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8$ m contributory hight for load,  
\* with cf=0.8 of pipe, 6.07 KN/m2 as blast pressure as per calculation,



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* load at the main grid beam =  $0.8*6.07*0.8*3 = 11.654$  KN...

\* applied at the centre of the beam

MEMBER LOAD

135 CON GZ -11.654

\*

\* blast load on cable trays

\*the second level is cladded with cable tray,

\* with  $cf=1.7$ , height = 2.3m, blast pressure = 6.07 kN/m<sup>2</sup>, cable tray span=6m,

\* cf isnot considered as whole area is being referred for the area.

\* load =  $2.3*6.07*6 = 83.766$  kN applied at the supporting location of the cable

\* trays.

\*\*\*

\*\*\*

\*\* the above method was too conservative. The cable trays are of 0.1m deep.

\*\* there are total 7 number of cable trays. With 6m C/C distances (span),

\*\* shape factor = 1.7 as individual cable trays are considered.

\*\* load =  $0.1*6.07*7*1.7*6 = 43.34$  KN.

MEMBER LOAD

\*\*\*\*\*3 9 15 21 27 91 CON GZ -83.766

3 9 15 21 27 91 CON GZ -43.34

\*

\* load on side frame, blast pressure = 3 KN/m<sup>2</sup>.

\* avergae depth of beam/column = 0.25m

\* load =  $cf*3*0.25 = 1.275$  KN/m, cf is ignored

\* final load =  $0.25*3 = 0.75$  KN/m

1 TO 6 55 TO 57 129 131 133 135 TO 137 180 182 199 221 222 235 237 UNI GX 0.75

25 TO 30 67 TO 69 274 UNI GX -0.75

\*\*\*

\*\*\*

LOAD 1001 NOTIONAL LOAD FOR DEAD LOAD IN X -(E-W) DIRECTION (NLDE)

NOTIONAL LOAD

10 X 0.005

\*

LOAD 1002 NOTIONAL LOAD FOR DEAD LOAD IN Z -(N-S) DIRECTION (NLDN)

NOTIONAL LOAD

10 Z 0.005

\*

LOAD 1003 NOTIONAL LOAD FOR EMPTY LOAD OF PIPING & EQUIPMENT IN X-(E-W) (NLEE)

NOTIONAL LOAD

30 X 0.005

\*

LOAD 1004 NOTIONAL LOAD FOR EMPTY LOAD OF PIPING & EQUIPMENT IN Z-(N-S)(NLEN)

NOTIONAL LOAD

30 Z 0.005

\*

LOAD 1005 NOTIONAL LOAD FOR OPERATING LOAD OF PIPING & EQUIPMNT IN X(E-W)(NLOE)

NOTIONAL LOAD

40 X 0.005

\*

LOAD 1006 NOTIONAL LOAD FOR OPERATING LOAD OF PIPING & EQUIPMNT IN Z(N-S)(NLON)

NOTIONAL LOAD

40 Z 0.005

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*-----  
LOAD 1007 NOTIONAL LOAD FOR LIVE LOAD IN X -(E-W) DIRECTION (NLLE)  
NOTIONAL LOAD  
20 X 0.005

\*-----  
LOAD 1008 NOTIONAL LOAD FOR LIVE LOAD IN Z -(N-S) DIRECTION (NLLN)  
NOTIONAL LOAD  
20 Z 0.005

\*\*\*  
\*\*\*\*\*LOAD COMBINATIONS FOR STAAD  
\*\*\*\*\*LOAD COMBINATION FOR SUPERSTRUCTURE\_SLS  
\*\*\*  
\*\*\*

LOAD 30001  
REPEAT LOAD  
10 1.0 30 1.0 85 1.0  
\*\*\*\*\*

LOAD 30002  
REPEAT LOAD  
10 1.0 30 1.0 86 1.0  
\*\*\*\*\*

LOAD 30003  
REPEAT LOAD  
10 1.0 30 1.0 631 0.5 61 1.0  
\*\*\*\*\*

LOAD 30004  
REPEAT LOAD  
10 1.0 30 1.0 611 0.5 62 1.0  
\*\*\*\*\*

LOAD 30005  
REPEAT LOAD  
10 1.0 30 1.0 6310 0.5 63 1.0  
\*\*\*\*\*

LOAD 30006  
REPEAT LOAD  
10 1.0 30 1.0 6110 0.5 64 1.0  
\*\*\*\*\*

LOAD 30007  
REPEAT LOAD  
10 1.0 30 1.0 6310 0.5 61 1.0  
\*\*\*\*\*

LOAD 30008  
REPEAT LOAD  
10 1.0 30 1.0 6110 0.5 62 1.0  
\*\*\*\*\*

LOAD 30009  
REPEAT LOAD  
10 1.0 30 1.0 631 0.5 63 1.0  
\*\*\*\*\*

LOAD 30010  
REPEAT LOAD  
10 1.0 30 1.0 611 0.5 64 1.0  
\*\*\*\*\*

LOAD 30011

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0

\*\*\*\*\*

LOAD 30012

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0

\*\*\*\*\*

LOAD 30013

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0

\*\*\*\*\*

LOAD 30014

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0

\*\*\*\*\*

LOAD 30015

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0

\*\*\*\*\*

LOAD 30016

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0

\*\*\*\*\*

LOAD 30017

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0

\*\*\*\*\*

LOAD 30018

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0

\*\*\*\*\*

LOAD 30019

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.0

\*\*\*\*\*

LOAD 30020

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.0

\*\*\*\*\*

LOAD 30021

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 85 1.0

\*\*\*\*\*

LOAD 30022

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 85 1.0

\*\*\*\*\*

LOAD 30023

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.0

\*\*\*\*\*

LOAD 30024

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30025  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 85 1.0  
\*\*\*\*\*

LOAD 30026  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 85 1.0  
\*\*\*\*\*

LOAD 30027  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 86 1.0  
\*\*\*\*\*

LOAD 30028  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 86 1.0  
\*\*\*\*\*

LOAD 30029  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.0  
\*\*\*\*\*

LOAD 30030  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.0  
\*\*\*\*\*

LOAD 30031  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 86 1.0  
\*\*\*\*\*

LOAD 30032  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 86 1.0  
\*\*\*\*\*

LOAD 30033  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.0  
\*\*\*\*\*

LOAD 30034  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.0  
\*\*\*\*\*

LOAD 30035  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 631 0.5 61 1.0 81 1.0 82 1.0  
\*\*\*\*\*

LOAD 30036  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 611 0.5 62 1.0 81 1.0 82 1.0  
\*\*\*\*\*

LOAD 30037  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 6310 0.5 63 1.0 81 -1.0 82 -1.0  
\*\*\*\*\*

LOAD 30038

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 6110 0.5 64 1.0 81 -1.0 82 -1.0  
 \*\*\*\*\*  
 LOAD 30039  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 6310 0.5 61 1.0 81 1.0 82 -1.0  
 \*\*\*\*\*  
 LOAD 30040  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 6110 0.5 62 1.0 81 -1.0 82 1.0  
 \*\*\*\*\*  
 LOAD 30041  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 631 0.5 63 1.0 81 -1.0 82 1.0  
 \*\*\*\*\*  
 LOAD 30042  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 611 0.5 64 1.0 81 1.0 82 -1.0  
 \*\*\*\*\*  
 LOAD 30043  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30044  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30045  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30046  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30047  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30048  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30049  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30050  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30051  
 REPEAT LOAD  
 10 1.0 40 1.0 631 0.5 61 1.0 81 1.0 82 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30052  
REPEAT LOAD  
10 1.0 40 1.0 611 0.5 62 1.0 81 1.0 82 1.0

\*\*\*\*\*

LOAD 30053  
REPEAT LOAD  
10 1.0 40 1.0 6310 0.5 63 1.0 81 -1.0 82 -1.0

\*\*\*\*\*

LOAD 30054  
REPEAT LOAD  
10 1.0 40 1.0 6110 0.5 64 1.0 81 -1.0 82 -1.0

\*\*\*\*\*

LOAD 30055  
REPEAT LOAD  
10 1.0 40 1.0 6310 0.5 61 1.0 81 1.0 82 -1.0

\*\*\*\*\*

LOAD 30056  
REPEAT LOAD  
10 1.0 40 1.0 6110 0.5 62 1.0 81 -1.0 82 1.0

\*\*\*\*\*

LOAD 30057  
REPEAT LOAD  
10 1.0 40 1.0 631 0.5 63 1.0 81 -1.0 82 1.0

\*\*\*\*\*

LOAD 30058  
REPEAT LOAD  
10 1.0 40 1.0 611 0.5 64 1.0 81 1.0 82 -1.0

\*\*\*\*\*

LOAD 30059  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 631 0.25 61 0.5

\*\*\*\*\*

LOAD 30060  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 611 0.25 62 0.5

\*\*\*\*\*

LOAD 30061  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 6310 0.25 63 0.5

\*\*\*\*\*

LOAD 30062  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 6110 0.25 64 0.5

\*\*\*\*\*

LOAD 30063  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 6310 0.25 61 0.5

\*\*\*\*\*

LOAD 30064  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 6110 0.25 62 0.5

\*\*\*\*\*

LOAD 30065

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 50 1.0 20 0.5 631 0.25 63 0.5  
\*\*\*\*\*

LOAD 30066

REPEAT LOAD

10 1.0 50 1.0 20 0.5 611 0.25 64 0.5  
\*\*\*\*\*

LOAD 30067

REPEAT LOAD

10 1.0 50 1.0 20 0.5 85 1.0  
\*\*\*\*\*

LOAD 30068

REPEAT LOAD

10 1.0 50 1.0 20 0.5 86 1.0  
\*\*\*\*\*

LOAD 30069

REPEAT LOAD

10 1.0 30 1.0 20 1.0 631 0.5 61 1.0 91 1.0  
\*\*\*\*\*

LOAD 30070

REPEAT LOAD

10 1.0 30 1.0 20 1.0 611 0.5 62 1.0 91 1.0  
\*\*\*\*\*

LOAD 30071

REPEAT LOAD

10 1.0 30 1.0 20 1.0 6310 0.5 63 1.0 91 1.0  
\*\*\*\*\*

LOAD 30072

REPEAT LOAD

10 1.0 30 1.0 20 1.0 6110 0.5 64 1.0 91 1.0  
\*\*\*\*\*

LOAD 30073

REPEAT LOAD

10 1.0 30 1.0 20 1.0 6310 0.5 61 1.0 91 1.0  
\*\*\*\*\*

LOAD 30074

REPEAT LOAD

10 1.0 30 1.0 20 1.0 6110 0.5 62 1.0 91 1.0  
\*\*\*\*\*

LOAD 30075

REPEAT LOAD

10 1.0 30 1.0 20 1.0 631 0.5 63 1.0 91 1.0  
\*\*\*\*\*

LOAD 30076

REPEAT LOAD

10 1.0 30 1.0 20 1.0 611 0.5 64 1.0 91 1.0  
\*\*\*\*\*

LOAD 30077

REPEAT LOAD

10 1.0 30 1.0 20 1.0 85 1.0 91 1.0  
\*\*\*\*\*

LOAD 30078

REPEAT LOAD

10 1.0 30 1.0 20 1.0 86 1.0 91 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30079

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30080

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30081

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 89 -1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30082

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 89 -1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30083

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 89 1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30084

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 89 -1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30085

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 89 -1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30086

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 89 1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30087

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 85 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30088

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 85 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30089

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 85 1.0 89 -1.0 90 -1.0 -  
93 1.0

\*\*\*\*\*

LOAD 30090

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 85 1.0 89 -1.0 90 -1.0 -  
93 1.0

\*\*\*\*\*

LOAD 30091

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 85 1.0 89 1.0 90 -1.0 -



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

93 1.0

\*\*\*\*\*

LOAD 30092

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 85 1.0 89 -1.0 90 1.0 -

93 1.0

\*\*\*\*\*

LOAD 30093

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 85 1.0 89 -1.0 90 1.0 -

93 1.0

\*\*\*\*\*

LOAD 30094

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 85 1.0 89 1.0 90 -1.0 -

93 1.0

\*\*\*\*\*

LOAD 30095

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 86 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30096

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 86 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30097

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 86 1.0 89 -1.0 90 -1.0 -

93 1.0

\*\*\*\*\*

LOAD 30098

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 86 1.0 89 -1.0 90 -1.0 -

93 1.0

\*\*\*\*\*

LOAD 30099

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 86 1.0 89 1.0 90 -1.0 -

93 1.0

\*\*\*\*\*

LOAD 30100

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 86 1.0 89 -1.0 90 1.0 -

93 1.0

\*\*\*\*\*

LOAD 30101

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 86 1.0 89 -1.0 90 1.0 -

93 1.0

\*\*\*\*\*

LOAD 30102

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 86 1.0 89 1.0 90 -1.0 -

93 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30103

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 89 1.0 90 1.0 93 1.0 94 1.0

\*\*\*\*\*

LOAD 30104

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 89 1.0 90 1.0 93 1.0 94 1.0

\*\*\*\*\*

LOAD 30105

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 89 -1.0 90 -1.0 93 1.0 -  
94 1.0

\*\*\*\*\*

LOAD 30106

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 89 -1.0 90 -1.0 93 1.0 -  
94 1.0

\*\*\*\*\*

LOAD 30107

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 89 1.0 90 -1.0 93 1.0 -  
94 1.0

\*\*\*\*\*

LOAD 30108

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 89 -1.0 90 1.0 93 1.0 -  
94 1.0

\*\*\*\*\*

LOAD 30109

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 89 -1.0 90 1.0 93 1.0 -  
94 1.0

\*\*\*\*\*

LOAD 30110

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 89 1.0 90 -1.0 93 1.0 -  
94 1.0

\*\*\*\*\*

LOAD 30111

REPEAT LOAD

10 1.0 40 1.0 20 1.0 631 0.5 61 1.0 81 1.0 82 1.0 87 1.0 89 1.0 90 1.0 -  
93 1.0

\*\*\*\*\*

LOAD 30112

REPEAT LOAD

10 1.0 40 1.0 20 1.0 611 0.5 62 1.0 81 1.0 82 1.0 88 1.0 89 1.0 90 1.0 -  
93 1.0

\*\*\*\*\*

LOAD 30113

REPEAT LOAD

10 1.0 40 1.0 20 1.0 6310 0.5 63 1.0 81 -1.0 82 -1.0 87 -1.0 89 -1.0 90 -1.0 -  
93 1.0

\*\*\*\*\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

LOAD 30114  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 6110 0.5 64 1.0 81 -1.0 82 -1.0 88 -1.0 89 -1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30115  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 6310 0.5 61 1.0 81 1.0 82 -1.0 87 1.0 89 1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30116  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 6110 0.5 62 1.0 81 -1.0 82 1.0 88 1.0 89 -1.0 90 1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30117  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 631 0.5 63 1.0 81 -1.0 82 1.0 87 -1.0 89 -1.0 90 1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30118  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 611 0.5 64 1.0 81 1.0 82 -1.0 88 -1.0 89 1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30119  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 89 1.0 90 1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30120  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 89 1.0 90 1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30121  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 89 -1.0 90 -1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30122  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 89 -1.0 90 -1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30123  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 89 1.0 90 -1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30124  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 89 -1.0 90 1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30125  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 89 -1.0 90 1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30126

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 89 1.0 90 -1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30127

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.0 89 1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30128

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.0 89 1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30129

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.0 89 -1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30130

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.0 89 -1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30131

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 85 1.0 89 1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30132

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 85 1.0 89 -1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30133

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 85 1.0 89 -1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30134

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 85 1.0 89 1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30135

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 86 1.0 89 1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30136

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 86 1.0 89 1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30137

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 86 1.0 89 -1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30138

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 86 1.0 89 -1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30139

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.0 89 1.0 90 -1.0 93 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30140  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.0 89 -1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30141  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.0 89 -1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30142  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.0 89 1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30143  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 631 0.25 61 0.5 87 0.5 93 1.0  
\*\*\*\*\*

LOAD 30144  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 611 0.25 62 0.5 88 0.5 93 1.0  
\*\*\*\*\*

LOAD 30145  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 6310 0.25 63 0.5 87 -0.5 93 1.0  
\*\*\*\*\*

LOAD 30146  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 6110 0.25 64 0.5 88 -0.5 93 1.0  
\*\*\*\*\*

LOAD 30147  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 6310 0.25 61 0.5 87 0.5 93 1.0  
\*\*\*\*\*

LOAD 30148  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 6110 0.25 62 0.5 88 0.5 93 1.0  
\*\*\*\*\*

LOAD 30149  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 631 0.25 63 0.5 87 -0.5 93 1.0  
\*\*\*\*\*

LOAD 30150  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 611 0.25 64 0.5 88 -0.5 93 1.0  
\*\*\*\*\*

LOAD 30151  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 85 1.0 93 1.0  
\*\*\*\*\*

LOAD 30152  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 86 1.0 93 1.0  
\*\*\*\*\*

LOAD 30153

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.5 89 1.0 90 1.0 92 1.0 93 1.0  
 \*\*\*\*\*

LOAD 30154

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.5 89 1.0 90 1.0 92 1.0 93 1.0  
 \*\*\*\*\*

LOAD 30155

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.5 89 -1.0 90 -1.0 92 1.0 93 1.0  
 \*\*\*\*\*

LOAD 30156

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.5 89 -1.0 90 -1.0 92 1.0 93 1.0  
 \*\*\*\*\*

LOAD 30157

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.5 89 1.0 90 -1.0 92 1.0 93 1.0  
 \*\*\*\*\*

LOAD 30158

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.5 89 -1.0 90 1.0 92 1.0 93 1.0  
 \*\*\*\*\*

LOAD 30159

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.5 89 -1.0 90 1.0 92 1.0 93 1.0  
 \*\*\*\*\*

LOAD 30160

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.5 89 1.0 90 -1.0 92 1.0 93 1.0  
 \*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\* LOAD WITH BLAST CASES

LOAD 30161

REPEAT LOAD

10 1.0 20 1.0 961 1.0  
 \*

LOAD 30162

REPEAT LOAD

10 1.0 20 1.0 962 1.0  
 \*

LOAD 30163

REPEAT LOAD

10 1.0 20 1.0 963 1.0  
 \*

LOAD 30164

REPEAT LOAD

10 1.0 20 1.0 964 1.0  
 \*

LOAD 30165

REPEAT LOAD

10 1.0 20 1.0 965 1.0  
 \*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

LOAD 30166  
REPEAT LOAD  
10 1.0 20 1.0 966 1.0  
\*

LOAD 30167  
REPEAT LOAD  
10 1.0 20 1.0 971 1.0  
\*

LOAD 30168  
REPEAT LOAD  
10 1.0 20 1.0 972 1.0  
\*

LOAD 30169  
REPEAT LOAD  
10 1.0 20 1.0 973 1.0  
\*

LOAD 30170  
REPEAT LOAD  
10 1.0 20 1.0 974 1.0  
\*

LOAD 30171  
REPEAT LOAD  
10 1.0 20 1.0 975 1.0  
\*

LOAD 30172  
REPEAT LOAD  
10 1.0 20 1.0 976 1.0  
\*  
\*

LOAD 30173  
REPEAT LOAD  
10 1.0 20 1.0 98 1.0  
\*

LOAD 30174  
REPEAT LOAD  
10 1.0 20 1.0 99 1.0  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

\*\*\*\*\*LOAD COMBINATIONS FOR STAAD  
\*\*\*\*\*LOAD COMBINATION FOR SUPERSTRUCTURE\_ULS

LOAD 40001  
REPEAT LOAD  
10 1.0 1001 1.0 30 1.0 1003 1.0 85 1.5  
\*\*\*\*\*

LOAD 40002  
REPEAT LOAD  
10 1.0 1002 1.0 30 1.0 1004 1.0 85 1.5  
\*\*\*\*\*

LOAD 40003  
REPEAT LOAD  
10 1.0 1001 -1.0 30 1.0 1003 -1.0 85 1.5  
\*\*\*\*\*

LOAD 40004

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 1002 -1.0 30 1.0 1004 -1.0 85 1.5  
\*\*\*\*\*

LOAD 40005

REPEAT LOAD

10 1.0 1001 1.0 30 1.0 1003 1.0 86 1.5  
\*\*\*\*\*

LOAD 40006

REPEAT LOAD

10 0.8 1002 0.8 30 0.8 1004 0.8 86 1.5  
\*\*\*\*\*

LOAD 40007

REPEAT LOAD

10 1.0 1001 -1.0 30 1.0 1003 -1.0 86 1.5  
\*\*\*\*\*

LOAD 40008

REPEAT LOAD

10 1.0 1002 -1.0 30 1.0 1004 -1.0 86 1.5  
\*\*\*\*\*

LOAD 40009

REPEAT LOAD

10 1.0 1001 1.0 30 1.0 1003 1.0 631 0.75 61 1.5  
\*\*\*\*\*

LOAD 40010

REPEAT LOAD

10 1.0 1002 1.0 30 1.0 1004 1.0 611 0.75 62 1.5  
\*\*\*\*\*

LOAD 40011

REPEAT LOAD

10 1.0 1001 -1.0 30 1.0 1003 -1.0 6310 0.75 63 1.5  
\*\*\*\*\*

LOAD 40012

REPEAT LOAD

10 1.0 1002 -1.0 30 1.0 1004 -1.0 6110 0.75 64 1.5  
\*\*\*\*\*

LOAD 40013

REPEAT LOAD

10 1.0 1001 1.0 30 1.0 1003 1.0 6310 0.75 61 1.5  
\*\*\*\*\*

LOAD 40014

REPEAT LOAD

10 1.0 1002 1.0 30 1.0 1004 1.0 6110 0.75 62 1.5  
\*\*\*\*\*

LOAD 40015

REPEAT LOAD

10 1.0 1001 -1.0 30 1.0 1003 -1.0 631 0.75 63 1.5  
\*\*\*\*\*

LOAD 40016

REPEAT LOAD

10 1.0 1002 -1.0 30 1.0 1004 -1.0 611 0.75 64 1.5  
\*\*\*\*\*

LOAD 40017

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 1.35



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40018

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 1.35 82 1.35

\*\*\*\*\*

LOAD 40019

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 -1.35

\*\*\*\*\*

LOAD 40020

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 -1.35 82 -1.35

\*\*\*\*\*

LOAD 40021

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 -1.35

\*\*\*\*\*

LOAD 40022

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 -1.35 82 1.35

\*\*\*\*\*

LOAD 40023

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 1.35

\*\*\*\*\*

LOAD 40024

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 1.35 82 -1.35

\*\*\*\*\*

LOAD 40025

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 85 1.5

\*\*\*\*\*

LOAD 40026

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 85 1.5

\*\*\*\*\*

LOAD 40027

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 85 1.5

\*\*\*\*\*

LOAD 40028

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 85 1.5

\*\*\*\*\*

LOAD 40029

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 85 1.5

\*\*\*\*\*

LOAD 40030

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 85 1.5

\*\*\*\*\*

LOAD 40031

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 85 1.5  
\*\*\*\*\*

LOAD 40032

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 85 1.5  
\*\*\*\*\*

LOAD 40033

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 86 1.5  
\*\*\*\*\*

LOAD 40034

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 86 1.5  
\*\*\*\*\*

LOAD 40035

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 86 1.5  
\*\*\*\*\*

LOAD 40036

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 86 1.5  
\*\*\*\*\*

LOAD 40037

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 86 1.5  
\*\*\*\*\*

LOAD 40038

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 86 1.5  
\*\*\*\*\*

LOAD 40039

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 86 1.5  
\*\*\*\*\*

LOAD 40040

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 86 1.5  
\*\*\*\*\*

LOAD 40041

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 631 0.75 61 1.5 81 1.2 -  
82 1.2  
\*\*\*\*\*

LOAD 40042

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 611 0.75 62 1.5 81 1.2 -  
82 1.2  
\*\*\*\*\*

LOAD 40043

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 6310 0.75 63 1.5 81 -1.2 -  
82 -1.2  
\*\*\*\*\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

LOAD 40044  
REPEAT LOAD  
10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 6110 0.75 64 1.5 81 -1.2 -  
82 -1.2  
\*\*\*\*\*

LOAD 40045  
REPEAT LOAD  
10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 6310 0.75 61 1.5 81 1.2 -  
82 -1.2  
\*\*\*\*\*

LOAD 40046  
REPEAT LOAD  
10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 6110 0.75 62 1.5 81 -1.2 -  
82 1.2  
\*\*\*\*\*

LOAD 40047  
REPEAT LOAD  
10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 631 0.75 63 1.5 81 -1.2 -  
82 1.2  
\*\*\*\*\*

LOAD 40048  
REPEAT LOAD  
10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 611 0.75 64 1.5 81 1.2 -  
82 -1.2  
\*\*\*\*\*

LOAD 40049  
REPEAT LOAD  
10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 94 1.5  
\*\*\*\*\*

LOAD 40050  
REPEAT LOAD  
10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 94 1.5  
\*\*\*\*\*

LOAD 40051  
REPEAT LOAD  
10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 94 1.5  
\*\*\*\*\*

LOAD 40052  
REPEAT LOAD  
10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 94 1.5  
\*\*\*\*\*

LOAD 40053  
REPEAT LOAD  
10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 94 1.5  
\*\*\*\*\*

LOAD 40054  
REPEAT LOAD  
10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 94 1.5  
\*\*\*\*\*

LOAD 40055  
REPEAT LOAD  
10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 94 1.5  
\*\*\*\*\*

LOAD 40056

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 94 1.5  
\*\*\*\*\*

LOAD 40057

REPEAT LOAD

10 0.8 1001 0.8 40 0.8 1005 0.8 631 0.75 61 1.5 81 1.0 82 1.0  
\*\*\*\*\*

LOAD 40058

REPEAT LOAD

10 0.8 1002 0.8 40 0.8 1006 0.8 611 0.75 62 1.5 81 1.0 82 1.0  
\*\*\*\*\*

LOAD 40059

REPEAT LOAD

10 0.8 1001 -0.8 40 0.8 1005 -0.8 6310 0.75 63 1.5 81 -1.0 82 -1.0  
\*\*\*\*\*

LOAD 40060

REPEAT LOAD

10 0.8 1002 -0.8 40 0.8 1006 -0.8 6110 0.75 64 1.5 81 -1.0 82 -1.0  
\*\*\*\*\*

LOAD 40061

REPEAT LOAD

10 0.8 1001 0.8 40 0.8 1005 0.8 6310 0.75 61 1.5 81 1.0 82 -1.0  
\*\*\*\*\*

LOAD 40062

REPEAT LOAD

10 0.8 1002 0.8 40 0.8 1006 0.8 6110 0.75 62 1.5 81 -1.0 82 1.0  
\*\*\*\*\*

LOAD 40063

REPEAT LOAD

10 0.8 1001 -0.8 40 0.8 1005 -0.8 631 0.75 63 1.5 81 -1.0 82 1.0  
\*\*\*\*\*

LOAD 40064

REPEAT LOAD

10 0.8 1002 -0.8 40 0.8 1006 -0.8 611 0.75 64 1.5 81 1.0 82 -1.0  
\*\*\*\*\*

LOAD 40065

REPEAT LOAD

10 1.35 1001 1.35 50 1.35 20 0.75 1007 0.75  
\*\*\*\*\*

LOAD 40066

REPEAT LOAD

10 1.35 1002 1.35 50 1.35 20 0.75 1008 0.75  
\*\*\*\*\*

LOAD 40067

REPEAT LOAD

10 1.35 1001 -1.35 50 1.35 20 0.75 1007 -0.75  
\*\*\*\*\*

LOAD 40068

REPEAT LOAD

10 1.35 1002 -1.35 50 1.35 20 0.75 1008 -0.75  
\*\*\*\*\*

LOAD 40069

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 631 0.375 61 0.75

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40070

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 611 0.375 62 0.75

\*\*\*\*\*

LOAD 40071

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 6310 0.375 63 0.75

\*\*\*\*\*

LOAD 40072

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 6110 0.375 64 0.75

\*\*\*\*\*

LOAD 40073

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 6310 0.375 61 0.75

\*\*\*\*\*

LOAD 40074

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 6110 0.375 62 0.75

\*\*\*\*\*

LOAD 40075

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 631 0.375 63 0.75

\*\*\*\*\*

LOAD 40076

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 611 0.375 64 0.75

\*\*\*\*\*

LOAD 40077

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 85 1.5

\*\*\*\*\*

LOAD 40078

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 85 1.5

\*\*\*\*\*

LOAD 40079

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 85 1.5

\*\*\*\*\*

LOAD 40080

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 85 1.5

\*\*\*\*\*

LOAD 40081

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 86 1.5

\*\*\*\*\*

LOAD 40082

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 86 1.5

\*\*\*\*\*

LOAD 40083

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 86 1.5  
\*\*\*\*\*

LOAD 40084

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 86 1.5  
\*\*\*\*\*

LOAD 40085

REPEAT LOAD

10 1.35 1001 1.35 30 1.35 1003 1.35 20 1.5 1007 1.5 91 1.5  
\*\*\*\*\*

LOAD 40086

REPEAT LOAD

10 1.35 1002 1.35 30 1.35 1004 1.35 20 1.5 1008 1.5 91 1.5  
\*\*\*\*\*

LOAD 40087

REPEAT LOAD

10 1.35 1001 -1.35 30 1.35 1003 -1.35 20 1.5 1007 -1.5 91 1.5  
\*\*\*\*\*

LOAD 40088

REPEAT LOAD

10 1.35 1002 -1.35 30 1.35 1004 -1.35 20 1.5 1008 -1.5 91 1.5  
\*\*\*\*\*

LOAD 40089

REPEAT LOAD

10 1.2 1001 1.2 30 1.2 1003 1.2 20 1.5 1007 1.5 631 0.75 61 1.5 91 1.5  
\*\*\*\*\*

LOAD 40090

REPEAT LOAD

10 1.2 1002 1.2 30 1.2 1004 1.2 20 1.5 1008 1.5 611 0.75 62 1.5 91 1.5  
\*\*\*\*\*

LOAD 40091

REPEAT LOAD

10 1.2 1001 -1.2 30 1.2 1003 -1.2 20 1.5 1007 -1.5 6310 0.75 63 1.5 91 1.5  
\*\*\*\*\*

LOAD 40092

REPEAT LOAD

10 1.2 1002 -1.2 30 1.2 1004 -1.2 20 1.5 1008 -1.5 6110 0.75 64 1.5 91 1.5  
\*\*\*\*\*

LOAD 40093

REPEAT LOAD

10 1.2 1001 1.2 30 1.2 1003 1.2 20 1.5 1007 1.5 6310 0.75 61 1.5 91 1.5  
\*\*\*\*\*

LOAD 40094

REPEAT LOAD

10 1.2 1002 1.2 30 1.2 1004 1.2 20 1.5 1008 1.5 6110 0.75 62 1.5 91 1.5  
\*\*\*\*\*

LOAD 40095

REPEAT LOAD

10 1.2 1001 -1.2 30 1.2 1003 -1.2 20 1.5 1007 -1.5 631 0.75 63 1.5 91 1.5  
\*\*\*\*\*

LOAD 40096

REPEAT LOAD

10 1.2 1002 -1.2 30 1.2 1004 -1.2 20 1.5 1008 -1.5 611 0.75 64 1.5 91 1.5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40097

REPEAT LOAD

10 1.2 1001 1.2 30 1.2 1003 1.2 20 1.5 1007 1.5 85 1.5 91 1.5

\*\*\*\*\*

LOAD 40098

REPEAT LOAD

10 1.2 1002 1.2 30 1.2 1004 1.2 20 1.5 1008 1.5 85 1.5 91 1.5

\*\*\*\*\*

LOAD 40099

REPEAT LOAD

10 1.2 1001 -1.2 30 1.2 1003 -1.2 20 1.5 1007 -1.5 85 1.5 91 1.5

\*\*\*\*\*

LOAD 40100

REPEAT LOAD

10 1.2 1002 -1.2 30 1.2 1004 -1.2 20 1.5 1008 -1.5 85 1.5 91 1.5

\*\*\*\*\*

LOAD 40101

REPEAT LOAD

10 1.2 1001 1.2 30 1.2 1003 1.2 20 1.5 1007 1.5 86 1.5 91 1.5

\*\*\*\*\*

LOAD 40102

REPEAT LOAD

10 1.2 1002 1.2 30 1.2 1004 1.2 20 1.5 1008 1.5 86 1.5 91 1.5

\*\*\*\*\*

LOAD 40103

REPEAT LOAD

10 1.2 1001 -1.2 30 1.2 1003 -1.2 20 1.5 1007 -1.5 86 1.5 91 1.5

\*\*\*\*\*

LOAD 40104

REPEAT LOAD

10 1.2 1002 -1.2 30 1.2 1004 -1.2 20 1.5 1008 -1.5 86 1.5 91 1.5

\*\*\*\*\*

LOAD 40105

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 1.35 83 1.35 -  
84 1.35 89 1.35 90 1.35 93 1.35

\*\*\*\*\*

LOAD 40106

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 1.35 82 1.35 83 1.35 -  
84 1.35 89 1.35 90 1.35 93 1.35

\*\*\*\*\*

LOAD 40107

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 -1.35 -  
83 -1.35 84 -1.35 89 -1.35 90 -1.35 93 1.35

\*\*\*\*\*

LOAD 40108

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 -1.35 82 -1.35 -  
83 -1.35 84 -1.35 89 -1.35 90 -1.35 93 1.35

\*\*\*\*\*

LOAD 40109

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 -1.35 83 1.35 -  
84 -1.35 89 1.35 90 -1.35 93 1.35

\*\*\*\*\*

LOAD 40110

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 -1.35 82 1.35 -  
83 -1.35 84 1.35 89 -1.35 90 1.35 93 1.35

\*\*\*\*\*

LOAD 40111

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 1.35 -  
83 -1.35 84 1.35 89 -1.35 90 1.35 93 1.35

\*\*\*\*\*

LOAD 40112

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 1.35 82 -1.35 -  
83 1.35 84 -1.35 89 1.35 90 -1.35 93 1.35

\*\*\*\*\*

LOAD 40113

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
85 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40114

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
85 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40115

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 85 1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40116

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 85 1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40117

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 85 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40118

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 85 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40119

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 85 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

LOAD 40120

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 85 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40121

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
86 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40122

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
86 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40123

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 86 1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40124

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 86 1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40125

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 86 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40126

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 86 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40127

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 86 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40128

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 86 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40129

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
89 1.2 90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40130

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
89 1.2 90 1.2 93 1.2 94 1.5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40131

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 89 -1.2 90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40132

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 89 -1.2 90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40133

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 89 1.2 90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40134

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 89 -1.2 90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40135

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 89 -1.2 90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40136

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 89 1.2 90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40137

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 631 0.75 61 1.5 81 1.2 -  
82 1.2 87 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40138

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 611 0.75 62 1.5 81 1.2 -  
82 1.2 88 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40139

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 6310 0.75 63 1.5 81 -1.2 -  
82 -1.2 87 -1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40140

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 6110 0.75 64 1.5 81 -1.2 -  
82 -1.2 88 -1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40141

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 6310 0.75 61 1.5 81 1.2 -

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

82 -1.2 87 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40142

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 6110 0.75 62 1.5 81 -1.2 -

82 1.2 88 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40143

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 631 0.75 63 1.5 81 -1.2 -

82 1.2 87 -1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40144

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 611 0.75 64 1.5 81 1.2 -

82 -1.2 88 -1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40145

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 89 1.2 90 1.2 -

93 1.2 94 1.5

\*\*\*\*\*

LOAD 40146

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 89 1.2 90 1.2 -

93 1.2 94 1.5

\*\*\*\*\*

LOAD 40147

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 89 -1.2 -

90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40148

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 89 -1.2 -

90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40149

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 89 1.2 -

90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40150

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 89 -1.2 -

90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40151

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 89 -1.2 -

90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40152

REPEAT LOAD

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 89 1.2 -  
90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40153

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 85 1.5 89 1.2 -  
90 1.2 93 1.2

\*\*\*\*\*

LOAD 40154

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 85 1.5 89 1.2 -  
90 1.2 93 1.2

\*\*\*\*\*

LOAD 40155

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 85 1.5 -  
89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40156

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 85 1.5 -  
89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40157

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 85 1.5 89 1.2 -  
90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40158

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 85 1.5 -  
89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40159

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 85 1.5 -  
89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40160

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 85 1.5 -  
89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40161

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 86 1.5 89 1.2 -  
90 1.2 93 1.2

\*\*\*\*\*

LOAD 40162

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 86 1.5 89 1.2 -  
90 1.2 93 1.2

\*\*\*\*\*

LOAD 40163

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 86 1.5 -  
89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40164

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 86 1.5 -  
89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40165

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 86 1.5 89 1.2 -  
90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40166

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 86 1.5 -  
89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40167

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 86 1.5 -  
89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40168

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 86 1.5 -  
89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40169

REPEAT LOAD

10 1.35 1001 1.35 50 1.35 20 0.75 1007 0.75 93 1.2

\*\*\*\*\*

LOAD 40170

REPEAT LOAD

10 1.35 1002 1.35 50 1.35 20 0.75 1008 0.75 93 1.2

\*\*\*\*\*

LOAD 40171

REPEAT LOAD

10 1.35 1001 -1.35 50 1.35 20 0.75 1007 -0.75 93 1.2

\*\*\*\*\*

LOAD 40172

REPEAT LOAD

10 1.35 1002 -1.35 50 1.35 20 0.75 1008 -0.75 93 1.2

\*\*\*\*\*

LOAD 40173

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 631 0.375 61 0.75 87 0.75 93 1.2

\*\*\*\*\*

LOAD 40174

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 611 0.375 62 0.75 88 0.75 93 1.2

\*\*\*\*\*

LOAD 40175

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 6310 0.375 63 0.75 87 -0.75 -  
93 1.2  
\*\*\*\*\*

LOAD 40176

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 6110 0.375 64 0.75 88 -0.75 -  
93 1.2  
\*\*\*\*\*

LOAD 40177

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 6310 0.375 61 0.75 87 0.75 93 1.2  
\*\*\*\*\*

LOAD 40178

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 6110 0.375 62 0.75 88 0.75 93 1.2  
\*\*\*\*\*

LOAD 40179

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 631 0.375 63 0.75 87 -0.75 93 1.2  
\*\*\*\*\*

LOAD 40180

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 611 0.375 64 0.75 88 -0.75 93 1.2  
\*\*\*\*\*

LOAD 40181

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 85 1.5 93 1.2  
\*\*\*\*\*

LOAD 40182

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 85 1.5 93 1.2  
\*\*\*\*\*

LOAD 40183

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 85 1.5 93 1.2  
\*\*\*\*\*

LOAD 40184

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 85 1.5 93 1.2  
\*\*\*\*\*

LOAD 40185

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 86 1.5 93 1.2  
\*\*\*\*\*

LOAD 40186

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 86 1.5 93 1.2  
\*\*\*\*\*

LOAD 40187

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 86 1.5 93 1.2  
\*\*\*\*\*

LOAD 40188

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 86 1.5 93 1.2

\*\*\*\*\*

LOAD 40189

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 1.35 89 1.35 -  
90 1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40190

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 1.35 82 1.35 89 1.35 -  
90 1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40191

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 -1.35 -  
89 -1.35 90 -1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40192

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 -1.35 82 -1.35 -  
89 -1.35 90 -1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40193

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 -1.35 89 1.35 -  
90 -1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40194

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 -1.35 82 1.35 -  
89 -1.35 90 1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40195

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 1.35 -  
89 -1.35 90 1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40196

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 1.35 82 -1.35 -  
89 1.35 90 -1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40197

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 85 1.5 89 1.2 -  
90 1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40198

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 85 1.5 89 1.2 -  
90 1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40199

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 85 1.5 -  
89 -1.2 90 -1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40200

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 85 1.5 -  
89 -1.2 90 -1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40201

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 86 1.5 89 1.2 -  
90 -1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40202

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 86 1.5 -  
89 -1.2 90 1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40203

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 86 1.5 -  
89 -1.2 90 1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40204

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 86 1.5 -  
89 1.2 90 -1.2 92 1.2 93 1.2

\*\*\*-----

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*

\* LOAD WITH BLAST CASES

LOAD 40205

REPEAT LOAD

10 1.0 20 1.0 961 1.0

\*

LOAD 40206

REPEAT LOAD

10 1.0 20 1.0 962 1.0

\*

LOAD 40207

REPEAT LOAD

10 1.0 20 1.0 963 1.0

\*

LOAD 40208

REPEAT LOAD

10 1.0 20 1.0 964 1.0

\*

LOAD 40209

REPEAT LOAD

10 1.0 20 1.0 965 1.0

\*

LOAD 40210



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD  
10 1.0 20 1.0 966 1.0  
\*

LOAD 40211  
REPEAT LOAD  
10 1.0 20 1.0 971 1.0  
\*

LOAD 40212  
REPEAT LOAD  
10 1.0 20 1.0 972 1.0  
\*

LOAD 40213  
REPEAT LOAD  
10 1.0 20 1.0 973 1.0  
\*

LOAD 40214  
REPEAT LOAD  
10 1.0 20 1.0 974 1.0  
\*

LOAD 40215  
REPEAT LOAD  
10 1.0 20 1.0 975 1.0  
\*

LOAD 40216  
REPEAT LOAD  
10 1.0 20 1.0 976 1.0  
\*

LOAD 40217  
REPEAT LOAD  
10 1.0 20 1.0 98 1.0  
\*

LOAD 40218  
REPEAT LOAD  
10 1.0 20 1.0 99 1.0  
\*\*\*\*\*

\*\*\*\*\*  
\*\*\*\*\*  
\*\*-----

PDELTA ANALYSIS SMALLDELTA PRINT STATICS CHECK  
\*\*\*-----

DEFINE ENVELOPE  
\*\*\*30001 TO 30160 ENVELOPE 1 TYPE SERVICEABILITY  
\*\*\*40001 TO 40204 ENVELOPE 2 TYPE STRENGTH

\*  
\* Envelope with blast load  
30001 TO 30174 ENVELOPE 1 TYPE SERVICEABILITY  
40001 TO 40218 ENVELOPE 2 TYPE STRENGTH

END DEFINE ENVELOPE  
\*\*\*

\*  
\*\*\* MINIMUM DESIGN PARAMETERS BASED ON EC8 TO BE ASSIGNED ARE LISTED AS  
FOLLOWS

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*STRENGTH CHECK

\*LOAD LIST 40001 TO 40204

LOAD LIST 40001 TO 40218

PARAMETER 1

CODE EN 1993-1-1:2005

\*\*\*NATIONAL ANNEX OF NETHERLAND TO BE USED

NA 2 MEMB 1 TO 57 64 TO 141 148 TO 163 176 TO 197 199 202 TO 204 221 222 245 -

246 252 253 263 TO 265 274

\*\*\*PY TO BE REDUCED BASED ON THICKNESS OF ELEMENT

\* Thickness is less than 41mm. hence as per &YARA A-PC 10000-Y50-00038,

\*  $f_y=235\text{N/mm}^2=235000\text{ KN/m}^2$ ,  $F_u=360\text{N/mm}^2=360000\text{KN/m}^2$

SGR 0 ALL

PY 235000 ALL

FU 360000 ALL

BEAM 3 ALL

\*\*\*FOR BUILTUP MEMBERS ONLY

SBLT 0 ALL

KC 0 ALL

\*\*\*

KY 1 MEMB 1 TO 30 131 133 136 TO 141 180 202 TO 204 207 208 221 222

KZ 1.2 MEMB 2 3 5 TO 18 20 21 23 24 26 27 29 30 131 133 136 137 180 -

202 TO 204 221 222

\*

KZ 1.5 MEMB 1 4 19 22 25 28 138 TO 141

KZ 2 MEMB 207 208

\*

LY 4 MEMB 39 43 47 51 70 TO 78 82 TO 84 190

UNL 4 MEMB 39 43 47 51 70 TO 78 82 TO 84 190

LZ 4 MEMB 39 43 47 51 70 TO 78 82 TO 84 190

LY 4 MEMB 59 60 62 63

UNL 4 MEMB 59 60 62 63

LZ 4 MEMB 59 60 62 63

LY 6 MEMB 41 42 45 46 49 50 53 54 149 TO 152 154 155 157 158

UNL 6 MEMB 41 42 45 46 49 50 53 54 149 TO 152 154 155 157 158

LZ 6 MEMB 41 42 45 46 49 50 52 53 149 TO 152 154 TO 157

LY 4 MEMB 127 128 176 177 192 TO 195

UNL 4 MEMB 127 128 176 177 192 TO 195

LZ 4 MEMB 127 128 176 177 192 TO 195

LY 4 MEMB 198

UNL 4 MEMB 198

LY 1.5 MEMB 61 251 254 255 257 258

UNL 1.5 MEMB 61 251 254 255 257 258

LY 2 MEMB 67 247 248 274

UNL 2 MEMB 67 247 248 274

LZ 4 MEMB 61 67 247 248 251 254 255 257 258 274

LY 3 MEMB 100 265 TO 267

UNL 3 MEMB 100 265 TO 267

LZ 4 MEMB 100 265 TO 267

\*\*\*

\*-----

TORSION 2 ALL

\*\*\*

\*-----

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*FOR ANY MEMBER FAILING IN TORSION, IF THE TORSION VALUE IS LESS THAN 3KN-M  
AND  
\*\*\*APPROPRIATE ARRANGEMENT IS PRESENT TO COUNTER THE TORSION MOMENT THEN  
ASSIGN  
\*\*\*?TORSION 3 MEMB ? TO THAT MEMBER  
RATIO 0.75 ALL  
TRACK 2 ALL  
CHECK CODE ALL

\*\*\*\*-----  
\*\*LOAD LIST 30001 TO 30160  
\*LOAD LIST 30001 TO 30174  
\*\*\*\*\*DEFLECTION CHECK  
\*PARAMETER 2  
\*CODE EN 1993-1-1:2005  
\*\*\*\*\*REFER DESIGN BASIS FOR LIMITS OF DEFLECTION  
\*\*\*\*\*TRACK 4 IS MANDATORY COMMAND FOR DEFLECTION CHECK  
\*DFE 300 MEMB 55 TO 57 59 60 62 TO 69 100 TO 106 129 130 135 148 159 TO 167 -  
\*196 TO 199 220 229 230 265 274  
\*DFE 300 MEMB 31 TO 54 70 TO 87 107 TO 110 127 128 149 TO 158 176 177 -  
\*182 TO 184 187 189 TO 195 205 206 209 210 245 246 252 253 263 264  
\*DJI 26 MEMB 39 82 TO 84  
\*DJI 27 MEMB 39 82 TO 84  
\*DJI 21 MEMB 43 73 TO 75 190  
\*DJI 22 MEMB 43 73 TO 75 190  
\*DJI 28 MEMB 41 149  
\*DJI 29 MEMB 41 149  
\*DJI 23 MEMB 45 151  
\*DJI 24 MEMB 45 151  
\*DJI 29 MEMB 42 150  
\*DJI 30 MEMB 42 150  
\*DJI 24 MEMB 46 152  
\*DJI 25 MEMB 46 152  
\*DJI 91 MEMB 184 187 189  
\*DJI 92 MEMB 184 187 189  
\*DJI 22 MEMB 59 164  
\*DJI 27 MEMB 59 164  
\*DJI 23 MEMB 62 166  
\*DJI 28 MEMB 62 166  
\*DJI 21 MEMB 43 190  
\*DJI 44 MEMB 43 190  
\*DJI 36 MEMB 47 76 TO 78  
\*DJI 37 MEMB 47 76 TO 78  
\*DJI 31 MEMB 51 70 TO 72  
\*DJI 32 MEMB 51 70 TO 72  
\*DJI 32 MEMB 52 156  
\*DJI 33 MEMB 52 156  
\*DJI 38 MEMB 49 154  
\*DJI 39 MEMB 49 154  
\*DJI 33 MEMB 53 157  
\*DJI 34 MEMB 53 157  
\*DJI 39 MEMB 50 155  
\*DJI 40 MEMB 50 155  
\*DJI 34 MEMB 54 158  
\*DJI 35 MEMB 54 158

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*DJ1 32 MEMB 60 165  
 \*DJ2 37 MEMB 60 165  
 \*DJ1 33 MEMB 63 167  
 \*DJ2 38 MEMB 63 167  
 \*DJ1 63 MEMB 127 177 192 193  
 \*DJ2 64 MEMB 127 177 192 193  
 \*DJ1 65 MEMB 128 176 194 195  
 \*DJ2 66 MEMB 128 176 194 195  
 \*DJ1 89 MEMB 198 220  
 \*DJ2 90 MEMB 198 220  
 \*DJ1 65 MEMB 129 199  
 \*DJ2 63 MEMB 129 199  
 \*DJ1 126 MEMB 266 267  
 \*DJ2 125 MEMB 266 267  
 \*DJ1 56 MEMB 100 265  
 \*DJ2 50 MEMB 100 265  
 \*DJ1 121 MEMB 254 255 258  
 \*DJ2 120 MEMB 254 255 258  
 \*DJ1 13 MEMB 61 251 257  
 \*DJ2 18 MEMB 61 251 257  
 \*DJ1 117 MEMB 247 248  
 \*DJ2 116 MEMB 247 248  
 \*DJ1 15 MEMB 67 274  
 \*DJ2 20 MEMB 67 274  
 \*TRACK 4 MEMB 1 TO 6 31 TO 57 59 60 62 TO 87 100 TO 110 127 TO 131 133 135 -  
 \*136 TO 137 148 TO 167 176 177 180 182 TO 184 187 189 TO 199 205 206 209 210 -  
 \*220 TO 222 229 230 245 246 252 253 263 TO 265 274  
 \*CHECK CODE ALL  
 \*  
 FINISH

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**15. ANNEXURE G: STAAD INPUT FILE FOR SUBSTRUCTURE ANALYSIS & DESIGN**

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

STAAD SPACE  
START JOB INFORMATION  
ENGINEER DATE 07-Sep-22  
JOB NAME SR0501 (piperack)  
JOB NO X  
JOB REV 00 FOR STRUCTURAL DESIGN  
JOB PART STATUS E  
ENGINEER NAME KHUSHAL PATEL  
CHECKER NAME MURTHY KOLLEPARA  
APPROVED NAME JIGNESH SHAH  
\*SET NL1050

END JOB INFORMATION

INPUT WIDTH 79

UNIT METER KN

JOINT COORDINATES

1 0 0.300001 0; 2 13 0.300001 0; 3 19 0.300001 0; 4 25 0.300001 0;  
5 31 0.300001 0; 6 0 0.300001 4; 7 13 0.300001 4; 8 19 0.300001 4;  
9 25 0.300001 4; 10 31 0.300001 4; 11 0 3.2 0; 12 13 3.2 0; 13 19 3.2 0;  
14 25 3.2 0; 15 31 3.2 0; 16 0 3.2 4; 17 13 3.2 4; 18 19 3.2 4; 19 25 3.2 4;  
20 31 3.2 4; 21 0 5.7 0; 22 13 5.7 0; 23 19 5.7 0; 24 25 5.7 0; 25 31 5.7 0;  
26 0 5.7 4; 27 13 5.7 4; 28 19 5.7 4; 29 25 5.7 4; 30 31 5.7 4; 31 0 8 0;  
32 13 8 0; 33 19 8 0; 34 25 8 0; 35 31 8 0; 36 0 8 4; 37 13 8 4; 38 19 8 4;  
39 25 8 4; 40 31 8 4; 41 4 8 0; 42 7 8 0; 43 10 8 0; 44 4 5.7 0; 45 7 5.7 0;  
46 10 5.7 0; 47 4 8 4; 48 7 8 4; 49 10 8 4; 50 4 3.2 0; 51 7 3.2 0;  
52 10 3.2 0; 53 4 5.7 4; 54 7 5.7 4; 55 10 5.7 4; 56 4 3.2 4; 57 7 3.2 4;  
58 10 3.2 4; 59 16 3.2 4; 60 16 3.2 0; 61 16 5.7 4; 62 16 5.7 0; 63 0 8.9 4;  
64 4 8.9 4; 65 0 8.9 0; 66 4 8.9 0; 67 0 12.1 0; 68 0 12.1 4; 69 13 0.400001 4;  
70 13 0.400001 0; 71 19 0.400001 4; 72 19 0.400001 0; 75 22 5.7 4; 76 28 5.7 4;  
77 22 5.7 0; 78 28 5.7 0; 79 16 8 4; 80 22 8 4; 81 28 8 4; 82 16 8 0;  
83 22 8 0; 84 28 8 0; 85 13 5.7 2; 86 13 8 2; 87 19 5.7 2; 88 19 8 2;  
89 3 8.9 0; 90 3 8.9 4; 91 0 5.7 -1.2; 92 4 5.7 -1.2; 93 0 4.5 0; 94 4 4.5 0;  
95 1.2 5.7 -1.2; 96 2 5.7 -1.2; 97 2 5.7 0; 98 1 8.9 4; 99 2 8.9 4;  
100 1 8.9 0; 101 2 8.9 0; 102 0 8.9 2; 103 13 6.7 0; 104 19 6.7 0;  
105 25 6.7 0; 106 19 9.2 0; 107 25 9.2 0; 108 20.2 9.2 0; 109 3 8.9 2;  
110 0 11.6 0; 111 0 11.6 4; 112 0 8.9 5; 113 4 8.9 5; 114 2 8.9 5;  
115 3.00001 8.9 5; 116 29.5 3.2 4; 117 29.5 3.2 0; 118 29.5 3.2 2;  
119 19 3.2 3.00001; 120 17.5 3.2 4; 121 17.5 3.2 0; 122 17.5 3.2 3.00001;  
123 19 3.2 1.5; 124 17.5 3.2 1.5; 125 3 3.2 4; 126 3 3.2 0; 127 4 3.2 3.00001;  
128 3 3.2 3.00001; 129 31 3.2 2; 130 0 -0.799999 0; 131 13 -0.799999 0;  
132 19 -0.799999 0; 133 25 -0.799999 0; 134 31 -0.799999 0; 135 0 -0.799999 4;  
136 13 -0.799999 4; 137 19 -0.799999 4; 138 25 -0.799999 4; 139 31 -0.799999 4;  
140 0.600001 -0.799999 0; 141 0.600001 -0.799999 4; 142 -0.600001 -0.799999 0;  
143 -0.600001 -0.799999 4; 144 0 -0.799999 -0.600001;  
145 0.600001 -0.799999 -0.600001; 146 -0.600001 -0.799999 -0.600001;  
147 0 -0.799999 4.6; 148 0.600001 -0.799999 4.6; 149 -0.600001 -0.799999 4.6;  
150 -0.600001 -0.799999 -0.400001; 151 -0.400001 -0.799999 -0.400001;  
152 -0.400001 -0.799999 -0.600001; 153 -0.600001 -0.799999 -0.2;  
154 -0.400001 -0.799999 -0.2; 155 -0.400001 -0.799999 0;  
156 -0.2 -0.799999 -0.400001; 157 -0.2 -0.799999 -0.600001;  
158 -0.2 -0.799999 -0.2; 159 -0.2 -0.799999 0; 160 0 -0.799999 -0.400001;  
161 0 -0.799999 -0.2; 162 0.2 -0.799999 -0.400001; 163 0.2 -0.799999 -0.600001;  
164 0.2 -0.799999 -0.2; 165 0.2 -0.799999 0; 166 0.400001 -0.799999 -0.400001;  
167 0.400001 -0.799999 -0.600001; 168 0.400001 -0.799999 -0.2;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

169 0.400001 -0.799999 0; 170 0.600001 -0.799999 -0.400001;  
171 0.600001 -0.799999 -0.2; 172 -0.600001 -0.799999 0.2;  
173 -0.400001 -0.799999 0.2; 174 -0.600001 -0.799999 0.4;  
175 -0.400001 -0.799999 0.4; 176 -0.600001 -0.799999 0.6;  
177 -0.400001 -0.799999 0.6; 178 -0.600001 -0.799999 0.8;  
179 -0.400001 -0.799999 0.8; 180 -0.600001 -0.799999 1;  
181 -0.400001 -0.799999 1; 182 -0.600001 -0.799999 1.2;  
183 -0.400001 -0.799999 1.2; 184 -0.600001 -0.799999 1.4;  
185 -0.400001 -0.799999 1.4; 186 -0.600001 -0.799999 1.6;  
187 -0.400001 -0.799999 1.6; 188 -0.600001 -0.799999 1.8;  
189 -0.400001 -0.799999 1.8; 190 -0.600001 -0.799999 2;  
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193 -0.400001 -0.799999 2.2; 194 -0.600001 -0.799999 2.4;  
195 -0.400001 -0.799999 2.4; 196 -0.600001 -0.799999 2.6;  
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203 -0.400001 -0.799999 3.2; 204 -0.600001 -0.799999 3.4;  
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207 -0.400001 -0.799999 3.6; 208 -0.600001 -0.799999 3.8;  
209 -0.400001 -0.799999 3.8; 210 -0.400001 -0.799999 4; 211 -0.2 -0.799999 0.2;  
212 -0.2 -0.799999 0.4; 213 -0.2 -0.799999 0.6; 214 -0.2 -0.799999 0.8;  
215 -0.2 -0.799999 1; 216 -0.2 -0.799999 1.2; 217 -0.2 -0.799999 1.4;  
218 -0.2 -0.799999 1.6; 219 -0.2 -0.799999 1.8; 220 -0.2 -0.799999 2;  
221 -0.2 -0.799999 2.2; 222 -0.2 -0.799999 2.4; 223 -0.2 -0.799999 2.6;  
224 -0.2 -0.799999 2.8; 225 -0.2 -0.799999 3; 226 -0.2 -0.799999 3.2;  
227 -0.2 -0.799999 3.4; 228 -0.2 -0.799999 3.6; 229 -0.2 -0.799999 3.8;  
230 -0.2 -0.799999 4; 231 0 -0.799999 0.2; 232 0 -0.799999 0.4;  
233 0 -0.799999 0.6; 234 0 -0.799999 0.8; 235 0 -0.799999 1;  
236 0 -0.799999 1.2; 237 0 -0.799999 1.4; 238 0 -0.799999 1.6;  
239 0 -0.799999 1.8; 240 0 -0.799999 2; 241 0 -0.799999 2.2;  
242 0 -0.799999 2.4; 243 0 -0.799999 2.6; 244 0 -0.799999 2.8;  
245 0 -0.799999 3; 246 0 -0.799999 3.2; 247 0 -0.799999 3.4;  
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251 0.2 -0.799999 0.4; 252 0.2 -0.799999 0.6; 253 0.2 -0.799999 0.8;  
254 0.2 -0.799999 1; 255 0.2 -0.799999 1.2; 256 0.2 -0.799999 1.4;  
257 0.2 -0.799999 1.6; 258 0.2 -0.799999 1.8; 259 0.2 -0.799999 2;  
260 0.2 -0.799999 2.2; 261 0.2 -0.799999 2.4; 262 0.2 -0.799999 2.6;  
263 0.2 -0.799999 2.8; 264 0.2 -0.799999 3; 265 0.2 -0.799999 3.2;  
266 0.2 -0.799999 3.4; 267 0.2 -0.799999 3.6; 268 0.2 -0.799999 3.8;  
269 0.2 -0.799999 4; 270 0.400001 -0.799999 0.2; 271 0.400001 -0.799999 0.4;  
272 0.400001 -0.799999 0.6; 273 0.400001 -0.799999 0.8;  
274 0.400001 -0.799999 1; 275 0.400001 -0.799999 1.2;  
276 0.400001 -0.799999 1.4; 277 0.400001 -0.799999 1.6;  
278 0.400001 -0.799999 1.8; 279 0.400001 -0.799999 2;  
280 0.400001 -0.799999 2.2; 281 0.400001 -0.799999 2.4;  
282 0.400001 -0.799999 2.6; 283 0.400001 -0.799999 2.8;  
284 0.400001 -0.799999 3; 285 0.400001 -0.799999 3.2;  
286 0.400001 -0.799999 3.4; 287 0.400001 -0.799999 3.6;  
288 0.400001 -0.799999 3.8; 289 0.400001 -0.799999 4;  
290 0.600001 -0.799999 0.2; 291 0.600001 -0.799999 0.4;  
292 0.600001 -0.799999 0.6; 293 0.600001 -0.799999 0.8;  
294 0.600001 -0.799999 1; 295 0.600001 -0.799999 1.2;  
296 0.600001 -0.799999 1.4; 297 0.600001 -0.799999 1.6;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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 302 0.600001 -0.799999 2.6; 303 0.600001 -0.799999 2.8;  
 304 0.600001 -0.799999 3; 305 0.600001 -0.799999 3.2;  
 306 0.600001 -0.799999 3.4; 307 0.600001 -0.799999 3.6;  
 308 0.600001 -0.799999 3.8; 309 -0.600001 -0.799999 4.2;  
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 317 0 -0.799999 4.2; 318 0 -0.799999 4.4; 319 0.2 -0.799999 4.2;  
 320 0.2 -0.799999 4.4; 321 0.2 -0.799999 4.6; 322 0.400001 -0.799999 4.2;  
 323 0.400001 -0.799999 4.4; 324 0.400001 -0.799999 4.6;  
 325 0.600001 -0.799999 4.2; 326 0.600001 -0.799999 4.4; 327 12.4 -0.799999 0;  
 328 12.4 -0.799999 4; 329 13.6 -0.799999 0; 330 13.6 -0.799999 4;  
 331 18.4 -0.799999 0; 332 18.4 -0.799999 4; 333 19.6 -0.799999 0;  
 334 19.6 -0.799999 4; 335 13 -0.799999 -0.600001; 336 19 -0.799999 -0.600001;  
 337 12.4 -0.799999 -0.600001; 338 13.6 -0.799999 -0.600001;  
 339 18.4 -0.799999 -0.600001; 340 19.6 -0.799999 -0.600001;  
 341 13 -0.799999 4.6; 342 19 -0.799999 4.6; 343 12.4 -0.799999 4.6;  
 344 13.6 -0.799999 4.6; 345 18.4 -0.799999 4.6; 346 19.6 -0.799999 4.6;  
 347 12.4 -0.799999 -0.400001; 348 12.6 -0.799999 -0.400001;  
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 352 12.6 -0.799999 0; 353 12.8 -0.799999 -0.400001;  
 354 12.8 -0.799999 -0.600001; 355 12.8 -0.799999 -0.2; 356 12.8 -0.799999 0;  
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 376 12.8 -0.799999 4; 377 12.8 -0.799999 4.4; 378 12.8 -0.799999 4.6;  
 379 13 -0.799999 4.2; 380 13 -0.799999 4.4; 381 13.2 -0.799999 4.2;  
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 391 18.4 -0.799999 -0.400001; 392 18.6 -0.799999 -0.400001;  
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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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444 12.6 -0.799999 1; 445 12.4 -0.799999 1.2; 446 12.6 -0.799999 1.2;  
447 12.4 -0.799999 1.4; 448 12.6 -0.799999 1.4; 449 12.4 -0.799999 1.6;  
450 12.6 -0.799999 1.6; 451 12.4 -0.799999 1.8; 452 12.6 -0.799999 1.8;  
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459 12.4 -0.799999 2.6; 460 12.6 -0.799999 2.6; 461 12.4 -0.799999 2.8;  
462 12.6 -0.799999 2.8; 463 12.4 -0.799999 3; 464 12.6 -0.799999 3;  
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477 12.8 -0.799999 1; 478 12.8 -0.799999 1.2; 479 12.8 -0.799999 1.4;  
480 12.8 -0.799999 1.6; 481 12.8 -0.799999 1.8; 482 12.8 -0.799999 2;  
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540 13.4 -0.799999 2.2; 541 13.4 -0.799999 2.4; 542 13.4 -0.799999 2.6;  
543 13.4 -0.799999 2.8; 544 13.4 -0.799999 3; 545 13.4 -0.799999 3.2;  
546 13.4 -0.799999 3.4; 547 13.4 -0.799999 3.6; 548 13.4 -0.799999 3.8;  
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552 13.6 -0.799999 0.8; 553 13.6 -0.799999 1; 554 13.6 -0.799999 1.2;  
555 13.6 -0.799999 1.4; 556 13.6 -0.799999 1.6; 557 13.6 -0.799999 1.8;  
558 13.6 -0.799999 2; 559 13.6 -0.799999 2.2; 560 13.6 -0.799999 2.4;  
561 13.6 -0.799999 2.6; 562 13.6 -0.799999 2.8; 563 13.6 -0.799999 3;  
564 13.6 -0.799999 3.2; 565 13.6 -0.799999 3.4; 566 13.6 -0.799999 3.6;  
567 13.6 -0.799999 3.8; 568 18.4 -0.799999 0.2; 569 18.6 -0.799999 0.2;  
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573 18.6 -0.799999 0.6; 574 18.4 -0.799999 0.8; 575 18.6 -0.799999 0.8;  
576 18.4 -0.799999 1; 577 18.6 -0.799999 1; 578 18.4 -0.799999 1.2;  
579 18.6 -0.799999 1.2; 580 18.4 -0.799999 1.4; 581 18.6 -0.799999 1.4;  
582 18.4 -0.799999 1.6; 583 18.6 -0.799999 1.6; 584 18.4 -0.799999 1.8;  
585 18.6 -0.799999 1.8; 586 18.4 -0.799999 2; 587 18.6 -0.799999 2;  
588 18.4 -0.799999 2.2; 589 18.6 -0.799999 2.2; 590 18.4 -0.799999 2.4;  
591 18.6 -0.799999 2.4; 592 18.4 -0.799999 2.6; 593 18.6 -0.799999 2.6;  
594 18.4 -0.799999 2.8; 595 18.6 -0.799999 2.8; 596 18.4 -0.799999 3;  
597 18.6 -0.799999 3; 598 18.4 -0.799999 3.2; 599 18.6 -0.799999 3.2;  
600 18.4 -0.799999 3.4; 601 18.6 -0.799999 3.4; 602 18.4 -0.799999 3.6;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

603 18.6 -0.799999 3.6; 604 18.4 -0.799999 3.8; 605 18.6 -0.799999 3.8;  
606 18.8 -0.799999 0.2; 607 18.8 -0.799999 0.4; 608 18.8 -0.799999 0.6;  
609 18.8 -0.799999 0.8; 610 18.8 -0.799999 1; 611 18.8 -0.799999 1.2;  
612 18.8 -0.799999 1.4; 613 18.8 -0.799999 1.6; 614 18.8 -0.799999 1.8;  
615 18.8 -0.799999 2; 616 18.8 -0.799999 2.2; 617 18.8 -0.799999 2.4;  
618 18.8 -0.799999 2.6; 619 18.8 -0.799999 2.8; 620 18.8 -0.799999 3;  
621 18.8 -0.799999 3.2; 622 18.8 -0.799999 3.4; 623 18.8 -0.799999 3.6;  
624 18.8 -0.799999 3.8; 625 19 -0.799999 0.2; 626 19 -0.799999 0.4;  
627 19 -0.799999 0.6; 628 19 -0.799999 0.8; 629 19 -0.799999 1;  
630 19 -0.799999 1.2; 631 19 -0.799999 1.4; 632 19 -0.799999 1.6;  
633 19 -0.799999 1.8; 634 19 -0.799999 2; 635 19 -0.799999 2.2;  
636 19 -0.799999 2.4; 637 19 -0.799999 2.6; 638 19 -0.799999 2.8;  
639 19 -0.799999 3; 640 19 -0.799999 3.2; 641 19 -0.799999 3.4;  
642 19 -0.799999 3.6; 643 19 -0.799999 3.8; 644 19.2 -0.799999 0.2;  
645 19.2 -0.799999 0.4; 646 19.2 -0.799999 0.6; 647 19.2 -0.799999 0.8;  
648 19.2 -0.799999 1; 649 19.2 -0.799999 1.2; 650 19.2 -0.799999 1.4;  
651 19.2 -0.799999 1.6; 652 19.2 -0.799999 1.8; 653 19.2 -0.799999 2;  
654 19.2 -0.799999 2.2; 655 19.2 -0.799999 2.4; 656 19.2 -0.799999 2.6;  
657 19.2 -0.799999 2.8; 658 19.2 -0.799999 3; 659 19.2 -0.799999 3.2;  
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666 19.4 -0.799999 0.8; 667 19.4 -0.799999 1; 668 19.4 -0.799999 1.2;  
669 19.4 -0.799999 1.4; 670 19.4 -0.799999 1.6; 671 19.4 -0.799999 1.8;  
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678 19.4 -0.799999 3.2; 679 19.4 -0.799999 3.4; 680 19.4 -0.799999 3.6;  
681 19.4 -0.799999 3.8; 682 19.6 -0.799999 0.2; 683 19.6 -0.799999 0.4;  
684 19.6 -0.799999 0.6; 685 19.6 -0.799999 0.8; 686 19.6 -0.799999 1;  
687 19.6 -0.799999 1.2; 688 19.6 -0.799999 1.4; 689 19.6 -0.799999 1.6;  
690 19.6 -0.799999 1.8; 691 19.6 -0.799999 2; 692 19.6 -0.799999 2.2;  
693 19.6 -0.799999 2.4; 694 19.6 -0.799999 2.6; 695 19.6 -0.799999 2.8;  
696 19.6 -0.799999 3; 697 19.6 -0.799999 3.2; 698 19.6 -0.799999 3.4;  
699 19.6 -0.799999 3.6; 700 19.6 -0.799999 3.8; 701 13.8 -0.799999 -0.400001;  
702 13.8 -0.799999 -0.600001; 703 13.8 -0.799999 -0.200001;  
704 13.8 -0.799999 -7.55613e-07; 705 13.8 -0.799999 0.199999;  
706 13.8 -0.799999 0.399999; 707 13.8 -0.799999 0.6; 708 13.8 -0.799999 0.8;  
709 13.8 -0.799999 1; 710 14 -0.799999 -0.400001; 711 14 -0.799999 -0.600001;  
712 14 -0.799999 -0.200001; 713 14 -0.799999 -7.58717e-07;  
714 14 -0.799999 0.199999; 715 14 -0.799999 0.4; 716 14 -0.799999 0.6;  
717 14 -0.799999 0.8; 718 14 -0.799999 1; 719 14.2 -0.799999 -0.400001;  
720 14.2 -0.799999 -0.600001; 721 14.2 -0.799999 -0.200001;  
722 14.2 -0.799999 -7.76723e-07; 723 14.2 -0.799999 0.199999;  
724 14.2 -0.799999 0.399999; 725 14.2 -0.799999 0.6; 726 14.2 -0.799999 0.8;  
727 14.2 -0.799999 1; 728 14.4 -0.799999 -0.400001;  
729 14.4 -0.799999 -0.600001; 730 14.4 -0.799999 -0.200001;  
731 14.4 -0.799999 -7.55613e-07; 732 14.4 -0.799999 0.199999;  
733 14.4 -0.799999 0.399999; 734 14.4 -0.799999 0.6; 735 14.4 -0.799999 0.8;  
736 14.4 -0.799999 1; 737 14.6 -0.799999 -0.400001;  
738 14.6 -0.799999 -0.600001; 739 14.6 -0.799999 -0.200001;  
740 14.6 -0.799999 -7.56855e-07; 741 14.6 -0.799999 0.199999;  
742 14.6 -0.799999 0.399999; 743 14.6 -0.799999 0.6; 744 14.6 -0.799999 0.8;  
745 14.6 -0.799999 1; 746 14.8 -0.799999 -0.400001;  
747 14.8 -0.799999 -0.600001; 748 14.8 -0.799999 -0.200001;  
749 14.8 -0.799999 -7.59959e-07; 750 14.8 -0.799999 0.199999;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

751 14.8 -0.799999 0.399999; 752 14.8 -0.799999 0.6; 753 14.8 -0.799999 0.8;  
754 14.8 -0.799999 1; 755 15 -0.799999 -0.400001; 756 15 -0.799999 -0.600001;  
757 15 -0.799999 -0.200001; 758 15 -0.799999 -7.66789e-07;  
759 15 -0.799999 0.199999; 760 15 -0.799999 0.399999; 761 15 -0.799999 0.6;  
762 15 -0.799999 0.8; 763 15 -0.799999 1; 764 15.2 -0.799999 -0.400001;  
765 15.2 -0.799999 -0.600001; 766 15.2 -0.799999 -0.200001;  
767 15.2 -0.799999 -7.64305e-07; 768 15.2 -0.799999 0.199999;  
769 15.2 -0.799999 0.4; 770 15.2 -0.799999 0.6; 771 15.2 -0.799999 0.8;  
772 15.2 -0.799999 1; 773 15.4 -0.799999 -0.400001;  
774 15.4 -0.799999 -0.600001; 775 15.4 -0.799999 -0.200001;  
776 15.4 -0.799999 -7.43195e-07; 777 15.4 -0.799999 0.199999;  
778 15.4 -0.799999 0.4; 779 15.4 -0.799999 0.6; 780 15.4 -0.799999 0.8;  
781 15.4 -0.799999 1; 782 15.6 -0.799999 -0.400001;  
783 15.6 -0.799999 -0.600001; 784 15.6 -0.799999 -0.200001;  
785 15.6 -0.799999 -7.50025e-07; 786 15.6 -0.799999 0.199999;  
787 15.6 -0.799999 0.399999; 788 15.6 -0.799999 0.6; 789 15.6 -0.799999 0.8;  
790 15.6 -0.799999 1; 791 15.8 -0.799999 -0.400001;  
792 15.8 -0.799999 -0.600001; 793 15.8 -0.799999 -0.200001;  
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804 16 -0.799999 0.199999; 805 16 -0.799999 0.4; 806 16 -0.799999 0.6;  
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814 16.2 -0.799999 0.4; 815 16.2 -0.799999 0.6; 816 16.2 -0.799999 0.8;  
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819 16.4 -0.799999 -0.600001; 820 16.4 -0.799999 -0.200001;  
821 16.4 -0.799999 -7.40091e-07; 822 16.4 -0.799999 0.199999;  
823 16.4 -0.799999 0.4; 824 16.4 -0.799999 0.6; 825 16.4 -0.799999 0.8;  
826 16.4 -0.799999 1; 827 16.6 -0.799999 -0.400001;  
828 16.6 -0.799999 -0.600001; 829 16.6 -0.799999 -0.200001;  
830 16.6 -0.799999 -7.37607e-07; 831 16.6 -0.799999 0.199999;  
832 16.6 -0.799999 0.4; 833 16.6 -0.799999 0.6; 834 16.6 -0.799999 0.8;  
835 16.6 -0.799999 1; 836 16.8 -0.799999 -0.400001;  
837 16.8 -0.799999 -0.600001; 838 16.8 -0.799999 -0.200001;  
839 16.8 -0.799999 -7.35124e-07; 840 16.8 -0.799999 0.199999;  
841 16.8 -0.799999 0.4; 842 16.8 -0.799999 0.6; 843 16.8 -0.799999 0.8;  
844 16.8 -0.799999 1; 845 17 -0.799999 -0.400001; 846 17 -0.799999 -0.600001;  
847 17 -0.799999 -0.200001; 848 17 -0.799999 -7.51267e-07;  
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852 17 -0.799999 0.8; 853 17 -0.799999 1; 854 17.2 -0.799999 -0.400001;  
855 17.2 -0.799999 -0.600001; 856 17.2 -0.799999 -0.200001;  
857 17.2 -0.799999 -7.30157e-07; 858 17.2 -0.799999 0.199999;  
859 17.2 -0.799999 0.4; 860 17.2 -0.799999 0.6; 861 17.2 -0.799999 0.8;  
862 17.2 -0.799999 1; 863 17.4 -0.799999 -0.400001;  
864 17.4 -0.799999 -0.600001; 865 17.4 -0.799999 -0.200001;  
866 17.4 -0.799999 -7.27673e-07; 867 17.4 -0.799999 0.199999;  
868 17.4 -0.799999 0.4; 869 17.4 -0.799999 0.6; 870 17.4 -0.799999 0.8;  
871 17.4 -0.799999 1; 872 17.6 -0.799999 -0.400001;  
873 17.6 -0.799999 -0.600001; 874 17.6 -0.799999 -0.200001;  
875 17.6 -0.799999 -7.2519e-07; 876 17.6 -0.799999 0.199999;  
877 17.6 -0.799999 0.4; 878 17.6 -0.799999 0.6; 879 17.6 -0.799999 0.8;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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882 17.8 -0.799999 -0.600001; 883 17.8 -0.799999 -0.200001;  
884 17.8 -0.799999 -7.59959e-07; 885 17.8 -0.799999 0.199999;  
886 17.8 -0.799999 0.4; 887 17.8 -0.799999 0.6; 888 17.8 -0.799999 0.8;  
889 17.8 -0.799999 1; 890 18 -0.799999 -0.400001; 891 18 -0.799999 -0.600001;  
892 18 -0.799999 -0.200001; 893 18 -0.799999 -7.20223e-07;  
894 18 -0.799999 0.199999; 895 18 -0.799999 0.4; 896 18 -0.799999 0.6;  
897 18 -0.799999 0.8; 898 18 -0.799999 1; 899 18.2 -0.799999 -0.400001;  
900 18.2 -0.799999 -0.600001; 901 18.2 -0.799999 -0.200001;  
902 18.2 -0.799999 -7.17739e-07; 903 18.2 -0.799999 0.199999;  
904 18.2 -0.799999 0.4; 905 18.2 -0.799999 0.6; 906 18.2 -0.799999 0.8;  
907 18.2 -0.799999 1; 908 13.8 -0.799999 3.6; 909 13.8 -0.799999 3.4;  
910 13.8 -0.799999 3.8; 911 13.8 -0.799999 4; 912 13.8 -0.799999 4.2;  
913 13.8 -0.799999 4.4; 914 13.8 -0.799999 4.6; 915 14 -0.799999 3.6;  
916 14 -0.799999 3.4; 917 14 -0.799999 3.8; 918 14 -0.799999 4;  
919 14 -0.799999 4.2; 920 14 -0.799999 4.4; 921 14 -0.799999 4.6;  
922 14.2 -0.799999 3.6; 923 14.2 -0.799999 3.4; 924 14.2 -0.799999 3.8;  
925 14.2 -0.799999 4; 926 14.2 -0.799999 4.2; 927 14.2 -0.799999 4.4;  
928 14.2 -0.799999 4.6; 929 14.4 -0.799999 3.6; 930 14.4 -0.799999 3.4;  
931 14.4 -0.799999 3.8; 932 14.4 -0.799999 4; 933 14.4 -0.799999 4.2;  
934 14.4 -0.799999 4.4; 935 14.4 -0.799999 4.6; 936 14.6 -0.799999 3.6;  
937 14.6 -0.799999 3.4; 938 14.6 -0.799999 3.8; 939 14.6 -0.799999 4;  
940 14.6 -0.799999 4.2; 941 14.6 -0.799999 4.4; 942 14.6 -0.799999 4.6;  
943 14.8 -0.799999 3.6; 944 14.8 -0.799999 3.4; 945 14.8 -0.799999 3.8;  
946 14.8 -0.799999 4; 947 14.8 -0.799999 4.2; 948 14.8 -0.799999 4.4;  
949 14.8 -0.799999 4.6; 950 15 -0.799999 3.6; 951 15 -0.799999 3.4;  
952 15 -0.799999 3.8; 953 15 -0.799999 4; 954 15 -0.799999 4.2;  
955 15 -0.799999 4.4; 956 15 -0.799999 4.6; 957 15.2 -0.799999 3.6;  
958 15.2 -0.799999 3.4; 959 15.2 -0.799999 3.8; 960 15.2 -0.799999 4;  
961 15.2 -0.799999 4.2; 962 15.2 -0.799999 4.4; 963 15.2 -0.799999 4.6;  
964 15.4 -0.799999 3.6; 965 15.4 -0.799999 3.4; 966 15.4 -0.799999 3.8;  
967 15.4 -0.799999 4; 968 15.4 -0.799999 4.2; 969 15.4 -0.799999 4.4;  
970 15.4 -0.799999 4.6; 971 15.6 -0.799999 3.6; 972 15.6 -0.799999 3.4;  
973 15.6 -0.799999 3.8; 974 15.6 -0.799999 4; 975 15.6 -0.799999 4.2;  
976 15.6 -0.799999 4.4; 977 15.6 -0.799999 4.6; 978 15.8 -0.799999 3.6;  
979 15.8 -0.799999 3.4; 980 15.8 -0.799999 3.8; 981 15.8 -0.799999 4;  
982 15.8 -0.799999 4.2; 983 15.8 -0.799999 4.4; 984 15.8 -0.799999 4.6;  
985 16 -0.799999 3.6; 986 16 -0.799999 3.4; 987 16 -0.799999 3.8;  
988 16 -0.799999 4; 989 16 -0.799999 4.2; 990 16 -0.799999 4.4;  
991 16 -0.799999 4.6; 992 16.2 -0.799999 3.6; 993 16.2 -0.799999 3.4;  
994 16.2 -0.799999 3.8; 995 16.2 -0.799999 4; 996 16.2 -0.799999 4.2;  
997 16.2 -0.799999 4.4; 998 16.2 -0.799999 4.6; 999 16.4 -0.799999 3.6;  
1000 16.4 -0.799999 3.4; 1001 16.4 -0.799999 3.8; 1002 16.4 -0.799999 4;  
1003 16.4 -0.799999 4.2; 1004 16.4 -0.799999 4.4; 1005 16.4 -0.799999 4.6;  
1006 16.6 -0.799999 3.6; 1007 16.6 -0.799999 3.4; 1008 16.6 -0.799999 3.8;  
1009 16.6 -0.799999 4; 1010 16.6 -0.799999 4.2; 1011 16.6 -0.799999 4.4;  
1012 16.6 -0.799999 4.6; 1013 16.8 -0.799999 3.6; 1014 16.8 -0.799999 3.4;  
1015 16.8 -0.799999 3.8; 1016 16.8 -0.799999 4; 1017 16.8 -0.799999 4.2;  
1018 16.8 -0.799999 4.4; 1019 16.8 -0.799999 4.6; 1020 17 -0.799999 3.6;  
1021 17 -0.799999 3.4; 1022 17 -0.799999 3.8; 1023 17 -0.799999 4;  
1024 17 -0.799999 4.2; 1025 17 -0.799999 4.4; 1026 17 -0.799999 4.6;  
1027 17.2 -0.799999 3.6; 1028 17.2 -0.799999 3.4; 1029 17.2 -0.799999 3.8;  
1030 17.2 -0.799999 4; 1031 17.2 -0.799999 4.2; 1032 17.2 -0.799999 4.4;  
1033 17.2 -0.799999 4.6; 1034 17.4 -0.799999 3.6; 1035 17.4 -0.799999 3.4;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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1039 17.4 -0.799999 4.4; 1040 17.4 -0.799999 4.6; 1041 17.6 -0.799999 3.6;  
1042 17.6 -0.799999 3.4; 1043 17.6 -0.799999 3.8; 1044 17.6 -0.799999 4;  
1045 17.6 -0.799999 4.2; 1046 17.6 -0.799999 4.4; 1047 17.6 -0.799999 4.6;  
1048 17.8 -0.799999 3.6; 1049 17.8 -0.799999 3.4; 1050 17.8 -0.799999 3.8;  
1051 17.8 -0.799999 4; 1052 17.8 -0.799999 4.2; 1053 17.8 -0.799999 4.4;  
1054 17.8 -0.799999 4.6; 1055 18 -0.799999 3.6; 1056 18 -0.799999 3.4;  
1057 18 -0.799999 3.8; 1058 18 -0.799999 4; 1059 18 -0.799999 4.2;  
1060 18 -0.799999 4.4; 1061 18 -0.799999 4.6; 1062 18.2 -0.799999 3.6;  
1063 18.2 -0.799999 3.4; 1064 18.2 -0.799999 3.8; 1065 18.2 -0.799999 4;  
1066 18.2 -0.799999 4.2; 1067 18.2 -0.799999 4.4; 1068 18.2 -0.799999 4.6;  
1069 24.4 -0.799999 0; 1070 30.4 -0.799999 0; 1071 24.4 -0.799999 4;  
1072 30.4 -0.799999 4; 1073 25.6 -0.799999 0; 1074 31.6 -0.799999 0;  
1075 25.6 -0.799999 4; 1076 31.6 -0.799999 4; 1077 25 -0.799999 -0.600001;  
1078 31 -0.799999 -0.600001; 1079 24.4 -0.799999 -0.600001;  
1080 30.4 -0.799999 -0.600001; 1081 25.6 -0.799999 -0.600001;  
1082 31.6 -0.799999 -0.600001; 1083 25 -0.799999 4.6; 1084 31 -0.799999 4.6;  
1085 24.4 -0.799999 4.6; 1086 30.4 -0.799999 4.6; 1087 25.6 -0.799999 4.6;  
1088 31.6 -0.799999 4.6; 1089 24.4 -0.799999 -0.400001;  
1090 24.6 -0.799999 -0.400001; 1091 24.6 -0.799999 -0.600001;  
1092 24.4 -0.799999 -0.2; 1093 24.6 -0.799999 -0.2; 1094 24.6 -0.799999 0;  
1095 24.8 -0.799999 -0.400001; 1096 24.8 -0.799999 -0.600001;  
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1100 25 -0.799999 -0.2; 1101 25.2 -0.799999 -0.400001;  
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1105 25.4 -0.799999 -0.400001; 1106 25.4 -0.799999 -0.600001;  
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1110 25.6 -0.799999 -0.2; 1111 24.4 -0.799999 4.2; 1112 24.6 -0.799999 4.2;  
1113 24.6 -0.799999 4; 1114 24.4 -0.799999 4.4; 1115 24.6 -0.799999 4.4;  
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1119 24.8 -0.799999 4.4; 1120 24.8 -0.799999 4.6; 1121 25 -0.799999 4.2;  
1122 25 -0.799999 4.4; 1123 25.2 -0.799999 4.2; 1124 25.2 -0.799999 4;  
1125 25.2 -0.799999 4.4; 1126 25.2 -0.799999 4.6; 1127 25.4 -0.799999 4.2;  
1128 25.4 -0.799999 4; 1129 25.4 -0.799999 4.4; 1130 25.4 -0.799999 4.6;  
1131 25.6 -0.799999 4.2; 1132 25.6 -0.799999 4.4;  
1133 30.4 -0.799999 -0.400001; 1134 30.6 -0.799999 -0.400001;  
1135 30.6 -0.799999 -0.600001; 1136 30.4 -0.799999 -0.2;  
1137 30.6 -0.799999 -0.2; 1138 30.6 -0.799999 0; 1139 30.8 -0.799999 -0.400001;  
1140 30.8 -0.799999 -0.600001; 1141 30.8 -0.799999 -0.2; 1142 30.8 -0.799999 0;  
1143 31 -0.799999 -0.400001; 1144 31 -0.799999 -0.2;  
1145 31.2 -0.799999 -0.400001; 1146 31.2 -0.799999 -0.600001;  
1147 31.2 -0.799999 -0.2; 1148 31.2 -0.799999 0; 1149 31.4 -0.799999 -0.400001;  
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1155 30.4 -0.799999 4.2; 1156 30.6 -0.799999 4.2; 1157 30.6 -0.799999 4;  
1158 30.4 -0.799999 4.4; 1159 30.6 -0.799999 4.4; 1160 30.6 -0.799999 4.6;  
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1167 31.2 -0.799999 4.2; 1168 31.2 -0.799999 4; 1169 31.2 -0.799999 4.4;  
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1173 31.4 -0.799999 4.4; 1174 31.4 -0.799999 4.6; 1175 31.6 -0.799999 4.2;  
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1179 24.4 -0.799999 0.4; 1180 24.6 -0.799999 0.4; 1181 24.4 -0.799999 0.6;  
1182 24.6 -0.799999 0.6; 1183 24.4 -0.799999 0.8; 1184 24.6 -0.799999 0.8;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

1185 24.4 -0.799999 1; 1186 24.6 -0.799999 1; 1187 24.4 -0.799999 1.2;  
 1188 24.6 -0.799999 1.2; 1189 24.4 -0.799999 1.4; 1190 24.6 -0.799999 1.4;  
 1191 24.4 -0.799999 1.6; 1192 24.6 -0.799999 1.6; 1193 24.4 -0.799999 1.8;  
 1194 24.6 -0.799999 1.8; 1195 24.4 -0.799999 2; 1196 24.6 -0.799999 2;  
 1197 24.4 -0.799999 2.2; 1198 24.6 -0.799999 2.2; 1199 24.4 -0.799999 2.4;  
 1200 24.6 -0.799999 2.4; 1201 24.4 -0.799999 2.6; 1202 24.6 -0.799999 2.6;  
 1203 24.4 -0.799999 2.8; 1204 24.6 -0.799999 2.8; 1205 24.4 -0.799999 3;  
 1206 24.6 -0.799999 3; 1207 24.4 -0.799999 3.2; 1208 24.6 -0.799999 3.2;  
 1209 24.4 -0.799999 3.4; 1210 24.6 -0.799999 3.4; 1211 24.4 -0.799999 3.6;  
 1212 24.6 -0.799999 3.6; 1213 24.4 -0.799999 3.8; 1214 24.6 -0.799999 3.8;  
 1215 24.8 -0.799999 0.2; 1216 24.8 -0.799999 0.4; 1217 24.8 -0.799999 0.6;  
 1218 24.8 -0.799999 0.8; 1219 24.8 -0.799999 1; 1220 24.8 -0.799999 1.2;  
 1221 24.8 -0.799999 1.4; 1222 24.8 -0.799999 1.6; 1223 24.8 -0.799999 1.8;  
 1224 24.8 -0.799999 2; 1225 24.8 -0.799999 2.2; 1226 24.8 -0.799999 2.4;  
 1227 24.8 -0.799999 2.6; 1228 24.8 -0.799999 2.8; 1229 24.8 -0.799999 3;  
 1230 24.8 -0.799999 3.2; 1231 24.8 -0.799999 3.4; 1232 24.8 -0.799999 3.6;  
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 1236 25 -0.799999 0.6; 1237 25 -0.799999 0.8; 1238 25 -0.799999 1;  
 1239 25 -0.799999 1.2; 1240 25 -0.799999 1.4; 1241 25 -0.799999 1.6;  
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 1257 25.2 -0.799999 1; 1258 25.2 -0.799999 1.2; 1259 25.2 -0.799999 1.4;  
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 1284 25.4 -0.799999 2.6; 1285 25.4 -0.799999 2.8; 1286 25.4 -0.799999 3;  
 1287 25.4 -0.799999 3.2; 1288 25.4 -0.799999 3.4; 1289 25.4 -0.799999 3.6;  
 1290 25.4 -0.799999 3.8; 1291 25.6 -0.799999 0.2; 1292 25.6 -0.799999 0.4;  
 1293 25.6 -0.799999 0.6; 1294 25.6 -0.799999 0.8; 1295 25.6 -0.799999 1;  
 1296 25.6 -0.799999 1.2; 1297 25.6 -0.799999 1.4; 1298 25.6 -0.799999 1.6;  
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 1302 25.6 -0.799999 2.4; 1303 25.6 -0.799999 2.6; 1304 25.6 -0.799999 2.8;  
 1305 25.6 -0.799999 3; 1306 25.6 -0.799999 3.2; 1307 25.6 -0.799999 3.4;  
 1308 25.6 -0.799999 3.6; 1309 25.6 -0.799999 3.8; 1310 30.4 -0.799999 0.2;  
 1311 30.6 -0.799999 0.2; 1312 30.4 -0.799999 0.4; 1313 30.6 -0.799999 0.4;  
 1314 30.4 -0.799999 0.6; 1315 30.6 -0.799999 0.6; 1316 30.4 -0.799999 0.8;  
 1317 30.6 -0.799999 0.8; 1318 30.4 -0.799999 1; 1319 30.6 -0.799999 1;  
 1320 30.4 -0.799999 1.2; 1321 30.6 -0.799999 1.2; 1322 30.4 -0.799999 1.4;  
 1323 30.6 -0.799999 1.4; 1324 30.4 -0.799999 1.6; 1325 30.6 -0.799999 1.6;  
 1326 30.4 -0.799999 1.8; 1327 30.6 -0.799999 1.8; 1328 30.4 -0.799999 2;  
 1329 30.6 -0.799999 2; 1330 30.4 -0.799999 2.2; 1331 30.6 -0.799999 2.2;  
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 1338 30.4 -0.799999 3; 1339 30.6 -0.799999 3; 1340 30.4 -0.799999 3.2;  
 1341 30.6 -0.799999 3.2; 1342 30.4 -0.799999 3.4; 1343 30.6 -0.799999 3.4;  
 1344 30.4 -0.799999 3.6; 1345 30.6 -0.799999 3.6; 1346 30.4 -0.799999 3.8;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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1353 30.8 -0.799999 1.2; 1354 30.8 -0.799999 1.4; 1355 30.8 -0.799999 1.6;  
1356 30.8 -0.799999 1.8; 1357 30.8 -0.799999 2; 1358 30.8 -0.799999 2.2;  
1359 30.8 -0.799999 2.4; 1360 30.8 -0.799999 2.6; 1361 30.8 -0.799999 2.8;  
1362 30.8 -0.799999 3; 1363 30.8 -0.799999 3.2; 1364 30.8 -0.799999 3.4;  
1365 30.8 -0.799999 3.6; 1366 30.8 -0.799999 3.8; 1367 31 -0.799999 0.2;  
1368 31 -0.799999 0.4; 1369 31 -0.799999 0.6; 1370 31 -0.799999 0.8;  
1371 31 -0.799999 1; 1372 31 -0.799999 1.2; 1373 31 -0.799999 1.4;  
1374 31 -0.799999 1.6; 1375 31 -0.799999 1.8; 1376 31 -0.799999 2;  
1377 31 -0.799999 2.2; 1378 31 -0.799999 2.4; 1379 31 -0.799999 2.6;  
1380 31 -0.799999 2.8; 1381 31 -0.799999 3; 1382 31 -0.799999 3.2;  
1383 31 -0.799999 3.4; 1384 31 -0.799999 3.6; 1385 31 -0.799999 3.8;  
1386 31.2 -0.799999 0.2; 1387 31.2 -0.799999 0.4; 1388 31.2 -0.799999 0.6;  
1389 31.2 -0.799999 0.8; 1390 31.2 -0.799999 1; 1391 31.2 -0.799999 1.2;  
1392 31.2 -0.799999 1.4; 1393 31.2 -0.799999 1.6; 1394 31.2 -0.799999 1.8;  
1395 31.2 -0.799999 2; 1396 31.2 -0.799999 2.2; 1397 31.2 -0.799999 2.4;  
1398 31.2 -0.799999 2.6; 1399 31.2 -0.799999 2.8; 1400 31.2 -0.799999 3;  
1401 31.2 -0.799999 3.2; 1402 31.2 -0.799999 3.4; 1403 31.2 -0.799999 3.6;  
1404 31.2 -0.799999 3.8; 1405 31.4 -0.799999 0.2; 1406 31.4 -0.799999 0.4;  
1407 31.4 -0.799999 0.6; 1408 31.4 -0.799999 0.8; 1409 31.4 -0.799999 1;  
1410 31.4 -0.799999 1.2; 1411 31.4 -0.799999 1.4; 1412 31.4 -0.799999 1.6;  
1413 31.4 -0.799999 1.8; 1414 31.4 -0.799999 2; 1415 31.4 -0.799999 2.2;  
1416 31.4 -0.799999 2.4; 1417 31.4 -0.799999 2.6; 1418 31.4 -0.799999 2.8;  
1419 31.4 -0.799999 3; 1420 31.4 -0.799999 3.2; 1421 31.4 -0.799999 3.4;  
1422 31.4 -0.799999 3.6; 1423 31.4 -0.799999 3.8; 1424 31.6 -0.799999 0.2;  
1425 31.6 -0.799999 0.4; 1426 31.6 -0.799999 0.6; 1427 31.6 -0.799999 0.8;  
1428 31.6 -0.799999 1; 1429 31.6 -0.799999 1.2; 1430 31.6 -0.799999 1.4;  
1431 31.6 -0.799999 1.6; 1432 31.6 -0.799999 1.8; 1433 31.6 -0.799999 2;  
1434 31.6 -0.799999 2.2; 1435 31.6 -0.799999 2.4; 1436 31.6 -0.799999 2.6;  
1437 31.6 -0.799999 2.8; 1438 31.6 -0.799999 3; 1439 31.6 -0.799999 3.2;  
1440 31.6 -0.799999 3.4; 1441 31.6 -0.799999 3.6; 1442 31.6 -0.799999 3.8;  
1443 25.8 -0.799999 -0.400001; 1444 25.8 -0.799999 -0.600001;  
1445 25.8 -0.799999 -0.200001; 1446 25.8 -0.799999 -8.76207e-07;  
1447 25.8 -0.799999 0.199999; 1448 25.8 -0.799999 0.399999;  
1449 25.8 -0.799999 0.599999; 1450 25.8 -0.799999 0.8; 1451 25.8 -0.799999 1;  
1452 25.8 -0.799999 1.2; 1453 25.8 -0.799999 1.4; 1454 25.8 -0.799999 1.6;  
1455 25.8 -0.799999 1.8; 1456 25.8 -0.799999 2; 1457 26 -0.799999 -0.400001;  
1458 26 -0.799999 -0.600001; 1459 26 -0.799999 -0.200001;  
1460 26 -0.799999 -8.85282e-07; 1461 26 -0.799999 0.199999;  
1462 26 -0.799999 0.399999; 1463 26 -0.799999 0.599999; 1464 26 -0.799999 0.8;  
1465 26 -0.799999 1; 1466 26 -0.799999 1.2; 1467 26 -0.799999 1.4;  
1468 26 -0.799999 1.6; 1469 26 -0.799999 1.8; 1470 26 -0.799999 2;  
1471 26.2 -0.799999 -0.400001; 1472 26.2 -0.799999 -0.600001;  
1473 26.2 -0.799999 -0.200001; 1474 26.2 -0.799999 -9.12983e-07;  
1475 26.2 -0.799999 0.199999; 1476 26.2 -0.799999 0.399999;  
1477 26.2 -0.799999 0.599999; 1478 26.2 -0.799999 0.8; 1479 26.2 -0.799999 1;  
1480 26.2 -0.799999 1.2; 1481 26.2 -0.799999 1.4; 1482 26.2 -0.799999 1.6;  
1483 26.2 -0.799999 1.8; 1484 26.2 -0.799999 2; 1485 26.4 -0.799999 -0.400001;  
1486 26.4 -0.799999 -0.600001; 1487 26.4 -0.799999 -0.200001;  
1488 26.4 -0.799999 -8.92541e-07; 1489 26.4 -0.799999 0.199999;  
1490 26.4 -0.799999 0.399999; 1491 26.4 -0.799999 0.599999;  
1492 26.4 -0.799999 0.8; 1493 26.4 -0.799999 1; 1494 26.4 -0.799999 1.2;  
1495 26.4 -0.799999 1.4; 1496 26.4 -0.799999 1.6; 1497 26.4 -0.799999 1.8;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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1500 26.6 -0.799999 -0.600001; 1501 26.6 -0.799999 -0.200001;  
1502 26.6 -0.799999 -8.95025e-07; 1503 26.6 -0.799999 0.199999;  
1504 26.6 -0.799999 0.399999; 1505 26.6 -0.799999 0.599999;  
1506 26.6 -0.799999 0.8; 1507 26.6 -0.799999 1; 1508 26.6 -0.799999 1.2;  
1509 26.6 -0.799999 1.4; 1510 26.6 -0.799999 1.6; 1511 26.6 -0.799999 1.8;  
1512 26.6 -0.799999 2; 1513 26.8 -0.799999 -0.400001;  
1514 26.8 -0.799999 -0.600001; 1515 26.8 -0.799999 -0.200001;  
1516 26.8 -0.799999 -9.08971e-07; 1517 26.8 -0.799999 0.199999;  
1518 26.8 -0.799999 0.399999; 1519 26.8 -0.799999 0.599999;  
1520 26.8 -0.799999 0.8; 1521 26.8 -0.799999 1; 1522 26.8 -0.799999 1.2;  
1523 26.8 -0.799999 1.4; 1524 26.8 -0.799999 1.6; 1525 26.8 -0.799999 1.8;  
1526 26.8 -0.799999 2; 1527 27 -0.799999 -0.400001;  
1528 27 -0.799999 -0.600001; 1529 27 -0.799999 -0.200001;  
1530 27 -0.799999 -8.80697e-07; 1531 27 -0.799999 0.199999;  
1532 27 -0.799999 0.399999; 1533 27 -0.799999 0.599999; 1534 27 -0.799999 0.8;  
1535 27 -0.799999 1; 1536 27 -0.799999 1.2; 1537 27 -0.799999 1.4;  
1538 27 -0.799999 1.6; 1539 27 -0.799999 1.8; 1540 27 -0.799999 2;  
1541 27.2 -0.799999 -0.400001; 1542 27.2 -0.799999 -0.600001;  
1543 27.2 -0.799999 -0.200001; 1544 27.2 -0.799999 -8.85664e-07;  
1545 27.2 -0.799999 0.199999; 1546 27.2 -0.799999 0.399999;  
1547 27.2 -0.799999 0.599999; 1548 27.2 -0.799999 0.8; 1549 27.2 -0.799999 1;  
1550 27.2 -0.799999 1.2; 1551 27.2 -0.799999 1.4; 1552 27.2 -0.799999 1.6;  
1553 27.2 -0.799999 1.8; 1554 27.2 -0.799999 2; 1555 27.4 -0.799999 -0.400001;  
1556 27.4 -0.799999 -0.600001; 1557 27.4 -0.799999 -0.200001;  
1558 27.4 -0.799999 -8.67706e-07; 1559 27.4 -0.799999 0.199999;  
1560 27.4 -0.799999 0.399999; 1561 27.4 -0.799999 0.599999;  
1562 27.4 -0.799999 0.8; 1563 27.4 -0.799999 1; 1564 27.4 -0.799999 1.2;  
1565 27.4 -0.799999 1.4; 1566 27.4 -0.799999 1.6; 1567 27.4 -0.799999 1.8;  
1568 27.4 -0.799999 2; 1569 27.6 -0.799999 -0.400001;  
1570 27.6 -0.799999 -0.600001; 1571 27.6 -0.799999 -0.200001;  
1572 27.6 -0.799999 -8.84136e-07; 1573 27.6 -0.799999 0.199999;  
1574 27.6 -0.799999 0.399999; 1575 27.6 -0.799999 0.599999;  
1576 27.6 -0.799999 0.8; 1577 27.6 -0.799999 0.999999; 1578 27.6 -0.799999 1.2;  
1579 27.6 -0.799999 1.4; 1580 27.6 -0.799999 1.6; 1581 27.6 -0.799999 1.8;  
1582 27.6 -0.799999 2; 1583 27.8 -0.799999 -0.400001;  
1584 27.8 -0.799999 -0.600001; 1585 27.8 -0.799999 -0.200001;  
1586 27.8 -0.799999 -8.89103e-07; 1587 27.8 -0.799999 0.199999;  
1588 27.8 -0.799999 0.399999; 1589 27.8 -0.799999 0.599999;  
1590 27.8 -0.799999 0.8; 1591 27.8 -0.799999 1; 1592 27.8 -0.799999 1.2;  
1593 27.8 -0.799999 1.4; 1594 27.8 -0.799999 1.6; 1595 27.8 -0.799999 1.8;  
1596 27.8 -0.799999 2; 1597 28 -0.799999 -0.400001;  
1598 28 -0.799999 -0.600001; 1599 28 -0.799999 -0.200001;  
1600 28 -0.799999 -8.9407e-07; 1601 28 -0.799999 0.199999;  
1602 28 -0.799999 0.399999; 1603 28 -0.799999 0.599999; 1604 28 -0.799999 0.8;  
1605 28 -0.799999 1; 1606 28 -0.799999 1.2; 1607 28 -0.799999 1.4;  
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1611 28.2 -0.799999 -0.400001; 1612 28.2 -0.799999 -0.600001;  
1613 28.2 -0.799999 -0.200001; 1614 28.2 -0.799999 -8.99037e-07;  
1615 28.2 -0.799999 0.199999; 1616 28.2 -0.799999 0.399999;  
1617 28.2 -0.799999 0.599999; 1618 28.2 -0.799999 0.8; 1619 28.2 -0.799999 1;  
1620 28.2 -0.799999 1.2; 1621 28.2 -0.799999 1.4; 1622 28.2 -0.799999 1.6;  
1623 28.2 -0.799999 1.8; 1624 28.2 -0.799999 2; 1625 28.4 -0.799999 -0.400001;  
1626 28.4 -0.799999 -0.600001; 1627 28.4 -0.799999 -0.200001;



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

1628 28.4 -0.799999 -9.04004e-07; 1629 28.4 -0.799999 0.199999;  
1630 28.4 -0.799999 0.399999; 1631 28.4 -0.799999 0.599999;  
1632 28.4 -0.799999 0.8; 1633 28.4 -0.799999 0.999999; 1634 28.4 -0.799999 1.2;  
1635 28.4 -0.799999 1.4; 1636 28.4 -0.799999 1.6; 1637 28.4 -0.799999 1.8;  
1638 28.4 -0.799999 2; 1639 28.6 -0.799999 -0.400001;  
1640 28.6 -0.799999 -0.600001; 1641 28.6 -0.799999 -0.200001;  
1642 28.6 -0.799999 -9.08971e-07; 1643 28.6 -0.799999 0.199999;  
1644 28.6 -0.799999 0.399999; 1645 28.6 -0.799999 0.599999;  
1646 28.6 -0.799999 0.799999; 1647 28.6 -0.799999 1; 1648 28.6 -0.799999 1.2;  
1649 28.6 -0.799999 1.4; 1650 28.6 -0.799999 1.6; 1651 28.6 -0.799999 1.8;  
1652 28.6 -0.799999 2; 1653 28.8 -0.799999 -0.400001;  
1654 28.8 -0.799999 -0.600001; 1655 28.8 -0.799999 -0.200001;  
1656 28.8 -0.799999 -9.13938e-07; 1657 28.8 -0.799999 0.199999;  
1658 28.8 -0.799999 0.399999; 1659 28.8 -0.799999 0.599999;  
1660 28.8 -0.799999 0.799999; 1661 28.8 -0.799999 1; 1662 28.8 -0.799999 1.2;  
1663 28.8 -0.799999 1.4; 1664 28.8 -0.799999 1.6; 1665 28.8 -0.799999 1.8;  
1666 28.8 -0.799999 2; 1667 29 -0.799999 -0.400001;  
1668 29 -0.799999 -0.600001; 1669 29 -0.799999 -0.200001;  
1670 29 -0.799999 -9.4183e-07; 1671 29 -0.799999 0.199999;  
1672 29 -0.799999 0.399999; 1673 29 -0.799999 0.599999;  
1674 29 -0.799999 0.799999; 1675 29 -0.799999 0.999999; 1676 29 -0.799999 1.2;  
1677 29 -0.799999 1.4; 1678 29 -0.799999 1.6; 1679 29 -0.799999 1.8;  
1680 29 -0.799999 2; 1681 29.2 -0.799999 -0.400001;  
1682 29.2 -0.799999 -0.600001; 1683 29.2 -0.799999 -0.200001;  
1684 29.2 -0.799999 -9.08971e-07; 1685 29.2 -0.799999 0.199999;  
1686 29.2 -0.799999 0.399999; 1687 29.2 -0.799999 0.599999;  
1688 29.2 -0.799999 0.8; 1689 29.2 -0.799999 0.999999; 1690 29.2 -0.799999 1.2;  
1691 29.2 -0.799999 1.4; 1692 29.2 -0.799999 1.6; 1693 29.2 -0.799999 1.8;  
1694 29.2 -0.799999 2; 1695 29.4 -0.799999 -0.400001;  
1696 29.4 -0.799999 -0.600001; 1697 29.4 -0.799999 -0.200001;  
1698 29.4 -0.799999 -9.16421e-07; 1699 29.4 -0.799999 0.199999;  
1700 29.4 -0.799999 0.399999; 1701 29.4 -0.799999 0.599999;  
1702 29.4 -0.799999 0.799999; 1703 29.4 -0.799999 1; 1704 29.4 -0.799999 1.2;  
1705 29.4 -0.799999 1.4; 1706 29.4 -0.799999 1.6; 1707 29.4 -0.799999 1.8;  
1708 29.4 -0.799999 2; 1709 29.6 -0.799999 -0.400001;  
1710 29.6 -0.799999 -0.600001; 1711 29.6 -0.799999 -0.200001;  
1712 29.6 -0.799999 -9.23872e-07; 1713 29.6 -0.799999 0.199999;  
1714 29.6 -0.799999 0.399999; 1715 29.6 -0.799999 0.599999;  
1716 29.6 -0.799999 0.8; 1717 29.6 -0.799999 0.999999; 1718 29.6 -0.799999 1.2;  
1719 29.6 -0.799999 1.4; 1720 29.6 -0.799999 1.6; 1721 29.6 -0.799999 1.8;  
1722 29.6 -0.799999 2; 1723 29.8 -0.799999 -0.400001;  
1724 29.8 -0.799999 -0.600001; 1725 29.8 -0.799999 -0.200001;  
1726 29.8 -0.799999 -9.77172e-07; 1727 29.8 -0.799999 0.199999;  
1728 29.8 -0.799999 0.399999; 1729 29.8 -0.799999 0.599999;  
1730 29.8 -0.799999 0.799999; 1731 29.8 -0.799999 0.999999;  
1732 29.8 -0.799999 1.2; 1733 29.8 -0.799999 1.4; 1734 29.8 -0.799999 1.6;  
1735 29.8 -0.799999 1.8; 1736 29.8 -0.799999 2; 1737 30 -0.799999 -0.400001;  
1738 30 -0.799999 -0.600001; 1739 30 -0.799999 -0.200001;  
1740 30 -0.799999 -9.38773e-07; 1741 30 -0.799999 0.199999;  
1742 30 -0.799999 0.399999; 1743 30 -0.799999 0.599999; 1744 30 -0.799999 0.8;  
1745 30 -0.799999 0.999999; 1746 30 -0.799999 1.2; 1747 30 -0.799999 1.4;  
1748 30 -0.799999 1.6; 1749 30 -0.799999 1.8; 1750 30 -0.799999 2;  
1751 30.2 -0.799999 -0.400001; 1752 30.2 -0.799999 -0.600001;  
1753 30.2 -0.799999 -0.200001; 1754 30.2 -0.799999 -9.46224e-07;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

1755 30.2 -0.799999 0.199999; 1756 30.2 -0.799999 0.399999;  
1757 30.2 -0.799999 0.599999; 1758 30.2 -0.799999 0.799999;  
1759 30.2 -0.799999 0.999999; 1760 30.2 -0.799999 1.2; 1761 30.2 -0.799999 1.4;  
1762 30.2 -0.799999 1.6; 1763 30.2 -0.799999 1.8; 1764 30.2 -0.799999 2;  
1765 4.00001 -0.799999 3.2; 1769 4.00001 -0.799999 3.8;  
1771 0.800002 -0.799999 2.8; 1772 0.800002 -0.799999 2.6;  
1773 0.800002 -0.799999 3; 1774 0.800002 -0.799999 3.2; 1775 1 -0.799999 2.8;  
1776 1 -0.799999 2.6; 1777 1 -0.799999 3; 1778 1 -0.799999 3.2;  
1779 1.2 -0.799999 2.8; 1781 1.2 -0.799999 3; 1782 1.2 -0.799999 3.2;  
1783 1.4 -0.799999 2.8; 1785 1.4 -0.799999 3; 1786 1.4 -0.799999 3.2;  
1787 1.6 -0.799999 2.8; 1789 1.6 -0.799999 3; 1790 1.6 -0.799999 3.2;  
1791 1.8 -0.799999 2.8; 1793 1.8 -0.799999 3; 1794 1.8 -0.799999 3.2;  
1795 2 -0.799999 2.8; 1797 2 -0.799999 3; 1798 2 -0.799999 3.2;  
1799 2.2 -0.799999 2.8; 1801 2.2 -0.799999 3; 1802 2.2 -0.799999 3.2;  
1803 2.4 -0.799999 2.8; 1805 2.4 -0.799999 3; 1806 2.4 -0.799999 3.2;  
1807 2.6 -0.799999 2.8; 1809 2.6 -0.799999 3; 1810 2.6 -0.799999 3.2;  
1811 2.80001 -0.799999 2.8; 1813 2.80001 -0.799999 3;  
1814 2.80001 -0.799999 3.2; 1815 3.00001 -0.799999 2.8;  
1817 3.00001 -0.799999 3; 1818 3.00001 -0.799999 3.2;  
1819 3.20001 -0.799999 2.8; 1821 3.20001 -0.799999 3;  
1822 3.20001 -0.799999 3.2; 1823 3.40001 -0.799999 2.8;  
1825 3.40001 -0.799999 3; 1826 3.40001 -0.799999 3.2;  
1827 3.60001 -0.799999 2.8; 1829 3.60001 -0.799999 3;  
1830 3.60001 -0.799999 3.2; 1831 3.80001 -0.799999 2.8;  
1833 3.80001 -0.799999 3; 1834 3.80001 -0.799999 3.2;  
1835 4.00001 -0.799999 2.8; 1836 4.00001 -0.799999 3;  
1837 0.800002 -0.799999 3.4; 1838 0.800002 -0.799999 3.6;  
1839 0.800002 -0.799999 3.8; 1840 1 -0.799999 3.4; 1841 1 -0.799999 3.6;  
1842 1 -0.799999 3.8; 1843 1.2 -0.799999 3.4; 1844 1.2 -0.799999 3.6;  
1845 1.2 -0.799999 3.8; 1846 1.4 -0.799999 3.4; 1847 1.4 -0.799999 3.6;  
1848 1.4 -0.799999 3.8; 1849 1.6 -0.799999 3.4; 1850 1.6 -0.799999 3.6;  
1851 1.6 -0.799999 3.8; 1852 1.8 -0.799999 3.4; 1853 1.8 -0.799999 3.6;  
1854 1.8 -0.799999 3.8; 1855 2 -0.799999 3.4; 1856 2 -0.799999 3.6;  
1857 2 -0.799999 3.8; 1858 2.2 -0.799999 3.4; 1859 2.2 -0.799999 3.6;  
1860 2.2 -0.799999 3.8; 1861 2.4 -0.799999 3.4; 1862 2.4 -0.799999 3.6;  
1863 2.4 -0.799999 3.8; 1864 2.6 -0.799999 3.4; 1865 2.6 -0.799999 3.6;  
1866 2.6 -0.799999 3.8; 1867 2.80001 -0.799999 3.4; 1868 2.80001 -0.799999 3.6;  
1869 2.80001 -0.799999 3.8; 1870 3.00001 -0.799999 3.4;  
1871 3.00001 -0.799999 3.6; 1872 3.00001 -0.799999 3.8;  
1873 3.20001 -0.799999 3.4; 1874 3.20001 -0.799999 3.6;  
1875 3.20001 -0.799999 3.8; 1876 3.40001 -0.799999 3.4;  
1877 3.40001 -0.799999 3.6; 1878 3.40001 -0.799999 3.8;  
1879 3.60001 -0.799999 3.4; 1880 3.60001 -0.799999 3.6;  
1881 3.60001 -0.799999 3.8; 1882 3.80001 -0.799999 3.4;  
1883 3.80001 -0.799999 3.6; 1884 3.80001 -0.799999 3.8;  
1885 4.00001 -0.799999 3.4; 1886 4.00001 -0.799999 3.6;  
1887 4.20001 -0.799999 2.8; 1889 4.20001 -0.799999 3;  
1890 4.20001 -0.799999 3.2; 1891 4.40001 -0.799999 2.8;  
1893 4.40001 -0.799999 3; 1894 4.40001 -0.799999 3.2;  
1897 4.20001 -0.799999 3.4; 1898 4.20001 -0.799999 3.6;  
1899 4.20001 -0.799999 3.8; 1900 4.40001 -0.799999 3.4;  
1901 4.40001 -0.799999 3.6; 1902 4.40001 -0.799999 3.8;  
1905 4.00001 3.39127e-06 3.2; 1906 19 3.39127e-06 3.2;  
1907 29.4 3.39127e-06 -9.16421e-07; 1908 -0.800001 -0.799999 -0.600001;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

1909 -0.800001 -0.799999 -0.400001; 1910 -0.800001 -0.799999 -0.2;  
1911 -0.800001 -0.799999 0; 1912 -0.800001 -0.799999 0.2;  
1913 -0.800001 -0.799999 0.4; 1914 -0.800001 -0.799999 0.6;  
1915 -0.800001 -0.799999 0.8; 1916 -0.800001 -0.799999 1;  
1917 -0.800001 -0.799999 1.2; 1918 -0.800001 -0.799999 1.4;  
1919 -0.800001 -0.799999 1.6; 1920 -0.800001 -0.799999 1.8;  
1921 -0.800001 -0.799999 2; 1922 -0.800001 -0.799999 2.2;  
1923 -0.800001 -0.799999 2.4; 1924 -0.800001 -0.799999 2.6;  
1925 -0.800001 -0.799999 2.8; 1926 -0.800001 -0.799999 3;  
1927 -0.800001 -0.799999 3.2; 1928 -0.800001 -0.799999 3.4;  
1929 -0.800001 -0.799999 3.6; 1930 -0.800001 -0.799999 3.8;  
1931 -0.800001 -0.799999 4; 1932 -0.800001 -0.799999 4.2;  
1933 -0.800001 -0.799999 4.4; 1934 -0.800001 -0.799999 4.6;  
1935 0.800001 -0.799999 -0.400001; 1936 0.800001 -0.799999 -0.600001;  
1937 0.800001 -0.799999 -0.2; 1938 0.800001 -0.799999 0;  
1939 0.800001 -0.799999 0.2; 1940 0.800001 -0.799999 0.4;  
1941 0.800001 -0.799999 0.6; 1942 0.800001 -0.799999 0.8;  
1943 0.800001 -0.799999 1; 1944 0.800001 -0.799999 1.2;  
1945 0.800001 -0.799999 1.4; 1946 0.800001 -0.799999 1.6;  
1947 0.800001 -0.799999 1.8; 1948 0.800001 -0.799999 2;  
1949 0.800001 -0.799999 2.2; 1950 0.800001 -0.799999 2.4;  
1951 0.800001 -0.799999 4; 1952 0.800001 -0.799999 4.2;  
1953 0.800001 -0.799999 4.4; 1954 0.800001 -0.799999 4.6;  
1955 -1 -0.799999 -0.600001; 1956 -1 -0.799999 -0.400001;  
1957 -1 -0.799999 -0.2; 1958 -1 -0.799999 0; 1959 -1 -0.799999 0.2;  
1960 -1 -0.799999 0.4; 1961 -1 -0.799999 0.6; 1962 -1 -0.799999 0.8;  
1963 -1 -0.799999 1; 1964 -1 -0.799999 1.2; 1965 -1 -0.799999 1.4;  
1966 -1 -0.799999 1.6; 1967 -1 -0.799999 1.8; 1968 -1 -0.799999 2;  
1969 -1 -0.799999 2.2; 1970 -1 -0.799999 2.4; 1971 -1 -0.799999 2.6;  
1972 -1 -0.799999 2.8; 1973 -1 -0.799999 3; 1974 -1 -0.799999 3.2;  
1975 -1 -0.799999 3.4; 1976 -1 -0.799999 3.6; 1977 -1 -0.799999 3.8;  
1978 -1 -0.799999 4; 1979 -1 -0.799999 4.2; 1980 -1 -0.799999 4.4;  
1981 -1 -0.799999 4.6; 1982 1 -0.799999 -0.400001; 1983 1 -0.799999 -0.600001;  
1984 1 -0.799999 -0.2; 1985 1 -0.799999 0; 1986 1 -0.799999 0.2;  
1987 1 -0.799999 0.4; 1988 1 -0.799999 0.6; 1989 1 -0.799999 0.8;  
1990 1 -0.799999 1; 1991 1 -0.799999 1.2; 1992 1 -0.799999 1.4;  
1993 1 -0.799999 1.6; 1994 1 -0.799999 1.8; 1995 1 -0.799999 2;  
1996 1 -0.799999 2.2; 1997 1 -0.799999 2.4; 1998 1 -0.799999 4;  
1999 1 -0.799999 4.2; 2000 1 -0.799999 4.4; 2001 1 -0.799999 4.6;  
2282 13.8 -0.799999 3.2; 2283 14 -0.799999 3.2; 2284 14.2 -0.799999 3.2;  
2285 14.4 -0.799999 3.2; 2286 14.6 -0.799999 3.2; 2287 14.8 -0.799999 3.2;  
2288 15 -0.799999 3.2; 2289 15.2 -0.799999 3.2; 2290 15.4 -0.799999 3.2;  
2291 15.6 -0.799999 3.2; 2292 15.8 -0.799999 3.2; 2293 16 -0.799999 3.2;  
2294 16.2 -0.799999 3.2; 2295 16.4 -0.799999 3.2; 2296 16.6 -0.799999 3.2;  
2297 16.8 -0.799999 3.2; 2298 17 -0.799999 3.2; 2299 17.2 -0.799999 3.2;  
2300 17.4 -0.799999 3.2; 2301 17.6 -0.799999 3.2; 2302 17.8 -0.799999 3.2;  
2303 18 -0.799999 3.2; 2304 18.2 -0.799999 3.2; 2305 13.8 -0.799999 3;  
2306 14 -0.799999 3; 2307 14.2 -0.799999 3; 2308 14.4 -0.799999 3;  
2309 14.6 -0.799999 3; 2310 14.8 -0.799999 3; 2311 15 -0.799999 3;  
2312 15.2 -0.799999 3; 2313 15.4 -0.799999 3; 2314 15.6 -0.799999 3;  
2315 15.8 -0.799999 3; 2316 16 -0.799999 3; 2317 16.2 -0.799999 3;  
2318 16.4 -0.799999 3; 2319 16.6 -0.799999 3; 2320 16.8 -0.799999 3;  
2321 17 -0.799999 3; 2322 17.2 -0.799999 3; 2323 17.4 -0.799999 3;  
2324 17.6 -0.799999 3; 2325 17.8 -0.799999 3; 2326 18 -0.799999 3;

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

2327 18.2 -0.799999 3; 2328 13.8 -0.799999 2.8; 2329 14 -0.799999 2.8;  
 2330 14.2 -0.799999 2.8; 2349 18 -0.799999 2.8; 2350 18.2 -0.799999 2.8;  
 2351 13.8 -0.799999 2.6; 2352 14 -0.799999 2.6; 2353 14.2 -0.799999 2.6;  
 2372 18 -0.799999 2.6; 2373 18.2 -0.799999 2.6; 2374 13.8 -0.799999 2.4;  
 2375 14 -0.799999 2.4; 2376 14.2 -0.799999 2.4; 2395 18 -0.799999 2.4;  
 2396 18.2 -0.799999 2.4; 2397 13.8 -0.799999 2.2; 2398 14 -0.799999 2.2;  
 2399 14.2 -0.799999 2.2; 2418 18 -0.799999 2.2; 2419 18.2 -0.799999 2.2;  
 2420 13.8 -0.799999 2; 2421 14 -0.799999 2; 2422 14.2 -0.799999 2;  
 2441 18 -0.799999 2; 2442 18.2 -0.799999 2; 2443 13.8 -0.799999 1.8;  
 2444 14 -0.799999 1.8; 2445 14.2 -0.799999 1.8; 2464 18 -0.799999 1.8;  
 2465 18.2 -0.799999 1.8; 2466 13.8 -0.799999 1.6; 2467 14 -0.799999 1.6;  
 2468 14.2 -0.799999 1.6; 2487 18 -0.799999 1.6; 2488 18.2 -0.799999 1.6;  
 2489 13.8 -0.799999 1.4; 2490 14 -0.799999 1.4; 2491 14.2 -0.799999 1.4;  
 2510 18 -0.799999 1.4; 2511 18.2 -0.799999 1.4; 2512 13.8 -0.799999 1.2;  
 2513 14 -0.799999 1.2; 2514 14.2 -0.799999 1.2; 2533 18 -0.799999 1.2;  
 2534 18.2 -0.799999 1.2; 2535 25.8 -0.799999 2.2; 2536 26 -0.799999 2.2;  
 2537 26.2 -0.799999 2.2; 2556 30 -0.799999 2.2; 2557 30.2 -0.799999 2.2;  
 3050 1.2 -0.799999 2.6; 3051 1.4 -0.799999 2.6; 3052 1.6 -0.799999 2.6;  
 3053 1.8 -0.799999 2.6; 3054 2 -0.799999 2.6; 3055 2.2 -0.799999 2.6;  
 3056 2.4 -0.799999 2.6; 3057 2.6 -0.799999 2.6; 3058 2.80001 -0.799999 2.6;  
 3059 3.00001 -0.799999 2.6; 3060 3.20001 -0.799999 2.6;  
 3061 3.40001 -0.799999 2.6; 3062 3.60001 -0.799999 2.6;  
 3063 3.80001 -0.799999 2.6; 3064 4.00001 -0.799999 2.6;  
 3065 4.20001 -0.799999 2.6; 3066 4.40001 -0.799999 2.6;  
 3067 1.2 -0.799999 -0.400001; 3068 1.2 -0.799999 -0.600001;  
 3069 1.2 -0.799999 -0.2; 3070 1.2 -0.799999 0; 3071 1.2 -0.799999 0.2;  
 3072 1.2 -0.799999 0.4; 3073 1.2 -0.799999 0.6; 3074 1.2 -0.799999 0.8;  
 3075 1.2 -0.799999 1; 3076 1.2 -0.799999 1.2; 3077 1.2 -0.799999 1.4;  
 3078 1.2 -0.799999 1.6; 3079 1.2 -0.799999 1.8; 3080 1.2 -0.799999 2;  
 3081 1.2 -0.799999 2.2; 3082 1.2 -0.799999 2.4; 3083 1.2 -0.799999 4;  
 3084 1.2 -0.799999 4.2; 3085 1.2 -0.799999 4.4; 3086 1.2 -0.799999 4.6;  
 3087 1.4 -0.799999 -0.400001; 3088 1.4 -0.799999 -0.600001;  
 3089 1.4 -0.799999 -0.2; 3090 1.4 -0.799999 0; 3091 1.4 -0.799999 0.2;  
 3092 1.4 -0.799999 0.4; 3093 1.4 -0.799999 0.6; 3094 1.4 -0.799999 0.8;  
 3095 1.4 -0.799999 1; 3096 1.4 -0.799999 1.2; 3097 1.4 -0.799999 1.4;  
 3098 1.4 -0.799999 1.6; 3099 1.4 -0.799999 1.8; 3100 1.4 -0.799999 2;  
 3101 1.4 -0.799999 2.2; 3102 1.4 -0.799999 2.4; 3103 1.4 -0.799999 4;  
 3104 1.4 -0.799999 4.2; 3105 1.4 -0.799999 4.4; 3106 1.4 -0.799999 4.6;  
 3107 1.6 -0.799999 -0.400001; 3108 1.6 -0.799999 -0.600001;  
 3109 1.6 -0.799999 -0.2; 3110 1.6 -0.799999 0; 3111 1.6 -0.799999 0.2;  
 3112 1.6 -0.799999 0.4; 3113 1.6 -0.799999 0.6; 3114 1.6 -0.799999 0.8;  
 3115 1.6 -0.799999 1; 3116 1.6 -0.799999 1.2; 3117 1.6 -0.799999 1.4;  
 3118 1.6 -0.799999 1.6; 3119 1.6 -0.799999 1.8; 3120 1.6 -0.799999 2;  
 3121 1.6 -0.799999 2.2; 3122 1.6 -0.799999 2.4; 3123 1.6 -0.799999 4;  
 3124 1.6 -0.799999 4.2; 3125 1.6 -0.799999 4.4; 3126 1.6 -0.799999 4.6;  
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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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**MEMBER INCIDENCES**

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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**ELEMENT INCIDENCES SHELL**

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

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**START GROUP DEFINITION**

**MEMBER**

\_BEAMS 31 TO 87 100 TO 110 127 TO 130 135 148 TO 167 176 177 182 TO 184 187 -  
189 TO 199 205 206 209 210 220 229 230 235 236 239 TO 242 245 TO 248 251 -  
252 TO 259 263 TO 268 274 275

**ELEMENT**

\_ONEWAYSHEAR 311 TO 322 331 TO 342 351 TO 362 371 TO 382 391 TO 402 -  
411 TO 422 527 TO 538 547 TO 558 567 TO 578 587 TO 598 607 TO 618 -  
627 TO 638 647 TO 658 667 TO 678 687 TO 698 707 TO 718 727 TO 738 -  
747 TO 758 772 TO 948 956 963 TO 1094 1183 TO 1194 1203 TO 1214 1223 TO 1234 -  
1243 TO 1254 1263 TO 1274 1283 TO 1294 1303 TO 1314 1323 TO 1334 -  
1343 TO 1354 1363 TO 1374 1383 TO 1394 1403 TO 1414 1427 TO 1718 -  
1726 TO 1731 1736 TO 1741 1743 1744 1746 1747 1749 1750 1752 1753 1755 1756 -  
1758 1759 1761 1762 1764 1765 1767 1768 1770 1771 1773 1774 1776 1777 1779 -  
1780 1782 1783 1785 1786 1790 TO 1837 1839 1840 1842 1843 1847 TO 1852 1866 -  
1867 TO 1877 1892 TO 1900 1905 TO 1950 2232 TO 2253 2255 TO 2281 2301 TO 2305 -  
2325 TO 2329 2349 TO 2353 2373 TO 2377 2397 TO 2401 2421 TO 2425 -  
2445 TO 2449 2469 TO 2473 2493 TO 2497 2517 TO 2521 2541 2542 3039 TO 3385 -  
3402 TO 3405 3422 TO 3425 3442 TO 3445 3462 TO 3465 3482 TO 3485 -  
3502 TO 3505 3522 TO 3525 3542 TO 3545 3562 TO 3565 3582 TO 3604

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\_TWOWAYSHEAR 310 TO 323 330 TO 343 350 TO 363 370 TO 383 390 TO 403 -  
410 TO 423 526 TO 539 546 TO 559 566 TO 579 586 TO 599 606 TO 619 -  
626 TO 639 646 TO 659 666 TO 679 686 TO 699 706 TO 719 726 TO 739 -  
746 TO 759 765 TO 1100 1182 TO 1195 1202 TO 1215 1222 TO 1235 1242 TO 1255 -  
1262 TO 1275 1282 TO 1295 1302 TO 1315 1322 TO 1335 1342 TO 1355 -  
1362 TO 1375 1382 TO 1395 1402 TO 1415 1420 TO 1731 1736 TO 1741 1743 1744 -  
1746 1747 1749 1750 1752 1753 1755 1756 1758 1759 1761 1762 1764 1765 1767 -  
1768 1770 1771 1773 1774 1776 1777 1779 1780 1782 1783 1785 TO 1837 1839 -  
1840 1842 1843 1847 TO 1852 1859 TO 1950 2231 TO 2281 2301 TO 2305 -  
2325 TO 2329 2349 TO 2353 2373 TO 2377 2397 TO 2401 2421 TO 2425 -  
2445 TO 2449 2469 TO 2473 2493 TO 2497 2517 TO 2521 2541 2542 3039 TO 3385 -  
3402 TO 3405 3422 TO 3425 3442 TO 3445 3462 TO 3465 3482 TO 3485 -  
3502 TO 3505 3522 TO 3525 3542 TO 3545 3562 TO 3565 3582 TO 3604

JOINT

END GROUP DEFINITION

ELEMENT PROPERTY

289 TO 444 451 TO 762 765 TO 1100 1107 TO 1418 1420 TO 1731 1736 TO 1741 1743 -  
1744 1746 1747 1749 1750 1752 1753 1755 1756 1758 1759 1761 1762 1764 1765 -  
1767 1768 1770 1771 1773 1774 1776 1777 1779 1780 1782 1783 1785 TO 1837 -  
1839 1840 1842 1843 1847 TO 1852 1859 TO 1950 2231 TO 2281 2301 TO 2305 2325 -  
2326 TO 2329 2349 TO 2353 2373 TO 2377 2397 TO 2401 2421 TO 2425 2445 TO 2449 -  
2469 TO 2473 2493 TO 2497 2517 TO 2521 2541 2542 3039 TO 3385 3402 TO 3405 -  
3422 TO 3425 3442 TO 3445 3462 TO 3465 3482 TO 3485 3502 TO 3505 -  
3522 TO 3525 3542 TO 3545 3562 TO 3565 3582 TO 3604 THICKNESS 0.6

MEMBER RELEASE

1 4 7 10 13 16 19 22 25 28 31 TO 54 79 TO 81 85 TO 87 89 91 93 95 97 99 101 -  
102 TO 106 111 TO 128 132 134 148 159 TO 163 178 179 182 TO 186 188 191 196 -  
197 TO 198 205 206 209 211 TO 219 223 224 235 TO 239 242 TO 244 247 249 250 -  
254 256 259 TO 262 266 268 TO 273 275 START MY MZ  
33 37 72 75 78 TO 81 84 TO 93 95 TO 99 101 TO 106 109 TO 126 148 TO 163 176 -  
177 TO 179 181 185 186 188 189 191 196 197 205 206 210 TO 220 223 224 237 -  
238 241 TO 246 248 TO 250 252 253 255 256 259 TO 264 267 TO 273 -  
275 END MY MZ

DEFINE MATERIAL START

ISOTROPIC STEEL

E 2.1e+08

POISSON 0.3

DENSITY 78.5

ALPHA 1.2e-05

DAMP 0.03

TYPE STEEL

STRENGTH FY 355000 FU 470000 RY 1.5 RT 1.2

G 8.1e+07

ISOTROPIC CONCRETE

E 2.17184e+07

POISSON 0.17

DENSITY 23.5615

ALPHA 5.5e-06

DAMP 0.05

TYPE CONCRETE

STRENGTH FCU 27578.9

END DEFINE MATERIAL

MEMBER PROPERTY EUROPEAN

1 4 7 10 13 16 138 TO 141 TABLE ST HE340B

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

56 59 62 65 68 100 135 164 166 209 210 229 230 265 TABLE ST HE240A  
178 179 185 186 211 223 224 237 238 244 249 250 TABLE ST L90X90X8  
31 35 79 TO 81 85 TO 99 132 134 181 TO 184 187 189 191 196 TO 198 220 235 -  
236 239 TO 243 247 248 254 TO 256 258 259 263 264 266 TO 268 -  
275 TABLE ST HE160A  
32 TO 34 36 37 107 108 245 252 253 TABLE ST HE220A  
111 TO 126 212 TO 219 270 TO 273 TABLE ST HE140A  
101 TO 106 148 159 TO 163 205 206 TABLE ST HE180A  
39 TO 54 57 60 63 66 69 TO 78 82 TO 84 109 110 127 TO 130 149 TO 158 165 167 -  
176 177 190 192 TO 195 199 TABLE ST HE200A  
38 246 TABLE ST HE300A  
58 61 251 257 TABLE ST HE360B  
19 22 25 28 TABLE ST HE340B  
64 67 274 TABLE ST HE360B  
2 3 5 6 8 9 11 12 14 15 17 18 20 21 23 24 26 27 29 30 131 133 136 137 180 -  
202 TO 204 207 208 221 222 TABLE ST HE300A  
188 260 TO 262 269 TABLE ST L75X75X8  
55 TABLE ST HE400B  
MEMBER PROPERTY EUROPEAN  
280 TO 285 PRIS YD 0.7 ZD 0.7  
276 TO 279 PRIS YD 0.7 ZD 0.7  
MEMBER PROPERTY EUROPEAN  
1856 1858 PRIS YD 0.6 ZD 1  
1857 PRIS YD 1 ZD 0.6  
CONSTANTS  
BETA 90 MEMB 1 TO 30 88 TO 99 131 TO 134 136 TO 141 180 181 202 TO 204 207 -  
208 221 222  
BETA 45 MEMB 178 179 185 186 188 211 223 224 249 250 260 TO 262 269  
MATERIAL STEEL MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 -  
236 TO 275  
MATERIAL CONCRETE MEMB 276 TO 285 289 TO 444 451 TO 762 765 TO 1100 -  
1107 TO 1418 1420 TO 1731 1736 TO 1741 1743 1744 1746 1747 1749 1750 1752 -  
1753 1755 1756 1758 1759 1761 1762 1764 1765 1767 1768 1770 1771 1773 1774 -  
1776 1777 1779 1780 1782 1783 1785 TO 1837 1839 1840 1842 1843 1847 TO 1852 -  
1856 TO 1950 2231 TO 2281 2301 TO 2305 2325 TO 2329 2349 TO 2353 -  
2373 TO 2377 2397 TO 2401 2421 TO 2425 2445 TO 2449 2469 TO 2473 -  
2493 TO 2497 2517 TO 2521 2541 2542 3039 TO 3385 3402 TO 3405 3422 TO 3425 -  
3442 TO 3445 3462 TO 3465 3482 TO 3485 3502 TO 3505 3522 TO 3525 -  
3542 TO 3545 3562 TO 3565 3582 TO 3604  
SUPPORTS  
131 TO 134 136 TO 139 155 210 803 988 1604 1765 1948 3130 3143 3279 -  
3295 FIXED BUT MX MY MZ KFX 3000 KFY 104000 KFZ 3000  
\*\*\*  
\*\*\*  
\*\*\*-----  
\*----- WIND LOAD DEFINITION -----  
\*\*\*-----  
DEFINE WIND LOAD  
TYPE 1 WIND 1  
INT 0.71 0.79 0.85 0.91 HEIG 6 8 10 12  
\*\*\*PRESSURE VS ITENSITY TO BE CONSIDERED FROM DESIGN BASIS  
\*\*\*-----  
LOAD 101 MODELLED STRUCTURAL/ FOUNDATION SELF WEIGHT  
\*\*\*-----

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**SELFWEIGHT Y -1.15**

**ELEMENT LOAD**

289 TO 444 451 TO 762 765 TO 1100 1107 TO 1418 1420 TO 1731 1736 TO 1741 1743 -  
1744 1746 1747 1749 1750 1752 1753 1755 1756 1758 1759 1761 1762 1764 1765 -  
1767 1768 1770 1771 1773 1774 1776 1777 1779 1780 1782 1783 1785 TO 1837 -  
1839 1840 1842 1843 1847 TO 1852 1859 TO 1950 2231 TO 2281 2301 TO 2305 2325 -  
2326 TO 2329 2349 TO 2353 2373 TO 2377 2397 TO 2401 2421 TO 2425 2445 TO 2449 -  
2469 TO 2473 2493 TO 2497 2517 TO 2521 2541 2542 3039 TO 3385 3402 TO 3405 -  
3422 TO 3425 3442 TO 3445 3462 TO 3465 3482 TO 3485 3502 TO 3505 -  
3522 TO 3525 3542 TO 3545 3562 TO 3565 3582 TO 3604 PR GY -5

\*\*\*

**LOAD 102 NODE/ CONNECTION WEIGHT/LIFTING LUG/ PAD-EYE WEIGHT**

\*\*\*

**LOAD 100 PRIMARY STRUCTURAL STEEL (SUM OF LC 101 TO 102)**

\*\*\*

**REPEAT LOAD**

101 1.0 102 1.0

\*\*\*

**LOAD 111 GRATING/ CHEQUERED PLATE /EQUIPMENT SUPPORTS / SECONDARY PLATFORMS/**

\*Staircase stringer /ladder /Handrail

\* as per procorr mail with 'GRP weights' dated 27 Sept 2022

**\*\*\*\*GRATING LOAD**

\* grating dead load = 0.25 KN/m<sup>2</sup>, for span of 1.0m, the load would be = 0.25\*1 =0.25kN/m

\* this is applied to internal beams, and 0.125 KN/m applied to external beam

\* at level +8.900

**MEMBER LOAD**

196 197 UNI GY -0.25

129 199 242 243 UNI GY -0.125

198 UNI GY -0.125 2 4

198 UNI GY -0.125 0 2

\*

\* grating dead load = 0.25KN/m<sup>2</sup>, for span of 1.2m, and as the load is shared by

\* two beams, load = 0.25\*1.2/2 = 0.15 KN/m, this is applied at level +5.700

**MEMBER LOAD**

189 190 UNI GY -0.15

\*

\* Handrail load = 0.06 KN/m applied at the gating floor beams

127 TO 129 183 189 190 192 194 195 199 UNI GY -0.06

\*

\* Ladder load = 0.10kN/m, length of the ladder = 6m

\* load = 0.10\*6 = 0.6 KN, applied at the location where ladder supports..

**JOINT LOAD**

89 FY -0.6

**MEMBER LOAD**

191 CON GY -0.6

\*

**\*\*\*\*SECONDARY BEAMS WEIGHT**

**\*\*\*\*HANDRAIL WEIGHT\*\*\*0.25KN/M**

\*\*\*

**LOAD 112 PIPE SUPPORTS/ MONORAILS, RUNWAY BEAMS, MATERIAL HANDLING ITEMS**

\*\*\*

**LOAD 113 RIGGING WEIGHT/SEA FASTENING/ LASHING/ SECURING WEIGHTS**

\*\*\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**LOAD 110 SECONDARY & TERTIARY STRUCTURAL STEEL (UNMODELED PART)**

\*(Sum of LC 111 to 113)

\*\*\*-----

**REPEAT LOAD**

111 1.0 112 1.0 113 1.0

\*\*\*-----

**LOAD 120 ADDITIONAL LOAD TO MATCH THE WCR STRUCTURAL WEIGHT**

\*\*\*-----

\*\*\*-----

**LOAD 131 PAINTING LOAD**

\*\*2% OF MODELLED STRUCTURAL STEEL WEIGHT CAN BE CONSIDERED AS AN EARLY ESTIMATE

\*\*\*-----

**LOAD 132 FIRE PROOFING LOADS**

\*\*\*-----

\*\*\*-----

**LOAD 130 MISCELLANEOUS LOADS (SUM OF LC 131 AND LC 132)**

\*\*\*-----

**REPEAT LOAD**

131 1.0 132 1.0

\*\*\*-----

**LOAD 140 HOOK UP LOADS**

\*\*\*-----

**LOAD 10 TOTAL STRUCTURAL DEAD LOAD (SUM OF LC 100, 110, 120, 130,140)**

\*\*\*-----

**REPEAT LOAD**

100 1.0 110 1.0 120 1.0 130 1.0 140 1.0

\*\*\*-----

**LOAD 201 OPEN AREA LIVE LOADS/ OPERATING PLATFORMS (5 KN/M2)**

\*\*\*-----

**\*\*\*\*LIVE LOAD ON MAIN OPERATING FLOOR**

\*\*\*-----

**LOAD 202 LIVE LOAD ON SERVICE PLATFORMS, PEDESTALS, WALKWAYS (3 KN/M2)**

**\*\*\*\*LIVE LOAD ON GRATING**

\* Live load = 3 KN/m<sup>2</sup>, for span of 1.0m, the load would be = 3\*1 =3kN/m

\* this is applied to internal beams, and for external beams = 3/2 = 1.5 KN/m

\* at level +8.900

**MEMBER LOAD**

196 197 UNI GY -3

129 198 199 220 242 243 UNI GY -1.5

\*

\* live load = 3KN/m<sup>2</sup>, for span of 1.2m, and as the load is shared by

\* two beams, load = 3\*1.2/2 = 1.8 KN/m, this is applied at level +5.700

**MEMBER LOAD**

189 190 UNI GY -1.8

\*\*\*-----

**LOAD 203 LIVE LOAD ON STAIRWAYS (5KN/M2)**

\*\*\*-----

**LOAD 204 LIVE LOADS ON STORAGE AREAS (LAYDOWN) (7.5 KN/M2)**

\*\*\*-----

**LOAD 20 TOTAL LIVE LOAD (SUM OF LC 201 TO 204) (LL)**

\*\*\*-----

**REPEAT LOAD**

201 1.0 202 1.0 203 1.0 204 1.0



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*-----

**LOAD 301 EMPTY WEIGHT OF PIPE (UDL)/PIPE AREA LOAD**

\* Loads are from the Load input file "Loads table SR0501"

\* Loads at +5.700m level = gR = 2 KN/m<sup>2</sup>

**MEMBER LOAD**

\* load at main grid transverse beam =  $2/3 * 6 * (2) = 8$  KN/m, (for 6m span)

56 59 62 65 68 105 164 166 UNI GY -8

\* load at intermediate beam =  $1/3 * 6 * (2 \text{ kN/m}^2) = 4$  KN/m, (for 6m span)

101 106 148 159 160 UNI GY -4

\*

\* Loads at +8.000m level = gR = 1 KN/m<sup>2</sup>

\* load for 3m span =  $1 * 3 = 3$  KN/m, applied at all beams considering,

\* that these small bore lines would be supported by all beams.

57 60 63 66 69 102 TO 104 161 TO 163 165 167 UNI GY -3

\*

\* Loads at +8.900m level = gR = 1 KN/m<sup>2</sup>

\* load for 1m span at internal beams =  $1 * 1 = 1$  kN/m

\* loads at external beams =  $1/2 = 0.5$ KN/m

**MEMBER LOAD**

196 197 UNI GY -1

129 198 199 220 UNI GY -0.5

\*

\*\*\*-----

\*\*\*-----

**LOAD 302 EMPTY WEIGHT OF PIPE VALVES, SUPPORTS (POINT LOAD)**

\* As per the load mentioned in the load input file "Load table SR0501".

**MEMBER LOAD**

\* load at +3.200, L01.01 = 70 KN (48"-CAJR01)

265 CON GY -70 0.199994

\* load at +3.200, L01.02 = 60 KN (48"-CAJR01)

251 CON GY -60 0.0999939

\* load at +3.200, L01.03 = 40 KN (48"-CAJR01)

246 CON GY -40 0.299999

\* load at +6.700, L02.01 = 5 KN

206 CON GY -5

\* load at +6.700, L02.02 = 5 KN

205 CON GY -5

\* load at +9.200, L03.01 = 5 KN

210 CON GY -5 1.8

\* load at +12.100, L04.01 = 10 KN

135 CON GY -10

\*\*\*

**LOAD 303 EMPTY WEIGHT OF PIPE VALVES, SUPPORTS ON HOOK UP STEEL**

\*\*\*

**LOAD 300 PIPING DRY WEIGHTS (SUM OF LC 301 TO 303)**

\*\*\*

**REPEAT LOAD**

301 1.0 302 1.0 303 1.0

\*\*\*

**LOAD 311 EQUIPMENT DRY WEIGHT (> 10MT)**

\*\*\*

\*\*\*

**LOAD 312 EQUIPMENT DRY WEIGHT (<10 MT) /AREA LOAD**

\*\*\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

LOAD 310 MECHANICAL DRY WEIGHTS (SUM OF LC 311 TO 312)

\*\*\*-----

REPEAT LOAD

311 1.0 312 1.0

\*\*\*-----

LOAD 321 ELECTRICAL EQUIPMENT DRY WEIGHT

\*\*\*-----

LOAD 322 ELECTRICAL CABLES, CABLE DUCTS/ TRAYS

\*\*\*-----

LOAD 320 ELECTRICAL DRY WEIGHTS (SUM OF LC 321 TO 322)

\*\*\*-----

REPEAT LOAD

321 1.0 322 1.0

\*\*\*-----

LOAD 331 INSTRUMENTATION EQUIPMENT DRY WEIGHT

\*\*\*-----

LOAD 332 INSTRUMENTATION CABLES, CABLE DUCTS/ TRAYS

\* load of 600mm wide cables trays = 1.3 KN/m as per 10000-Y50-026

\* (&YARA A-PC 1000-Y50-00026)

\* the cable tray loads were applied at main/secondary column directly with the magnitude mentioned below.

\* total number of cable trays= 7

\* total point load =  $1.3 * 7 * 6 = 54.6$  KN

\* moment at the end of the cable tray support =  $54.6 * 0.4 = 21.84$  KN.m

\* for 7m span point load =  $1.3 * 7 * 7 = 63.7$  kN, moment =  $63.7 * 0.4 = 25.5$  Kn.m

MEMBER LOAD

3 9 15 21 27 CON GY -54.6

3 9 15 21 27 CMOM GX 21.84

\*

MEMBER LOAD

91 CON GY -63.7

91 CMOM GX 25.5

\*\*\*-----

LOAD 330 INSTRUMENTATION DRY WEIGHTS (SUM OF LC 331 TO 332)

\*\*\*-----

REPEAT LOAD

331 1.0 332 1.0

\*\*\*-----

LOAD 30 TOTAL EMPTY WEIGHT OF PIPING/ EQUIPMENT/ E&I

\*(Sum of LC 300,310,320,330)(EQE)

\*\*\*-----

REPEAT LOAD

300 1.0 310 1.0 320 1.0 330 1.0

\*\*\*-----

LOAD 401 OPERATING WEIGHT OF PIPE (UDL)/ AREA LOAD

\*\*

\* Loads are from the Load input file "Loads table SR0501"

\* Loads at +5.700m level = pR = 3.5 KN/m<sup>2</sup>

MEMBER LOAD

\* load at main grid transverse beam =  $2/3 * 6 * (3.5) = 14$  KN/m, (for 6m span)

56 59 62 65 68 105 164 166 UNI GY -14

\* load at intermediate beam =  $1/3 * 6 * (2 \text{ kN/m}^2) = 7$  KN/m, (for 6m span)

101 106 148 159 160 UNI GY -7

\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* Loads at +8.000m level = pR = 2.5 KN/m<sup>2</sup>  
 \* load for 3m span = 2.5\*3 = 7.5 kN/m, applied at all beams considering,  
 \* that these small bore lines would be supported by all beams.  
 57 60 63 66 69 102 TO 104 161 TO 163 165 167 UNI GY -7.5

\* Loads at +8.900m level = pR = 2 KN/m<sup>2</sup>  
 \* load for 1m span at internal beams= 2\*1 = 2 kN/m  
 \* loads at external beams = 2/2 = 1 KN/m

MEMBER LOAD

196 197 UNI GY -2  
 129 198 199 220 UNI GY -1

\*\*\*-----  
 \*\*\*-----

LOAD 402 OPERATING WEIGHT OF PIPE SUPPORT (POINT LOAD)

\* As per the load mentioned in the load input file "Load table SR0501".

MEMBER LOAD

\* load at +3.200, L01.01 = 80 KN (48"-CAJR01)  
 265 CON GY -80 0.199994  
 \* load at +3.200, L01.01 = 70 KN (48"-CAJR01)  
 251 CON GY -70 0.0999939  
 \* load at +3.200, L01.01 = 50 KN (48"-CAJR01)  
 246 CON GY -50 0.299999  
 \* load at +6.700, L02.01 = 10 KN  
 206 CON GY -10  
 \* load at +6.700, L02.02 = 10 KN  
 205 CON GY -10  
 \* load at +9.200, L03.01 = 10 KN  
 210 CON GY -10 1.8  
 \* load at +12.100, L04.01 = 25 KN  
 135 CON GY -25

\*\*\*-----  
 LOAD 400 OPERATING PIPE WEIGHTS (SUM OF LC 401 TO 402)  
 \*\*\*-----

REPEAT LOAD

401 1.0 402 1.0

\*\*\*-----  
 LOAD 411 EQUIPMENT OPERATING WEIGHT (> 10MT)  
 \*\*\*-----

REPEAT LOAD

311 1.15

\*\*\*-----  
 LOAD 412 EQUIPMENT OPERATING WEIGHT (<10 MT)  
 \*\*\*-----

LOAD 410 MECHANICAL EQUIPMENT WEIGHTS (SUM OF LC 411 TO 412)

\*\*\*-----  
 REPEAT LOAD

411 1.0 412 1.0

\*\*\*-----  
 LOAD 421 ELECTRICAL EQUIPMENT WEIGHT/ BULK ITEMS/CABLES, CABLE DUCTS/ TRAYS  
 \*\*\*-----

LOAD 420 ELECTRICAL ITEM WEIGHTS IN OPERATING CONDITION(LC 421)

\* load of 600mm wide cables trays = 1.3 KN/m as per 10000-Y50-026  
 \* (&YARA A-PC 1000-Y50-00026)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

- \* the cable tray loads were applied at main/secondary column directly with the
- \* magnitude mentioned below.
- \* total number of cable trays= 7
- \* total point load =  $1.3*7*6 = 54.6$  KN
- \* moment at the end of the cable tray support =  $54.6*0.4 = 21.84$  KN.m
- \* for 7m span point load =  $1.3*7*7 = 63.7$  kN, moment =  $63.7*0.4 = 25.5$  Kn.m

MEMBER LOAD

3 9 15 21 27 CON GY -54.6  
3 9 15 21 27 CMOM GX 21.84  
\*

MEMBER LOAD

91 CON GY -63.7  
91 CMOM GX 25.5  
\*

\*\*\*-----

REPEAT LOAD

421 1.0

\*\*\*-----

LOAD 431 INSTRUMENTATION EQUIPMENT WEIGHT/BULK ITEMS/CABLES,CABLE DUCTS/TRAYS

\*\*\*-----

LOAD 430 INSTRUMENTATION ITEM WEIGHTS IN OPERATING CONDITION (LC 431)

\*\*\*-----

REPEAT LOAD

431 1.0

\*\*\*-----

LOAD 40 TOTAL OPERATING WEIGH OF PIPING/EQUIPMENT/E&I

\*(Sum of LC 400,410,420,430)(EQLO)

\*\*\*-----

REPEAT LOAD

400 1.0 410 1.0 420 1.0 430 1.0

\*\*\*-----

LOAD 501 HYDROTEST WEIGHT OF PIPING (UDL)

\*\*\*-----

LOAD 502 HYDROTEST WEIGHT OF PIPE SUPPORTS (POINT LOAD)

\* load from LEDD, LP1=300kN, LP2 = 300KN, LP=150KN

JOINT LOAD

1905 FY -300  
1906 FY -300  
1907 FY -150

\*\*

\* The loads are not applicable here.

\*\*\*-----

LOAD 500 PIPING HYDROTEST WEIGHTS (SUM OF LC 501 & LC 502)

\*\*\*-----

REPEAT LOAD

501 1.0 502 1.0

\*\*\*-----

LOAD 511 EQUIPMENT HYDROTEST WEIGHT (> 10MT)

\*\*\*-----

LOAD 512 EQUIPMENT HYDROTEST WEIGHT (<10 MT)

\*\*\*-----

LOAD 510 MECHANICAL HYDROTEST WEIGHTS (SUM OF LC 511 & LC 512)

\*\*\*-----

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

511 1.0 512 1.0

\*\*\*

LOAD 50 TOTAL HYDROTEST WEIGH OF PIPING/EQUIPMENT/E&I

\*(Sum of LC 500,510,420,430)(EQLT)

\*\*\*

REPEAT LOAD

500 1.0 510 1.0 420 1.0 430 1.0

\*\*\*

LOAD 6110 WIND LOADS DUE TO STRUCTURE SELF OBSTRUCTION [W-E] -VE X DIRECTION

\*

WIND LOAD X -1.7 TYPE 1 XR -1 1 YR 0 13 ZR 0 4 OPEN

WIND LOAD X -1.7 TYPE 1 XR 6 8 YR 0 8 ZR 0 4 OPEN

WIND LOAD X -1.7 TYPE 1 XR 12 14 YR 0 8 ZR 0 4 OPEN

WIND LOAD X -1.7 TYPE 1 XR 18 20 YR 0 10 ZR 0 4 OPEN

WIND LOAD X -1.7 TYPE 1 XR 24 26 YR 0 10 ZR 0 4 OPEN

WIND LOAD X -1.7 TYPE 1 XR 30 32 YR 0 8 ZR 0 4 OPEN

\*

\*\*\*

\*\*\*

LOAD 6310 WIND LOADS DUE TO STRUCTURE SELF OBSTRUCTION [S-N] -VE Z DIRECTION

\*

\* (as per calculation, the wind load on frame is with  $cf=1.8$  on both the frames)

\* as per &YARA A-PC 100000-Y50-00026, 10.2 - factor for longitudinal frame -

\* - would be 1.7.

WIND LOAD Z -1.7 TYPE 1 XR 0 31 YR 0 13 ZR -1 1 OPEN

WIND LOAD Z -1.7 TYPE 1 XR 0 31 YR 0 13 ZR 3 5 OPEN

\*

\*\*\*

\*\*\*\*\* the comparison of wind with earthquake load...

\* As per Eurocode8

\*  $T=Ct.H^{3/4} = 0.085*7.7^{0.75} = 0.393.....$  (4.6)

\* for type 2, and ground type D, as per table 3.3, the different values are

\*  $S=1.8, Ta=0.1, Tc=0.3, TD=1.2,$

\* hence  $T > Tc, T < TD,$  hence  $Sd(t) = ag.S.2.5/q*Tc/T...$  (3.15)

\*  $Sd(t) = 0.05*1.8*2.5/q*0.3/0.393$  (ag in terms of g,  $ag=0.05$ )

\*  $q = qo*kw...(5.2.2.2)$

\*  $qo = 3.ao/a1... table 5.1, ao/a1=1.2, kw=1,$

\*  $q = 3*1.2*1 = 3.6,$

\*  $Sd(t) = 0.05*1.8*2.5/3.6*0.3/0.393 = 0.048 .....$

\* Base shear =  $Fb = Sd(t)*m*lemda$

\*  $lemda = 1, m$  is mass of the structure

\* Base shear =  $0.048*m....$

\* means the base shear is 4.8 or say 5% of the mass

\*

\* the wind load in both the direction are coming more than this seismic.

\* hence seismic load will not govern and hence not applied...

\*\*\*

LOAD 611 WIND LOAD ON STR. DUE TO SELF OBSTRUCTION IN +VE X-(E-W) DIRECTION

\*\*\*\*\* as per calculation, the wind load on first frame is with  $cf=1.7$  factor,

\*\*\*\*\* wind load on all other frames =  $cf=0.64.$

WIND LOAD X 1.7 TYPE 1 XR -1 1 YR 0 13 ZR 0 4 OPEN

WIND LOAD X 1.7 TYPE 1 XR 6 8 YR 0 8 ZR 0 4 OPEN

WIND LOAD X 1.7 TYPE 1 XR 12 14 YR 0 8 ZR 0 4 OPEN

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

WIND LOAD X 1.7 TYPE 1 XR 18 20 YR 0 10 ZR 0 4 OPEN  
WIND LOAD X 1.7 TYPE 1 XR 24 26 YR 0 10 ZR 0 4 OPEN  
WIND LOAD X 1.7 TYPE 1 XR 30 32 YR 0 8 ZR 0 4 OPEN

\*\*\*-----  
\*\*\*-----

LOAD 612 WIND LOAD ON PIPING IN +VE X-(E-W) DIRECTION

\*  
\*\*\*\* as per section 10.3, &YARA A-PC 10000-Y50-00026, the horizontal load  
\* Htot shall be provided as HS (or HWL or HE)+ HA (longitudinal direction)  
\* A) Hs stability force = 1.5 % of the weight of the structure and the operating -  
\* - loads of the pipes.  
\* weight of the structure = 405kN, operating piping weight = 1437 kN.  
\* LC101-self weight of structure, LC40-operating load  
\*\*\*\* hence Hs = 1.5/100\*(405+1437) = 27.63KN,  
\*-----  
\* HWL = longitudinal wind force = 0.3\*(DP+HB)\*pw\*L  
\* DP=1.2, HB=0.2m, Pw=0.8KN/m2, L=31m (total length of the piperack considered),  
\*\*\*\* hence HWL = 0.3\*(1.2+0.2)\*0.8\*31 = 10.416 kN.....@2.7m level  
\*\*\*\* (so per joint, 10.416/2 = 5.25 kN)  
\*\*\*\* HWL = 0.3\*(0.3+0.2)\*0.8\*31 = 3.72 kN.....@5.7m level  
\*\*\*\* (so per joint, 3.72/2 = 1.86 kN)  
\*\*\*\* HWL = 0.3\*(0.05+0.2)\*0.8\*31 = 1.86 kN.....& 7.0m level  
\*\*\*\* (so per joint, 1.86/2 = 0.93 kN)  
\*\*\* total = 10.416+3.72+1.86 = 15.996 KN,  
\* \*-----  
\*\*\*\* the governing is 27.63 KN, this load is applied at top level  
\* to have the more effect on the structure.  
\* load = 28/2 = 14 KN, applied at two nodes.

JOINT LOAD  
31 36 FX 14

\*\*\*-----  
\*\*\*-----

LOAD 613 WIND LOAD ON EQUIPMENT +VE X-(E-W) DIRECTION

\*\*\*-----  
\*\*\*-----

LOAD 614 WIND LOAD ON CABLE TRAY +VE X-(E-W) DIRECTION

\*the cable tray gallery height = 2.65m, width of the cables=0.8m,  
\* the wind pressure = 0.8 KN/m2, cf=1.7  
\* hence load on cables trays considering fully cladded = 2.65\*0.8\*0.8\*1.7=2.9KN,  
\* this load is applied to the column where the cable trays are attached.  
\* torsional force due to this wind on cables not considered as, the beams would  
\* be restrained by the cables.

MEMBER LOAD

3 9 15 21 27 91 CON GX 2.9

\*\*\*-----  
\*\*\*-----

LOAD 61 TOTAL WIND LOAD IN +VE X-(E-W) DIRECTION (LC 611)

\*\*\*-----  
\*\*\*-----

REPEAT LOAD

611 1.0 612 1.0 613 1.0 614 1.0

\*\*\*-----  
\*\*\*-----

LOAD 621 WIND LOAD ON STRUCTURE DUE TO SELF OBSTRUCTION IN +VE Z-(N-S) DIR

\* (as per calculation, the wind load on frame is with cf=1.8 on both the frames)  
\* as per &YARA A-PC 10000-Y50-00026, 10.2 - factor for longitudinal frame -  
\* - would be 1.7.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

WIND LOAD Z 1.7 TYPE 1 XR 0 31 YR 0 13 ZR -1 1 OPEN  
WIND LOAD Z 1.7 TYPE 1 XR 0 31 YR 0 13 ZR 3.5 4.5 OPEN

\*\*\*-----  
\*\*\*-----

LOAD 622 WIND LOAD ON PIPING IN +VE Z-(N-S) DIRECTION

\* Load at +3.200m level

\* wind load on big pipe:

\*  $H_{wp} = DP + w \cdot \tan(10) = 1.2 + (1.2 \cdot \tan(10)) = 1.4\text{m}$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $0.8\text{ KN/m}^2$  as wind pressure as per calculation,  $L=20\text{m}$

\* length of the pipe, load1 (L01.01) =  $0.8 \cdot 1.4 \cdot 0.8 \cdot 24 = 21.5\text{ kN}$ ,

\* for 15m length, load2 (L01.02) =  $0.8 \cdot 1.4 \cdot 0.8 \cdot 15 = 13.5\text{ kN}$

MEMBER LOAD

265 CON GZ 21.5 0.199994

251 CON GZ 13.5 0.0999939

\* Load at +5.700m level

\*  $H_{wp} = DP + w \cdot \tan(10) = 0.4 + (4 \cdot \tan(10)) = 1.1\text{m}$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $0.8\text{ KN/m}^2$  as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 1.1 \cdot 0.8 \cdot (2/3 \cdot 6) = 2.82\text{ KN}...$

\* applied at the centre of the beam

MEMBER LOAD

56 65 68 105 CON GZ 2.82

JOINT LOAD

85 87 FZ 2.82

\*

\* load at intermediate beam =  $0.8 \cdot 1.1 \cdot 0.8 \cdot 1/3 \cdot 6 = 1.41\text{ KN}...$

\* applied at the centre of the beam

MEMBER LOAD

101 106 148 159 160 CON GZ 1.41

\*

\* Load at +8.000m level

\*  $H_{wp} = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8\text{m}$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $0.8\text{ KN/m}^2$  as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 0.8 \cdot 0.8 \cdot 3 = 1.55\text{ KN}...$

\* applied at the centre of the beam

MEMBER LOAD

57 66 69 102 TO 104 161 TO 163 CON GZ 1.55

JOINT LOAD

86 88 FZ 1.55

\*

\* Load at 12.100m level

\*  $H_{wp} = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8\text{m}$  contributory hight for load,

\* with  $cf=0.8$  of pipe,  $0.9\text{ KN/m}^2$  as wind pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 0.9 \cdot 0.8 \cdot 3 = 1.75\text{ KN}...$

\* applied at the centre of the beam

MEMBER LOAD

135 CON GZ 1.75

\*\*\*-----

\*\*\*-----

LOAD 623 WIND LOAD ON EQUIPMENT +VE Z-(N-S) DIRECTION

\*\*\*-----

\*\*\*-----

LOAD 624 WIND LOAD ON CABLE TRAY +VE Z-(N-S) DIRECTION

\*the second level is cladded with cable tray,

\* with  $cf=1.7$ , height =  $2.3\text{m}$ , wind pressure =  $0.8\text{ kN/m}^2$ , cable tray span= $6\text{m}$ ,

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* cf isnot considered as whole area is considered.  
\* load =  $2.3*0.8*6 = 11.04$  kN applied at the supporting location of the cable  
\* trays.

**MEMBER LOAD**

3 9 15 21 27 91 CON GZ 11.04

\*\*\*-----  
LOAD 62 TOTAL WIND LOAD IN +VE Z-(N-S) DIRECTION (LC 621)

\*\*\*-----  
REPEAT LOAD  
621 1.0 622 1.0 623 1.0 624 1.0

\*\*\*-----  
LOAD 631 WIND LOAD ON STRUCTURE DUE TO SELF OBSTRUCTION IN -VE X-(W-E) DIR

\*\*\*\* as per calculation, the wind load on frame is with  $cf=1.7$  on both the frames  
WIND LOAD -X -1.7 TYPE 1 XR 30 32 YR 0 8 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR 24 26 YR 0 10 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR 18 20 YR 0 10 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR 12 14 YR 0 8 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR 6 8 YR 0 8 ZR 0 4 OPEN  
WIND LOAD -X -1.7 TYPE 1 XR -1 1 YR 0 13 ZR 0 4 OPEN

\*\*\*-----  
LOAD 632 WIND LOAD ON PIPING IN -VE X-(W-E) DIRECTION

\*  
\*\*\*\* as per section 10.3, &YARA A-PC 10000-Y50-00026, the horizontal load  
\* Htot shall be provided as HS (or HWL or HE)+ HA (longitudinal direction)  
\* A) Hs stability force = 1.5 % of the weight of the structure and the operating -  
\* - loads of the pipes.  
\* weight of the structure = 405kN, operating piping weight = 1437 kN.  
\* LC101-self weight of structure, LC40-operating load  
\*\*\*\* hence  $Hs = 1.5/100*(405+1437) = 27.63KN,$   
\*-----  
\* HWL = longitudinal wind force =  $0.3*(DP+HB)*pw*L$   
\* DP=1.2, HB=0.2m, Pw=0.8KN/m2, L=31m (total length of the piperack considered),  
\*\*\*\* hence  $HWL = 0.3*(1.2+0.2)*0.8*31 = 10.416$  kN.....@2.7m level  
\*\*\*\* (so per joint,  $10.416/2 = 5.25$  kN)  
\*\*\*\*  $HWL = 0.3*(0.3+0.2)*0.8*31 = 3.72$  kN.....@5.7m level  
\*\*\*\* (so per joint,  $3.72/2 = 1.86$  kN)  
\*\*\*\*  $HWL = 0.3*(0.05+0.2)*0.8*31 = 1.86$  kN.....& 7.0m level  
\*\*\*\* (so per joint,  $1.86/2 = 0.93$  kN)  
\*\*\* total =  $10.416+3.72+1.86 = 15.996$  KN,

\* \*-----  
\*\*\*\* the governing is 27.63 KN, this load is applied at top level.

\* load =  $28/2 = 14$  KN, applied at two nodes.

**JOINT LOAD**

35 40 FX -14

\*\*\*-----  
LOAD 633 WIND LOAD ON EQUIPMENT -VE X-(W-E) DIRECTION

\*\*\*-----  
LOAD 634 WIND LOAD ON CABLE TRAY -VE X-(W-E) DIRECTION

\*the cable tray gallery height = 2.65m, width of the cables=0.8m,  
\* the wind pressure = 0.8 KN/m2,  $cf=1.7$   
\* hence load on cables trays considering fully cladde =  $2.65*0.8*0.8*1.7=2.9KN,$



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

- \* this load is applied to the column where the cable trays are attached.
- \* torsional force due to this wind on cables not considered as, the beams would
- \* be restrained by the cables.

MEMBER LOAD

3 9 15 21 27 91 CON GX -2.9

\*\*\*

LOAD 63 TOTAL WIND LOAD IN -VE X-(W-E) DIRECTION (LC 631)

\*\*\*

REPEAT LOAD

631 1.0 632 1.0 633 1.0 634 1.0

\*\*\*

LOAD 641 WIND LOAD ON STRUCTURE DUE TO SELF OBSTRUCTION IN -VE Z-(S-N) DIR

- \* (as per calculation, the wind load on frame is with  $cf=1.8$  on both the frames)
- \* as per &YARA A-PC 100000-Y50-00026, 10.2 - factor for longitudinal frame -
- \* - would be 1.7.

WIND LOAD -Z -1.7 TYPE 1 XR 0 31 YR 0 13 ZR -1 1 OPEN

WIND LOAD -Z -1.7 TYPE 1 XR 0 32 YR 0 13 ZR 3.5 4.5 OPEN

\*\*\*

\*\*\*

LOAD 642 WIND LOAD ON PIPING IN -VE Z-(S-N) DIRECTION

- \* Load at +3.200m level
- \* wind load on big pipe:
- \*  $Hwp = DP+w.tan(10) = 1.2 + (1.2*tan(10)) = 1.4m$  contributory hight for load,
- \* with  $cf=0.8$  of pipe, 0.8 KN/m2 as wind pressure as per calculation,  $L=20m$
- \* length of the pipe, load1 (L01.01) =  $0.8*1.4*0.8*24 = 21.5$  kN,
- \* for 15m length, load2 (L01.02) =  $0.8*1.4*0.8*15 = 13.5$  kN

MEMBER LOAD

265 CON GZ -21.5 0.199994

251 CON GZ -13.5 0.0999939

\* Load at +5.700m level

- \*  $Hwp = DP+w.tan(10) = 0.4 + (4*tan(10)) = 1.1m$  contributory hight for load,
- \* with  $cf=0.8$  of pipe, 0.8 KN/m2 as wind pressure as per calculation,
- \* load at the main grid beam =  $0.8*1.1*0.8*(2/3*6) = 2.82$  KN...

\* applied at the centre of the beam

MEMBER LOAD

56 65 68 105 CON GZ -2.82

JOINT LOAD

85 87 FZ -2.82

\*

\* load at intermediate beam =  $0.8*1.1*0.8*1/3*6 = 1.41$  KN...

\* applied at the centre of the beam

MEMBER LOAD

101 106 148 159 160 CON GZ -1.41

\*

\* Load at +8.000m level

- \*  $Hwp = DP+w.tan(10) = 0.1 + (4*tan(10)) = 0.8m$  contributory hight for load,
- \* with  $cf=0.8$  of pipe, 0.8 KN/m2 as wind pressure as per calculation,
- \* load at the main grid beam =  $0.8*0.8*0.8*3 = 1.55$  KN...

\* applied at the centre of the beam

MEMBER LOAD

57 66 69 102 TO 104 161 TO 163 CON GZ -1.55

JOINT LOAD

86 88 FZ -1.55

\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

- \* Load at 12.100m level
- \*  $Hwp = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8\text{m}$  contributory hight for load,
- \* with  $cf=0.8$  of pipe,  $0.9\text{ KN/m}^2$  as wind pressure as per calculation,
- \* load at the main grid beam =  $0.8 \cdot 0.9 \cdot 0.8 \cdot 3 = 1.75\text{ KN}...$
- \* applied at the centre of the beam

MEMBER LOAD  
135 CON GZ -1.75

\*

\*\*\*-----

\*\*\*-----

LOAD 643 WIND LOAD ON EQUIPMENT -VE Z-(S-N) DIRECTION

\*\*\*-----

\*\*\*-----

LOAD 644 WIND LOAD ON CABLE TRAY -VE Z-(S-N) DIRECTION

- \* the second level is cladded with cable tray,
- \* with  $cf=1.7$ , height =  $2.3\text{m}$ , wind pressure =  $0.8\text{ kN/m}^2$ , cable tray span= $6\text{m}$ ,
- \*  $cf$  is not considered as whole area is considered.
- \* load =  $2.3 \cdot 0.8 \cdot 6 = 11.04\text{ kN}$  applied at the supporting location of the cable
- \* trays.

MEMBER LOAD  
3 9 15 21 27 91 CON GZ -11.04

\*\*\*-----

LOAD 64 TOTAL WIND LOAD IN -VE Z-(S-N) DIRECTION (LC 641)

\*\*\*-----

REPEAT LOAD

641 1.0 642 1.0 643 1.0 644 1.0

\*\*\*-----

LOAD 81 PIPING THERMAL LOAD IN E-W DIRECTION (FDN/GLOBAL DESIGN) (TLE)

\*\*\*\*\* Load applied are as per "Load table SR 0501"\*\*\*\*\*

MEMBER LOAD

\* Load at +3.200 level, L01.01 =  $25\text{ KN}$  (48"- CAJR01)

265 CON GX 25 0.199994

\* Load at +3.200 level, L01.02 =  $20\text{ KN}$  (48"- CAJR01)

251 CON GX 20 0.0999939

\* Load at +3.200 level, L01.01 =  $25\text{ KN}$  (48"- CAJR01)

246 CON GX 15 0.299999

\* Load at +6.700 level, L02.01 =  $3\text{ KN}$

206 CON GX 3

\* Load at +6.700 level, L02.02 =  $3\text{ KN}$

205 CON GX 3

\* Load at +9.200 level, L03.01 =  $3\text{ KN}$

210 CON GX 3 1.8

\* Load at +12.100 level, L04.01 =  $3\text{ KN}$

135 CON GX 8

\* Load at +5.700m level,  $hE=0.5\text{ KN/m}^2$

\* load at main grid transverse beam =  $2/3 \cdot 6 \cdot (0.5) = 2\text{ KN/m}$ , (for 6m span),

\* load at intermediate beam =  $1/3 \cdot 6 \cdot (0.5\text{ kN/m}^2) = 1\text{ KN/m}$ , (for 6m span),

56 59 62 65 68 105 164 166 UNI GX 2

101 106 148 159 160 UNI GX 1

\*

\* Loads at +8.000m level =  $hE = 0.4\text{ KN/m}^2$

\* load for 3m span =  $0.4 \cdot 3 = 1.2\text{ kN/m}$ , applied at all beams considering,

\* that these small bore lines would be supported by all beams.

57 60 63 66 69 102 TO 104 161 TO 163 165 167 UNI GX 1.2

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*

- \* Loads at +8.900m level =  $hE = 0.2 \text{ KN/m}^2$
- \* load for 1m span at internal beams =  $0.2 * 1 = 0.2 \text{ kN/m}$
- \* loads at external beams =  $0.2/2 = 0.1 \text{ KN/m}$

MEMBER LOAD

196 197 UNI GX 0.2  
129 198 199 220 UNI GX 0.1

\*\*\*-----  
\*\*\*-----

LOAD 82 PIPING THERMAL LOAD IN N-S DIRECTION (FDN/GLOBAL DESIGN) (TLN)

\*

- \* Load applied are as per "Load table SR 0501"
- \* 12" pipe considered at +5.700 level, hence load =  $3 \text{ KN/m}^2$
- \* load at main grid transverse beam =  $2/3 * 6 * (3) = 12 \text{ KN/m}$ , (for 6m span),
- \* with 0.3 factor, load =  $0.3 * 12 = 3.6 \text{ kN/m}$
- \* load at intermediate beam =  $1/3 * 6 * (3 \text{ kN/m}^2) = 6 \text{ KN/m}$ , (for 6m span),
- \* with 0.3 factor, load =  $0.3 * 6 = 1.8 \text{ kN}$
- \* (0.3 factor is friction coefficient between steel to steel)

MEMBER LOAD

\*\*\*\*\*59 62 65 105 164 166 UNI GZ 3.6  
\*\*\*\*\*106 148 159 UNI GZ 1.8

- \* Load at +3.200 level, L01.03 =  $15 \text{ KN}$  (48"- CAJR01)
- 246 CON GZ 15 0.299999
- \* Load at +6.700 level, L02.01 =  $3 \text{ KN}$
- 206 CON GZ 3
- \* Load at +6.700 level, L02.02 =  $3 \text{ KN}$
- 205 CON GZ 3
- \* Load at +9.200 level, L03.01 =  $3 \text{ KN}$
- 210 CON GZ 3 1.8

\*

- \* Loads at +8.900m level =  $hE = 0.2 \text{ KN/m}^2$
- \* load for 1m span at internal beams =  $0.2 * 1 = 0.2 \text{ kN/m}$
- \* load at external beam =  $0.2/2 = 0.1 \text{ KN/m}$

MEMBER LOAD

196 197 UNI GZ 0.2  
129 198 199 220 UNI GZ 0.1

\*\*\*-----  
\*\*\*-----

LOAD 83 PIPE/EQUIPMENT FRICTION LOAD IN E-W DIRECTION (FLE)

\*

- \* the big pipe load assumed =  $5 \text{ KN/m}$ , for 25m span, load =  $5 * 25 = 125 \text{ KN}$ , for
- \* 16m span, load =  $5 * 16 = 80 \text{ kN}$ ,
- \* factor 0.3 is considered, load =  $0.3 * 125 = 37.5 \text{ kN}$ , &  $0.3 * 80 = 24 \text{ kN}$ ,
- \*(0.3 factor is friction coefficient between steel to steel)

\*

- \* 12" pipe considered at +5.700 level, hence load =  $3 \text{ KN/m}^2$
- \* load at main grid transverse beam =  $2/3 * 6 * (3) = 12 \text{ KN/m}$ , (for 6m span)
- \* with  $0.3 * 0.5 = 0.15$  factor, load =  $0.15 * 12 = 1.8 \text{ KN/m}$
- \* load at intermediate beam =  $1/3 * 6 * (3 \text{ kN/m}^2) = 6 \text{ KN/m}$ , (for 6m span)
- \* with  $0.3 * 0.5 = 0.15$  factor, load =  $0.15 * 6 = 0.9 \text{ kN/m}$
- \* (0.3 factor is friction coefficient between steel to steel & 0.5 as per 4.2.2
- \* of & YARA A PC 10000 Y50 00026)
- \* load for smaller dia. at +8.0m level is considered as  $1.5 \text{ KN/m}^2$
- \* load for 3m span =  $1.5 * 3 = 4.5 \text{ kN/m}^2$ , applied at all beams considering,

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

- \* that the these small bore lines would be supported by all beams.
- \* with load =  $0.3 \times 0.5 = 0.15$ , load =  $4.5 \times 0.15 = 0.675$
- \* (0.3 factor is friction coefficient between steel to steel & 0.5 as per 4.2.2
- \* of &YARA A PC 10000 Y50 00026)

\*\*\*-----  
**LOAD 84 PIPE/EQUIPMENT FRICTION LOAD IN N-S DIRECTION (FLN)**  
 \*

- \* the big pipe load assumed = 5 KN/m, for 6m span, load =  $5 \times 6 = 30\text{kN}$ ,
- \* factor = 0.3 considered, load =  $0.3 \times 30 = 9\text{KN}$
- \*
- \* load for smaller dia. at +8.0m level is considered as 1.5 KN/m<sup>2</sup>
- \* load for 3m span =  $1.5 \times 3 = 4.5 \text{ kN/m}^2$ , applied at all beams considering,
- \* that the these small bore lines would be supported by all beams.
- \* with factor  $0.3 \times 0.5 = 0.15$ , load =  $0.15 \times 4.5 = 0.675 \text{ kN/m}$
- \* (0.3 factor is friction coefficient between steel to steel & 0.5 as per 4.2.2
- \* of &YARA A PC 10000 Y50 00026)

\*\*\*-----  
**LOAD 85 STEEL THERMAL LOAD ON STRUCTURE IN WARM CONDITION (ENT+)**

- \* as per 16471-C50-00001-published 2.4.2.2, maximum temperature=40degreeC,
- \* consider the erection temperature = 10degree, net =  $40 - 10 = 30$

**TEMPERATURE LOAD**

1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 275 TEMP 30

\*\*\*-----  
 \*\*\*-----

**LOAD 86 STEEL THERMAL LOAD ON STRUCTURE IN COLD CONDITION (ENT-)**

- \* as per 16471-C50-00001-published 2.4.2.2, minimum temperature=-20degreeC,
- \* consider the erection temperature = 10degree, net =  $10 - (-20) = 30(-)$

**TEMPERATURE LOAD**

1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 275 TEMP -30

\*\*\*-----  
 \*\*\*-----

**LOAD 87 LOCAL WIND LOAD ON PIPE/EQUIPMENT IN X -(E-W) DIRECTION (LOCAL DESIGN)**

\*\*\*-----

**LOAD 88 LOCAL WIND LOAD ON PIPE/EQUIPMENT IN Z -(N-S) DIRECTION (LOCAL DESIGN)**

\*\*\*-----

**LOAD 89 LOCAL PIPE HORIZONTAL LOAD IN E-W DIRECTION (LOCAL DESIGN) (TLELOCAL)**

\*\*\*-----

**LOAD 90 LOCAL PIPE HORIZONTAL LOAD IN N-S DIRECTION (LOCAL DESIGN) (TLNLOCAL)**

\*\*\*-----

**LOAD 911 VERTICAL LOAD DUE TO CRANE, MONORAIL AND BUNDLE PULL LOADS  
 ELEMENT LOAD**

289 TO 444 451 TO 762 765 TO 1100 1107 TO 1418 1420 TO 1731 1736 TO 1741 1743 -  
 1744 1746 1747 1749 1750 1752 1753 1755 1756 1758 1759 1761 1762 1764 1765 -  
 1767 1768 1770 1771 1773 1774 1776 1777 1779 1780 1782 1783 1785 TO 1837 -  
 1839 1840 1842 1843 1847 TO 1852 1859 TO 1950 2231 TO 2281 2301 TO 2305 2325 -  
 2326 TO 2329 2349 TO 2353 2373 TO 2377 2397 TO 2401 2421 TO 2425 2445 TO 2449 -  
 2469 TO 2473 2493 TO 2497 2517 TO 2521 2541 2542 3039 TO 3385 3402 TO 3405 -  
 3422 TO 3425 3442 TO 3445 3462 TO 3465 3482 TO 3485 3502 TO 3505 -  
 3522 TO 3525 3542 TO 3545 3562 TO 3565 3582 TO 3604 PR GY -20

\*\*\*-----

**LOAD 912 HORIZONTAL LOAD DUE TO CRANE, MONORAIL AND BUNDLE PULL LOADS**

\*\*\*-----

**LOAD 91 MAINTENANCE LOAD (SUM OF LC 911 & LC 912) (ML)**

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*-----

**REPEAT LOAD**

911 1.0 912 1.0

\*\*\*-----

**LOAD 92 HORIZONTAL LOADS OF PSV (LOCAL DESIGN) (PSV)**

\*\*\*-----

**LOAD 93 MINIMUM VERTICAL LOAD FOR BEAM DESIGN (VMIN)**

\*

\* consider 10KN load at the centre of all longitudinal beams for the member design.

\* also load at top of the main grid column of 10 KN (as contingency load)

\* applied for member design.

\* at +3.20m level, load for member design

**MEMBER LOAD**

33 37 55 CON GY -10

\*\*\*\*\*38 CON GY -10 4.49975

\*\*\*\*\*34 CON GY -10 4.49975

**JOINT LOAD**

59 60 FY -10

\*

\* at +5.70m level, load for member design

**JOINT LOAD**

61 62 75 TO 78 FY -10

\*

\* at +8.0m level, load for member design

42 48 79 TO 84 FY -10

32 TO 35 37 TO 40 67 68 FY -10

\*\*\*-----

**LOAD 94 SNOW LOAD (SL)**

\* snow load as per 16471-C50-00001\_published,

\* characteristic value of snow load,  $S_k = 0.7 \text{ KN/m}^2$ , Exposure coefficient= $C_e=1$ ,

\* Thermal coefficient =  $c_t = 1$ ,

\* as per EN-1991-1-3/NA, (m) snow load shape coefficient for 0 degree roof = 0.8,

\* the same value would be used for cable tray, grating floor & the big pipe.

\* load =  $m \cdot c_e \cdot c_t \cdot s_k = 0.8 * 1 * 1 * 0.7 = 0.56 \text{ KN/m}^2$

\*\*

\* load on grating = with 1.0m width, load =  $1 * 0.56 = 0.56$  say 0.6 KN/m applied -

\* - at grating supporting beams at internal beams

\* this is applied to all grating supporting beams at level +8.900

\* loads at external beams =  $0.6/2 = 0.3 \text{ KN/m}$

**MEMBER LOAD**

196 197 UNI GY -0.6

129 198 199 220 242 243 UNI GY -0.3

\* two beams, load =  $0.6 * 1.2/2 = 0.36 \text{ KN/m}$ , this is applied at level +5.700

**MEMBER LOAD**

189 190 UNI GY -0.36

\*\*

\* load on cable tray = for the top layer = 0.6 KN/m, load for 6.0m span = 3.6KN,

\* load at all other cable trays would be considered 50% =  $0.5 * 3.6 = 1.8 \text{ kN}$ ,

\* total load =  $3.6 + (6 * 1.8) = 14.4 \text{ KN}$ , moment =  $14.4 * 0.4 = 5.76 \text{ KN.m}$

**MEMBER LOAD**

3 9 15 21 27 91 CON GY -14.4

3 9 15 21 27 91 CMOM GX 5.76

\*\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* snow load on piping  
\* At +5.700 level, snow load = 0.6 KN/m<sup>2</sup>, 50% reduction considered as +8.0piping - ,  
\* is covered with 100% snow load, hence lower piping levels where considered  
\* with 50% reduction of the load.  
\* load = 0.5\*0.6 = 0.3 KN/m<sup>2</sup>  
\* load at main grid transverse beam = 2/3\*6\*(0.3 KN/m<sup>2</sup>) = 1.2 KN/m, (for 6m span)  
\* load at intermediate beam = 1/3\*6\*(0.3 KN/m<sup>2</sup>) = 0.6 KN/m, (for 6m span)  
\*

\* load at +8.0m level, snow load = 0.6 KN/m<sup>2</sup>,  
\* load for 3m span = 0.6\*3 = 1.8 KN/m, applied at all beams considering,

**MEMBER LOAD**

56 59 62 65 68 105 164 166 UNI GY -1.2

101 106 148 159 160 UNI GY -0.6

\*

57 60 63 66 69 102 TO 104 161 TO 163 165 167 UNI GY -1.8

\*

\* snow at +2.7m level,

\* snow load = 0.6 KN/m<sup>2</sup>, diameter of pipe = 1.22m,

\* load = 0.6\*1.22 = 0.732 kN/m

\* for 25m span, load = 0.732\*25 = 18.3 KN, for

\* 16m span, load = 0.732\*16 = 11.7 kN, and for 6m span, load = 0.732\*6 = 4.4kN.

**MEMBER LOAD**

265 CON GY -18.3 0.199994

64 CON GY -11.7 3.2

246 CON GY -4.4 0.299999

\*

\*\*\*\*\*

\*\*\*\*\*

LOAD 96 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

\*\*\*\*\* Blast load on structure

\*\*\*\*\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>

\*\*\*\*\* load on frame = cf\*0.25\*6.07 = 2.58

\*\*\*\*\*MEMBER LOAD

\*\*\*\*\*1 TO 30 55 TO 69 90 91 96 97 103 105 129 131 133 135 TO 141 164 TO 167 180 -

\*\*\*\*\*182 185 199 202 TO 204 207 208 221 222 229 235 237 251 257 274 UNI GX 2.58

\*\*\*\*\*

\*\*\*\*\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,

\*\*\*\*\* this is at side frames.

\*\*\*\*\* load on frame = cf\*0.25\*3 = 1.275

\*\*\*\*\*

\*\*\*\*\*4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -

\*\*\*\*\*70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -

\*\*\*\*\*136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -

\*\*\*\*\*224 246 253 264 UNI GZ 1.275

\*\*\*\*\*1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -

\*\*\*\*\*76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -

\*\*\*\*\*140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -1.275

\* on front face and the 3 KN/m<sup>2</sup> at the side faces.

\*

\*\*\*\* as per section 10.3, &YARA A-PC 10000-Y50-00026, the horizontal load

\*\* Blast load on pipes in longitudinal direction would be calculated as...

\*\* \*-----

\*\* HWL = longitudinal wind force = 0.3\*(DP+HB)\*pw\*L

\*\* DP=1.2, HB=0.2m, Pw=6.07KN/m<sup>2</sup>, L=31m (total length of the piperack considered),

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\* hence  $HWL = 0.3 \times (1.2 + 0.2) \times 6.07 \times 31 = 79.031$  kN.....@2.7m level  
 \*\*\*\*\* (so per joint,  $79.031/2 = 39.516$  kN)  
 \*\*\*\*\*  $HWL = 0.3 \times (0.3 + 0.2) \times 6.07 \times 31 = 28$  kN.....@5.7m level  
 \*\*\*\*\* (so per joint,  $28.226/2 = 14.113$  kN)  
 \*\*\*\*\*  $HWL = 0.3 \times (0.05 + 0.2) \times 6.07 \times 31 = 14.113$  kN.....& 7.0m level  
 \*\*\*\*\* (so per joint,  $14.113/2 = 7.056$  kN)  
 \*\*\*\*

\*\* \*-----

**\*JOINT LOAD**

\*11 16 FX 39.516  
 \*21 26 FX 14.113  
 \*31 36 FX 7.056

\*\*

\*\*the cable tray gallery height = 2.65m, width of the cables=0.8m,  
 \*\* the Blast pressure = 6.07 KN/m<sup>2</sup>, cf=1.7  
 \*\* hence load on cables trays considering fully cladded =  $2.65 \times 0.8 \times 6.07 \times 1.7 = 21.876$ KN  
 \*\* this load is applied to the column where the cable trays are attached.  
 \*\* torsional force due to this wind on cables not considered as, the beams would  
 \*\* be restrained by the cables.

**\*MEMBER LOAD**

\*3 9 15 21 27 91 CON GX 21.876

\*\*\*\*\*  
 \*\*\*\*\*

\*

**LOAD 961 LOADTYPE None TITLE BLAST LOAD +X DIRECTION**

\* Blast load on structure  
 \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
 \* load on frame =  $cf \times 0.25 \times 6.07 = 2.58$ , cf is ignored as load was provided to  
 \* lateral direction also.  
 \* final load =  $0.25 \times 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

1 TO 6 55 TO 57 129 131 133 135 TO 137 180 182 185 199 221 222 235 -  
 237 UNI GX 1.52

\*

\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,  
 \* this is at side frames.  
 \* load on frame =  $cf \times 0.25 \times 3 = 1.275$ , cf is ignored  
 \* final load =  $0.25 \times 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
 70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
 136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
 224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
 76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
 140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
 \*\*\*\*\*

**LOAD 962 LOADTYPE None TITLE BLAST LOAD +X DIRECTION**

\* Blast load on structure  
 \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
 \* load on frame =  $cf \times 0.25 \times 6.07 = 2.58$ , cf is ignored as load was provided to  
 \* lateral direction also.  
 \* final load =  $0.25 \times 6.07 = 1.518$  say 1.52 KN/m

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

**MEMBER LOAD**

90 91 96 97 103 105 229 UNI GX 1.52

\*

- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
\*\*\*\*\*

LOAD 963 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

7 TO 12 58 138 139 202 UNI GX 1.52

60 UNI GX 1.52 2 4

60 UNI GX 1.52 0 2

59 UNI GX 1.52 2 4

59 UNI GX 1.52 0 2

\*

- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*

\*\*\*\*\*this load is applied\*\*\*\*\*

- \*\* as per section 10.3, & YARA A-PC 10000-Y50-00026, the horizontal load
- \* Blast load on pipes in longitudinal direction would be calculated as...

\* \*-----\*

- \* HWL = longitudinal wind force =  $0.3 \cdot (DP + HB) \cdot pw \cdot L$
- \* DP=1.2, HB=0.2m, Pw=6.07KN/m<sup>2</sup>, L=31m (total length of the piperack considered),
- \* hence HWL =  $0.3 \cdot (1.2 + 0.2) \cdot 6.07 \cdot 31 = 79.031$  kN.....@2.7m level
- \* (so per joint,  $79.031/2 = 39.516$  kN)
- \* HWL =  $0.3 \cdot (0.3 + 0.2) \cdot 6.07 \cdot 31 = 28$  kN.....@5.7m level
- \* (so per joint,  $28.226/2 = 14.113$  kN)
- \* HWL =  $0.3 \cdot (0.05 + 0.2) \cdot 6.07 \cdot 31 = 14.113$  kN.....& 7.0m level



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* (so per joint,  $14.113/2 = 7.056$  kN)

JOINT LOAD

11 16 FX 39.516

21 26 FX 14.113

31 36 FX 7.056

\*

\*the cable tray gallery height = 2.00m, width of the cables=0.8m,

\* the Blast pressure = 6.07 KN/m<sup>2</sup>, cf=1.7, 1 if whole area is considered

\* hence load on cables trays considering fully cladded =  $2*0.8*6.07*1=9.712$ KN

\* this load is applied to the column where the cable trays are attached.

\* torsional force due to this wind on cables not considered as, the beams would

\* be restrained by the cables.

MEMBER LOAD

3 9 15 21 27 91 CON GX 9.712

\*\*\*\*\*

\*\*\*

LOAD 964 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

\* Blast load on structure

\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>

\* load on frame =  $cf*0.25*6.07 = 2.58$ , cf is ignored as load was provided to

\* lateral direction also.

\* final load =  $0.25*6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

13 TO 18 61 140 141 203 207 251 257 UNI GX 1.52

63 UNI GX 1.52 2 4

63 UNI GX 1.52 0 2

62 UNI GX 1.52 2 4

62 UNI GX 1.52 0 2

\*

\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,

\* this is at side frames.

\* load on frame =  $cf*0.25*3 = 1.275$ , cf is ignored

\* final load =  $0.25*3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -

70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -

136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -

224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -

76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -

140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*

\*\*\*\*\*

LOAD 965 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

\* Blast load on structure

\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>

\* load on frame =  $cf*0.25*6.07 = 2.58$ , cf is ignored as load was provided to

\* lateral direction also.

\* final load =  $0.25*6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

19 TO 24 64 TO 66 204 208 UNI GX 1.52

\*

\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,

\* this is at side frames.

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored  
 \* final load =  $0.25 \cdot 3 = 0.75$  KN/m  
 \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
 70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
 136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
 224 246 253 264 UNI GZ 0.75  
 1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
 76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
 140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
 \*\*\*\*\*

LOAD 966 LOADTYPE None TITLE BLAST LOAD +X DIRECTION

\* Blast load on structure  
 \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
 \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to  
 \* lateral direction also.  
 \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

25 TO 30 67 TO 69 274 UNI GX 1.52

\*  
 \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,  
 \* this is at side frames.  
 \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored  
 \* final load =  $0.25 \cdot 3 = 0.75$  KN/m  
 \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
 70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
 136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
 224 246 253 264 UNI GZ 0.75  
 1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
 76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
 140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
 \*\*\*

\*\*\*\*\*

\*\*\*\*\*LOAD 97 LOADTYPE None TITLE BLAST LOAD - X DIRECTION

\*\*\*\*\* Blast load on structure  
 \*\*\*\*\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
 \*\*\*\*\* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$

\*\*\*\*\*MEMBER LOAD

\*\*\*\*\*1 TO 30 55 TO 69 90 91 96 97 103 105 129 131 133 135 TO 141 164 TO 167 180 -  
 \*\*\*\*\*182 185 199 202 TO 204 207 208 221 222 229 235 237 251 257 -  
 \*\*\*\*\*274 UNI GX -2.58

\*\*\*\*\*

\*\*\*\*\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,  
 \*\*\*\*\* this is at side frames.  
 \*\*\*\*\* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$   
 \*\*\*\*\*

\*\*\*\*\*4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
 \*\*\*\*\*70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
 \*\*\*\*\*136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
 \*\*\*\*\*224 246 253 264 UNI GZ 1.275  
 \*\*\*\*\*1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
 \*\*\*\*\*140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -1.275  
 \*\*\*\*\* on front face and the 3 KN/m<sup>2</sup> at the side faces.

\*\*\*\*\*

\*\*\*\*\* as per section 10.3, & YARA A-PC 10000-Y50-00026, the horizontal load

\*\*\*\*\* Blast load on pipes in longitudinal direction would be calculated as...

\*\*\*\*\* \*-----\*

\*\*\*\*\* HWL = longitudinal wind force =  $0.3 \cdot (DP + HB) \cdot P_w \cdot L$

\*\*\*\*\* DP=1.2, HB=0.2m, P<sub>w</sub>=6.07KN/m<sup>2</sup>, L=31m (total length of the piperack considered),

\*\*\*\*\* hence HWL =  $0.3 \cdot (1.2 + 0.2) \cdot 6.07 \cdot 31 = 79.031$  kN.....@2.7m level

\*\*\*\*\* (so per joint,  $79.031/2 = 39.516$  kN)

\*\*\*\*\* HWL =  $0.3 \cdot (0.3 + 0.2) \cdot 6.07 \cdot 31 = 28$  kN.....@5.7m level

\*\*\*\*\* (so per joint,  $28.226/2 = 14.113$  kN)

\*\*\*\*\* HWL =  $0.3 \cdot (0.05 + 0.2) \cdot 6.07 \cdot 31 = 14.113$  kN.....& 7.0m level

\*\*\*\*\* (so per joint,  $14.113/2 = 7.056$  kN)

\*\*\*\*\*

\*\*\*\*\* \*-----\*

\*\*\*\*\*JOINT LOAD

\*\*\*\*\*15 20 FX -39.516

\*\*\*\*\*15 20 25 30 FX -14.113

\*\*\*\*\*35 40 FX -7.056

\*\*\*\*\*

\*\*\*\*\*the cable tray gallery height = 2.65m, width of the cables=0.8m,

\*\*\*\*\* the Blast pressure = 6.07 KN/m<sup>2</sup>, cf=1.7

\*\*\*\*\* hence load on cables trays considering fully cladded =  $2.65 \cdot 0.8 \cdot 6.07 \cdot 1.7 = 21.876$ KN

\*\*\*\*\* this load is applied to the column where the cable trays are attached.

\*\*\*\*\* torsional force due to this wind on cables not considered as, the beams would

\*\*\*\*\* be restrained by the cables.

\*\*\*\*\*MEMBER LOAD

\*\*\*\*\*3 9 15 21 27 91 CON GX -21.876

\*\*\*\*\*

\*\*

LOAD 971 LOADTYPE None TITLE BLAST LOAD -X DIRECTION

\* Blast load on structure

\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>

\* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to

\* lateral direction also.

\* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

1 TO 6 55 TO 57 129 131 133 135 TO 137 180 182 185 199 221 222 235 -

237 UNI GX -1.52

\*

\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,

\* this is at side frames.

\* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored

\* final load =  $0.25 \cdot 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -

70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -

136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -

224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -

76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -

140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

\*\*\*\*\*

LOAD 972 LOADTYPE None TITLE BLAST LOAD -X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

90 91 96 97 103 105 229 UNI GX -1.52

- \*
- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m
- \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*

\*\*\*\*\*

LOAD 973 LOADTYPE None TITLE BLAST LOAD -X DIRECTION

- \* Blast load on structure
- \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>
- \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to lateral direction also.
- \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

MEMBER LOAD

7 TO 12 58 138 139 202 UNI GX -1.52

60 UNI GX -1.52 2 4

60 UNI GX -1.52 0 2

59 UNI GX -1.52 2 4

59 UNI GX -1.52 0 2

- \*
- \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,
- \* this is at side frames.
- \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored
- \* final load =  $0.25 \cdot 3 = 0.75$  KN/m
- \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*this load is applied\*\*\*\*\*

- \*\* as per section 10.3, & YARA A-PC 10000-Y50-00026, the horizontal load
- \* Blast load on pipes in longitudinal direction would be calculated as...
- \* \*-----

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* HWL = longitudinal wind force =  $0.3 \cdot (DP+HB) \cdot p_w \cdot L$   
 \* DP=1.2, HB=0.2m, Pw=6.07KN/m<sup>2</sup>, L=31m (total length of the piperack considered),  
 \* hence HWL =  $0.3 \cdot (1.2+0.2) \cdot 6.07 \cdot 31 = 79.031$  kN.....@2.7m level  
 \* (so per joint,  $79.031/2 = 39.516$  kN)  
 \* HWL =  $0.3 \cdot (0.3+0.2) \cdot 6.07 \cdot 31 = 28$  kN.....@5.7m level  
 \* (so per joint,  $28.226/2 = 14.113$  kN)  
 \* HWL =  $0.3 \cdot (0.05+0.2) \cdot 6.07 \cdot 31 = 14.113$  kN.....& 7.0m level  
 \* (so per joint,  $14.113/2 = 7.056$  kN)

**JOINT LOAD**

11 16 FX -39.516  
 21 26 FX -14.113  
 31 36 FX -7.056

\*  
 \*the cable tray gallery height = 2.00m, width of the cables=0.8m,  
 \* the Blast pressure = 6.07 KN/m<sup>2</sup>, cf=1.7, 1 if whole area is considered  
 \* hence load on cables trays considering fully cladded =  $2 \cdot 0.8 \cdot 6.07 \cdot 1 = 9.712$ KN  
 \* this load is applied to the column where the cable trays are attached.  
 \* torsional force due to this wind on cables not considered as, the beams would  
 \* be restrained by the cables.

**MEMBER LOAD**

3 9 15 21 27 91 CON GX -9.712

\*\*\*\*\*  
 \*\*\*

**LOAD 974 LOADTYPE None TITLE BLAST LOAD -X DIRECTION**

\* Blast load on structure  
 \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
 \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to  
 \* lateral direction also.  
 \* final load =  $0.25 \cdot 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

13 TO 18 61 140 141 203 207 251 257 UNI GX -1.52  
 63 UNI GX -1.52 2 4  
 63 UNI GX -1.52 0 2  
 62 UNI GX -1.52 2 4  
 62 UNI GX -1.52 0 2

\*  
 \* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,  
 \* this is at side frames.  
 \* load on frame =  $cf \cdot 0.25 \cdot 3 = 1.275$ , cf is ignored  
 \* final load =  $0.25 \cdot 3 = 0.75$  KN/m  
 \*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
 70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
 136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
 224 246 253 264 UNI GZ 0.75  
 1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
 76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
 140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*  
 \*\*\*\*\*

**LOAD 975 LOADTYPE None TITLE BLAST LOAD -X DIRECTION**

\* Blast load on structure  
 \* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>  
 \* load on frame =  $cf \cdot 0.25 \cdot 6.07 = 2.58$ , cf is ignored as load was provided to

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\* lateral direction also.  
\* final load =  $0.25 \times 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

19 TO 24 64 TO 66 204 208 UNI GX -1.52

\*

\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,  
\* this is at side frames.

\* load on frame =  $cf \times 0.25 \times 3 = 1.275$ , cf is ignored

\* final load =  $0.25 \times 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*

\*\*\*\*\*

**LOAD 976 LOADTYPE None TITLE BLAST LOAD -X DIRECTION**

\* Blast load on structure

\* The size (thickness) is considered as 0.25m, with blast load of 6.07 KN/m<sup>2</sup>

\* load on frame =  $cf \times 0.25 \times 6.07 = 2.58$ , cf is ignored as load was provided to

\* lateral direction also.

\* final load =  $0.25 \times 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

25 TO 30 67 TO 69 274 UNI GX -1.52

\*

\* The size (thickness) is considered as 0.25m, with blast load of 3 KN/m<sup>2</sup>,  
\* this is at side frames.

\* load on frame =  $cf \times 0.25 \times 3 = 1.275$ , cf is ignored

\* final load =  $0.25 \times 3 = 0.75$  KN/m

\*

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -  
224 246 253 264 UNI GZ 0.75

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -  
76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -  
140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -0.75

\*\*\*\*\*

**LOAD 98 LOADTYPE None TITLE BLAST LOAD +Z DIRECTION**

\* the blast load is considered as the wind load application.

\* as per the excel, the front face pressure = 6.07 KN/m<sup>2</sup>

\* the side face pressure = 3 KN/m<sup>2</sup>

\* the back face load isnot applied.

\* for member size of 0.25m, the load =  $CF \times 6.07 \times 0.25$

\*  $CF=1.7$ , LOAD = 2.58 KN/m, cf is ignored as load was provided to

\* lateral direction also.

\* final load =  $0.25 \times 6.07 = 1.518$  say 1.52 KN/m

**MEMBER LOAD**

4 TO 6 10 TO 12 16 TO 18 22 TO 24 28 TO 30 35 TO 38 43 TO 46 51 TO 54 -  
70 TO 75 79 TO 81 94 TO 99 108 110 113 114 117 118 123 TO 126 128 133 134 -  
136 139 141 151 152 156 TO 158 176 178 180 181 190 194 195 202 TO 211 221 -

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

224 246 253 264 UNI GZ 1.52

\*

\* Load at +3.200m level

\* blast load on big pipe:

\*  $Hwp = DP + w \cdot \tan(10) = 1.2 + (1.2 \cdot \tan(10)) = 1.4m$  contributory hight for load,

\* with  $cf=0.8$  of pipe, 6.07 KN/m<sup>2</sup> as wind pressure as per calculation, L=20m

\* length of the pipe, load1 (L01.01) =  $0.8 \cdot 1.4 \cdot 6.07 \cdot 18 = 122$  kN, (length reduced)

\* for 13m length, load2 (L01.02) =  $0.8 \cdot 1.4 \cdot 6.07 \cdot 13 = 88$  kN (length reduced)

MEMBER LOAD

265 CON GZ 122 0.199994

251 CON GZ 88 0.0999939

\* Load at +5.700m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.4 + (4 \cdot \tan(10)) = 1.1m$  contributory hight for load,

\* with  $cf=0.8$  of pipe, 6.07 KN/m<sup>2</sup> as blast pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 1.1 \cdot 6.07 \cdot (2/3 \cdot 6) = 21.366$  KN...

\* applied at the centre of the beam

MEMBER LOAD

56 65 68 105 CON GZ 21.366

\*

\* load at intermediate beam =  $0.8 \cdot 1.1 \cdot 6.07 \cdot 1/3 \cdot 6 = 10.683$  KN...

\* applied at the centre of the beam

MEMBER LOAD

101 106 148 159 160 CON GZ 10.683

\*

\* Load at +8.000m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8m$  contributory hight for load,

\* with  $cf=0.8$  of pipe, 6.07 KN/m<sup>2</sup> as blast pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 0.8 \cdot 6.07 \cdot 3 = 11.654$  KN...

\* applied at the centre of the beam

MEMBER LOAD

57 66 69 102 TO 104 161 TO 163 CON GZ 11.654

\*

\* Load at 12.100m level

\*  $Hwp = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8m$  contributory hight for load,

\* with  $cf=0.8$  of pipe, 6.07 KN/m<sup>2</sup> as blast pressure as per calculation,

\* load at the main grid beam =  $0.8 \cdot 6.07 \cdot 0.8 \cdot 3 = 11.654$  KN...

\* applied at the centre of the beam

MEMBER LOAD

135 CON GZ 11.654

\*

\* blast load on cable trays

\*the second level is cladded with cable tray,

\* with  $cf=1.7$ , height = 2.3m, blast pressure = 6.07 kN/m<sup>2</sup>, cable tray span=6m,

\*  $cf$  is not required to be considered as full area is considered.

\* load =  $2.3 \cdot 6.07 \cdot 6 = 83.766$  kN applied at the supporting location of the cable

\* trays.

\*\*\*

\*\* the above method was too conservative. The cable trays are of 0.1m deep.

\*\* there are total 7 number of cable trays. With 6m C/C distances (span),

\*\* shape factor = 1.7 as individual cable trays are considered.

\*\* load =  $0.1 \cdot 6.07 \cdot 7 \cdot 1.7 \cdot 6 = 43.34$  KN.

MEMBER LOAD

\*\*\*\*\*3 9 15 21 27 91 CON GZ 83.766

3 9 15 21 27 91 CON GZ 43.34

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*

\* load on side frame, blast pressure = 3 KN/m<sup>2</sup>.

\* average depth of beam/column = 0.25m

\* cf = 1.7,

\* load = 1.7\*3\*0.25 = 1.275 KN/m, cf is ignored

\* final load = 0.25\*3 = 0.75 KN/m

1 TO 6 55 TO 57 129 131 133 135 TO 137 180 182 199 221 222 235 237 UNI GX 0.75

25 TO 30 67 TO 69 274 UNI GX -0.75

\*\*\*\*\*

LOAD 99 LOADTYPE None TITLE BLAST LOAD -Z DIRECTION

\* the blast load is considered as the wind load application.

\* as per the excel, the front face pressure = 6.07 KN/m<sup>2</sup>

\* the side face pressure = 3 KN/m<sup>2</sup>

\* the back face load is not applied.

\* for member size of 0.25m, the load = cf\*6.07\*0.25

\* cf = 1.7, load = 2.58 KN/m, cf is ignored as load was provided to

\* lateral direction also.

\* final load = 0.25\*6.07 = 1.518 say 1.52 KN/m

MEMBER LOAD

1 TO 3 7 TO 9 13 TO 15 19 TO 21 25 TO 27 31 TO 34 39 TO 42 47 TO 50 -

76 TO 78 82 TO 93 107 109 111 112 115 116 119 TO 122 127 131 132 137 138 -

140 149 150 153 TO 155 177 179 192 193 222 223 245 252 263 UNI GZ -1.52

\*

\* Load at +3.200m level

\* blast load on big pipe:

\* Hwp = DP+w.tan(10) = 1.2 + (1.2\*tan(10)) = 1.4m contributory height for load,

\* with cf=0.8 of pipe, 6.07 KN/m<sup>2</sup> as wind pressure as per calculation, L=20m

\* length of the pipe, load1 (L01.01) = 0.8\*1.4\*6.07\*18 = 122 kN,

\* for 15m length, load2 (L01.02) = 0.8\*1.4\*6.07\*13 = 88 kN

MEMBER LOAD

265 CON GZ -122 0.199994

251 CON GZ -88.976 0.0999939

\* Load at +5.700m level

\* Hwp = DP+w.tan(10) = 0.4 + (4\*tan(10)) = 1.1m contributory height for load,

\* with cf=0.8 of pipe, 6.07 KN/m<sup>2</sup> as blast pressure as per calculation,

\* load at the main grid beam = 0.8\*1.1\*6.07\*(2/3\*6) = 21.366 KN...

\* applied at the centre of the beam

MEMBER LOAD

56 65 68 105 CON GZ -21.366

\*

\* load at intermediate beam = 0.8\*1.1\*6.07\*1/3\*6 = 10.683 KN...

\* applied at the centre of the beam

MEMBER LOAD

101 106 148 159 160 CON GZ -10.683

\*

\* Load at +8.000m level

\* Hwp = DP+w.tan(10) = 0.1 + (4\*tan(10)) = 0.8m contributory height for load,

\* with cf=0.8 of pipe, 6.07 KN/m<sup>2</sup> as blast pressure as per calculation,

\* load at the main grid beam = 0.8\*0.8\*6.07\*3 = 11.654 KN...

\* applied at the centre of the beam

MEMBER LOAD

57 66 69 102 TO 104 161 TO 163 CON GZ -11.654

\*

\* Load at 12.100m level



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

- \*  $Hwp = DP + w \cdot \tan(10) = 0.1 + (4 \cdot \tan(10)) = 0.8m$  contributory hight for load,
- \* with  $cf=0.8$  of pipe,  $6.07 \text{ KN/m}^2$  as blast pressure as per calculation,
- \* load at the main grid beam =  $0.8 \cdot 6.07 \cdot 0.8 \cdot 3 = 11.654 \text{ KN}...$
- \* applied at the centre of the beam

**MEMBER LOAD**

135 CON GZ -11.654

\*

- \* blast load on cable trays
- \* the second level is cladded with cable tray,
- \* with  $cf=1.7$ , height =  $2.3m$ , blast pressure =  $6.07 \text{ kN/m}^2$ , cable tray span= $6m$ ,
- \*  $cf$  is not considered as whole area is being referred for the area.
- \* load =  $2.3 \cdot 6.07 \cdot 6 = 83.766 \text{ kN}$  applied at the supporting location of the cable
- \* trays.

\*\*\*

\*\*\*

- \*\* the above method was too conservative. The cable trays are of  $0.1m$  deep.
- \*\* there are total 7 number of cable trays. With  $6m$  C/C distances (span),
- \*\* shape factor =  $1.7$  as individual cable trays are considered.
- \*\* load =  $0.1 \cdot 6.07 \cdot 7 \cdot 1.7 \cdot 6 = 43.34 \text{ KN}$ .

**MEMBER LOAD**

\*\*\*\*\*3 9 15 21 27 91 CON GZ -83.766

3 9 15 21 27 91 CON GZ -43.34

\*

- \* load on side frame, blast pressure =  $3 \text{ KN/m}^2$ .
- \* average depth of beam/column =  $0.25m$
- \* load =  $cf \cdot 3 \cdot 0.25 = 1.275 \text{ KN/m}$ ,  $cf$  is ignored
- \* final load =  $0.25 \cdot 3 = 0.75 \text{ KN/m}$
- 1 TO 6 55 TO 57 129 131 133 135 TO 137 180 182 199 221 222 235 237 UNI GX 0.75
- 25 TO 30 67 TO 69 274 UNI GX -0.75

\*\*\*

\*\*\*

LOAD 1001 NOTIONAL LOAD FOR DEAD LOAD IN X -(E-W) DIRECTION (NLDE)  
NOTIONAL LOAD

10 X 0.005

\*-----

LOAD 1002 NOTIONAL LOAD FOR DEAD LOAD IN Z -(N-S) DIRECTION (NLDN)  
NOTIONAL LOAD

10 Z 0.005

\*-----

LOAD 1003 NOTIONAL LOAD FOR EMPTY LOAD OF PIPING & EQUIPMENT IN X-(E-W) (NLEE)  
NOTIONAL LOAD

30 X 0.005

\*-----

LOAD 1004 NOTIONAL LOAD FOR EMPTY LOAD OF PIPING & EQUIPMENT IN Z-(N-S)(NLEN)  
NOTIONAL LOAD

30 Z 0.005

\*-----

LOAD 1005 NOTIONAL LOAD FOR OPERATING LOAD OF PIPING & EQUIPMNT IN X(E-W)(NLOE)

NOTIONAL LOAD

40 X 0.005

\*-----

LOAD 1006 NOTIONAL LOAD FOR OPERATING LOAD OF PIPING & EQUIPMNT IN Z(N-S)(NLON)

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

NOTIONAL LOAD

40 Z 0.005

\*-----

LOAD 1007 NOTIONAL LOAD FOR LIVE LOAD IN X -(E-W) DIRECTION (NLLE)

NOTIONAL LOAD

20 X 0.005

\*-----

LOAD 1008 NOTIONAL LOAD FOR LIVE LOAD IN Z -(N-S) DIRECTION (NLLN)

NOTIONAL LOAD

20 Z 0.005

\*\*\*

\*\*\*\*\*LOAD COMBINATIONS FOR STAAD

\*\*\*\*\*LOAD COMBINATION FOR SUPERSTRUCTURE\_SLS

\*\*\*

\*\*\*

LOAD 30001

REPEAT LOAD

10 1.0 30 1.0 85 1.0

\*\*\*\*\*

LOAD 30002

REPEAT LOAD

10 1.0 30 1.0 86 1.0

\*\*\*\*\*

LOAD 30003

REPEAT LOAD

10 1.0 30 1.0 631 0.5 61 1.0

\*\*\*\*\*

LOAD 30004

REPEAT LOAD

10 1.0 30 1.0 611 0.5 62 1.0

\*\*\*\*\*

LOAD 30005

REPEAT LOAD

10 1.0 30 1.0 6310 0.5 63 1.0

\*\*\*\*\*

LOAD 30006

REPEAT LOAD

10 1.0 30 1.0 6110 0.5 64 1.0

\*\*\*\*\*

LOAD 30007

REPEAT LOAD

10 1.0 30 1.0 6310 0.5 61 1.0

\*\*\*\*\*

LOAD 30008

REPEAT LOAD

10 1.0 30 1.0 6110 0.5 62 1.0

\*\*\*\*\*

LOAD 30009

REPEAT LOAD

10 1.0 30 1.0 631 0.5 63 1.0

\*\*\*\*\*

LOAD 30010

REPEAT LOAD

10 1.0 30 1.0 611 0.5 64 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30011

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0

\*\*\*\*\*

LOAD 30012

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0

\*\*\*\*\*

LOAD 30013

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0

\*\*\*\*\*

LOAD 30014

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0

\*\*\*\*\*

LOAD 30015

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0

\*\*\*\*\*

LOAD 30016

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0

\*\*\*\*\*

LOAD 30017

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0

\*\*\*\*\*

LOAD 30018

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0

\*\*\*\*\*

LOAD 30019

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.0

\*\*\*\*\*

LOAD 30020

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.0

\*\*\*\*\*

LOAD 30021

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 85 1.0

\*\*\*\*\*

LOAD 30022

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 85 1.0

\*\*\*\*\*

LOAD 30023

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.0

\*\*\*\*\*

LOAD 30024

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.0  
\*\*\*\*\*

LOAD 30025

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 85 1.0  
\*\*\*\*\*

LOAD 30026

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 85 1.0  
\*\*\*\*\*

LOAD 30027

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 86 1.0  
\*\*\*\*\*

LOAD 30028

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 86 1.0  
\*\*\*\*\*

LOAD 30029

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.0  
\*\*\*\*\*

LOAD 30030

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.0  
\*\*\*\*\*

LOAD 30031

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 86 1.0  
\*\*\*\*\*

LOAD 30032

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 86 1.0  
\*\*\*\*\*

LOAD 30033

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.0  
\*\*\*\*\*

LOAD 30034

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.0  
\*\*\*\*\*

LOAD 30035

REPEAT LOAD

10 1.0 40 1.0 20 1.0 631 0.5 61 1.0 81 1.0 82 1.0  
\*\*\*\*\*

LOAD 30036

REPEAT LOAD

10 1.0 40 1.0 20 1.0 611 0.5 62 1.0 81 1.0 82 1.0  
\*\*\*\*\*

LOAD 30037

REPEAT LOAD

10 1.0 40 1.0 20 1.0 6310 0.5 63 1.0 81 -1.0 82 -1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30038  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 6110 0.5 64 1.0 81 -1.0 82 -1.0  
\*\*\*\*\*

LOAD 30039  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 6310 0.5 61 1.0 81 1.0 82 -1.0  
\*\*\*\*\*

LOAD 30040  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 6110 0.5 62 1.0 81 -1.0 82 1.0  
\*\*\*\*\*

LOAD 30041  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 631 0.5 63 1.0 81 -1.0 82 1.0  
\*\*\*\*\*

LOAD 30042  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 611 0.5 64 1.0 81 1.0 82 -1.0  
\*\*\*\*\*

LOAD 30043  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 94 1.0  
\*\*\*\*\*

LOAD 30044  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 94 1.0  
\*\*\*\*\*

LOAD 30045  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 94 1.0  
\*\*\*\*\*

LOAD 30046  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 94 1.0  
\*\*\*\*\*

LOAD 30047  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 94 1.0  
\*\*\*\*\*

LOAD 30048  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 94 1.0  
\*\*\*\*\*

LOAD 30049  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 94 1.0  
\*\*\*\*\*

LOAD 30050  
REPEAT LOAD  
10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 94 1.0  
\*\*\*\*\*

LOAD 30051

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 40 1.0 631 0.5 61 1.0 81 1.0 82 1.0  
\*\*\*\*\*

LOAD 30052

REPEAT LOAD

10 1.0 40 1.0 611 0.5 62 1.0 81 1.0 82 1.0  
\*\*\*\*\*

LOAD 30053

REPEAT LOAD

10 1.0 40 1.0 6310 0.5 63 1.0 81 -1.0 82 -1.0  
\*\*\*\*\*

LOAD 30054

REPEAT LOAD

10 1.0 40 1.0 6110 0.5 64 1.0 81 -1.0 82 -1.0  
\*\*\*\*\*

LOAD 30055

REPEAT LOAD

10 1.0 40 1.0 6310 0.5 61 1.0 81 1.0 82 -1.0  
\*\*\*\*\*

LOAD 30056

REPEAT LOAD

10 1.0 40 1.0 6110 0.5 62 1.0 81 -1.0 82 1.0  
\*\*\*\*\*

LOAD 30057

REPEAT LOAD

10 1.0 40 1.0 631 0.5 63 1.0 81 -1.0 82 1.0  
\*\*\*\*\*

LOAD 30058

REPEAT LOAD

10 1.0 40 1.0 611 0.5 64 1.0 81 1.0 82 -1.0  
\*\*\*\*\*

LOAD 30059

REPEAT LOAD

10 1.0 50 1.0 20 0.5 631 0.25 61 0.5  
\*\*\*\*\*

LOAD 30060

REPEAT LOAD

10 1.0 50 1.0 20 0.5 611 0.25 62 0.5  
\*\*\*\*\*

LOAD 30061

REPEAT LOAD

10 1.0 50 1.0 20 0.5 6310 0.25 63 0.5  
\*\*\*\*\*

LOAD 30062

REPEAT LOAD

10 1.0 50 1.0 20 0.5 6110 0.25 64 0.5  
\*\*\*\*\*

LOAD 30063

REPEAT LOAD

10 1.0 50 1.0 20 0.5 6310 0.25 61 0.5  
\*\*\*\*\*

LOAD 30064

REPEAT LOAD

10 1.0 50 1.0 20 0.5 6110 0.25 62 0.5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30065  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 631 0.25 63 0.5  
\*\*\*\*\*

LOAD 30066  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 611 0.25 64 0.5  
\*\*\*\*\*

LOAD 30067  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 85 1.0  
\*\*\*\*\*

LOAD 30068  
REPEAT LOAD  
10 1.0 50 1.0 20 0.5 86 1.0  
\*\*\*\*\*

LOAD 30069  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 631 0.5 61 1.0 91 1.0  
\*\*\*\*\*

LOAD 30070  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 611 0.5 62 1.0 91 1.0  
\*\*\*\*\*

LOAD 30071  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 6310 0.5 63 1.0 91 1.0  
\*\*\*\*\*

LOAD 30072  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 6110 0.5 64 1.0 91 1.0  
\*\*\*\*\*

LOAD 30073  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 6310 0.5 61 1.0 91 1.0  
\*\*\*\*\*

LOAD 30074  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 6110 0.5 62 1.0 91 1.0  
\*\*\*\*\*

LOAD 30075  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 631 0.5 63 1.0 91 1.0  
\*\*\*\*\*

LOAD 30076  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 611 0.5 64 1.0 91 1.0  
\*\*\*\*\*

LOAD 30077  
REPEAT LOAD  
10 1.0 30 1.0 20 1.0 85 1.0 91 1.0  
\*\*\*\*\*

LOAD 30078

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 30 1.0 20 1.0 86 1.0 91 1.0

\*\*\*\*\*

LOAD 30079

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30080

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30081

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 89 -1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30082

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 89 -1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30083

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 89 1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30084

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 89 -1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30085

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 89 -1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30086

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 89 1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30087

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 85 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30088

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 85 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30089

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 85 1.0 89 -1.0 90 -1.0 -

93 1.0

\*\*\*\*\*

LOAD 30090

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 85 1.0 89 -1.0 90 -1.0 -

93 1.0

\*\*\*\*\*

LOAD 30091



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 85 1.0 89 1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30092

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 85 1.0 89 -1.0 90 1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30093

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 85 1.0 89 -1.0 90 1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30094

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 85 1.0 89 1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30095

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 86 1.0 89 1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30096

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 86 1.0 89 1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30097

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 86 1.0 89 -1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30098

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 86 1.0 89 -1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30099

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 86 1.0 89 1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30100

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 86 1.0 89 -1.0 90 1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30101

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 86 1.0 89 -1.0 90 1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30102

REPEAT LOAD

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 86 1.0 89 1.0 90 -1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30103  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 89 1.0 90 1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30104  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 83 1.0 84 1.0 89 1.0 90 1.0 93 1.0 94 1.0  
\*\*\*\*\*

LOAD 30105  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 89 -1.0 90 -1.0 93 1.0 -  
94 1.0  
\*\*\*\*\*

LOAD 30106  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 83 -1.0 84 -1.0 89 -1.0 90 -1.0 93 1.0 -  
94 1.0  
\*\*\*\*\*

LOAD 30107  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 89 1.0 90 -1.0 93 1.0 -  
94 1.0  
\*\*\*\*\*

LOAD 30108  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 89 -1.0 90 1.0 93 1.0 -  
94 1.0  
\*\*\*\*\*

LOAD 30109  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 83 -1.0 84 1.0 89 -1.0 90 1.0 93 1.0 -  
94 1.0  
\*\*\*\*\*

LOAD 30110  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 83 1.0 84 -1.0 89 1.0 90 -1.0 93 1.0 -  
94 1.0  
\*\*\*\*\*

LOAD 30111  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 631 0.5 61 1.0 81 1.0 82 1.0 87 1.0 89 1.0 90 1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30112  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 611 0.5 62 1.0 81 1.0 82 1.0 88 1.0 89 1.0 90 1.0 -  
93 1.0  
\*\*\*\*\*

LOAD 30113  
REPEAT LOAD

10 1.0 40 1.0 20 1.0 6310 0.5 63 1.0 81 -1.0 82 -1.0 87 -1.0 89 -1.0 90 -1.0 -

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

93 1.0  
 \*\*\*\*\*  
 LOAD 30114  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 6110 0.5 64 1.0 81 -1.0 82 -1.0 88 -1.0 89 -1.0 90 -1.0 -  
 93 1.0  
 \*\*\*\*\*  
 LOAD 30115  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 6310 0.5 61 1.0 81 1.0 82 -1.0 87 1.0 89 1.0 90 -1.0 -  
 93 1.0  
 \*\*\*\*\*  
 LOAD 30116  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 6110 0.5 62 1.0 81 -1.0 82 1.0 88 1.0 89 -1.0 90 1.0 -  
 93 1.0  
 \*\*\*\*\*  
 LOAD 30117  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 631 0.5 63 1.0 81 -1.0 82 1.0 87 -1.0 89 -1.0 90 1.0 -  
 93 1.0  
 \*\*\*\*\*  
 LOAD 30118  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 611 0.5 64 1.0 81 1.0 82 -1.0 88 -1.0 89 1.0 90 -1.0 -  
 93 1.0  
 \*\*\*\*\*  
 LOAD 30119  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 89 1.0 90 1.0 93 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30120  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 89 1.0 90 1.0 93 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30121  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 89 -1.0 90 -1.0 93 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30122  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 89 -1.0 90 -1.0 93 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30123  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 89 1.0 90 -1.0 93 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30124  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 89 -1.0 90 1.0 93 1.0 94 1.0  
 \*\*\*\*\*  
 LOAD 30125  
 REPEAT LOAD  
 10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 89 -1.0 90 1.0 93 1.0 94 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30126

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 89 1.0 90 -1.0 93 1.0 94 1.0

\*\*\*\*\*

LOAD 30127

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30128

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30129

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.0 89 -1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30130

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.0 89 -1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30131

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 85 1.0 89 1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30132

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 85 1.0 89 -1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30133

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 85 1.0 89 -1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30134

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 85 1.0 89 1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30135

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 86 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30136

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 86 1.0 89 1.0 90 1.0 93 1.0

\*\*\*\*\*

LOAD 30137

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 86 1.0 89 -1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30138

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 86 1.0 89 -1.0 90 -1.0 93 1.0

\*\*\*\*\*

LOAD 30139

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.0 89 1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30140

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.0 89 -1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30141

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.0 89 -1.0 90 1.0 93 1.0  
\*\*\*\*\*

LOAD 30142

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.0 89 1.0 90 -1.0 93 1.0  
\*\*\*\*\*

LOAD 30143

REPEAT LOAD

10 1.0 50 1.0 20 0.5 631 0.25 61 0.5 87 0.5 93 1.0  
\*\*\*\*\*

LOAD 30144

REPEAT LOAD

10 1.0 50 1.0 20 0.5 611 0.25 62 0.5 88 0.5 93 1.0  
\*\*\*\*\*

LOAD 30145

REPEAT LOAD

10 1.0 50 1.0 20 0.5 6310 0.25 63 0.5 87 -0.5 93 1.0  
\*\*\*\*\*

LOAD 30146

REPEAT LOAD

10 1.0 50 1.0 20 0.5 6110 0.25 64 0.5 88 -0.5 93 1.0  
\*\*\*\*\*

LOAD 30147

REPEAT LOAD

10 1.0 50 1.0 20 0.5 6310 0.25 61 0.5 87 0.5 93 1.0  
\*\*\*\*\*

LOAD 30148

REPEAT LOAD

10 1.0 50 1.0 20 0.5 6110 0.25 62 0.5 88 0.5 93 1.0  
\*\*\*\*\*

LOAD 30149

REPEAT LOAD

10 1.0 50 1.0 20 0.5 631 0.25 63 0.5 87 -0.5 93 1.0  
\*\*\*\*\*

LOAD 30150

REPEAT LOAD

10 1.0 50 1.0 20 0.5 611 0.25 64 0.5 88 -0.5 93 1.0  
\*\*\*\*\*

LOAD 30151

REPEAT LOAD

10 1.0 50 1.0 20 0.5 85 1.0 93 1.0  
\*\*\*\*\*

LOAD 30152

REPEAT LOAD

10 1.0 50 1.0 20 0.5 86 1.0 93 1.0

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 30153

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.5 89 1.0 90 1.0 92 1.0 93 1.0

\*\*\*\*\*

LOAD 30154

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 1.0 85 1.5 89 1.0 90 1.0 92 1.0 93 1.0

\*\*\*\*\*

LOAD 30155

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.5 89 -1.0 90 -1.0 92 1.0 93 1.0

\*\*\*\*\*

LOAD 30156

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 -1.0 85 1.5 89 -1.0 90 -1.0 92 1.0 93 1.0

\*\*\*\*\*

LOAD 30157

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.5 89 1.0 90 -1.0 92 1.0 93 1.0

\*\*\*\*\*

LOAD 30158

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.5 89 -1.0 90 1.0 92 1.0 93 1.0

\*\*\*\*\*

LOAD 30159

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 -1.0 82 1.0 86 1.5 89 -1.0 90 1.0 92 1.0 93 1.0

\*\*\*\*\*

LOAD 30160

REPEAT LOAD

10 1.0 40 1.0 20 1.0 81 1.0 82 -1.0 86 1.5 89 1.0 90 -1.0 92 1.0 93 1.0

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\* LOAD WITH BLAST CASES

LOAD 30161

REPEAT LOAD

10 1.0 20 1.0 961 1.0

\*

LOAD 30162

REPEAT LOAD

10 1.0 20 1.0 962 1.0

\*

LOAD 30163

REPEAT LOAD

10 1.0 20 1.0 963 1.0

\*

LOAD 30164

REPEAT LOAD

10 1.0 20 1.0 964 1.0

\*

LOAD 30165

REPEAT LOAD

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

10 1.0 20 1.0 965 1.0

\*

LOAD 30166

REPEAT LOAD

10 1.0 20 1.0 966 1.0

\*

LOAD 30167

REPEAT LOAD

10 1.0 20 1.0 971 1.0

\*

LOAD 30168

REPEAT LOAD

10 1.0 20 1.0 972 1.0

\*

LOAD 30169

REPEAT LOAD

10 1.0 20 1.0 973 1.0

\*

LOAD 30170

REPEAT LOAD

10 1.0 20 1.0 974 1.0

\*

LOAD 30171

REPEAT LOAD

10 1.0 20 1.0 975 1.0

\*

LOAD 30172

REPEAT LOAD

10 1.0 20 1.0 976 1.0

\*

\*

LOAD 30173

REPEAT LOAD

10 1.0 20 1.0 98 1.0

\*

LOAD 30174

REPEAT LOAD

10 1.0 20 1.0 99 1.0

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*LOAD COMBINATIONS FOR STAAD

\*\*\*\*\*LOAD COMBINATION FOR SUPERSTRUCTURE\_ULS

LOAD 40001

REPEAT LOAD

10 1.0 1001 1.0 30 1.0 1003 1.0 85 1.5

\*\*\*\*\*

LOAD 40002

REPEAT LOAD

10 1.0 1002 1.0 30 1.0 1004 1.0 85 1.5

\*\*\*\*\*

LOAD 40003

REPEAT LOAD

10 1.0 1001 -1.0 30 1.0 1003 -1.0 85 1.5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40004

REPEAT LOAD

10 1.0 1002 -1.0 30 1.0 1004 -1.0 85 1.5

\*\*\*\*\*

LOAD 40005

REPEAT LOAD

10 1.0 1001 1.0 30 1.0 1003 1.0 86 1.5

\*\*\*\*\*

LOAD 40006

REPEAT LOAD

10 0.8 1002 0.8 30 0.8 1004 0.8 86 1.5

\*\*\*\*\*

LOAD 40007

REPEAT LOAD

10 1.0 1001 -1.0 30 1.0 1003 -1.0 86 1.5

\*\*\*\*\*

LOAD 40008

REPEAT LOAD

10 1.0 1002 -1.0 30 1.0 1004 -1.0 86 1.5

\*\*\*\*\*

LOAD 40009

REPEAT LOAD

10 1.0 1001 1.0 30 1.0 1003 1.0 631 0.75 61 1.5

\*\*\*\*\*

LOAD 40010

REPEAT LOAD

10 1.0 1002 1.0 30 1.0 1004 1.0 611 0.75 62 1.5

\*\*\*\*\*

LOAD 40011

REPEAT LOAD

10 1.0 1001 -1.0 30 1.0 1003 -1.0 6310 0.75 63 1.5

\*\*\*\*\*

LOAD 40012

REPEAT LOAD

10 1.0 1002 -1.0 30 1.0 1004 -1.0 6110 0.75 64 1.5

\*\*\*\*\*

LOAD 40013

REPEAT LOAD

10 1.0 1001 1.0 30 1.0 1003 1.0 6310 0.75 61 1.5

\*\*\*\*\*

LOAD 40014

REPEAT LOAD

10 1.0 1002 1.0 30 1.0 1004 1.0 6110 0.75 62 1.5

\*\*\*\*\*

LOAD 40015

REPEAT LOAD

10 1.0 1001 -1.0 30 1.0 1003 -1.0 631 0.75 63 1.5

\*\*\*\*\*

LOAD 40016

REPEAT LOAD

10 1.0 1002 -1.0 30 1.0 1004 -1.0 611 0.75 64 1.5

\*\*\*\*\*

LOAD 40017



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 1.35  
\*\*\*\*\*

LOAD 40018

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 1.35 82 1.35  
\*\*\*\*\*

LOAD 40019

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 -1.35  
\*\*\*\*\*

LOAD 40020

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 -1.35 82 -1.35  
\*\*\*\*\*

LOAD 40021

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 -1.35  
\*\*\*\*\*

LOAD 40022

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 -1.35 82 1.35  
\*\*\*\*\*

LOAD 40023

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 1.35  
\*\*\*\*\*

LOAD 40024

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 1.35 82 -1.35  
\*\*\*\*\*

LOAD 40025

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 85 1.5  
\*\*\*\*\*

LOAD 40026

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 85 1.5  
\*\*\*\*\*

LOAD 40027

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 85 1.5  
\*\*\*\*\*

LOAD 40028

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 85 1.5  
\*\*\*\*\*

LOAD 40029

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 85 1.5  
\*\*\*\*\*

LOAD 40030

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 85 1.5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40031

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 85 1.5

\*\*\*\*\*

LOAD 40032

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 85 1.5

\*\*\*\*\*

LOAD 40033

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 86 1.5

\*\*\*\*\*

LOAD 40034

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 86 1.5

\*\*\*\*\*

LOAD 40035

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 86 1.5

\*\*\*\*\*

LOAD 40036

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 86 1.5

\*\*\*\*\*

LOAD 40037

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 86 1.5

\*\*\*\*\*

LOAD 40038

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 86 1.5

\*\*\*\*\*

LOAD 40039

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 86 1.5

\*\*\*\*\*

LOAD 40040

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 86 1.5

\*\*\*\*\*

LOAD 40041

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 631 0.75 61 1.5 81 1.2 -

82 1.2

\*\*\*\*\*

LOAD 40042

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 611 0.75 62 1.5 81 1.2 -

82 1.2

\*\*\*\*\*

LOAD 40043

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 6310 0.75 63 1.5 81 -1.2 -

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

82 -1.2  
 \*\*\*\*\*  
 LOAD 40044  
 REPEAT LOAD  
 10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 6110 0.75 64 1.5 81 -1.2 -  
 82 -1.2  
 \*\*\*\*\*  
 LOAD 40045  
 REPEAT LOAD  
 10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 6310 0.75 61 1.5 81 1.2 -  
 82 -1.2  
 \*\*\*\*\*  
 LOAD 40046  
 REPEAT LOAD  
 10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 6110 0.75 62 1.5 81 -1.2 -  
 82 1.2  
 \*\*\*\*\*  
 LOAD 40047  
 REPEAT LOAD  
 10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 631 0.75 63 1.5 81 -1.2 -  
 82 1.2  
 \*\*\*\*\*  
 LOAD 40048  
 REPEAT LOAD  
 10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 611 0.75 64 1.5 81 1.2 -  
 82 -1.2  
 \*\*\*\*\*  
 LOAD 40049  
 REPEAT LOAD  
 10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 94 1.5  
 \*\*\*\*\*  
 LOAD 40050  
 REPEAT LOAD  
 10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 94 1.5  
 \*\*\*\*\*  
 LOAD 40051  
 REPEAT LOAD  
 10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 94 1.5  
 \*\*\*\*\*  
 LOAD 40052  
 REPEAT LOAD  
 10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 94 1.5  
 \*\*\*\*\*  
 LOAD 40053  
 REPEAT LOAD  
 10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 94 1.5  
 \*\*\*\*\*  
 LOAD 40054  
 REPEAT LOAD  
 10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 94 1.5  
 \*\*\*\*\*  
 LOAD 40055  
 REPEAT LOAD  
 10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 94 1.5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40056

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 94 1.5

\*\*\*\*\*

LOAD 40057

REPEAT LOAD

10 0.8 1001 0.8 40 0.8 1005 0.8 631 0.75 61 1.5 81 1.0 82 1.0

\*\*\*\*\*

LOAD 40058

REPEAT LOAD

10 0.8 1002 0.8 40 0.8 1006 0.8 611 0.75 62 1.5 81 1.0 82 1.0

\*\*\*\*\*

LOAD 40059

REPEAT LOAD

10 0.8 1001 -0.8 40 0.8 1005 -0.8 6310 0.75 63 1.5 81 -1.0 82 -1.0

\*\*\*\*\*

LOAD 40060

REPEAT LOAD

10 0.8 1002 -0.8 40 0.8 1006 -0.8 6110 0.75 64 1.5 81 -1.0 82 -1.0

\*\*\*\*\*

LOAD 40061

REPEAT LOAD

10 0.8 1001 0.8 40 0.8 1005 0.8 6310 0.75 61 1.5 81 1.0 82 -1.0

\*\*\*\*\*

LOAD 40062

REPEAT LOAD

10 0.8 1002 0.8 40 0.8 1006 0.8 6110 0.75 62 1.5 81 -1.0 82 1.0

\*\*\*\*\*

LOAD 40063

REPEAT LOAD

10 0.8 1001 -0.8 40 0.8 1005 -0.8 631 0.75 63 1.5 81 -1.0 82 1.0

\*\*\*\*\*

LOAD 40064

REPEAT LOAD

10 0.8 1002 -0.8 40 0.8 1006 -0.8 611 0.75 64 1.5 81 1.0 82 -1.0

\*\*\*\*\*

LOAD 40065

REPEAT LOAD

10 1.35 1001 1.35 50 1.35 20 0.75 1007 0.75

\*\*\*\*\*

LOAD 40066

REPEAT LOAD

10 1.35 1002 1.35 50 1.35 20 0.75 1008 0.75

\*\*\*\*\*

LOAD 40067

REPEAT LOAD

10 1.35 1001 -1.35 50 1.35 20 0.75 1007 -0.75

\*\*\*\*\*

LOAD 40068

REPEAT LOAD

10 1.35 1002 -1.35 50 1.35 20 0.75 1008 -0.75

\*\*\*\*\*

LOAD 40069

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 631 0.375 61 0.75  
\*\*\*\*\*

LOAD 40070

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 611 0.375 62 0.75  
\*\*\*\*\*

LOAD 40071

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 6310 0.375 63 0.75  
\*\*\*\*\*

LOAD 40072

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 6110 0.375 64 0.75  
\*\*\*\*\*

LOAD 40073

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 6310 0.375 61 0.75  
\*\*\*\*\*

LOAD 40074

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 6110 0.375 62 0.75  
\*\*\*\*\*

LOAD 40075

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 631 0.375 63 0.75  
\*\*\*\*\*

LOAD 40076

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 611 0.375 64 0.75  
\*\*\*\*\*

LOAD 40077

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 85 1.5  
\*\*\*\*\*

LOAD 40078

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 85 1.5  
\*\*\*\*\*

LOAD 40079

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 85 1.5  
\*\*\*\*\*

LOAD 40080

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 85 1.5  
\*\*\*\*\*

LOAD 40081

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 86 1.5  
\*\*\*\*\*

LOAD 40082

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 86 1.5

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40083  
REPEAT LOAD  
10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 86 1.5  
\*\*\*\*\*

LOAD 40084  
REPEAT LOAD  
10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 86 1.5  
\*\*\*\*\*

LOAD 40085  
REPEAT LOAD  
10 1.35 1001 1.35 30 1.35 1003 1.35 20 1.5 1007 1.5 91 1.5  
\*\*\*\*\*

LOAD 40086  
REPEAT LOAD  
10 1.35 1002 1.35 30 1.35 1004 1.35 20 1.5 1008 1.5 91 1.5  
\*\*\*\*\*

LOAD 40087  
REPEAT LOAD  
10 1.35 1001 -1.35 30 1.35 1003 -1.35 20 1.5 1007 -1.5 91 1.5  
\*\*\*\*\*

LOAD 40088  
REPEAT LOAD  
10 1.35 1002 -1.35 30 1.35 1004 -1.35 20 1.5 1008 -1.5 91 1.5  
\*\*\*\*\*

LOAD 40089  
REPEAT LOAD  
10 1.2 1001 1.2 30 1.2 1003 1.2 20 1.5 1007 1.5 631 0.75 61 1.5 91 1.5  
\*\*\*\*\*

LOAD 40090  
REPEAT LOAD  
10 1.2 1002 1.2 30 1.2 1004 1.2 20 1.5 1008 1.5 611 0.75 62 1.5 91 1.5  
\*\*\*\*\*

LOAD 40091  
REPEAT LOAD  
10 1.2 1001 -1.2 30 1.2 1003 -1.2 20 1.5 1007 -1.5 6310 0.75 63 1.5 91 1.5  
\*\*\*\*\*

LOAD 40092  
REPEAT LOAD  
10 1.2 1002 -1.2 30 1.2 1004 -1.2 20 1.5 1008 -1.5 6110 0.75 64 1.5 91 1.5  
\*\*\*\*\*

LOAD 40093  
REPEAT LOAD  
10 1.2 1001 1.2 30 1.2 1003 1.2 20 1.5 1007 1.5 6310 0.75 61 1.5 91 1.5  
\*\*\*\*\*

LOAD 40094  
REPEAT LOAD  
10 1.2 1002 1.2 30 1.2 1004 1.2 20 1.5 1008 1.5 6110 0.75 62 1.5 91 1.5  
\*\*\*\*\*

LOAD 40095  
REPEAT LOAD  
10 1.2 1001 -1.2 30 1.2 1003 -1.2 20 1.5 1007 -1.5 631 0.75 63 1.5 91 1.5  
\*\*\*\*\*

LOAD 40096

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1002 -1.2 30 1.2 1004 -1.2 20 1.5 1008 -1.5 611 0.75 64 1.5 91 1.5  
\*\*\*\*\*

LOAD 40097

REPEAT LOAD

10 1.2 1001 1.2 30 1.2 1003 1.2 20 1.5 1007 1.5 85 1.5 91 1.5  
\*\*\*\*\*

LOAD 40098

REPEAT LOAD

10 1.2 1002 1.2 30 1.2 1004 1.2 20 1.5 1008 1.5 85 1.5 91 1.5  
\*\*\*\*\*

LOAD 40099

REPEAT LOAD

10 1.2 1001 -1.2 30 1.2 1003 -1.2 20 1.5 1007 -1.5 85 1.5 91 1.5  
\*\*\*\*\*

LOAD 40100

REPEAT LOAD

10 1.2 1002 -1.2 30 1.2 1004 -1.2 20 1.5 1008 -1.5 85 1.5 91 1.5  
\*\*\*\*\*

LOAD 40101

REPEAT LOAD

10 1.2 1001 1.2 30 1.2 1003 1.2 20 1.5 1007 1.5 86 1.5 91 1.5  
\*\*\*\*\*

LOAD 40102

REPEAT LOAD

10 1.2 1002 1.2 30 1.2 1004 1.2 20 1.5 1008 1.5 86 1.5 91 1.5  
\*\*\*\*\*

LOAD 40103

REPEAT LOAD

10 1.2 1001 -1.2 30 1.2 1003 -1.2 20 1.5 1007 -1.5 86 1.5 91 1.5  
\*\*\*\*\*

LOAD 40104

REPEAT LOAD

10 1.2 1002 -1.2 30 1.2 1004 -1.2 20 1.5 1008 -1.5 86 1.5 91 1.5  
\*\*\*\*\*

LOAD 40105

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 1.35 83 1.35 -  
84 1.35 89 1.35 90 1.35 93 1.35  
\*\*\*\*\*

LOAD 40106

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 1.35 82 1.35 83 1.35 -  
84 1.35 89 1.35 90 1.35 93 1.35  
\*\*\*\*\*

LOAD 40107

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 -1.35 -  
83 -1.35 84 -1.35 89 -1.35 90 -1.35 93 1.35  
\*\*\*\*\*

LOAD 40108

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 -1.35 82 -1.35 -  
83 -1.35 84 -1.35 89 -1.35 90 -1.35 93 1.35

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40109

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 -1.35 83 1.35 -  
84 -1.35 89 1.35 90 -1.35 93 1.35

\*\*\*\*\*

LOAD 40110

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 -1.35 82 1.35 -  
83 -1.35 84 1.35 89 -1.35 90 1.35 93 1.35

\*\*\*\*\*

LOAD 40111

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 1.35 -  
83 -1.35 84 1.35 89 -1.35 90 1.35 93 1.35

\*\*\*\*\*

LOAD 40112

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 1.35 82 -1.35 -  
83 1.35 84 -1.35 89 1.35 90 -1.35 93 1.35

\*\*\*\*\*

LOAD 40113

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
85 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40114

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
85 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40115

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 85 1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40116

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 85 1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40117

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 85 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40118

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 85 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40119

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 83 -1.2 -



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

84 1.2 85 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40120

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 83 1.2 -

84 -1.2 85 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40121

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -

86 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40122

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -

86 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40123

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 83 -1.2 -

84 -1.2 86 1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40124

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 83 -1.2 -

84 -1.2 86 1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40125

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 83 1.2 -

84 -1.2 86 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40126

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 83 -1.2 -

84 1.2 86 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40127

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 83 -1.2 -

84 1.2 86 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40128

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 83 1.2 -

84 -1.2 86 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40129

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -

89 1.2 90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40130

REPEAT LOAD

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 83 1.2 84 1.2 -  
89 1.2 90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40131

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 89 -1.2 90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40132

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 83 -1.2 -  
84 -1.2 89 -1.2 90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40133

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 89 1.2 90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40134

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 89 -1.2 90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40135

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 83 -1.2 -  
84 1.2 89 -1.2 90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40136

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 83 1.2 -  
84 -1.2 89 1.2 90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40137

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 631 0.75 61 1.5 81 1.2 -  
82 1.2 87 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40138

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 611 0.75 62 1.5 81 1.2 -  
82 1.2 88 1.5 89 1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40139

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 6310 0.75 63 1.5 81 -1.2 -  
82 -1.2 87 -1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40140

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 6110 0.75 64 1.5 81 -1.2 -  
82 -1.2 88 -1.5 89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40141

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 6310 0.75 61 1.5 81 1.2 -  
82 -1.2 87 1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40142

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 6110 0.75 62 1.5 81 -1.2 -  
82 1.2 88 1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40143

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 631 0.75 63 1.5 81 -1.2 -  
82 1.2 87 -1.5 89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40144

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 611 0.75 64 1.5 81 1.2 -  
82 -1.2 88 -1.5 89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40145

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 89 1.2 90 1.2 -  
93 1.2 94 1.5

\*\*\*\*\*

LOAD 40146

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 89 1.2 90 1.2 -  
93 1.2 94 1.5

\*\*\*\*\*

LOAD 40147

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 89 -1.2 -  
90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40148

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 89 -1.2 -  
90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40149

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 89 1.2 -  
90 -1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40150

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 89 -1.2 -  
90 1.2 93 1.2 94 1.5

\*\*\*\*\*

LOAD 40151

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 89 -1.2 -  
90 1.2 93 1.2 94 1.5

\*\*\*\*\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

LOAD 40152  
REPEAT LOAD  
10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 89 1.2 -  
90 -1.2 93 1.2 94 1.5  
\*\*\*\*\*

LOAD 40153  
REPEAT LOAD  
10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 85 1.5 89 1.2 -  
90 1.2 93 1.2  
\*\*\*\*\*

LOAD 40154  
REPEAT LOAD  
10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 85 1.5 89 1.2 -  
90 1.2 93 1.2  
\*\*\*\*\*

LOAD 40155  
REPEAT LOAD  
10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 85 1.5 -  
89 -1.2 90 -1.2 93 1.2  
\*\*\*\*\*

LOAD 40156  
REPEAT LOAD  
10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 85 1.5 -  
89 -1.2 90 -1.2 93 1.2  
\*\*\*\*\*

LOAD 40157  
REPEAT LOAD  
10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 85 1.5 89 1.2 -  
90 -1.2 93 1.2  
\*\*\*\*\*

LOAD 40158  
REPEAT LOAD  
10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 85 1.5 -  
89 -1.2 90 1.2 93 1.2  
\*\*\*\*\*

LOAD 40159  
REPEAT LOAD  
10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 85 1.5 -  
89 -1.2 90 1.2 93 1.2  
\*\*\*\*\*

LOAD 40160  
REPEAT LOAD  
10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 85 1.5 -  
89 1.2 90 -1.2 93 1.2  
\*\*\*\*\*

LOAD 40161  
REPEAT LOAD  
10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 86 1.5 89 1.2 -  
90 1.2 93 1.2  
\*\*\*\*\*

LOAD 40162  
REPEAT LOAD  
10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 86 1.5 89 1.2 -  
90 1.2 93 1.2

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40163

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 86 1.5 -  
89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40164

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 86 1.5 -  
89 -1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40165

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 86 1.5 89 1.2 -  
90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40166

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 86 1.5 -  
89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40167

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 86 1.5 -  
89 -1.2 90 1.2 93 1.2

\*\*\*\*\*

LOAD 40168

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 86 1.5 -  
89 1.2 90 -1.2 93 1.2

\*\*\*\*\*

LOAD 40169

REPEAT LOAD

10 1.35 1001 1.35 50 1.35 20 0.75 1007 0.75 93 1.2

\*\*\*\*\*

LOAD 40170

REPEAT LOAD

10 1.35 1002 1.35 50 1.35 20 0.75 1008 0.75 93 1.2

\*\*\*\*\*

LOAD 40171

REPEAT LOAD

10 1.35 1001 -1.35 50 1.35 20 0.75 1007 -0.75 93 1.2

\*\*\*\*\*

LOAD 40172

REPEAT LOAD

10 1.35 1002 -1.35 50 1.35 20 0.75 1008 -0.75 93 1.2

\*\*\*\*\*

LOAD 40173

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 631 0.375 61 0.75 87 0.75 93 1.2

\*\*\*\*\*

LOAD 40174

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 611 0.375 62 0.75 88 0.75 93 1.2

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40175

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 6310 0.375 63 0.75 87 -0.75 -  
93 1.2

\*\*\*\*\*

LOAD 40176

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 6110 0.375 64 0.75 88 -0.75 -  
93 1.2

\*\*\*\*\*

LOAD 40177

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 6310 0.375 61 0.75 87 0.75 93 1.2

\*\*\*\*\*

LOAD 40178

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 6110 0.375 62 0.75 88 0.75 93 1.2

\*\*\*\*\*

LOAD 40179

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 631 0.375 63 0.75 87 -0.75 93 1.2

\*\*\*\*\*

LOAD 40180

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 611 0.375 64 0.75 88 -0.75 93 1.2

\*\*\*\*\*

LOAD 40181

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 85 1.5 93 1.2

\*\*\*\*\*

LOAD 40182

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 85 1.5 93 1.2

\*\*\*\*\*

LOAD 40183

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 85 1.5 93 1.2

\*\*\*\*\*

LOAD 40184

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 85 1.5 93 1.2

\*\*\*\*\*

LOAD 40185

REPEAT LOAD

10 1.2 1001 1.2 50 1.2 20 0.75 1007 0.75 86 1.5 93 1.2

\*\*\*\*\*

LOAD 40186

REPEAT LOAD

10 1.2 1002 1.2 50 1.2 20 0.75 1008 0.75 86 1.5 93 1.2

\*\*\*\*\*

LOAD 40187

REPEAT LOAD

10 1.2 1001 -1.2 50 1.2 20 0.75 1007 -0.75 86 1.5 93 1.2

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40188

REPEAT LOAD

10 1.2 1002 -1.2 50 1.2 20 0.75 1008 -0.75 86 1.5 93 1.2

\*\*\*\*\*

LOAD 40189

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 1.35 89 1.35 -  
90 1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40190

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 1.35 82 1.35 89 1.35 -  
90 1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40191

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 -1.35 -  
89 -1.35 90 -1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40192

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 -1.35 82 -1.35 -  
89 -1.35 90 -1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40193

REPEAT LOAD

10 1.35 1001 1.35 40 1.35 1005 1.35 20 1.5 1007 1.5 81 1.35 82 -1.35 89 1.35 -  
90 -1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40194

REPEAT LOAD

10 1.35 1002 1.35 40 1.35 1006 1.35 20 1.5 1008 1.5 81 -1.35 82 1.35 -  
89 -1.35 90 1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40195

REPEAT LOAD

10 1.35 1001 -1.35 40 1.35 1005 -1.35 20 1.5 1007 -1.5 81 -1.35 82 1.35 -  
89 -1.35 90 1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40196

REPEAT LOAD

10 1.35 1002 -1.35 40 1.35 1006 -1.35 20 1.5 1008 -1.5 81 1.35 82 -1.35 -  
89 1.35 90 -1.35 92 1.35 93 1.35

\*\*\*\*\*

LOAD 40197

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 1.2 85 1.5 89 1.2 -  
90 1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40198

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 1.2 82 1.2 85 1.5 89 1.2 -  
90 1.2 92 1.2 93 1.2

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*\*\*

LOAD 40199

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 -1.2 85 1.5 -  
89 -1.2 90 -1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40200

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 -1.2 82 -1.2 85 1.5 -  
89 -1.2 90 -1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40201

REPEAT LOAD

10 1.2 1001 1.2 40 1.2 1005 1.2 20 1.5 1007 1.5 81 1.2 82 -1.2 86 1.5 89 1.2 -  
90 -1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40202

REPEAT LOAD

10 1.2 1002 1.2 40 1.2 1006 1.2 20 1.5 1008 1.5 81 -1.2 82 1.2 86 1.5 -  
89 -1.2 90 1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40203

REPEAT LOAD

10 1.2 1001 -1.2 40 1.2 1005 -1.2 20 1.5 1007 -1.5 81 -1.2 82 1.2 86 1.5 -  
89 -1.2 90 1.2 92 1.2 93 1.2

\*\*\*\*\*

LOAD 40204

REPEAT LOAD

10 1.2 1002 -1.2 40 1.2 1006 -1.2 20 1.5 1008 -1.5 81 1.2 82 -1.2 86 1.5 -  
89 1.2 90 -1.2 92 1.2 93 1.2

\*\*\*\_-----

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\* LOAD WITH BLAST CASES

LOAD 40205

REPEAT LOAD

10 1.0 20 1.0 961 1.0

\*

LOAD 40206

REPEAT LOAD

10 1.0 20 1.0 962 1.0

\*

LOAD 40207

REPEAT LOAD

10 1.0 20 1.0 963 1.0

\*

LOAD 40208

REPEAT LOAD

10 1.0 20 1.0 964 1.0

\*

LOAD 40209

REPEAT LOAD

10 1.0 20 1.0 965 1.0



Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*

LOAD 40210  
REPEAT LOAD  
10 1.0 20 1.0 966 1.0

\*

LOAD 40211  
REPEAT LOAD  
10 1.0 20 1.0 971 1.0

\*

LOAD 40212  
REPEAT LOAD  
10 1.0 20 1.0 972 1.0

\*

LOAD 40213  
REPEAT LOAD  
10 1.0 20 1.0 973 1.0

\*

LOAD 40214  
REPEAT LOAD  
10 1.0 20 1.0 974 1.0

\*

LOAD 40215  
REPEAT LOAD  
10 1.0 20 1.0 975 1.0

\*

LOAD 40216  
REPEAT LOAD  
10 1.0 20 1.0 976 1.0

\*

\*

LOAD 40217  
REPEAT LOAD  
10 1.0 20 1.0 98 1.0

\*

LOAD 40218  
REPEAT LOAD  
10 1.0 20 1.0 99 1.0

\*

\*\*\*\*\*

\*\*\*\*\*

\*\*\*\*\*

\*\*-----

PDELTA ANALYSIS SMALLDELTA PRINT STATICS CHECK

\*\*\*-----

DEFINE ENVELOPE

\*30001 TO 30160 ENVELOPE 1 TYPE SERVICEABILITY

\*40001 TO 40204 ENVELOPE 2 TYPE STRENGTH

\*

\* Envelope with blast load

30001 TO 30174 ENVELOPE 1 TYPE SERVICEABILITY

40001 TO 40218 ENVELOPE 2 TYPE STRENGTH

\*

END DEFINE ENVELOPE

\*\*\*

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*

\*\* MINIMUM DESIGN PARAMETERS BASED ON EC8 TO BE ASSIGNED ARE LISTED AS FOLLOWS

\*\*STRENGTH CHECK

\*LOAD LIST 40001 TO 40204

LOAD LIST 40001 TO 40218

PARAMETER 1

CODE EN 1993-1-1:2005

\*\*\*NATIONAL ANNEX OF NETHERLAND TO BE USED

NA 2 MEMB 1 TO 57 59 60 62 TO 141 148 TO 167 176 TO 199 202 TO 204 -

220 TO 222 245 246 252 253 263 TO 265 274

\*\*\*PY TO BE REDUCED BASED ON THICKNESS OF ELEMENT

\* Thickness is less than 41mm. hence as per &YARA A-PC 10000-Y50-00038,

\*  $f_y=235\text{N/mm}^2=235000\text{KN/m}^2$ ,  $F_u=360\text{N/mm}^2=360000\text{KN/m}^2$

SGR 0 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

PY 235000 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

FU 360000 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

BEAM 3 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

\*\*\*\*FOR BUILTUP MEMBERS ONLY

SBLT 0 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

KC 0 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

\*\*\*

KY 1 MEMB 1 TO 30 131 133 136 TO 141 180 202 TO 204 207 208 221 222

KZ 1.2 MEMB 2 3 5 TO 18 20 21 23 24 26 27 29 30 131 133 136 137 180 -

202 TO 204 221 222

\*

KZ 1.5 MEMB 1 4 19 22 25 28 138 TO 141

KZ 2 MEMB 207 208

\*

LY 4 MEMB 39 43 47 51 70 TO 78 82 TO 84 190

UNL 4 MEMB 39 43 47 51 70 TO 78 82 TO 84 190

LZ 4 MEMB 39 43 47 51 70 TO 78 82 TO 84 190

LY 4 MEMB 59 60 62 63 164 TO 167

UNL 4 MEMB 59 60 62 63 164 TO 167

LZ 4 MEMB 59 60 62 63 164 TO 167

LY 6 MEMB 41 42 45 46 49 50 53 54 149 TO 152 154 155 157 158

UNL 6 MEMB 41 42 45 46 49 50 53 54 149 TO 152 154 155 157 158

LZ 6 MEMB 41 42 45 46 49 50 52 53 149 TO 152 154 TO 157

LY 4 MEMB 127 128 176 177 192 TO 195

UNL 4 MEMB 127 128 176 177 192 TO 195

LZ 4 MEMB 127 128 176 177 192 TO 195 198 220

LY 4 MEMB 198 220

UNL 4 MEMB 198 220

LY 1.5 MEMB 61 251 254 255 257 258

UNL 1.5 MEMB 61 251 254 255 257 258

LY 2 MEMB 67 247 248 274

UNL 2 MEMB 67 247 248 274

LZ 4 MEMB 61 67 247 248 251 254 255 257 258 274

LY 3 MEMB 100 265 TO 267

UNL 3 MEMB 100 265 TO 267

LZ 4 MEMB 100 265 TO 267

\*\*\*

\*-----

TORSION 2 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	1	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>

\*\*\*

\*

\*\*\*FOR ANY MEMBER FAILING IN TORSION, IF THE TORSION VALUE IS LESS THAN 3KN-M AND

\*\*\*APPROPRIATE ARRANGEMENT IS PRESENT TO COUNTER THE TORSION MOMENT THEN ASSIGN

\*\*\*?TORSION 3 MEMB ? TO THAT MEMBER

RATIO 0.75 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

TRACK 2 MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

CHECK CODE MEMB 1 TO 141 148 TO 167 176 TO 199 202 TO 224 229 230 235 TO 285

\*\*\*\*\*

\*\*LOAD LIST 30001 TO 30160

\*LOAD LIST 30001 TO 30174

\*\*\*\*\*DEFLECTION CHECK

\*PARAMETER 2

\*CODE EN 1993-1-1:2005

\*\*\*\*\*REFER DESIGN BASIS FOR LIMITS OF DEFLECTION

\*\*\*\*\*TRACK 4 IS MANDATORY COMMAND FOR DEFLECTION CHECK

\*DFE 300 MEMB 55 TO 57 59 60 62 TO 69 100 TO 106 129 130 135 148 159 TO 167 -

\*196 TO 199 220 229 230 265 274

\*DFE 300 MEMB 31 TO 54 70 TO 87 107 TO 110 127 128 149 TO 158 176 177 -

\*182 TO 184 187 189 TO 195 205 206 209 210 245 246 252 253 263 264

\*DJ1 26 MEMB 39 82 TO 84

\*DJ2 27 MEMB 39 82 TO 84

\*DJ1 21 MEMB 43 73 TO 75 190

\*DJ2 22 MEMB 43 73 TO 75 190

\*DJ1 28 MEMB 41 149

\*DJ2 29 MEMB 41 149

\*DJ1 23 MEMB 45 151

\*DJ2 24 MEMB 45 151

\*DJ1 29 MEMB 42 150

\*DJ2 30 MEMB 42 150

\*DJ1 24 MEMB 46 152

\*DJ2 25 MEMB 46 152

\*DJ1 91 MEMB 184 187 189

\*DJ2 92 MEMB 184 187 189

\*DJ1 22 MEMB 59 164

\*DJ2 27 MEMB 59 164

\*DJ1 23 MEMB 62 166

\*DJ2 28 MEMB 62 166

\*DJ1 21 MEMB 43 190

\*DJ2 44 MEMB 43 190

\*DJ1 36 MEMB 47 76 TO 78

\*DJ2 37 MEMB 47 76 TO 78

\*DJ1 31 MEMB 51 70 TO 72

\*DJ2 32 MEMB 51 70 TO 72

\*DJ1 32 MEMB 52 156

\*DJ2 33 MEMB 52 156

\*DJ1 38 MEMB 49 154

\*DJ2 39 MEMB 49 154

\*DJ1 33 MEMB 53 157

\*DJ2 34 MEMB 53 157

\*DJ1 39 MEMB 50 155


\*DJ2 40 MEMB 50 155


Linde Project No: <b>3710 A3T8</b>	Linde Issue	Client Project No: <b>16471</b>	Client Rev.
Linde Doc No: <b>0542FA4650 2001 N-CS 1003 (EN)</b>	<b>1</b>	Client Doc No: <b>16471-Y16-00010</b>	<b>00</b>


\*DJ1 34 MEMB 54 158  
 \*DJ2 35 MEMB 54 158  
 \*DJ1 32 MEMB 60 165  
 \*DJ2 37 MEMB 60 165  
 \*DJ1 33 MEMB 63 167  
 \*DJ2 38 MEMB 63 167  
 \*DJ1 63 MEMB 127 177 192 193  
 \*DJ2 64 MEMB 127 177 192 193  
 \*DJ1 65 MEMB 128 176 194 195  
 \*DJ2 66 MEMB 128 176 194 195  
 \*DJ1 89 MEMB 198 220  
 \*DJ2 90 MEMB 198 220  
 \*DJ1 65 MEMB 129 199  
 \*DJ2 63 MEMB 129 199  
 \*DJ1 126 MEMB 266 267  
 \*DJ2 125 MEMB 266 267  
 \*DJ1 56 MEMB 100 265  
 \*DJ2 50 MEMB 100 265  
 \*DJ1 121 MEMB 254 255 258  
 \*DJ2 120 MEMB 254 255 258  
 \*DJ1 13 MEMB 61 251 257  
 \*DJ2 18 MEMB 61 251 257  
 \*DJ1 117 MEMB 247 248  
 \*DJ2 116 MEMB 247 248  
 \*DJ1 15 MEMB 67 274  
 \*DJ2 20 MEMB 67 274  
 \*TRACK 4 MEMB 1 TO 6 31 TO 57 59 60 62 TO 87 100 TO 110 127 TO 131 133 135 -  
 \*136 TO 137 148 TO 167 176 177 180 182 TO 184 187 189 TO 199 205 206 209 210 -  
 \*220 TO 222 229 230 245 246 252 253 263 TO 265 274  
 \*CHECK CODE ALL  
 \*  
 FINISH

# Base Of Design Leidingbrug "CCS Project" Yara

Opdrachtgever : **Yara Sluiskil B.V.**

Adres /  : Industrieweg 10  
4541 HJ Sluiskil

 : 5.1.2.e

 : info.yara.sluiskil@yara.com

contactpersoon : 5.1.2.e

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				Industrieweg 40 5.1.2.e 5.1.2.e www.konstruktis.com	
				Project	CCS Project
				Klant	Yara
				Locatie	Sluiskil
				Onderdeel	Base Of Design Leidingbrug
Berekend	5.1.2.e	Project nummer		Document nummer	Rev.
Gecontroleerd	5.1.2.e	4922005		B01	A
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## 0. Inhoud

	page	rev
<b>1. Constructieve uitgangspunten</b>		
1.1. Constructie opbouw	1-1	A
1.2. Doel van het rapport / Principes van berekening / Uitvoeringsvereisten	1-3	A
1.3. Software	1-4	A
1.4. Ontwerp overzicht	1-4	A
<b>2. Algemeen</b>	2-1	A
2.1. Opmerkingen	2-1	A
2.2. Gebruikte eenheden / Assenstelsel	2-1	A
2.3. Gehanteerde Normen / Literatuur	2-2	A
2.4. Referentie tekeningen/documenten	2-2	A
<b>3. Ontwerputgangspunten Constructie</b>	3-1	A
3.1. Algemene uitgangspunten	3-1	A
3.2. Functie bouwwerk, gevolgklasse en ontwerplevensduur	3-1	A
3.3. Belastingcombinatie's + factoren	3-3	A
3.4. Eisen t.a.v. doorbuiging	3-4	A
3.5. Belastingsschikking	3-5	A
3.6. Imperfecties	3-6	A
<b>4. Toegepaste Materialen &amp; Duurzaamheid</b>	4-1	A
4.1. Materialen	4-1	A
4.2. Duurzaamheid/Conservering	4-1	A
<b>5. Belastingen</b>	5-1	A
5.1. Permanente en opgelegde belastingen volgens EN 1991-1-1 + NB	5-1	A
5.2. Horizontale belasting op afscheidingen: leuningen/railingen volgens EN 1991-1-1 +NB	5-1	A
5.3. Speciale vloerbelasting volgens EN 1991-1-1 +NB	5-1	A
5.4. Speciale vloerbelasting door voertuigen volgens EN 1991-1-1 +NB	5-2	A
5.5. Belasting t.g.v. brand volgens EN 1991-1-2 +NB	5-2	A
5.6. Sneeuw volgens EN 1991-1-3 +NB	5-2	A
5.7. Wateraccumulatie volgens EN 1991-1-3 +NB	5-2	A
5.8. Windbelasting volgens EN 1991-1-4 +NB	5-2	A
5.9. Temperatuur volgens EN 1991-1-5 +NB	5-2	A
5.10. Stootbelasting volgens EN 1991-1-7 +NB	5-2	A
5.11. Explosiebelasting volgens EN 1991-1-7 +NB	5-3	A
5.12. Belasting t.g.v. geotechnische oorzaken	5-3	A
5.13. Belasting t.g.v. kranen volgens EN 1991-3 +NB	5-3	A
5.14. Belasting op leidingbruggen	5-3	A
5.15. Belasting t.g.v. waterstroming volgens EN 1991-1-6 +NB	5-3	A
<b>6. Ontwerp principes</b>	6-1	A
6.1. Basisopzet	6-1	A
6.2. Fundering	6-2	A
6.3. Belasting gevallen	6-3	A
6.4. Combinaties	6-3	A

### Bijlage

- A Overzicht materiaaleigenschappen
- B Bepaling sneeuwbelasting
- C Bepaling windbelasting
- D Overzicht Normen / Literatuur

Deze berekening is eigendom van Konstruktis. Niets uit dit document mag worden verveelvoudigd, opgeslagen in een automatisch gegevens bestand, of openbaar gemaakt worden in enige wijze, het zij elektronisch, mechanisch, door fotokopieën, opnamen, of op enige andere manier zonder voorafgaande schriftelijke toestemming van Konstruktis



## 1. Constructieve uitgangspunten

### 1.1. Constructie opbouw

#### 1.1.1. Inleiding

Voor het project 'CCS Project' te Sluiskil is door Yara Sluiskil B.V. opdracht gegeven aan Konstruktis om de Base Of Design uit te voeren van de Leidingbrug. Hiervoor zijn de volgende uitgangspunten gehanteerd:

- Berekeningen worden zoveel mogelijk in 3D uitgevoerd, met 2D controles.
- De hoofdberekening van de constructie is uitgevoerd met het 3D eindige elementen programma Scia Engineer.
- De doorsnede- en stabiliteitcontroles van de verschillende staaf- & plaalementen worden binnen het programma uitgevoerd volgens de geldende normen.
- De detailberekening worden uitgevoerd middels IDEA statica / Excel bladen
- Waar nodig worden de berekening aangevuld middels controles via geverifieerde Excel werkbladen / Handcontroles.
- De berekening worden uitgevoerd op basis van de Eurocode, inclusief Nationale Bijlage (NB) welke voor dit project de Nederlandse NEN betreft.

In dit document worden de uitgangspunten vastgelegd waar op basis van de berekeningen gemaakt zullen worden. Dit houdt in dat in dit document alle referentiedocument, belastingen, normen en overige uitgangspunten worden benoemd.

#### 1.1.2. Algemeen project gegevens

De constructie bestaat uit meerdere nieuwe leidingbruggen t.b.v. de benodigde aan/afvoer leidingen voor het nieuwe CCS project. Dit document omhelst de constructieve uitgangspunten t.a.v.: Belasting / Stabiliteit / Fundatie



### 1.1.3. Definitie

De adviestaak van Konstruktis in dit rapport heeft betrekking op de aspecten van de constructieve draagstructuur van het project. Hierbij worden de volgende definities aangehouden voor de uit te voeren werken:

#### *Constructieve draagstructuur*

Tot de constructieve draagstructuur worden de elementen verstaan zoals omschreven in En 1990 +NB & Bouwbesluit

#### *Definitie volgens EN 1990 +NB:*

art. 1.5.1.6. constructie

Systematisch samenstel van met elkaar verbonden constructieve elementen ontworpen om belastingen te dragen en voldoende stijfheid te verschaffen.

art. 1.5.1.7. constructief element (constructieve elementen)

fysisch goed te onderscheiden deel van een constructie, bijv. een kolom, een balk/ligger, een plaat, een funderingspaal

#### *Definitie volgens Bouwbesluit*

- Bouwconstructie: onderdeel van een bouwwerk dat bestemd is om belasting te dragen

Bouwconstructie bedoelt voor het afdragen van horizontale belastingen, met uitzondering van stabiliserende elementen maken geen onderdeel uit van de constructieve draagstructuur.

### 1.1.4. Opbouw constructie

Voor de opbouw van de verschillende constructieonderdelen zijn de volgende inschattingen gemaakt als uitgangspunt voor deze berekening:

De fundering bestaat uit:

Type fundering:	Fundering op palen
Balken:	800x800 mm
Palen geschatte afmeting:	Boorpaal Ø 450

De bepaling van de gewichten, en overige opbouwen volgens gewichtberekening "5. Belastingen".

### 1.1.5. Mechanica van de constructie

Het uitgangspunt is dat e.e.a. statisch onbepaald zal zijn i.v.m. de fundatie op verende steunpunten.

Voor de brugdelen zal wel zoveel mogelijk alles terug worden geschematiseerd tot statisch bepaalde constructiedelen.

## 1.2. Doel van het rapport / Principes van berekening / Uitvoeringsvereisten

### 1.2.1. Doel van het rapport / Principes van berekening

Het doel van onderliggend document is om aan te tonen dat de berekende constructie voldoet aan de, door de van toepassing zijnde normen, gestelde eisen / klant vraagspecificatie. Hiervoor zijn de volgende uitgangspunten gehanteerd:

### 1.2.2. Uitvoeringsvereisten

#### 1.2.2.1. Staal

Basis uitvoering conform EN 1090-1 +NB & EN 1090-2 +NB

Materiaal -> volgens EN 10025 +NB, min. kwaliteit volgens §4.1.

Bouten -> rekentechnisch volgens ISO 4017 (volledige draad), uitvoering met bouten volgens ISO 4014 (bout met steel)

Moeren -> uitgangspunt voor moeren is sterkte kwaliteit 8 bij 8.8 bouten, en kwaliteit 10 bij 10.9 bouten

Conform EN 1993-1-8 3.6.1 (12) + NB dient tenzij in de berekening anders vermeld wordt een maximale vulplaat dikte te worden gehanteerd van  $\frac{1}{4}$  van de nominale boutdiameter.

Voor b.v. M30 is de maximale toegestane vulplaat  $30/3 = 10$  mm t.a.v.

Verbindingen worden standaard gecategoriseerd in Categorie A en/of Categorie D van EN 1993-1-8 +NB.

Indien het speciale verbinding met voorspanning betreft worden deze volgens Categorie C en Categorie E van EN 1993-1-8 +NB bepaald.

#### 1.2.2.2. Beton

Betonwerken dienen te worden uitgevoerd volgens EN 13670 +NB

Materiaal -> volgens EN 206-1 +NB, min. sterkte kwaliteit volgens §4.1.

De verwerkbaarheid van het beton wordt door de aannemer vastgesteld. Het gekozen consistentiegebied dient te worden afgestemd op de uitvoeringsmethode, echter rekeninghoudend met de toelaatbare water/cementfactor t.a.v. de milieuklasse.

#### 1.2.2.3. Hout

Niet van toepassing

#### 1.2.2.4. Metaalwerk

Niet van toepassing





#### 1.2.2.5. Aluminium

Niet van toepassing

#### 1.2.2.6. GRP

Niet van toepassing

#### 1.2.2.7. Fundering

Paalfunderingen dienen volgens EN 1997-1 + NB te worden uitgevoerd, i.c.m. de eisen van NEN 6742, en de uitvoeringsnormen t.b.v. de gekozen paaltypes.

### 1.3. Software

De volgende software is toegepast bij de uitvoering van het werk:

Microsoft Office Excel

Microsoft Office Word

Scia Engineer

Zie uitvoer voor actuele versie

IDEA StatiCa CONNECTION

Zie uitvoer voor actuele versie

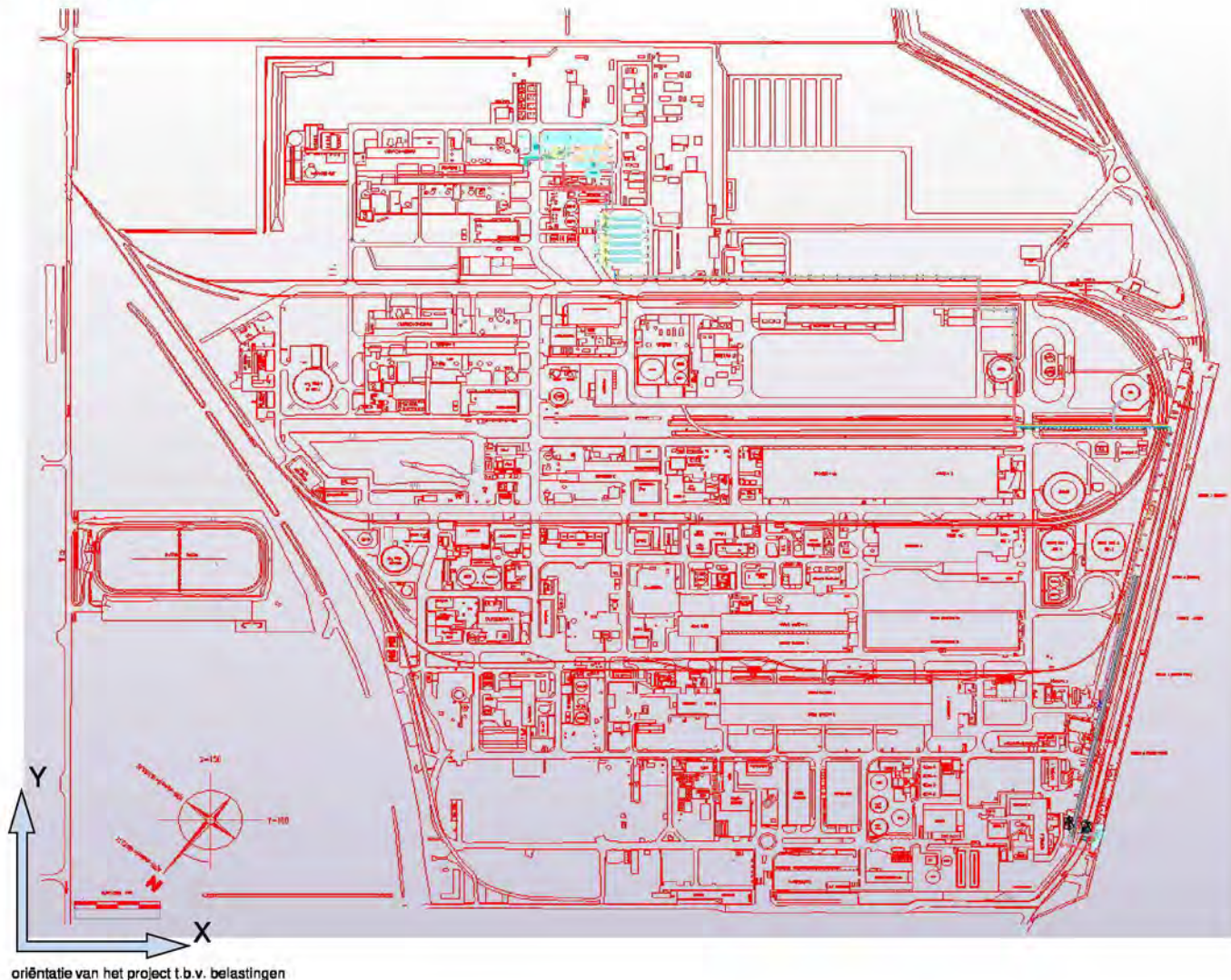
GEO5 Pile CPT

Zie uitvoer voor actuele versie

GEO5 Spread Footing CPT

Zie uitvoer voor actuele versie

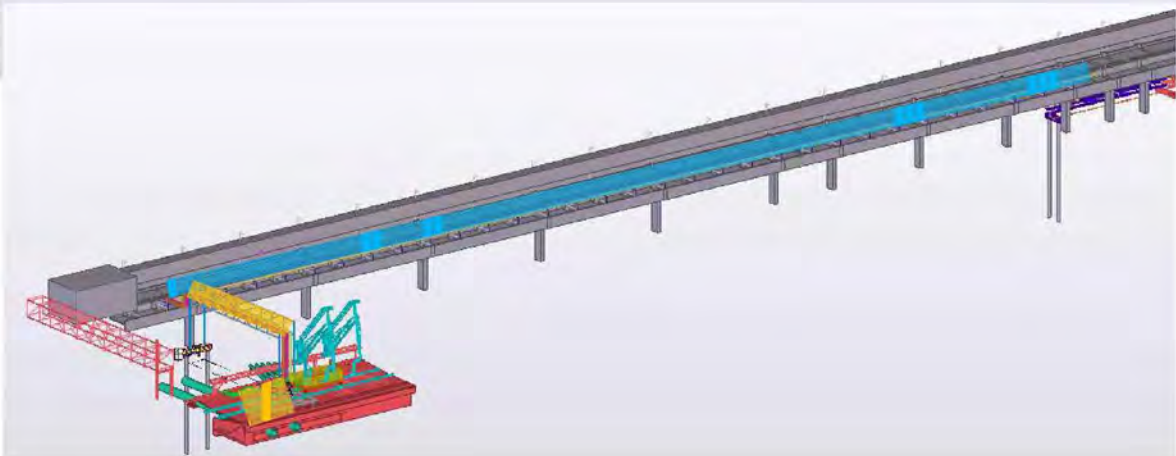
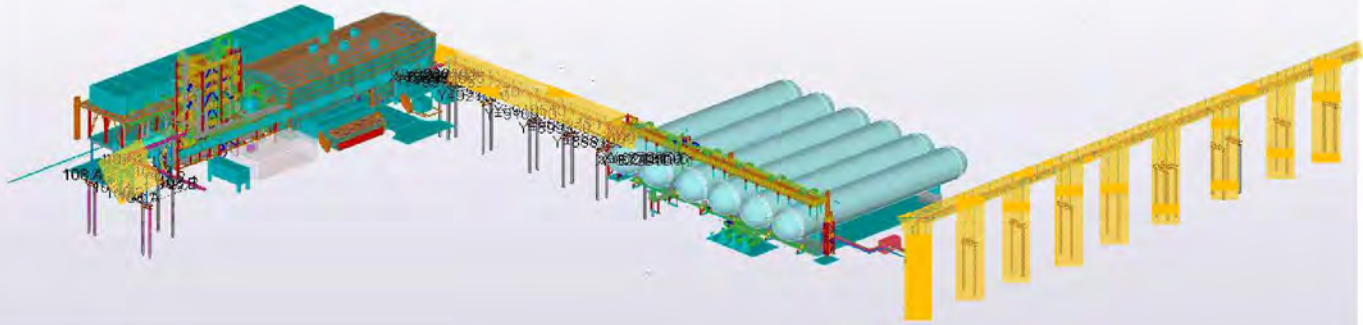
### 1.4. Ontwerp overzicht





Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project



Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Inleiding 1-4/41

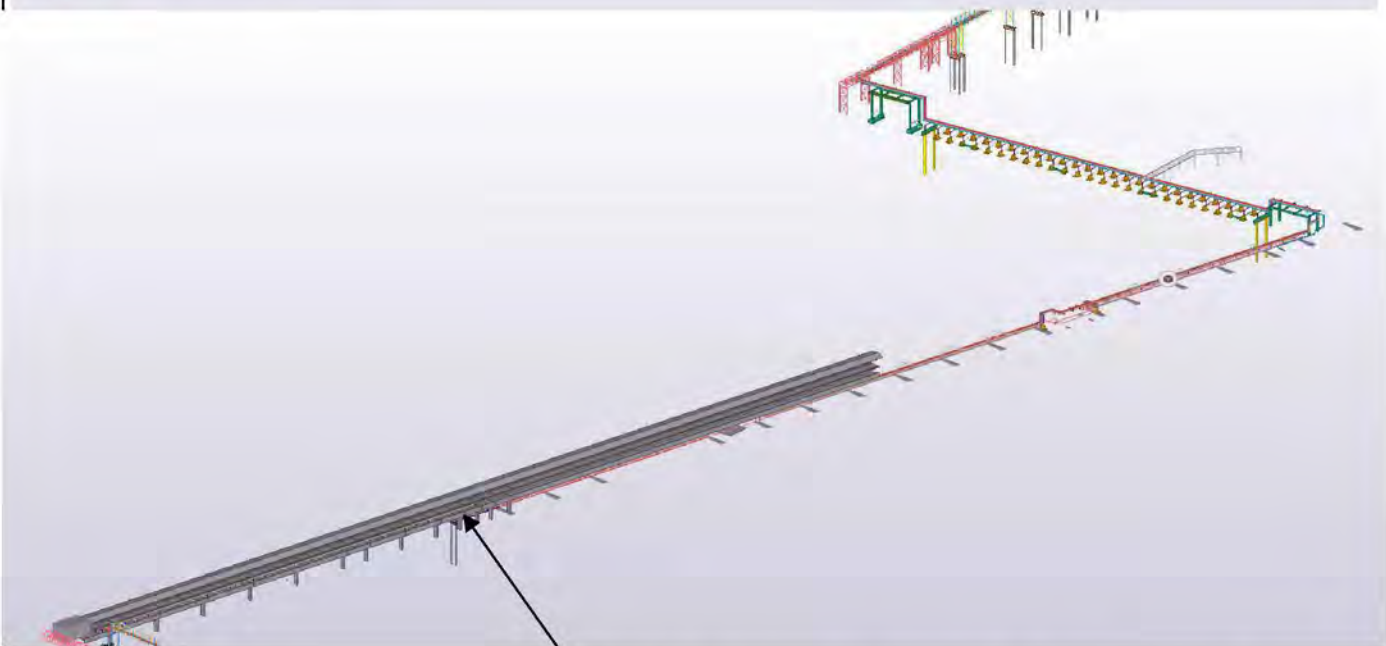




Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Inleiding 1-5/41

 routing op bestaande racks  
 routing op nieuwe racks



Gedeeltelijk gebruikmakend reeds bestaande leidingbruggen / kadegallerij.

## 2. Algemeen

### 2.1. Opmerkingen

Dit rapport bevat constructieve-berekeningen en principe schetsen en randvoorwaarden.

Deze berekeningen worden zoveel mogelijk in 3D uitgevoerd met eventuele 2D controles voor een zo accuraat mogelijk inzicht in het constructief gedrag t.a.v. de optredende krachten, verplaatsingen en vervormingen.

Het dient de aanbeveling de principe schetsen en randvoorwaarden uit dit document over te nemen op de daarvoor van toepassing zijnde tekeningen alvorens er met de werkzaamheden gestart worden. Dit zodat de aanwijzingen uit dit document op de bouw/werkplaats goed verwerkt worden.

Deze afstemming en juistheid op basis van de ons aangereikte gegevens valt buiten onze verantwoordelijkheid.

De aannames uit dit rapport dienen (in het werk) gecontroleerd te worden en zonodig te worden teruggekoppeld.

Indien er afwijkingen met dit rapport worden gevonden of onverwachte constatering in het werk worden gedaan, dienen deze zo spoedig mogelijk te worden gemeld aan de constructeur. Diens aanwijzingen ten aanzien van deze constatering dienen te worden opgevolgd, of te worden voorzien van een alternatief wat ter goedkeuring dient te worden voorgelegd.

De uitvoerders van het project dienen met vakmanschap en goed constructief inzicht het werk uit te voeren. Hierbij dienen zij op de hoogte te zijn van de geldende uitvoeringsnormen.

Op al onze adviezen in zowel berekening, e-mail als ook telefonisch gelden de standaard in onze offerte/ op website vermelde voorwaarden inzake de verhouding tussen opdrachtgever en adviserend ingenieursbureau: de DNR 2011 met de aanvulling bepaling, zoals in offerte/ op website vermeld.

### 2.2. Gebruikte eenheden / Assenstelsel

#### 2.2.1. Gebruikte Eenheden

Tenzij bij de betreffende berekening anders aangegeven zijn de volgende eenheden gehanteerd:

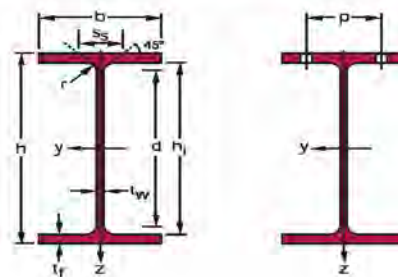
Maatvoering 3D model	in mm
Overspanningen	in m <sup>1</sup>
Afmetingen / oppervlakten	in mm en mm <sup>2</sup>
Belastingen	in kN/m <sup>2</sup> , in kN/m en in kN
Veerconstanten	in kN/m en in MNm/rad
Spanningen	in N/mm <sup>2</sup> en Mpa
Weerstandsmomenten	in mm <sup>3</sup>
Verplaatsingen	in mm en mrad

#### 2.2.2. Assenstelsel

Het gebruikte assenstelsel voor 3D berekening bestaat uit de X-as en Y-as in het horizontaalvlak en de Z-as als verticale as.

#### 2.2.3. Notatie van krachten

Krachtrichting	Eenheid
+ N = Trekkkracht in verbinding / staaf	kN
- N = Drukkkracht in verbinding / staaf	kN
V <sub>y</sub> = Afschuiving zwakke as in verbinding / staaf	kN
V <sub>z</sub> = Afschuiving sterke as in verbinding / staaf	kN
M <sub>x</sub> = Torsie in verbinding / staaf	kNm
M <sub>y</sub> = Moment in sterke as van verbinding / staaf	kNm
M <sub>z</sub> = Moment in zwakke as van verbinding / staaf	kNm



### 2.3. Gehanteerde Normen / Literatuur

De berekeningen worden in basis uitgevoerd conform Eurocode (EN) i.c.m. de geldende Nationale Bijlage (NB) De van toepassing zijnde hoofdnormen (dik & schuin gedrukt) zijn hiervoor:

<b>EN 1990 +NB</b>	<b>Algemene norm</b>
<b>EN 1991 +NB</b>	<b>Normen voor Belastingen</b>
<b>EN 1992 +NB</b>	<b>Normen voor controle van Beton</b>
<b>EN 1993 +NB</b>	<b>Normen voor controle van Staal</b>
<b>EN 1994 +NB</b>	<b>Normen voor controle van Staal-Beton constructies</b>
EN 1995 +NB	Normen voor controle van Hout
EN 1996 +NB	Normen voor controle van Metselwerk
<b>EN 1997 +NB</b>	<b>Normen voor controle van Geotechnische constructies</b>
EN 1998 +NB	Normen voor Aardbevingsontwerp
EN 1999 +NB	Normen voor controle van Aluminium
NEN 8700	Normen voor bestaande bouw

Een volledig overzicht van de van toepassing zijnde hoofd/subnormen zijn vermeld in bijlage D

Daarbij is ook een overzicht aanwezig van de van toepassing zijnde uitvoeringsnormen, materiaalnormen en verbindingnormen als ook een overzicht van de gehanteerde vakliteratuur, welke t.b.v. gelijkwaardigheid voor rekenwijze wordt geraadpleegd / toegepast.

In sommige gevallen wordt verder verwezen naar waarden uit de nationale bijlages van andere landen. Dit wordt gedaan voor speciale gevallen waarbij in de van toepassing zijnde nationale bijlage ontwerp data (zoals b.v.  $\psi$ -waarden) ontbreken. Hierbij worden dan de Nationale Bijlages / Normen van overige (omliggende) landen gehanteerd op basis van gelijkwaardigheid.

#### Yara Specifications:

Nr.	Name	Rev.:	Date:
10000-Y50-00026	SPECIFICATION FOR CIVIL AND STRUCTURAL STEEL DESIGN	5.0	22-2-2021
10000-Y50-00028	SPECIFICATION FOR ARCHITECTURAL DESIGN	7.0	22-2-2021
10000-Y50-00029	SPECIFICATION FOR PILING	6.0	10-10-2019
10000-Y50-00032	SPECIFICATION FOR ACID PROOFING	4.0	7-5-2021
10000-Y50-00033	SPECIFICATION FOR ANCHORING IN CONCRETE	03M	8-10-2019
10000-Y50-00034	SPECIFICATION FOR CLADDING	4.0	18-6-2021
10000-Y50-00035	SPECIFICATION FOR CONCRETE WORKS	8.0	5-5-2021
10000-Y50-00036	SPECIFICATION FOR GRP GRATING, LADDERS AND HANDRAILS	8.0	22-2-2021
10000-Y50-00037	SPECIFICATION OF INFRASTRUCTURE	01M	31-10-2018
10000-Y50-00038	SPECIFICATION FOR STRUCTURAL STEEL	2.0	16-6-2021
10000-Y50-00042	SPECIFICATION FOR SURFACE PROTECTION	6.0	27-4-2021
10000-Y50-00044	SPECIFICATION FOR STEEL FIRE PROOFING	1.0	22-2-2021
10000-E50-00003	DESIGN AND INSTALLATION OF PROTECTIVE EARTHING	6.0	1-7-2021

### 2.4. Referentie tekeningen/documenten

tek./doc.	omschrijving	rev.:	datum:
4921002-B01	Constructieve uitgangspunten Geotechnisch Advies	-	17-08-2021
4922005-TO_001	Algemeen overzicht routing	-	15-12-2022
4922006-TO_002	Algemeen overzicht tekening verwijzingen	-	15-12-2022
4922005-TO_101	Overzicht zone 1	-	15-12-2022
4922005-TO_102	Overzicht zone 2	-	15-12-2022
4922005-TO_103	Overzicht zone 3	-	15-12-2022
4922005-TO_104	Overzicht zone 4	-	15-12-2022
4922005-TO_105	Overzicht zone 5	-	15-12-2022
4922005-TO_106	Overzicht zone 6	-	15-12-2022
4922005-TO_107	Overzicht zone 7	-	15-12-2022
4922005-TO_108	Overzicht zone 8	-	15-12-2022
4922005-TO_109	Overzicht zone 9	-	15-12-2022
4922005-TO_110	Overzicht zone 10	-	15-12-2022
4922005-TO_111	Overzicht zone 11 en 12	-	15-12-2022
4922005-TO_113	Overzicht zone 13 en 12	-	15-12-2022
4922005-TO_114	Overzicht zone 14	-	15-12-2022
4922005-TO_115	Overzicht zone 15	-	15-12-2022
4922005-TO_116	Overzicht zone 16	-	15-12-2022
4922005-TO_117	Overzicht zone 17	-	15-12-2022



Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Algemeen 2-3/41

4922005-M101	Memo Laadbordes zone 1	-	15-12-2022
4922005-M401	Memo nieuw rack zone 4	-	15-12-2022
4922005-M501	Memo Nieuw rack zone 5	-	15-12-2022
4922005-M1101	Memo Sleepers	-	15-12-2022
4922005-B1401	Berekening zone 14	-	14-12-2022
4922005-B1501	Berekening zone 15	-	12-12-2022
4922005-M1701	Memo zone 17	-	15-12-2022

## 3. Ontwerputgangspunten Constructie

### 3.1. Algemene uitgangspunten

In dit hoofdstuk zijn de ontwerputgangspunten vermeld die de basis vormen voor de constructieve berekeningen van het project. De berekeningen worden uitgevoerd conform de in §2.3. "Gehanteerde Normen / Literatuur" vermelde normen.

Daarnaast zijn de ontwerpgegevens opgenomen die volgen uit de interactie tussen de verschillende ontwerpdisciplines die van toepassing zijn op het werk.

### 3.2. Functie bouwwerk, gevolgklasse en ontwerplevensduur

#### 3.1.1. Functies van constructie

	ontwerplevens- duurklasse	gevolgklasse	gebruiks-categorie	geleijkijdige waarde van de veranderlijke belasting	frequente waarde van de veranderlijke belasting	quasi-blijvende waarde van de veranderlijke belasting	correctiefactor voor levensduur
<b>Industrie ondersteunende functie</b>				$\psi_0$	$\psi_1$	$\psi_2$	$\psi_t$
hoofdfunctie = <b>Leidingbruggen</b>	<b>3</b>	<b>CC2</b>	<b>E2</b>	1.0	0.9	0.8	1
maatgevend =	3	CC2					1

#### $\psi$ waarden volgens EN 1990, bijlage A + NB

	$\psi_0$	$\psi_1$	$\psi_2$		
A Wonen en huishoudelijk gebruik		0.4	0.5	0.3	
B Kantoren		0.5	0.5	0.3	
C Bijeenkomst van mensen		0.4 / 0.6 **	0.7	0.6	
D Winkels		0.4	0.7	0.6	
E1 Opslag van goederen		1	0.9	0.8	
E2 Industrieel gebruik		1	0.9	0.8	
F Verkeersruimte, voertuiggewicht <30 kN		0.7	0.7	0.6	
G Verkeersruimte, 30 kN < voertuiggewicht < 160 kN		0.7	0.5	0.3	
H Dak, niet toegankelijk (I1 dakhelling $\alpha < 15^\circ$ , I2 dakhelling $15^\circ < \alpha < 20^\circ$ , I3 dakhelling $\alpha > 20^\circ$ )		0	0	0	
I Dak, toegankelijk volgens klassen A t/m D		0	0	0	
J Dak, speciaal gebruik		0	0	0	
K Landingsplaatsen voor helikopters		0	0	0	
S Sneeuw		0.5	0.2	0	
Wa Wateraccumulatie		0	0	0	
Wi Windbelasting		0	0.2	0	
T Temperatuur (geen brand)		0	0.5	0	
Sp Speciale belasting tijdens uitvoering		1	1	0.2	Volgens NB België
Z Zettingen		1	1	1	Volgens NB Duitsland

#### 3.1.2. Toepassingsgebied

Ontwerplevensduurklasse	hoofdconstructie	= 3	volgens EN 1990 + NB, § A1.1
Ontwerplevensduur		= 50 jaar	volgens EN 1990 + NB, § A1.1
Gereduceerde ontwerplevensduur		= 50 jaar	
Toegepaste ontwerplevensduur		= 50 jaar	volgens EN 1990 + NB, § A1.1
Referentietijd t.b.v. sneeuw/wind		= 50 jaar	volgens EN 1991-1-6 + NB

#### 3.1.3. Gevolg- en betrouwbaarheidsklasse

Gevolgklasse	= CC2	volgens EN 1990 + NB, § B3.1
Betrouwbaarheidsklasse	= RC2	volgens EN 1990 + NB, § B3.2
Kfi-factor	= 1.0	volgens EN 1990 + NB, § B3.3
Betrouwbaarheidsfactor	= 3.8	volgens EN 1990 + NB, § B3.2
Omschrijving	= gemiddelde kans of middelmatige gevolgen t.a.v. verlies van mensenlevens	

#### 3.1.4. Controle en inspectieniveau

Controle ontwerpniveau	= DSL2	volgens EN 1990 + NB, § B4
	(in combinatie met RC2, normaal supervisie)	
	Controle door andere personen dan die oorspronkelijk verantwoordelijk waren en volgens de werkwijze van de organisatie	

Inspectie niveau = IL2 volgens EN 1990 + NB, § B5  
 (in combinatie met RC2, normaal inspectieviveau)  
 Inspectie volgens de werkwijze van de organisatie

### 3.1.5. Uitvoeringsklassen

#### 3.1.5.1. Staal

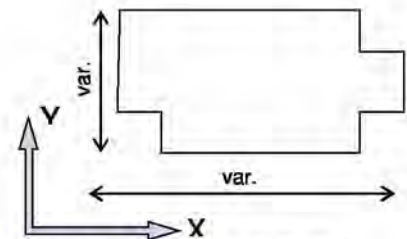
Belastings-categorie = BC1 Volgens EN 1993-1-1 + NB, §C  
 Productie-categorie = PC1 Volgens EN 1993-1-1 + NB, §C  
 Uitvoeringsklasse = EXC2 Volgens EN 1993-1-1 + NB, §C

#### 3.1.5.2. Beton

Ontwerplevensduur = 50 jaar  
 Constructieklasse = S4

### 3.1.6. Dimensies

Aantal bouwlagen = 2 stk  
 Hoogte per bouwlaag = 2000 mm  
 Breedte constructie X-as = var. mm  
 Diepte constructie Y-as = var. mm  
 Hoogte constructie = var. mm  
 Hoogte constructie t.o.v. maaiveld = var. mm



oriëntatie van het project t.b.v. belastingen  
 alg. afbeelding t.b.v. hoe maatvoering wordt

### 3.3. Belastingcombinatie's + factoren

#### 3.3.1. Nieuwbouw volgens EN 1990, bijlage A + NB

Grenstoestand	Gunstig / ongunstig	Blijvende belasting	Overheersende veranderlijke belasting	Veranderlijke belasting, gelijktijdig met de overheersende
Uiterste grenstoestand EQU (groep A)	Ongunstig	1.1 * G <sub>k</sub>	+ 1.5 * Q <sub>k</sub>	+ 1.5 * ψ <sub>0,i</sub> * Q <sub>k,i</sub>
	Gunstig	0.9 * G <sub>k</sub>	+ 1.5 * Q <sub>k</sub>	+ 1.5 * ψ <sub>0,i</sub> * Q <sub>k,i</sub>
Uiterste grenstoestand STR/GEO (groep B)	Ongunstig	1.35 * G <sub>k</sub>	+ 1.5 * Q <sub>k</sub>	+ 1.5 * ψ <sub>0,i</sub> * Q <sub>k,i</sub>
	Gunstig	1 * G <sub>k</sub>	+ 1.5 * Q <sub>k</sub>	+ 1.5 * ψ <sub>0,i</sub> * Q <sub>k,i</sub>
Uiterste grenstoestand STR/GEO (groep C)	Ongunstig	1.35 * G <sub>k</sub>	+ 1.3 * Q <sub>k</sub>	+ 1.5 * ψ <sub>0,i</sub> * Q <sub>k,i</sub>
	Gunstig	1.2 * G <sub>k</sub>	+ 1.3 * Q <sub>k</sub>	+ 1.5 * ψ <sub>0,i</sub> * Q <sub>k,i</sub>

Grenstoestand	Blijvende belasting	Buitengewoon / aardbeving	Overheersende veranderlijke belasting	Veranderlijke belasting, gelijktijdig met de overheersende
Uiterste grenstoestand buitengewoonbelasting	1 * G <sub>k</sub>	+ 1 * Q <sub>kb</sub>	+ 1 * ψ <sub>1,1</sub> * Q <sub>k,1</sub>	+ 1 * ψ <sub>2,1</sub> * Q <sub>k,1</sub>
Uiterste grenstoestand aardbeving	1 * G <sub>k</sub>	+ 1 * Q <sub>ka</sub>	+ 1 * ψ <sub>2,1</sub> * Q <sub>k,1</sub>	+ 1 * ψ <sub>2,1</sub> * Q <sub>k,1</sub>

#### 3.3.2. Combinaties t.b.v. bruikbaarheid

Bruikbaarheids grenstoestand	Blijvende belasting	Overheersende veranderlijke belasting	Veranderlijke belasting, gelijktijdig met de overheersende
Karakteristiek	1 * G <sub>k</sub>	+ 1 * Q <sub>k</sub>	+ Σ 1 * ψ <sub>0,i</sub> * Q <sub>k,i</sub>
Frequent	1 * G <sub>k</sub>	+ 1 * ψ <sub>1,1</sub> * Q <sub>k,1</sub>	+ Σ 1 * ψ <sub>2,1</sub> * Q <sub>k,1</sub>
Quasi-blijvend	1 * G <sub>k</sub>	+ 1 * ψ <sub>2,1</sub> * Q <sub>k,1</sub>	+ Σ 1 * ψ <sub>2,1</sub> * Q <sub>k,1</sub>



### 3.4. Eisen t.a.v. doorbuiging

De constructie dient aan de vervormingseisen t.a.v. een veilig en behagelijk gevoel te voldoen.

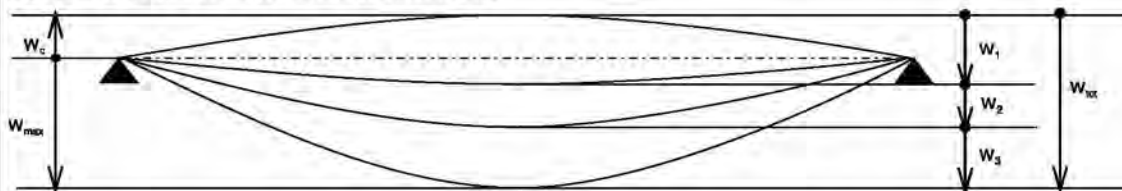
Voor alle elementen die niet zijn ondervangen door de YARA specificatie, zijn de volgende uitgangspunten gehanteerd voor de kolommen en liggers:

#### Bepaling verticale doorbuiging liggers/vloeren

Algemene eis	L/300	(L/150 voor uitkraging)
Ligger in vloer intensief gebruik door personen	L/333.33	(L/166.665 voor uitkraging)
Ligger die scheidingswanden draagt	L/500 **	(L/250 voor uitkraging)
Dakligger met intensief gebruik door personen	L/333.33	(L/166.665 voor uitkraging)
Dakligger onder normale omstandigheden	L/250	(L/125 voor uitkraging)
Kolom algemeen	L/300	(L/150 voor uitkraging)
Gevelkolom	L/300	(L/150 voor uitkraging)
Secundaire kolom	L/300	(L/150 voor uitkraging)
Gording	L/250	(L/125 voor uitkraging)
Kraanbaan	L/600	(L/300 voor uitkraging)

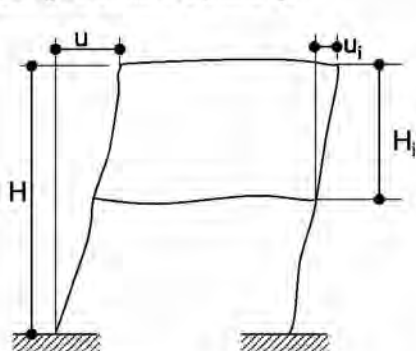
\*\* Voor vloeren en liggers die scheidingswanden dragen is een verdere aanbeveling de bijkomende doorbuigingen zoveel mogelijk te beperken tot ten hoogste 15 mm, en bij uitkragingen tot ten hoogste 10 mm

Volgens EN-1990 + NB nl A1.4.3 + EN-1993-6 + NA



- $W_c$  = de rekenwaarde van de zeeg van de bouwconstructie of constructie-onderdeel in de bruikbaarheidsgrenstoestand (BGT)
- $W_{max}$  = blijvende totale doorbuiging na aftrek zeeg
- $W_1$  = aanvangsdeel van de doorbuiging onder de blijvende belastingen uit de van toepassing zijnde belastingcombinatie overeenkomstig de formules (6.14a) tot en met (6.16b) bepaald met de korte-duur eigenschappen;
- $W_2$  = lange-termijn deel van de doorbuiging onder de blijvende belastingen volgens de quasi-blijvende belastingcombinatie, gelijk aan de doorbuiging bij de quasi-blijvende belastingcombinatie bepaald met lange-duur eigenschappen verminderd met de doorbuiging bij de quasi-blijvende belastingcombinatie bepaald met korte-duur eigenschappen (gevolgen van Kruip)
- $W_3$  = bijkomend deel van de doorbuiging ten gevolge van de veranderlijke belastingen uit de van toepassing zijnde belastingcombinatie bepaald met de korte-duur eigenschappen
- $W_{tot}$  = de rekenwaarde van de totale doorbuiging van de bouwconstructie of constructie-onderdeel in de bruikbaarheidsgrenstoestand

#### Bepaling horizontale verplaatsing



- $H$  = hoogte van het gebouw
- $H_i$  = hoogte van 1 verdieping
- $u$  = totale horizontale verplaatsing van het gebouw
- $u_i$  = horizontale verplaatsing van 1 verdieping
- toelaatbaar voor bouwwerken van 1 bouwlaag:
  - $h/150$  voor industriegebouwen
  - $h/300$  voor andere bouwwerken
- toelaatbaar voor bouwwerken van meer dan 1 bouwlaag:
  - $h/300$  per bouwlaag
  - $h/500$  voor het gehele bouwwerk
- Volgens EN-1990 +NB nl A1.4.3

#### Vloerafscheidingen

De vervormingen dienen aan de volgende eisen te voldoen:

Alle vervormingen dienen elastisch te blijven.

De verticale doorbuiging van de bovenrand, of bovenrand en de onderrand, of onderregel moeten kleiner zijn dan  $L/150$  van de afstand tussen 2 steunpunten

Bij vloerafscheidingen dient de horizontale doorbuiging van de bovenrand niet groter te zijn dan 20 mm

Volgens EN-1990 + NB nl A1.4.3



### 3.5. Belastingchikking

In EN 1991-1-1 art. 6.2.1. en 6.2.2. worden de volgende regels gesteld:

Art. 6.2.1: Vloeren, liggers en daken (geldt ook voor funderingen):

- 1.) Voor het ontwerp en de berekening van de vloerconstructie van één van de verdiepingen of van een dak, moet de opgelegde belasting in rekening zijn gebracht als een vrije belasting ter plaatse van het meest ongunstige deel van het invloedsoppervlak van de beschouwde belastingseffecten.
- 2.) Waar de belastingen op andere verdiepingen van toepassing zijn, mogen deze gelijkmatig verdeeld zijn aangenomen (vaste belastingen).
- 3.) Om een minimale plaatselijke weerstand van de vloerconstructie te waarborgen, moet een afzonderlijke toetsing plaatsvinden met een geconcentreerde belasting die, tenzij anders is vermeld, niet mag zijn gecombineerd met de gelijkmatig verdeelde belastingen of andere veranderlijke belastingen.
- 4.) Opgelegde belastingen van één enkele klasse mogen zijn gereduceerd, overeenkomend met de oppervlakken ondersteund door het betreffende element, met een reductiefactor  $\alpha_A$  volgens 6.3.1.2 (10). Dit is echter niet toegestaan in Nederland. Reductie wordt daarom standaard niet gebruikt.

Art. 6.2.2: Kolommen en wanden (geldt ook voor funderings palen):

Voor het ontwerp en de berekening van kolommen en wanden, behoort de opgelegde belasting op alle ongunstige plaatsen te worden aangebracht. Voor het ontwerp en de berekening van kolommen en wanden moet de opgelegde belasting zijn beschouwd op ten minste één vloer (de vloer die het meest ongunstige resultaat oplevert).

- 2.) Waar de opgelegde belastingen uit een aantal verdiepingvloeren, kolommen en wanden belasten, mag het totaal van de opgelegde belastingen zijn gereduceerd met een factor  $\alpha_n$  volgens 6.3.1.2 (11) en 3.3.1 (2)P.

### 3.6. Imperfecties

In het ontwerp en de uitwerking dient rekening te worden gehouden de volgende imperfecties:

Funderingspalen	Buispalen	Geen; Plaatsingsafwijking kleiner dan 1/8 van de diameter van de stalen buispaal worden geacht binnen de marge van de controleberekeningen te vallen en behoeven niet separaat in rekening te worden gebracht.
Betonconstructies		Imperfecties zijn opgenomen in de wijze van berekenen. Maatafwijkingen van de uitvoering dienen daarbij te vallen binnen de maattoleranties van de van toepassing zijnde uitvoeringsnormen. Afwijkingen die hier buiten vallen dienen te worden gemeld en te worden gecotroleerd of de constructie hieraan voldoet.
Staalconstructies		Imperfecties zijn opgenomen in de wijze van berekenen conform art. 5.3 van EN 1993-1-1 +NB. Maatafwijkingen van de uitvoering dienen daarbij te vallen binnen de maattoleranties van de van toepassing zijnde uitvoeringsnormen. Afwijkingen die hier buiten vallen dienen te worden gemeld en te worden gecotroleerd of de constructie hieraan voldoet.

## 4. Toegepaste Materialen & Duurzaamheid

### 4.1. Materialen

Voor de materialen gelden, tenzij in de berekening anders vermeld, de volgende uitgangspunten:

Staalconstructies	-> Constructiestaal	Standaard constructiestaal	S235JR
	Verbindingen	-> Kop/voetplaten	S235JR
		Bouten	8.8
		Ankers	8.8 met volgplaat 80x80*15
		Lassen	min. a = 4 mm
Betonconstructies	In het werk gestort		C35/45
	Prefab	volgens leverancier, minimaal	C45/55
	Wapeningstaal	Staven	B500B
		Gepuntlaste wapeningsnetten	B500A
	Cementsoort		Hoogovencement CEM III/B 42,5 LH/HS
Ondersabelingsmortel	->		Krimparme ondersabelingsmortel min. K70 kwaliteit t.a.v.

Eigenschappen van materialen volgens bijlage A

### 4.2. Duurzaamheid/Conservering

#### 4.2.1. Staal

Basis uitvoering conform EN 1090-1 +NB & EN 1090-2 +NB

Materiaal -> volgens EN 10025 +NB, min. kwaliteit volgens bovenstaand.

Voor het conserveren van de constructie wordt geadviseerd om minimaal de volgende uitgangspunten aan te houden, tenzij bij het specifieke onderdeel anders wordt opgegeven, of het bestek hiervan afwijkend is:

Klimaatklasse = C5-I

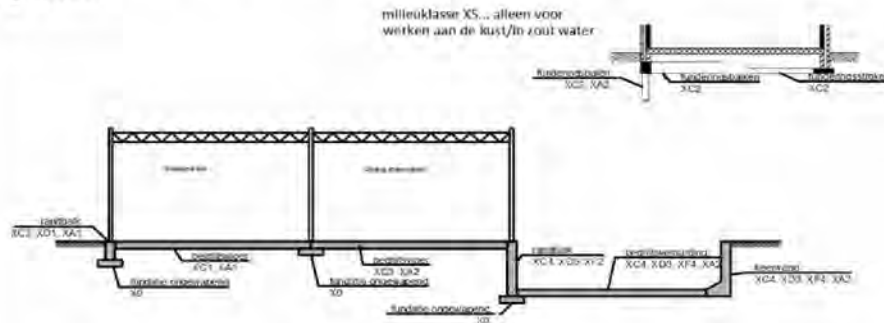
Groep	Locatie	Type behandeling	Corrosie-snelheid (mm/jaar) indien onbehandeld
0	Staal in beton	onbehandeld toepassen	
1	Staal in binnenmilieu C1	gemenied	0.005-0.03
2	Staal in binnenmilieu C2	thermisch verzinkt + coating	0.03-0.08
3	Staal buiten C3	thermisch verzinkt + coating	0.08-0.12
4	Staal in chemisch milieu C4	thermisch verzinkt + coating	0.12-0.15
4	Staal in industrie C5-I	thermisch verzinkt + coating	0.012-0.15
5	Staal aan de kust C5-M	thermisch verzinkt	0.015-0.20
-	verduurzaamd staal in beton	gechromateerd	

Klimaatklasse	Locatie	Kwaliteit omgeving	Voorbeelden
C1	Binnen	Weinig agressief	Verwarmd gebouw
C2	Binnen	Matig agressief	Onverwarmd gebouw (o.a. staal in spouw)
C3	Buiten	Weinig agressief	Bedrijfsruimte met hoge luchtvochtigheid
C4	Industrie	Matig agressief	Chemiebedrijf, zwembad e.d.
C5-I	Industrie	Agressief	Industriegebied met hoge luchtvochtigheid en corrosieve atmosfeer
C5-M	Industrie	Agressief	Kustgebied met hoog zoutgehalte, offshore

Oppervlakte behandeling van alle onderdelen conform YARA specificatie: 10000-Y50-00042

## 4.2.2. Beton

Voor de samenstelling van het beton en detaileren van de wapening dienen t.a.v. de volgende milieuklassen te worden aangehouden:



Onderdeel	Constructie klasse	Milieuklasse	$C_{minb}$ [mm]	$C_{mindur}$ [mm]	$\Delta c_{dev}$ [mm]	$C_{nom}$ vereist [mm]	$C_{nom}$ toegepast [mm]
Funderingspalen							
Geboord	S4	XA3	16	40	5	45	125
Funderingsbalken							
Bovenzijde	S4	XA3	16	50	10	60	65
Zijkant	S4	XA3	16	50	10	60	65
Onderzijde	S4	XA3	16	45	10	55	65

Betonwerken dienen te worden uitgevoerd volgens EN 13670 +NB

Materiaal -> volgens EN 206-1 +NB & EN 10080 +NB en eventuele nationale normen

De verwerkbaarheid van het beton wordt door de aannemer vastgesteld. Het gekozen consistensiegebied dient te worden afgestemd op de uitvoeringsmethode, echter rekeninghoudend met de toelaatbare water/cementfactor t.a.v. de milieuklasse.

Cement uitvoeren als Hoogoven Cement CEM III/B42.5 LH/HS t.a.v.

4.2.3. Hout *n.v.t.*

4.2.4. Metselwerk *n.v.t.*

## 5. Belastingen

### 5.1. Permanente en opgelegde belastingen volgens EN 1991-1-1 + NB

#### 5.1.1. Algemeen, samenvattingstabel

Het eigengewicht van de gemodelleerde constructie wordt door Scia bepaald.

Deze belastingen worden bepaald aan de hand van de volgende soortelijke gewichten:

Beton	droog	ongewapend	=	2400	kg/m <sup>3</sup>
	nat	ongewapend	=	2500	kg/m <sup>3</sup>
	droog	gewapend	=	2500	kg/m <sup>3</sup>
	nat	gewapend	=	2600	kg/m <sup>3</sup>
Betonstaal			=	7850	kg/m <sup>3</sup>
Constructiestaal			=	8000	kg/m <sup>3</sup>
Roest Vast Staal			=	8000	kg/m <sup>3</sup>

#### 5.1.2. Vloeren

Er zijn geen vloerelement aanwezig in het ontwerp.

#### 5.1.3. Wanden

Er zijn geen wandelement aanwezig.

#### 5.1.4. Balken / staafelementen

De balk/staafelementen zijn worden door het rekenprogramma bepaald.

#### 5.1.5. Opgegeven belasting door Opdrachtgever

Voor het ontwerp is aangegeven dat er gerekend dient te worden op:

min. 4 leidingen DN 250 per laag, over 2 lagen.

Horizontaal dient er vanuit het leidinggewicht met 30% veranderlijk als belasting in zowel x-as als y-as te worden gerekend t.b.v. stroming.

Daarnaast wordt het ontwerp uitgevoerd op een u.c. van max. ±70%

Voor de overige equipment t.p.v. het overslagpunt wordt in de betreffende rapporten de daar van toepassing zijnde belasting gegeven.

#### 5.1.5. Belasting t.g.v. scheefstand

Conform EN 1993-1-1 +NB art. 5.3.1 (3) moet er met een algemene imperfectie van raamwerken en lokale imperfecties van profielen/elementen van staal rekening gehouden worden. De lokale imperfecties zijn verwerkt in de formules voor weerstand tegen knikken van staven conform EN 1993-1-1+NB art. 5.3.4 (1). De algemene imperfecties van raamwerken dienen middels onderstaande equivalente horizontale krachten te worden opgenomen op elke kolom, conform EN 1993-1-1 +NB art. 5.3.2 (7).

Voor de scheefstand is de formule (5.5) van EN 1993-1-1 +NB art. 5.3.2 (3) van toepassing:

$$\phi = \phi_a * \alpha_h * \alpha_m$$

waarin

$$\phi_a = 1/200 \quad \text{basiswaarde conform EN 1993-1-1 +NB 5.3.2 (3)}$$

$$\alpha_h = 2 / \sqrt{h} \quad \text{maar } 2/3 \leq \alpha_h \leq 1 \quad = 0.67$$

$$h = \text{hoogte constructie} = 18.3 \text{ m}$$

$$\alpha_m = \sqrt{0.5 * (1 + 1/m)} \quad \alpha_{m-1} \quad 0.87 \quad \alpha_{m-2} \quad 0.87$$

m = is het aantal kolommen in een rij, die een verticale belasting hebben die niet kleiner is dan 50% van de gemiddelde verticale kracht op de kolommen in het beschouwde verticale vlak.

$$m_x = 2 \text{ stk} \quad = \text{var. minimaal altijd 2 kolommen aanwezig}$$

$$m_y = 2 \text{ stk} \quad = \text{var. minimaal altijd 2 kolommen aanwezig}$$

$$\phi = 2.887 \text{ mm/m} \quad \phi_z = 2.887 \text{ mm/m}$$

$$\phi_y = 2.887 \text{ mm/m}$$

### 5.2. Horizontale belasting op afscheidingen: leuningen/rellingen volgens EN 1991-1-1 +NB

Er zijn geen afscheidingen aanwezig waarop de belastingen van toepassing worden geacht.

### 5.3. Speciale vloerbelasting volgens EN 1991-1-1 +NB

Er zijn geen vloeren in aanwezig die middels stellingen / of gelijkaardige constructie worden belast waarbij de belasting boven de normale opgelegde belasting uit komt. Hierdoor is deze belasting niet van toepassing geacht.

#### 5.4. Speciale vloerbelasting door voertuigen volgens EN 1991-1-1 +NB

Er zijn geen vloeren in aanwezig die middels stellingen / of gelijkaardige constructie worden belast waarbij de belasting boven de normale opgelegde belasting uit komt. Hierdoor is deze belasting niet van toepassing geacht.

#### 5.5. Belasting t.g.v. brand volgens EN 1991-1-2 +NB

Belastingen t.g.v. brand zijn niet meegenomen in het ontwerp.

#### 5.6. Sneeuw volgens EN 1991-1-3 +NB

Belasting vanuit sneeuw zijn bepaald in bijlage B. Hieruit volgt:

Belasting voor platte / eenzijdig hellende (lessenaars) daken  $q_{sn} = 0.56 \text{ kN/m}^2$

#### 5.7. Wateraccumulatie volgens EN 1991-1-3 +NB

Wateraccumulatie wordt als niet van toepassing op de open constructie van leidingbruggen.

#### 5.8. Windbelasting volgens EN 1991-1-4 +NB

Belasting t.g.v. windbelasting worden in bijlage C bepaald op basis van onderstaande uitgangspunten:

Land = Nederland  
Locatie = Sluiskil  
Windgebied = 2  
Referentie hoogte = 18.3 m  
Hieruit volgt een winddruk van =  $1.04 \text{ kN/m}^2$

Overige factoren volgens bijlage C.

Verdere uitwerking van windbelasting volgens §6. Ontwerp principes / Bijlage C

#### 5.9. Temperatuur volgens EN 1991-1-5 +NB

Belasting t.g.v. temperatuursveranderingen anders dan brand zijn:

conform EN-1991-1-5 + NB:      Uitgangspunt absorberend vermogen: 0.9 donker

$T_{min}$	=	-25 °C	$T_{out}$	=	75 °C
$T_{max}$	=	30 °C	$\Delta T_u$	=	100 °C
$T_3$	=	20 °C	montage temperatuur $T_0$	=	10 °C
$T_4$	=	30 °C			
$T_5$	=	45 °C			

verschil 1 =  $-35.0$  °C => invoer voor in Rekenprogramma

verschil 2 =  $65.0$  °C => invoer voor in Rekenprogramma

#### 5.10. Stootbelasting volgens EN 1991-1-7 +NB

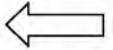
De constructie wordt niet belast door wind. Deze belasting is daarom niet meegenomen.

## 5.11. Explosiebelasting volgens EN 1991-1-7 +NB

Er wordt gebruik gemaakt van de volgende punten om te bepalen of een gebouw getoetst moet worden op een explosiebelasting:

- Constructies die worden bepaald conform CC1 klasse, hoeven niet getoetst te worden op explosiebelasting.
- Er is een stookruimte in de constructie aanwezig die aan de belastingeisen voldoet.
- Er zijn drukluiken aanwezig welke bij een overdruksituatie openen
- Het betreft een open constructie, waarin geen druk kan opbouwen

nee
nee
nee
ja



Uit deze toetsinglijst volgt dat het niet nodig is om een uitgebreide analyse van een explosiebelasting uit te voeren.



90% van de bruggen zitten daarbij in de zone van 10 mbar = 1 kN/m<sup>2</sup> aan belastingdruk.  
 Dit betekent dat de belastingdruk t.g.v. wind en explosie ong. gelijkwaardig zal zijn.

## 5.12. Belasting t.g.v. geotechnische oorzaken

### 5.12.1. Belasting t.g.v. gronddruk volgens EN 1991-1-1 +NB / EN 1997-1 +NB

Er zijn geen belastingen t.g.v. gronddruk aanwezig op de constructie.

### 5.12.2. Belasting t.g.v. aardbeving EN 1991-1-1 +NB / EN 1997-1 +NB / EN 1998-1 +NB

Voor deze locatie en constructie is het niet noodzakelijk om met een aardbevingsbelasting te rekenen.

## 5.13. Belasting t.g.v. kranen volgens EN 1991-3 +NB

Er zijn geen hijsbalken in het ontwerp aanwezig.

## 5.14. Belasting op leidingbruggen

Voor leiding eigengewicht en veranderlijk

Aangenomen leidingdiameter + wanddikte **BG 273.0 x 9** + 60 mm isolatie (DN 250)

type leiding = **Staal 80 kN/m<sup>3</sup>**

product = **Water 10 kN/m<sup>3</sup>**

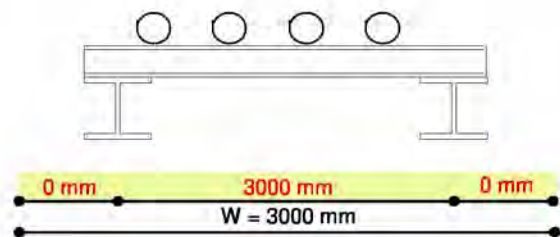
A = 7680 mm<sup>2</sup>

A<sub>inwendig</sub> = 50854.4 mm<sup>2</sup>

g = 0.61 kN/m

q = 0.51 kN/m

Per Laag:



max. aantal leidingen op brug n =  $W / d = 4$  leidingen

P per steun = h.o.h. \* g \* n = 6.15 kN

p per ondersteuningslengte = **2.05** kN/m =>

Q per steun = h.o.h. \* q \* n = 5.09 kN

q per ondersteuningslengte = **1.70** kN/m =>

Voor het bewegen van het product word een factor van 30 % aangehouden.

q horizontaal q \* 0.3 = **0.51** kN/m =>

Voor wanneer als vlaklast gerekend wordt:

**0.82** kN/m<sup>2</sup> reken met **1.00** kN/m<sup>2</sup>

**0.68** kN/m<sup>2</sup> reken met **1.00** kN/m<sup>2</sup>

**0.20** kN/m<sup>2</sup> reken met **0.30** kN/m<sup>2</sup>

## 5.15. Belasting t.g.v. waterstroming volgens EN 1991-1-6 +NB

Er zijn geen belastingen t.g.v. waterstroming tegen de constructie in het ontwerp aanwezig.





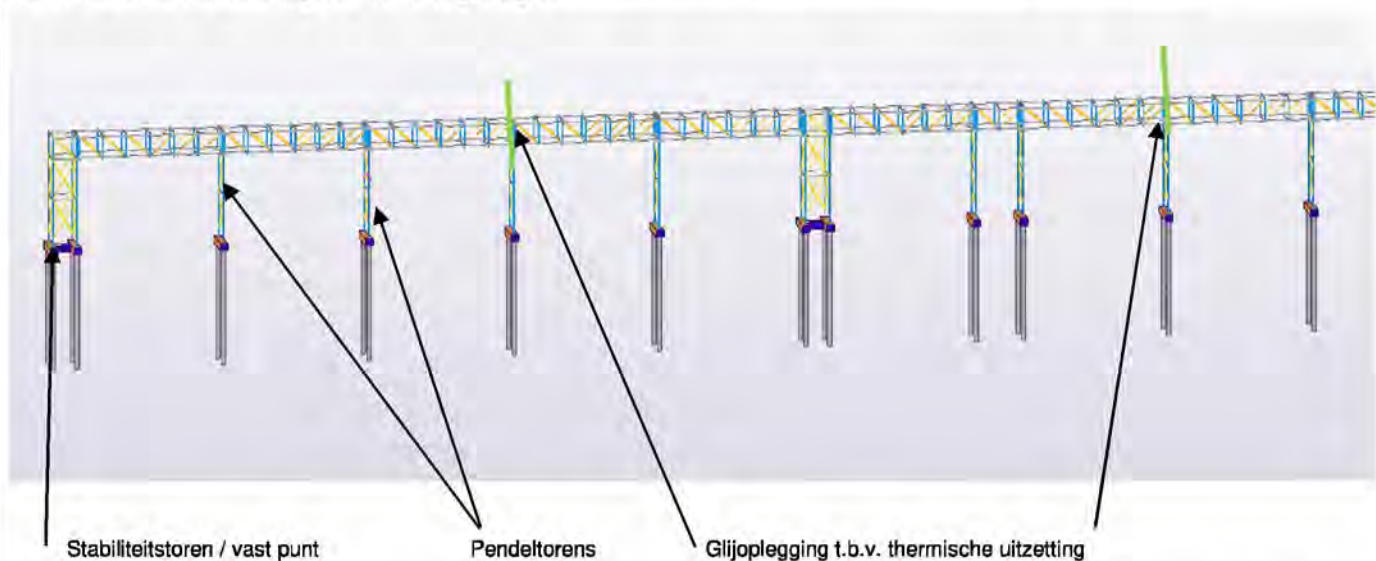
## 6. Ontwerp principes

### 6.1. Basisopzet

#### 6.1.1. Basis

Voor de basis van het ontwerp van de piperacks zal gewerkt worden met een module opzet. Dit betekent dat er steeds in standaard lengtes gewerkt zal worden, waarbij de zijstukken van de vakwerken in elkaar gelast worden en de tussenliggers hier op/onder worden gebouwd.

Hierbij worden op intervallen stabiliteitstorens tussen geplaatst van waaruit in 2 richting dan leidingbruggen weg gaan. In ongeveer het midden van deze stukken worden de uitserste modules via een glijoplegging op de pendelkolommen gelegd, zodat hierin de te verwachten thermische uitzetting kan worden opgevangen.



Voor de fundaties wordt uitgegaan van een fundatie op palen, gekoppeld door een fundatiebalk met hierop kleine betonpoertjes tot net boven de grond.

#### 6.1.2. Stabiliteit

De stabiliteit wordt verzorgd door de stabiliteitstorens welke voorzien worden van verbanden in alle richtingen.

Voor de vakwerken zal worden gewerkt met een combinaties van kleine verbanden + semi-stijve knopen.

De pendeltorens worden in de langs-as van de bruggen met een kleine verende inklemming op het beton gerekend. Aan de bovenzijde zitten zij scharnierend / glijdend vast aan de brug.

In de zijdelingse as worden zij voorzien van windverbanden.

## 6.2. Fundering

Voor de fundaties dienen nog CPT testen te worden uitgevoerd.

Op de zone waar de nieuwe opslag voor de CO2 tanks komen te staan is echter al wel de grondopbouw bekend.

Hiervan is in document 4921002-B01 rev- d.d. 17-08-2021 reeds een opzet gemaakt voor de draagkracht:

Zone 2 / 3 / 4, Tankundatie



Hiervoor zijn de sonderingen van zones 2 / 3 / 4 van toepassing

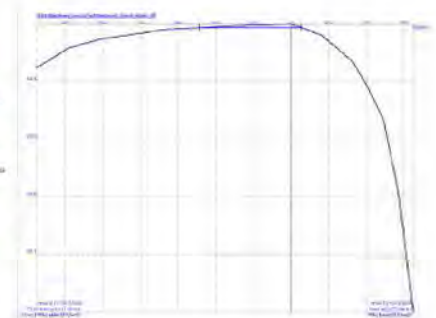
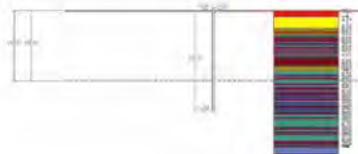
Waarbij de CPT's 1407 / 1408 / 1413 de 3 testen zijn die het dichtst bij deze nieuwe constructie zitten.

### Zone 2

Maatgevende sondering 1407

Paalpuntniveau [m] t.o.v. maaiveld	R <sub>cid</sub> [kN] bij toepassing van diameter [mm] schacht/voet		
	ø380-450	ø460-560	ø540-660
23	1315.66	1617.88	1949.97
23.5	1461.91	1819.44	2211.67
24	1588.39	1984.97	2385.84
24.5	1705.97	2121.51	2541.67
25	1815.38	2244.31	2725.88

### Zone 2/3/4



### Zone 3

Maatgevende sondering 1416

Paalpuntniveau [m] t.o.v. maaiveld	R <sub>cid</sub> [kN] bij toepassing van diameter [mm] schacht/voet		
	ø380-450	ø460-560	ø540-660
23	1393.61	1717.72	2073.06
23.5	1485.81	1843.47	2230.05
24	1596.03	1972.85	2387.64
24.5	1706.14	2103.64	2537.38
25	1790.68	2209.81	2674.52

R <sub>cid</sub> [kN]	W <sub>cid</sub> [mm]	k <sub>cid</sub> [kN/mm]
2833	72.6	39.0
2590	19	134.3
2267	8.9	254.7
1983	5.58	355.4
1700	3.72	457.0
1417	2.23	635.2
1133	1.48	765.7
850	1.15	739.1
567	0.56	1011.9
283	0.25	1133.3

### Zone 4

Maatgevende sondering 1423

Paalpuntniveau [m] t.o.v. maaiveld	R <sub>cid</sub> [kN] bij toepassing van diameter [mm] schacht/voet		
	ø380-450	ø460-560	ø540-660
24	1310.47	1648.27	2042.3
24.5	1437.46	1794.97	2208.31
25	1522.67	1893.72	2318.97
25.5	1668.46	2092.81	2594.5
26	1843.05	2302.58	2833.19

### 6.3. Belasting gevallen

In het model zijn de volgende belastinggevallen opgenomen:

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	'Master' belastinggeval	Specificatie	Duur
BG101	Eigen gewicht	Permanent	LG1	Eigen gewicht			
BG102	Permanent gewicht leidingen	Permanent	LG1	Standaard			
BG111	Veranderlijke belasting leidingen Z-as	Variabel	LG2	Statisch	Geen	Standaard	Kort
BG112	Veranderlijke belasting leidingen X-as	Variabel	LG3	Statisch	Geen	Standaard	Kort
BG113	Veranderlijke belasting leidingen Y-as	Variabel	LG3	Statisch	Geen	Standaard	Kort
BG121	Sneeuw	Variabel	LG3	Statisch	Geen	Standaard	Kort
BG131	Temperatuur -35	Variabel	LG4	Statisch	Geen	Standaard	Kort
BG132	Temperatuur +65	Variabel	LG5	Statisch	Geen	Standaard	Kort
BG141	Wind x-as brug	Variabel	LG6	Statisch	Geen	Standaard	Kort
BG142	Wind y-as brug	Variabel	LG7	Statisch	Geen	Standaard	Kort

### 6.4. Combinaties

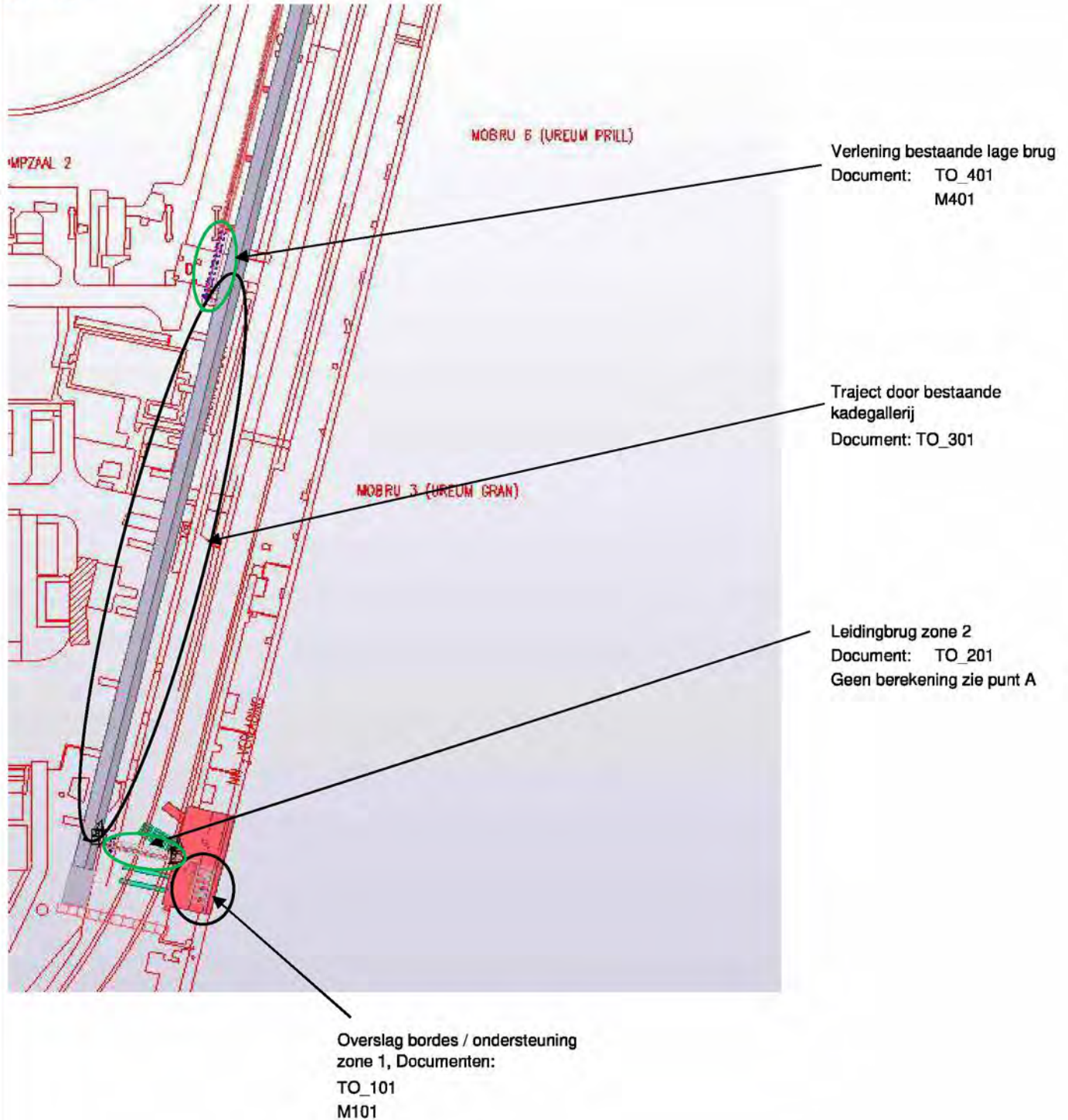
Op basis van de ingevoerde belastinggevallen met bijbehorende lastgroepen bepaald Scia de combinaties.  
 Deze zijn op basis van onderstaand schema.

		Comb ID	1	2	3
		Type	ULS	BGT	BGT
		Naam	UGT-Set B	BGT-Kar	BGT-quasi
LC Name	LC Omschrijving				
BG101	Eigen gewicht		1.00	1.00	1.00
BG102	Permanent gewicht leidingen		1.00	1.00	1.00
BG111	Veranderlijke belasting leidingen Z-as		1.00	1.00	1.00
BG112	Veranderlijke belasting leidingen X-as		1.00	1.00	1.00
BG113	Veranderlijke belasting leidingen Y-as		1.00	1.00	1.00
BG121	Sneeuw		1.00	1.00	1.00
BG131	Temperatuur -35		1.00	1.00	1.00
BG132	Temperatuur +65		1.00	1.00	1.00
BG141	Wind x-as brug		1.00	1.00	1.00
BG142	Wind y-as brug		1.00	1.00	1.00



## 7. Overzicht documenten

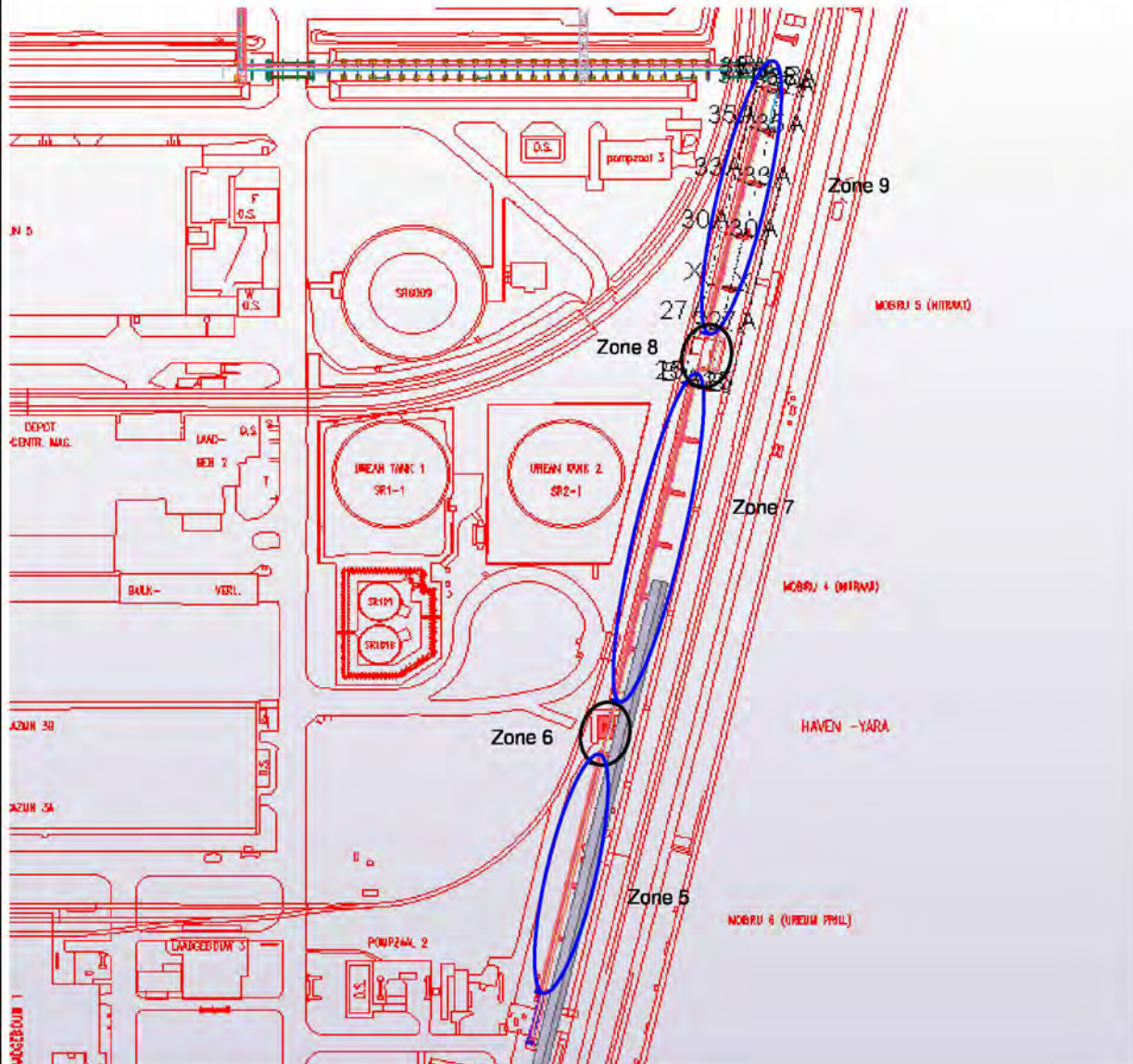
### 7.1. Locaties





Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Documenten 7-2



Bestaand rack zone 5

Document: TO\_501  
M501

Extra supports aan bestaand rack zone 6

Document: TO\_601  
Geen berekening zie punt B

Bestaand rack zone 7

Document: TO\_701  
Geen berekening zie punt B

Extra supports aan bestaand rack zone 8

Document: TO\_801  
Geen berekening zie punt B

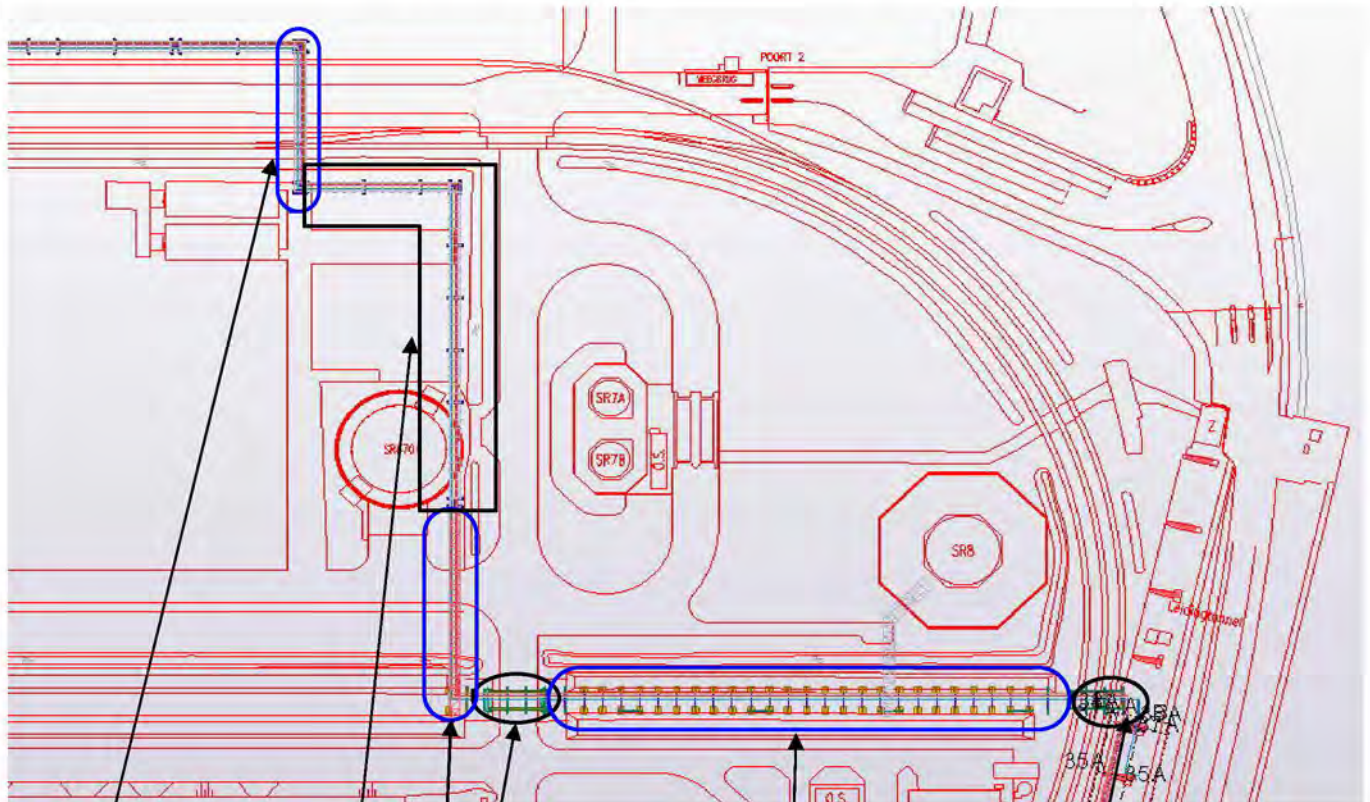
Bestaand rack zone 9

Document: TO\_901  
Geen berekening zie punt B



Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Documenten 7-3



Nieuw hoograck zone 14  
Document: TO\_1401  
B1401

Nieuw normaal rack zone 13  
Document: TO\_1301  
Geen berekening zie punt A

Bestaand rack zone 12  
Document: TO\_1201  
Geen berekening zie punt C

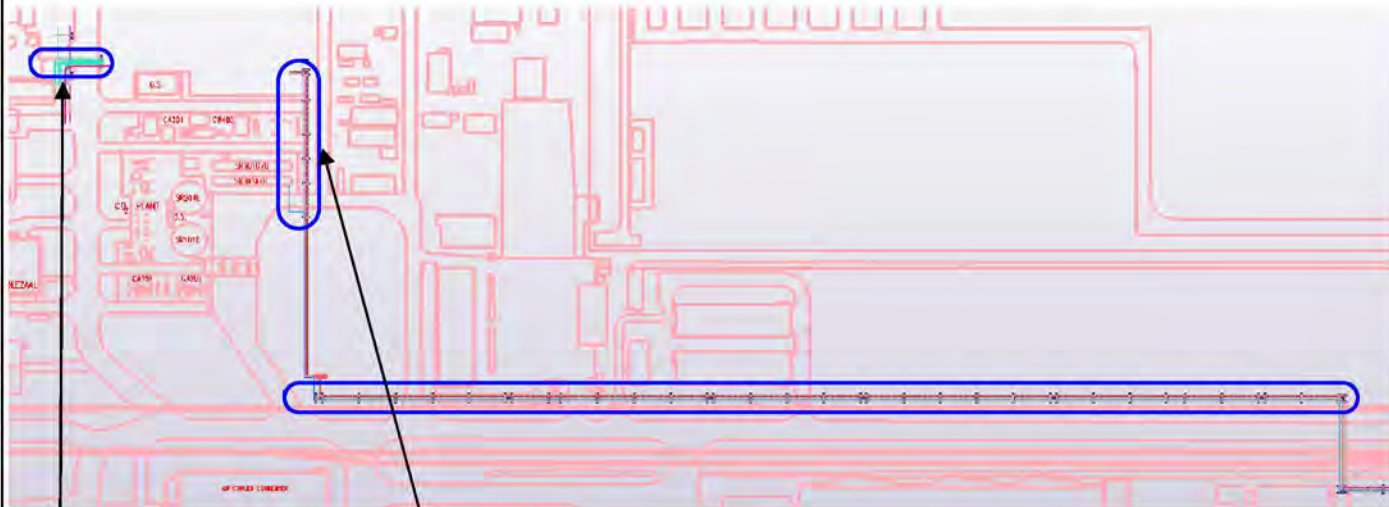
Bestaande sleepers zone 11  
Document: TO\_1101  
M1101

Bestaand rack zone 10  
Document: TO\_1101  
Geen berekening zie punt C



Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Documenten 7-4



Nieuw rack naar bestaand  
Zone 17  
Documenten: TO\_1701  
M1701

Nieuw rack zone 16  
Document: TO\_1601  
Geen berekening zie punt A

Nieuw normaal rack zone 15  
Document: TO\_1501  
B1501

### 7.2. Toelichtingen

- Punt A: Nieuwe racks welke voor deze eerste opzet gelijk zijn gehouden qua uitvoering aan het lange rack van zone 15. Berekening voor DO fase daarom gelijk gesteld aan de resultaten van document B1501
- Punt B: Bestaand laag rack  
Gelijk aan zone 5, memo zone 5 daarom aangehouden.  
Ook voor de extra supports van zones 6 en 8 is hier e.e.a. opgenomen.
- Punt C: Bestaand beton en staal rack  
Nog geen berekening van gemaakt. Deze wordt bij de UO fase uitgevoerd.  
Na controle v/d CPT's zodat ook de fundatie volledig kan worden meegenomen.



Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Bijlage A-1/41

## Bijlage A Overzicht materiaaleigenschappen

### Inhoud

Bijlage A.1.	Overzicht Staal
Bijlage A.2.	Overzicht Aluminium
Bijlage A.3.	Overzicht Hout
Bijlage A.4.	Overzicht Beton + Wapeningsstaal
Bijlage A.5.	Overzicht Bout & Ankerkwaliteiten
Bijlage A.6.	Overzicht Metselwerk
Bijlage A.7.	Overzicht RVS





### A. Overzicht materiaaleigenschappen

#### A.1. Overzicht Staal

Algemene gegevens staal

Massa per eenheid

$m = 7850 \text{ kg/m}^3$  rekenmodel  $8000 \text{ kg/m}^3$

Elasticiteitsmodulus

$E = 210000 \text{ N/mm}^2$

Glijdingsmodulus

$G = 80769 \text{ N/mm}^2$

Poissoncoëfficiënt

$\nu = 0.3$

Lineaire thermische uitzettingscoëfficiënt

$\alpha = 0.000012 \text{ per } ^\circ\text{C}$  (voor  $T \leq 100 \text{ }^\circ\text{C}$ )

Naam	Onderlimiet [mm]	Bovenlimiet [mm]	$f_y$ [N/mm <sup>2</sup> ]	$f_u$ [N/mm <sup>2</sup> ]	
S 235 JR	0	3	235	360	
S 235 J0	3	16	235	360	
S 235 J2 (voor dikte 250-400)	16	40	225	360	
	40	63	215	360	
volgens EN 10025-2	63	80	215	360	
	80	100	215	360	
	100	150	195	350	
	150	200	185	340	
	200	250	175	340	
	250	400	165	330	** alleen S 235 J2
S 275 JR	0	3	275	430	
S 275 J0	3	16	275	410	
S 275 J2 (voor dikte 250-400)	16	40	265	410	
	40	63	255	410	
volgens EN 10025-2	63	80	245	410	
	80	100	235	410	
	100	150	225	400	
	150	200	215	380	
	200	250	205	380	
	250	400	195	380	** alleen S 275 J2
S 355 JR	0	3	355	510	
S 355 J0	3	16	355	470	
S 355 J2	16	40	345	470	
S 355 K2	40	63	335	470	
volgens EN 10025-2	63	80	325	470	
	80	100	315	470	
	100	150	295	450	
	150	200	285	450	
	200	250	275	450	
	250	400	265	450	** alleen S 355 J2 & S 355 K2
S 450J0	3	16	450	550	
volgens EN 10025-2	16	40	430	550	
	40	63	410	550	
	63	80	390	550	
	80	100	380	550	
	100	150	380	530	

#### A.2. Overzicht Aluminium

n.v.t.

#### A.3. Overzicht Hout

n.v.t.

### A.4. Overzicht Beton + Wapeningsstaal

#### Beton

naam	Cilinderdruk sterkte	Kubedruksterkte	Rekenwaarde cilinderdruk sterkte gemiddelde	Rekenwaarde cilinderdruksterkte	Karakteristieke treksterkte	Rekenwaarde treksterkte	Secans-elasticiteits modulus bij 0,4 $f_{cm}$	$f_{min}$	wapeningspercentage	$f_{max}$	wapeningspercentage	$\alpha$	$\beta$
	$f_{ck}$ MPa	$f_{ck,cube}$ MPa	$f_{cd}$ MPa	$f_{cm}$ MPa	$f_{ctm}$ MPa	$f_{ctd}$ MPa	$E_{cm}$ MPa	%	$\rho_{min}$ %	$\rho_{max}$ %			
C12/15	12	15	8	20	1.57	0.73	27000	0.13	0.62	0.75	0.39	=> stampbeton voor werkvloer	
C16/20	16	20	10.7	24	1.9	0.89	29000	0.13	0.82	0.75	0.39		
C20/25	20	25	13.3	28	2.21	1.03	30000	0.13	1.03	0.75	0.39	=> standaard beton	
C25/30	25	30	16.7	33	2.56	1.2	31000	0.13	1.29	0.75	0.39		
C30/37	30	37	20	38	2.9	1.35	33000	0.15	1.55	0.75	0.39		
C35/45	35	45	23.3	43	3.21	1.5	34000	0.17	1.8	0.75	0.39	=> standaard beton	
C40/50	40	50	26.7	48	3.51	1.64	35000	0.18	2.06	0.75	0.39		
C45/55	45	55	30	53	3.8	1.77	36000	0.2	2.32	0.75	0.39	=> standaard prefabbeton	
C50/60	50	60	33.3	58	4.07	1.9	37000	0.21	2.58	0.75	0.39		
C53/65	53	65	35.3	61	4.16	1.94	38000	0.22	2.12	0.72	0.38		
C55/67	55	67	36.7	63	4.21	1.97	38000	0.22	2.1	0.71	0.37		
C60/75	60	75	40	68	4.35	2.03	39000	0.23	2.1	0.67	0.36		
C70/85	70	85	46.7	78	4.61	2.15	41000	0.24	2.22	0.62	0.35		
C80/95	80	95	53.3	88	4.84	2.26	42000	0.25	2.28	0.58	0.34		
C90/105	90	105	60	98	5.04	2.35	44000	0.26	2.49	0.56	0.34		

#### Wapening

##### Algemene gegevens wapeningsstaal

Massa per eenheid

$m = 7850 \text{ kg/m}^3$

Elasticiteitsmodulus

$E = 210000 \text{ MPa}$

Glijdingsmodulus

$G = 80769 \text{ MPa}$

Poissoncoëfficiënt

$\nu = 0.3$

Lineaire thermische uitzettingscoëfficiënt

$\alpha = 0.000012 \text{ per } ^\circ\text{C (voor } T \leq 100 \text{ } ^\circ\text{C)}$

naam	$f_{yk}$ MPa	$f_{yd}$ MPa	
FEB200	220	191	=> alleen voor bestaande bouw
B 400A	400	348	
B 500A	500	435	=> voor standaard netten
B 600A	600	522	
B 400B	400	348	
B 500B	500	435	=> voor standaard staafstaal
B 600B	600	522	
B 400C	400	348	
B 500C	500	435	=> standaard voor aardbevingsgebied
B 600C	600	522	

### A.5. Overzicht Bout & Ankerkwaliteiten

naam	$f_{yb}$ MPa	$f_{tb}$ MPa	naam	$f_{yb}$ MPa	$f_{tb}$ MPa
4.6	240	400	10.9	900	1000
4.8	320	400	12.9	1080	1200
5.6	300	500	A4-50	210	500
5.8	400	500	A4-70	450	700
6.8	480	600	A4-80	600	800
8.8	640	800			

\*\* niet in Nederland toepasbaar conform NEN-EN 1993-1-8

\*\*\* voor Hilti Lijmankers, verder niet toepasbaar in Nederland conform NEN-EN 1993-1-8

### A.6. Overzicht Metselwerk

n.v.t.

### A.7. Overzicht RVS

n.v.t.



Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Bijlage B-1/41

## Bijlage B Bepaling sneeuwbelasting

### Inhoud

Bijlage B.1. Sneeuwbelasting volgens Eurocode EN-1991-1-3 + NB

## B.1. Sneeuwbelasting volgens Eurocode EN-1991-1-3 + NB

### B.1.1. Bepaling basis sneeuwlast

karakteristieke waarde sneeuw =  
 blootstellingscoëfficiënt =  
 warmtecoëfficiënt =  
 herhalingstijd =  
 jaarlijkse waarschijnlijkheid =  
 variatiecoëfficiënt =  
 reductiefactor voor jaarlijks overschreiden:  

$$\psi_t = \frac{1 - V \cdot \sqrt{6} / \pi \cdot (\ln(-\ln(P_n)) + 0.5722)}{1 + 2.5923 \cdot V} =$$
  
 basis waarde voor sneeuw =

$\rho_{sk} = 0.7 \text{ kN/m}^2$   
 $C_e = 1$   
 $C_t = 1$   
 $n = 50 \text{ jr.}$   
 $P_n = 0.020$   
 $V = 0.8$   
 $= 1.001$   
 $\rho_{sn} = 0.70 \text{ kN/m}^2$

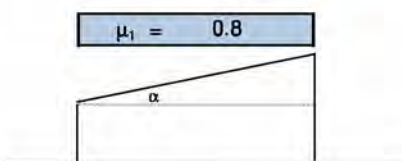
### B.1.2. Bepaling $\mu$ coëfficiënten dak

#### B.1.2.1. Algemene bepalingmethode voor coëfficiënten

Dakhoeck of -helling $\alpha$	voor $0^\circ \leq \alpha \leq 30^\circ$	voor $30^\circ < \alpha \leq 60^\circ$	voor $\alpha \leq 60^\circ$
$\mu_1$	0.8	$0.8 \cdot (60 - \alpha) / 30$	0
$\mu_2$	$0.8 + 0.8 \cdot \alpha / 30$	1.6	0

#### B.1.2.2. Platte en lessenaarsdaken, volgens EN-1991-1-3 + NB, § 5.3.2

$\alpha = 0^\circ$   
 $Q_{sneeuw} = \rho_{sn} \cdot \mu_1$   
 $Q_{sneeuw} = 0.56 \text{ kN/m}^2$



#### B.1.2.3. Zadeldaken, volgens EN-1991-1-3 + NB, § 5.3.3

n.v.t.

#### B.1.2.4. Daken met meer dan één overspanning, volgens EN-1991-1-3 + NB, § 5.3.4

n.v.t.

#### B.1.2.5. Cillinderdaken, volgens EN-1991-1-3 + NB, § 5.3.5

n.v.t.

#### B.1.2.6. Daken grenzend aan hogere bouwwerken, volgens EN-1991-1-3 + NB, § 5.3.6

n.v.t.

#### B.1.2.7. Sneeuwophoping ter hoogte van uitstekende delen/obstakels, volgens EN-1991-1-3 + NB, § 6.2

n.v.t.



Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Bijlage C-1/41

## Bijlage C Bepaling windbelasting

### Inhoud

Bijlage C.1.	Windbelasting volgens Eurocode EN-1991-1-4 + NB
Bijlage C.2.	Windvormfactoren volgens EN-1991-1-4 + NB

## C.1. Windbelasting volgens Eurocode EN-1991-1-4 + NB

### C.1.1. Algemene gegevens wind

Land	=	Nederland
Locatie	=	Sluiskil
Windgebied	=	2
Terreinklasse	=	2
Constructievorm	=	b
Aantal bouwlagen	=	1
Breedte gebouw	$b_{gem}$ / x-as	= 2.4 m min. breedte
Diepte gebouw	$d_{gem}$ / y-as	= 15 m min. lengte
Hoogte t.o.v. peil	$h_1$	= 0 m
Hoogte gebouw	$h$	= 18.25 m
Totale hoogte gebouw	$z_1$	= 18.25 m max. constructie hoogte
Dakhelling	=	-
Type constructie	=	stalen bruggen en stalen vakwerktorens gewone bouten



Terreinklasse	$z_0$	$z_{min}$	Constructievorm	$z_s$
0 Zee of kustgebied met wind aanstormend over open zee		0.01	1	a verticale constructies zoals gebouwen enz. $0.6 \cdot h > z_{min}$ b horizontale constructies zoals liggers enz. $h_1 + h/2 > z_{min}$ c puntachtige constructies zoals verkeersborden enz. $h_1 + h/2 > z_{min}$ d overige constructies h
1 Meren of vlak en horizontaal gebied met verwaarloosbare vegetatie en zonder obstakels		n.v.t.	n.v.t.	
2 Gebied met lage begroeiing als gras en vrijstaande obstakels (bomen, gebouwen) met tussenruimte van ten minste 20 obstakelhoogtes		0.2	4	ruwheidslengte, volgens terreinklasse $z_0 = 0.2$ m minimum waarde hoogte $z_{min} = 4.0$ m maximum waarde hoogte $z_{max} = 200$ m referentiehoogte voor bouwwerkfactor, volgens fig. 6.1 van EN-1991-1-4 $z_s = 9.1$ m
3 Gebied met regelmatige begroeiing of gebouwen of vrijstaande obstakels met een tussenruimte van ten hoogste 20 obstakelhoogtes (zoals dorpen, voorstedelijk terrein, blijvend bos)		0.5	7	
4 Gebied waar ten minste 15% van de oppervlakte is bedekt met gebouwen met een gemiddelde hoogte boven 15 m		n.v.t.	n.v.t.	maatgevende rekenwaarde hoogte $z = 18.3$ m

### C.1.2. Wind druk

#### basis windsnelheid § 4.2

$$\begin{aligned}
 v_b &= C_{prob} \cdot C_{dir} \cdot C_{season} \cdot v_{b0} = 27.0 \text{ m/s} \\
 C_{dir} &= 1 \\
 C_{season} &= 1 \\
 v_{b0} &= 27.0 \text{ m/s} \\
 C_{prob} &= \left( \frac{1 - K \cdot \ln(-\ln(1-p))}{1 - K \cdot \ln(-\ln(0.98))} \right)^n = 1.0 \\
 K &= 0.2 \\
 n &= 0.5 \\
 p &= 1 / \text{referentie tijd} = 0.02
 \end{aligned}$$

#### windturbulentie volgens § 4.4

$$\begin{aligned}
 l_{v(z)} &= (k_t \cdot v_b \cdot k_1) / v_{m(z)} = 0.22 \\
 k_1 &= 1.00
 \end{aligned}$$

#### gemiddelde windsnelheid volgens § 4.3

$$\begin{aligned}
 v_{m(z)} &= C_{r(z)} \cdot C_{o(z)} \cdot v_b = 25.51 \text{ m/s} \\
 C_{o(z)} &= 1 \\
 v_b &= 27.00 \text{ m/s} \\
 C_{r(z)} &= k_r \cdot \ln(z/z_0) \quad \text{voor } z_{min} < z < z_{max} \\
 &= C_r(z_{min}) \quad \text{voor } z < z_{min} \\
 k_r &= 0.19 \cdot (z_0/0.05)^{0.07} = 0.21 \\
 C_{r(z)} &= 0.94
 \end{aligned}$$

#### extreme stuwdruk volgens § 4.5

$$\begin{aligned}
 q_{p(z)} &= (1 + 7 \cdot l_{v(z)}) \cdot 0.5 \cdot \rho \cdot v_{m(z)}^2 = 1.04 \text{ kN/m}^2 \\
 \rho &= 1.25 \text{ kg/m}^3
 \end{aligned}$$

### C.1.3. Bepaling $C_s C_d$

#### Bepaling volgens § 6.3.1 + Bijlage B

#### wind richting

	Richting X-as	Richting Y-as
$C_s C_d$	$(1 + 2 \cdot k_b \cdot l_{v(zs)} \cdot (B^2 + R^2)^{0.5}) / (1 + 7 \cdot l_{v(zs)}) = 1.27$	1.03
$B^2$	0.66	0.59
$R^2$	1.06	0.39
$k_b$	3.78	3.72
$l_{v(zs)}$	0.26	0.26

## C.2. Windvormfactoren volgens EN-1991-1-4 + NB

### C.2.1. Algemene gegevens wind

breedte gebouw	$b_{gem} / x\text{-as}$	= 2.4 m	verhoudingsgetal X-as	= <b>7.60</b>
diepte gebouw	$d_{gem} / y\text{-as}$	= 15 m	verhoudingsgetal Y-as	= <b>1.22</b>
hoogte t.o.v. peil	$h_{w.r.t. 0+}$	= 0 m	winddruk op X-as	= <b>1.32</b> kN/m <sup>2</sup>
hoogte gebouw	$h_{go}$	= 18.3 m	winddruk op Y-as	= <b>1.07</b> kN/m <sup>2</sup>
totale hoogte gebouw	$h_{gem}$	= 18.3 m	$e_{vg} = \min(x; 2 \cdot h)$	= <b>2</b> m
dakhelling		= 6 °	$e_{zg} = \min(y; 2 \cdot h)$	= <b>15</b> m
	$z$	= 18.3 m		
	$A$	= 274 m <sup>2</sup>	Factoren voor Onderdruk	= <b>-0.30</b>
			Overdruk	= <b>0.20</b>

### C.2.2. Bepaling $C_{pe}$ waarde op gevels

Er zijn geen gevels waarop windbelasting conform dit artikel zou zitten aanwezig. Deze zijn dan ook niet bepaald.

### C.2.3. Bepaling $C_{pe}$ op dak

Er zijn geen dakvlakken waarop windbelasting conform dit artikel zou zitten aanwezig. Deze zijn dan ook niet bepaald.

### C.2.4. Bepaling $C_{pe}$ op vrijstaande wanden, borstweringen, schermen en (reclame)borden

Niet van toepassing op deze constructie.

### C.2.5. Bepaling $C_{pe}$ op lossa profielen

#### C.2.5.1. Waarden profielen met scherpe hoeken, volgens § 7.7

$C_f = C_{f,0} \cdot \psi_\lambda =$  **2.00**  
 $C_{f,0} =$  2 standaard waarde volgens Nationale Bijlage  
 $\psi_\lambda =$  1 bepaald volgens onderstaande tabel, veilige aanname.

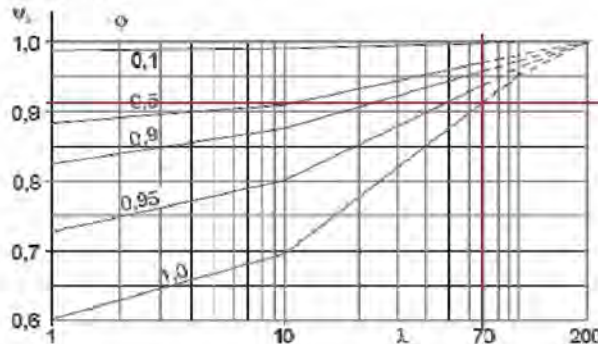


$\lambda$  factoren volgens tabel 7.16

Nr.	Positie van de constructie, wind normaal op het vlak van de pagina	Effectieve slankheid $\lambda$
1		Voor veelhoekige, rechthoekige doorsneden met scherpe hoeken en vakwerconstructies: voor $l \geq 50$ m: neem de kleinste van $\lambda = 1,4 \ell/b$ of $\lambda = 70$ , voor $l < 15$ m: neem de kleinste van $\lambda = 2 \ell/b$ of $\lambda = 70$ .
2		Voor cirkelvormige cilinders: voor $l \geq 50$ m: neem de kleinste van $\lambda = 0,7 \ell/b$ of $\lambda = 70$ , voor $l < 15$ m: neem de kleinste van $\lambda = \ell/b$ of $\lambda = 70$ .
3		Voor tussenliggende waarden van $\ell$ behoort lineair te zijn geïnterpoleerd.
4		voor $l \geq 50$ m: neem de grootste waarde van $\lambda = 0,7 \ell/b$ of $\lambda = 70$ ; voor $l < 15$ m: neem de grootste waarde van $\lambda = \ell/b$ of $\lambda = 70$ . Voor tussenliggende waarden van $\ell$ behoort lineair te zijn geïnterpoleerd.

$\lambda =$  **70**

Figuur 7.36 (van EN 1991-1-4) — Indicatieve waarden van de eindeffectfactor  $\psi_A$  als functie van volheidsgraden  $\phi$  versus slankheid

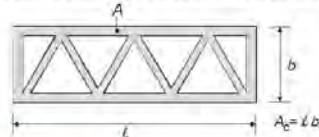


De volheidsgraad is  $\phi$  (zie figuur 7.37 van EN 1991-1-4 + NB) is gegeven in onderstaande uitdrukking:

$$\phi = \frac{A}{A_c}$$

A = is de som van het geprojecteerde oppervlak van de elementen      A = 1 m<sup>2</sup>  
 A<sub>c</sub> = is het totaal ingesloten oppervlakte      A<sub>c</sub> = 1 m<sup>2</sup>

$\phi = 1.000$



**C.2.5.2. Waarden voor cilindrische profielen volgens § 7.9**

Er zijn geen losse profielen aanwezig die aan dit artikel voldoen. Daarom niet van toepassing.

**C.2.5.3. Waarden voor leidingbruggen**

Voor leidingen + liggers in leidingbrug:

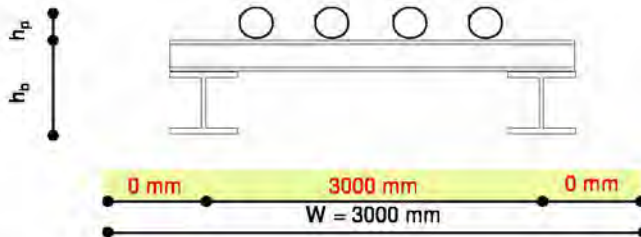
Ingeschatte liggerhoogte:

$h_b = 240 \text{ mm}$

leidingdiameter:

$h_p = 340 \text{ mm}$

$q_w = 1.32 \text{ kN/m}^2$



Voor wind haaks op leidingen:

$$q = (2.2 * h_b + 0.7 * (h_p + 0.1 * W)) * q_w = 1.28 \text{ kN/m} \Rightarrow \boxed{0.64} \text{ kN/m per ligger}$$

Voor wind evenwijdig op leidingen:

$$q = (0.3 * (h_b + h_p)) * q_w = \boxed{0.23} \text{ kN/m}$$





Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Bijlage D-1/41

### Bijlage D Overzicht Normen / Literatuur

#### Inhoud

Bijlage D.1.	Gehanteerde Normen	
Bijlage D.2.	Uitvoeringsnormen	
Bijlage D.3.	Materiaalnormen	
Bijlage D.4.	Normen voor Verbindingen	
Bijlage D.5.	Overige toegepaste normen	
Bijlage D.6.	Gehanteerde vakliteratuur	



### D. Overzicht Normen / Literatuur

#### D.1. Gehanteerde Normen

##### D.1.1. Basis normen t.b.v. berekeningen

###### Eurocode 0: Grondslagen

EN 1990+NB

Eurocode - Grondslagen van het constructief ontwerp

###### Eurocode 1: Belastingen op constructies

EN 1991-1-1+NB

Eurocode 1: Belastingen op constructies - Deel 1-1: Algemene belastingen - Volumieke gewichten, eigengewicht en opgelegde belastingen voor gebouwen

EN 1991-1-3+NB

Eurocode 1: Belastingen op constructies - Deel 1-3: Algemene belastingen - Sneeuwbelasting

EN 1991-1-4+NB

Eurocode 1: Belastingen op constructies - Deel 1-4: Algemene belastingen - Windbelasting

EN 1991-1-5+NB

Eurocode 1: Belastingen op constructies - Deel 1-5: Algemene belastingen - Thermische belasting

EN 1991-1-6+NB

Eurocode 1: Belastingen op constructies - Deel 1-6: Algemene belastingen - Belasting tijdens uitvoering

EN 1991-1-7+NB

Eurocode 1: Belastingen op constructies - Deel 1-7: Algemene belastingen - Buitengewone belastingen: stootbelastingen en ontploffingen

###### Eurocode 2: Betonconstructies

EN 1992-1-1+NB

Eurocode 2: Ontwerp en berekening van betonconstructies - Deel 1-1: Algemene regels en regels voor gebouwen

###### Eurocode 3: Staalconstructies

EN 1993-1-1+NB

Eurocode 3: Ontwerp en berekening van staalconstructies - Deel 1-1: Algemene regels en regels voor gebouwen

EN 1993-1-5+NB

Eurocode 3: Ontwerp en berekening van staalconstructies - Deel 1-5: Algemene regels - Constructieve plaatvelden

EN 1993-1-8+NB

Eurocode 3: Ontwerp en berekening van staalconstructies - Deel 1-8: Algemene regels - Ontwerp en berekening van verbindingen

EN 1993-1-10+NB

Eurocode 3: Ontwerp en berekening van staalconstructies - Deel 1-10: Algemene regels - Materiaalbaarheid en eigenschappen in de dikterichting

EN 1993-1-11+NB

Eurocode 3: Ontwerp en berekening van staalconstructies - Deel 1-11: Algemene regels - Ontwerp en berekening van op trek belaste componenten

EN 1993-3-1+NB

Eurocode 3: Ontwerp en berekening van staalconstructies - Deel 3-1: Torens, masten en schoorstenen - Torens en masten

EN 1993-5+NB

Eurocode 3: Ontwerp en berekening van staalconstructies - Deel 5: Palen en damwanden

###### Eurocode 4: Staal-betonconstructies

EN 1994-1-1+NB

Eurocode 4: Ontwerp en berekening van staal-betonconstructies - Deel 1-1: Algemene regels en regels voor gebouwen

###### Eurocode 7: Geotechnisch ontwerp

EN 1997-1+NB

Eurocode 7: Geotechnisch ontwerp - Deel 1: Algemene regels

EN 1997-2+NB

Eurocode 7: Geotechnisch ontwerp - Deel 2: Grondonderzoek en beproeving

NEN 9997-1

Geotechnisch ontwerp van constructies - Deel 1: Algemene regels



### D.2. Uitvoeringsnormen

EN 1090-1+NB

Het vervaardigen van staal- en aluminiumconstructies - Deel 1: Eisen voor het vaststellen van de conformiteit van constructieve onderdelen

EN 1090-2+NB

Het vervaardigen van staal- en aluminiumconstructies - Deel 2: Technische eisen voor staalconstructie

EN 13670+NB

Het vervaardigen van betonconstructies

### D.3. Materiaalnormen

#### D.3.1. Normen voor staal

EN 10025

Warmgewalste producten van constructiestaal

EN 10029

Warmgewalste staalplaat van 3 mm of dikker

EN 10034

I- en H-profielen van constructiestaal

EN 10051

Continu warmgewalste niet-beklede plaat en band van ongelegeerd en gelegeerd staal

EN 10055

Warmgewalste stalen gelijkzijdige T-profielen met afgeronde kanten

EN 10056

Gelijkzijdige en ongelijkzijdige hoekstaven van constructiestaal

En 10164

Producten van staal met verbeterde vervormingseigenschappen loodrecht op het productoppervlak

En 10210

Warmvervaardigde buisprofielen voor constructiedoeleinden van ongelegeerde en fijnkorrelige staalsoorten

EN 10219

Koudvervaardigde gelaste buisprofielen voor constructiedoeleinden van ongelegeerde en fijnkorrelige staalsoorten

EN ISO 12944

Verven en vernissen - Bescherming van staalconstructies tegen corrosie door middel van verfsystemen

EN-ISO 1461

Door thermisch verzinken aangebrachte deklagen op ijzeren en stalen voorwerpen - Specificaties en beproevingsmethoden

#### D.3.2. Normen voor beton

EN 206-1+NB

Beton - Deel 1: Specificatie, eigenschappen, vervaardiging en conformiteit

NEN 8005

Nederlandse invulling van NEN-EN 206-1: Beton - Deel 1: Specificatie, eigenschappen, vervaardiging en conformiteit

EN 197-1+NB

Cement - Deel 1: Samenstelling, specificaties en conformiteitscriteria voor gewone cementsoorten

EN 14216 +NB

Cement - Samenstelling, specificaties en conformiteitscriteria voor bijzondere cementsoorten met erg lage hydratatiewarmte

NEN 3550

Cement volgens NEN-EN 197-1 of NEN-EN 14216, met aanvullende speciale eigenschappen - Definities en eisen

NEN 6008

Betonstaal

EN 10080+NB

Staal voor het wapenen van beton - Lasbaar betonstaal - Algemeen

EN 12390 +NB (alle delen)

Beproeving van verhard beton

EN ISO 17660 +NB (alle delen)

Lassen - Lassen van wapeningsstaal

EN 10138 +NB

Voorspanstaal Deel 1 algemene eisen

NEN 3868

Voorspanstaal

EN ISO 15630

Staal voor de wapening en voorspanning van beton - Beproevingmethoden - Deel 1: Wapeningsstaven, -draad en -strengen

**D.3.3. Normen voor hout** **N.V.T.**

**D.3.4. Normen voor Metselwerk** **N.V.T.**

**D.4. Normen voor Verbindingen**

**D.4.1. Normen voor Voetplaten**

EN 1992-4 +NB

Eurocode 2: Ontwerp en berekening van betonconstructies - Deel 4: Ontwerp en berekening van bevestigingsmiddelen voor gebruikt in beton

CUR/BmS rapport 10 kolomvoetplaten

**D.4.2. Bouten moeren en sluitringen**

EN 14399

Verbindingen met hoge voorspanning voor staalconstructies

EN ISO 898

Mechanische eigenschappen van bevestigingsartikelen

EN ISO 2320

Borgmoeren van staal

EN ISO 4014

Zeskantbouten - Productklassen A en B

EN ISO 4017

Tapbouten - Productklassen A en B

EN ISO 4032

Zeskantmoeren, type 1 - Productklassen A en B

EN ISO 4033

Zeskantmoeren, type 2 - Productklassen A en B

ISO 286-2

ISO-passingstelsel - Deel 2: Tabellen met standaard tolerantiekwaliteiten en grensmaatafwijkingen voor gaten en assen

ISO 1891

Bevestigingsmiddelen - Terminologie

EN ISO 7089

Vlakke sluitringen - Normale reeks - Productklasse A

EN ISO 7090

Vlakke sluitringen, afgeschuind - Normale reeks - Productklasse A

**D.4.3. Lasverbindingen**

EN 12345

Lassen - Meertalige termen voor lasverbindingen met afbeeldingen

EN ISO 14555

Lassen - Boogboutlassen van metalen

EN ISO 13918

Lassen - Bouten en keramische ringen voor boogboutlassen

EN ISO 15614-1

Beschrijven en goedkeuren van lasmethoden voor metalen - Lasmethodebeproeving - Deel 1: Boog- en autogeenlassen van staal en booglassen van nikkel en nikkellegeringen

EN ISO 5817

Lassen - Smeltlasverbindingen in staal, nikkel, titanium en hun legeringen (elektronenbundel- en laserlassen uitgezonderd) onvolkomenheden (ISO 5817:2003, gecorrigeerde versie 2005, inclusief correctieblad C1:2006, IDT)

EN 1011

Lassen - Aanbevelingen voor het lassen van metalen

**D.5. Overige toegepaste normen**

Geen andere normen toegepast, anders de vermelde normen



Projectnr. : 4922005  
Doc. nr. : B01  
Project : CCS Project

Revisie : A  
Datum : 15-dec-22  
Pagina nr. : Bijlage D-5/41

### D.6. Gehanteerde vakliteratuur

documenten	omschrijving
Publicaties SCI	Verscheidene publicaties van het "Steel Construction Institute" over het berekenen van Staalconstructies
Publicaties BmS	Verschillende boeken en documenten van "Bouwen met Staal"
GTS 2013	Grafieken en Tabellen Staalbouw 2013 van "Bouwen met Staal"
Stahlbau-Praxis	Band 1 to 3 van BBB Beuth
Kranbahnen	Bemessung und konstruktive Gestaltung nach Eurocode, van BBB Beuth
Design of Steel Structures	ECCS publicatie, ECCS Eurocode Design Manuals Voor de algemene ontwerpregels van staalconstructies
Design of Joints in Steel and Composite Structures	ECCS publicatie, ECCS Eurocode Design Manuals Voor detailberekeningen volgens EN 1993-1-8
Design of Plated Structures	ECCS publicatie, ECCS Eurocode Design Manuals Voor de algemene ontwerpregels van staalconstructies, voor staalplaten volgens EN 1993-1-5
GTB 2013	Grafieken en Tabellen Beton 2013 van "Betonvereniging"
Betonbauteile nach Eurocode	Hintergründe, Auslegungen, Praxisbeispiele Beiträge aus Praxis und Wissenschaft
Holzbau kompakt nach Eurocode 5	Bauwerk-Basis-Bibliothek
Geotechniek nach Eurocode Band 1: Bodenmechanik	Grundlagen, Nachweise, Berechnungsbeispiele
Geotechniek nach Eurocode Band 2: Grundbau	Grundlagen, Nachweise, Berechnungsbeispiele Bauwerk-Basis-Bibliothek
NB-overige landen / Andere normen	Daar waar voor speciale gevallen ontwerp data (zoals $\psi$ -waarden voor b.v. montage) ontbreken worden de Nationale Bijlages / Normen van overige landen gehanteerd.



15-12-2022

## Piperacks CCS Zone 4

### Aan

5.1.2.e  
5.1.2.e [@yara.com](mailto:@yara.com)

### Van

5.1.2.e  
5.1.2.e [@konstruktis.com](mailto:@konstruktis.com)

### CC

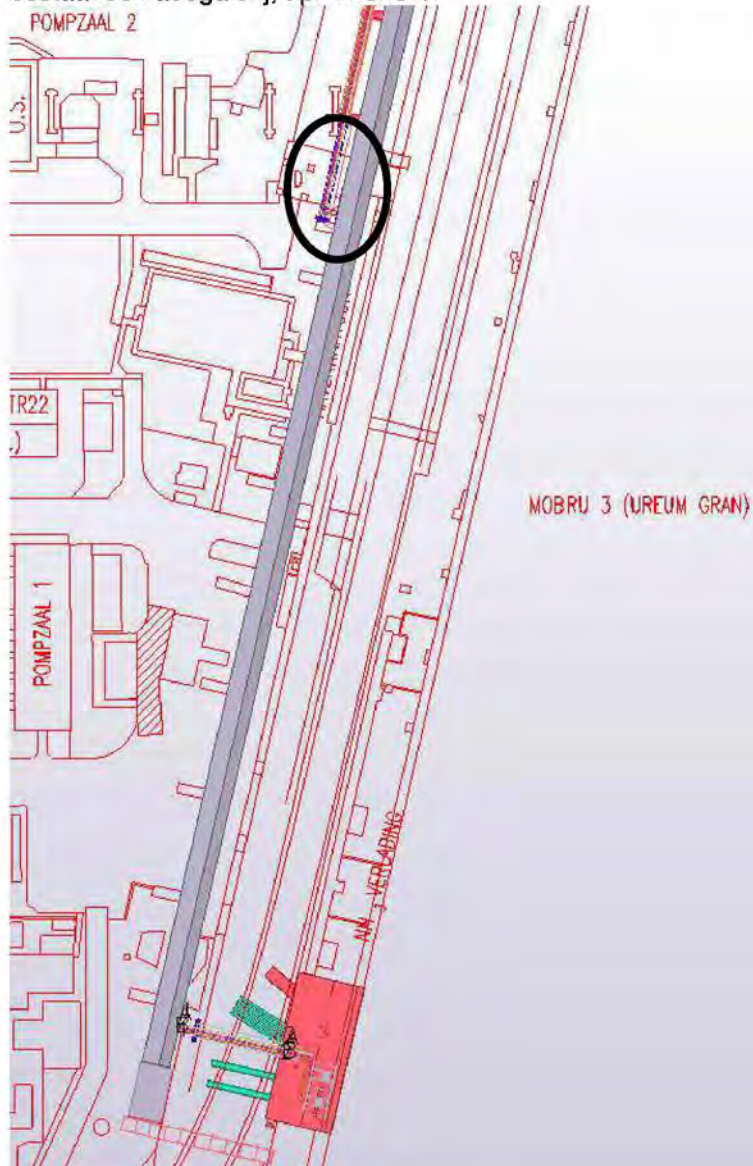
5.1.2.e  
5.1.2.e [@konstruktis.com](mailto:@konstruktis.com)

### Betreft

Piperacks CCS Zones 4

Beste 5.1.2.e

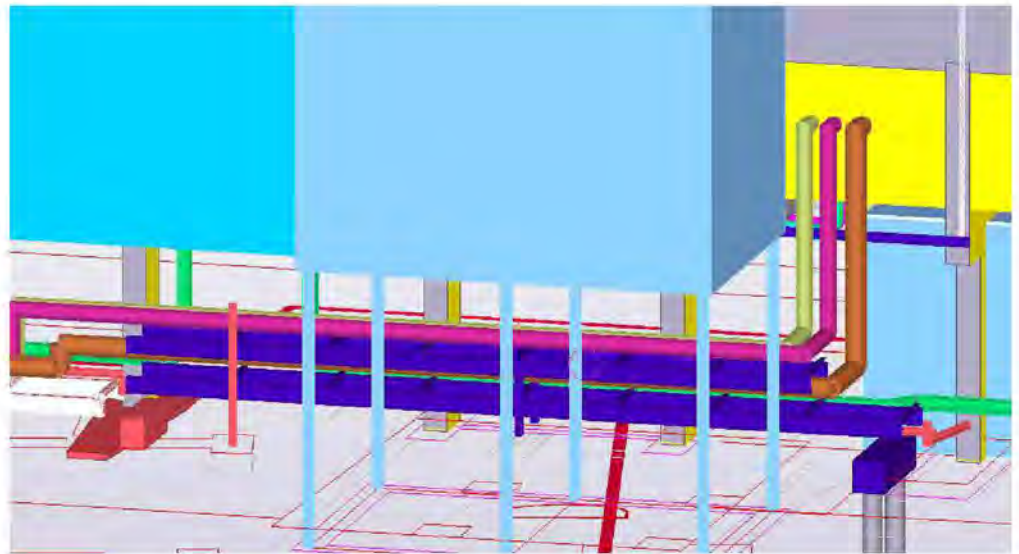
In deze memo worden, middels een snelle eenvoudige toetsing, de profielen gecontroleerd van het nieuwe deel v/d piperack die evenwijdig loopt aan de bestaande kadegalerij, t.p.v. zone 4:





Projectno. : 4922005  
Doc. no. : M401  
Project : Piperacks CCS

revision : -  
Date : 15-dec-22  
Page no. : MEM - 2



De maximale overspanning bedraagt 20 meter.  
Met een werkende breedte van 1.68 m (reken 2 m).  
Reken met een  $q = 3 \text{ kN/m}^2$ . De belasting op de liggers bedraagt daarmee:  $3 * 2 / 2 * 1.5 = 4.5 \text{ kN/m}$   
Het moment wordt dan  $\frac{1}{8} * 4.5 * 20^2 = 225 \text{ kNm}$  = IPE360, kies in functie van vervormingscapaciteit voor een IPE400.  
In de zijdelingse richting worden verbanden voorzien zodat er een klein vakwerk ontstaat, uitvoering met L60x6.  
De kolommen op de uiteinden krijgen max. een druk van 90 kN te verwerken =  $4.5 * 20 / 2 = 45 \text{ kN} * 2$  (lagen) = 90 kN. Hoogte bedraagt 2 meter, kies praktisch een HEA180.  
Voor de fundatie is een reactiekracht van  $9 * 20 / 2 * 2 = 180 \text{ kN}$  van toepassing.  
In afwachting de definitieve CPT's is het uitgangspunt een Fundexpaal  $\varnothing 380$  met een lengte van 16 meter aangehouden.



15-12-2022

## Piperacks CCS Zone 5 / 6 / 7 / 8 / 9

### Aan

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5.1.2.e @yara.com

### Van

5.1.2.e  
5.1.2.e @konstruktis.com

### CC

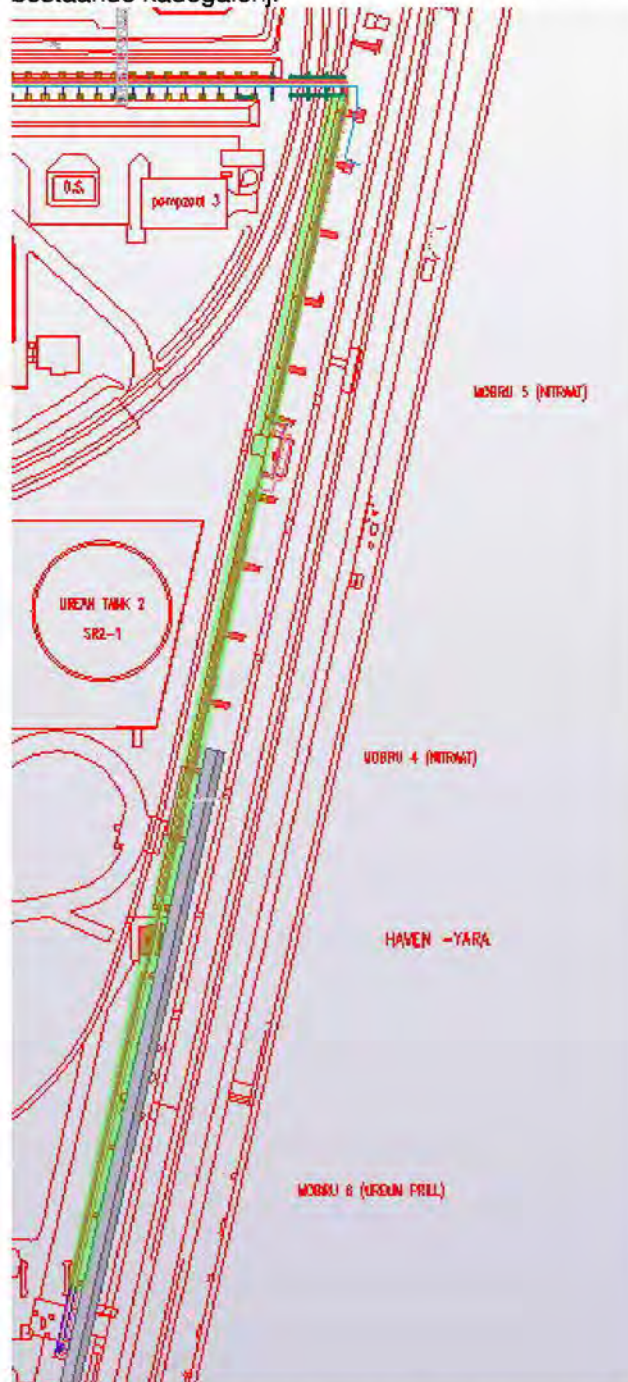
5.1.2.e  
5.1.2.e @konstruktis.com

### Betreft

Piperacks CCS Zones 5 /  
6 / 7 / 8 / 9

Beste 5.1.2.e

In deze memo worden, middels een snelle eenvoudige toetsing, de profielen gecontroleerd van het bestaande deel v/d piperacks die evenwijdig loopt aan de bestaande kadegalerij.



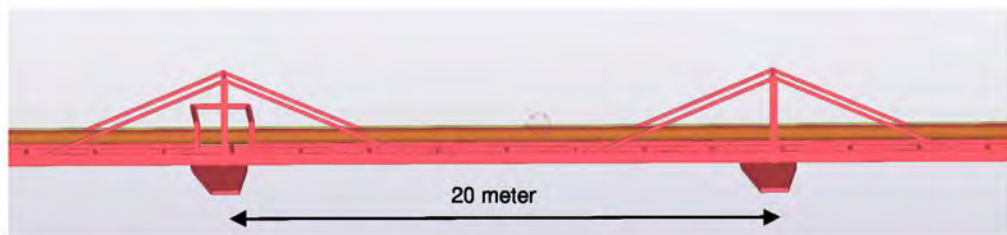
Het rack bestaat uit een dubbele ligger die op fundatiebalken liggen met een overspanning van 20 meter, waarbij middels standers/schoren de overspanningen worden verkleind.





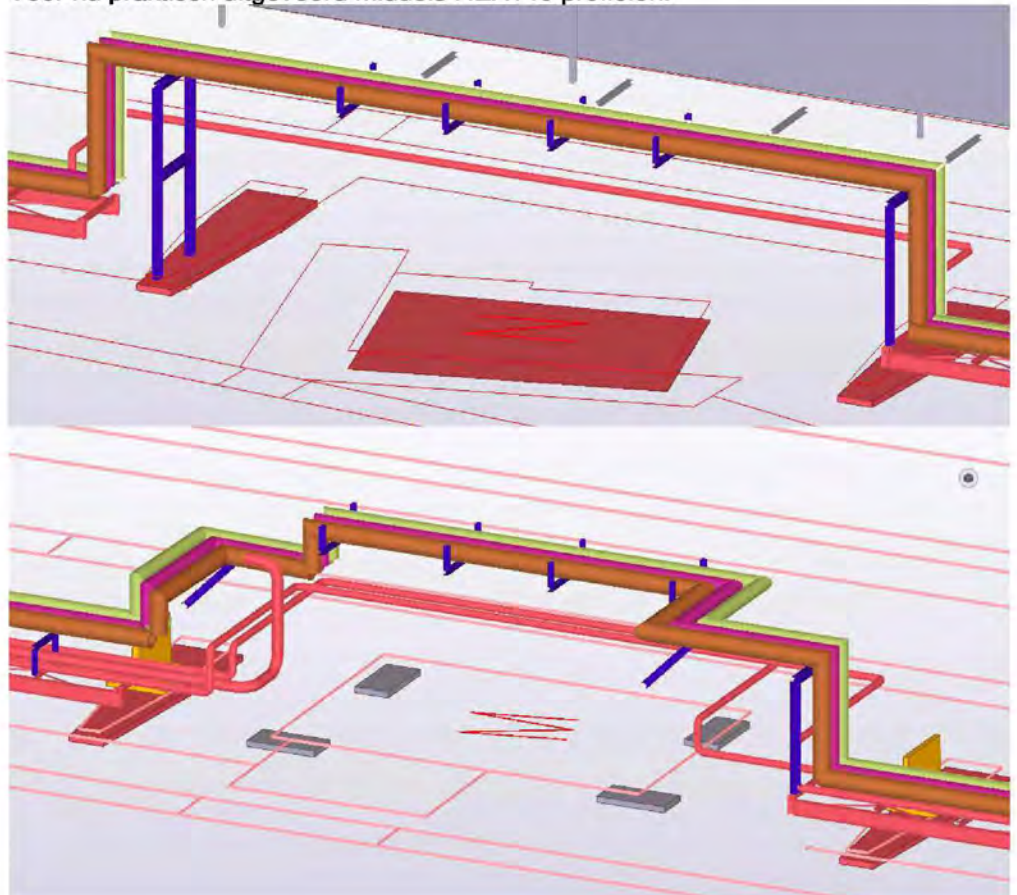
Projectno. : 4922005  
Doc. no. : M501  
Project : Piperacks CCS

revision : -  
Date : 15-dec-22  
Page no. : MEM - 2



Overspanning bedraagt max. 20 meter (schoorconstructie niet meegenomen)  
Profielen zijn IPE400 bij een werkende breedte van 2200 mm.  
Reken met  $3 \text{ kN/m}^2$ , dan komt de last op de liggers uit op:  $3 * 2.2/2 * 1.5 = 4.95 \text{ kN/m}$   
Het moment in de liggers wordt daarmee:  $\frac{1}{8} * 5 * 20^2 = 250 \text{ kNm}$   
Capaciteit IPE400 = 307 kNm, basis voldoet. Bij uitvoering volgt een volledige toetsing, voor nu is dit traject akkoord

T.p.v. van de torens M en N zullen enkele portalen / supports extra worden aangebracht.  
Definitieve controles pas in de UO fase, zodra alle bestaande obstakels in beeld zijn.  
Voor nu praktisch uitgevoerd middels HEA140 profielen.





15-12-2022

## Sleepers CCS Zone 11

### Aan

5.1.2.e  
5.1.2.e @yara.com

### Van

5.1.2.e  
5.1.2.e @konstruktis.com

### CC

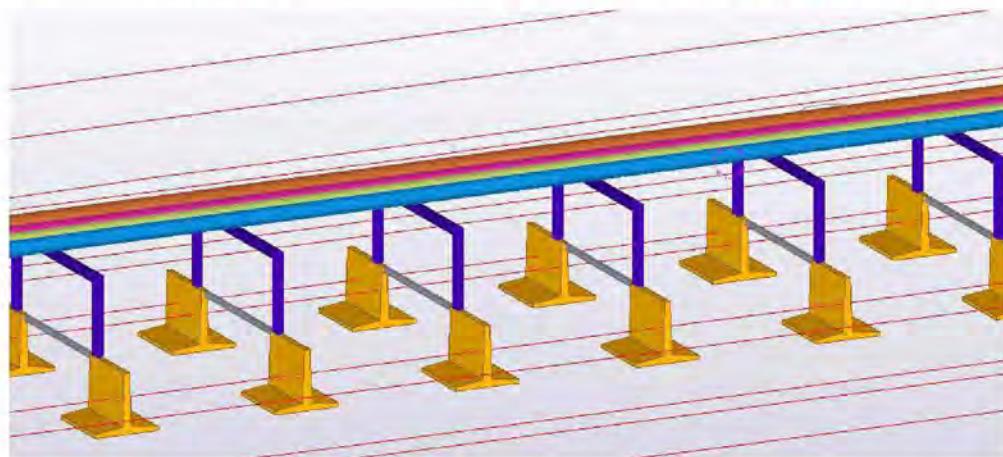
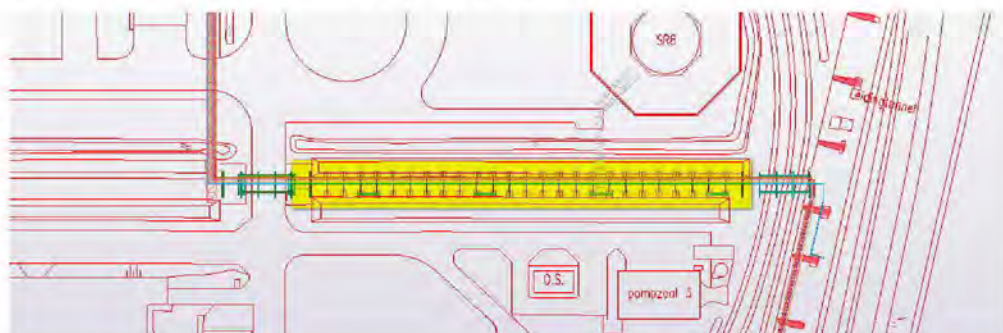
5.1.2.e  
5.1.2.e @konstruktis.com

### Betreft

Sleepers CCS Zone 11

Beste 5.1.2.e

In deze memo worden, middels een snelle eenvoudige toetsing, sleepers getoetst, i.c.m. de poerfundaties. Een exacte controle hiervan is nog niet mogelijk i.v.m. dat de sonderingen nog uitgevoerd dienen te worden.



Reken voor het bestaande dek met  $4.5 \text{ kN/m}^2$ , op het nieuwe dek komt een belasting van  $2 \text{ kN/m}^2$  wat resulteert in een totaal van  $6.5 \text{ kN/m}^2$ . De poeren hebben een h.o.h. van  $5 \text{ m}$ , en het traject is  $7.98 (8) \text{ m}$  breed. De belasting op de poeren wordt daarmee:  $5 * 6.5 * 1.5 * 8 / 2 = 195 \text{ kN}$ .

Het gewicht van het beton bedraagt  $2650 \text{ kg} = 26.5 \text{ kN} * 1.35 = 35.8 \text{ kN}$ .

De fundatie heeft een grondoppervlak van  $1.99 * 1.75 = 3.48 \text{ m}^2$ .

De eenvoudige gronddruk komt daarmee uit op  $(195 + 35.8) / 3.48 = 66.27 \text{ kN/m}^2$  gronddruk.

Bij een slechte grondopbouw is een waarde van  $50 \text{ kN/m}^2$  het uitgangspunt als toelaatbaar i.v.m. zettingen. We gaan hier nu iets over. Echter is dit rekenend met een volledig gevuld dek over 2 lagen, waar dat het nieuwe deel slechts over ong. 60% beslaat. Daarnaast is ook het bestaand niet 100% dicht gelegd.

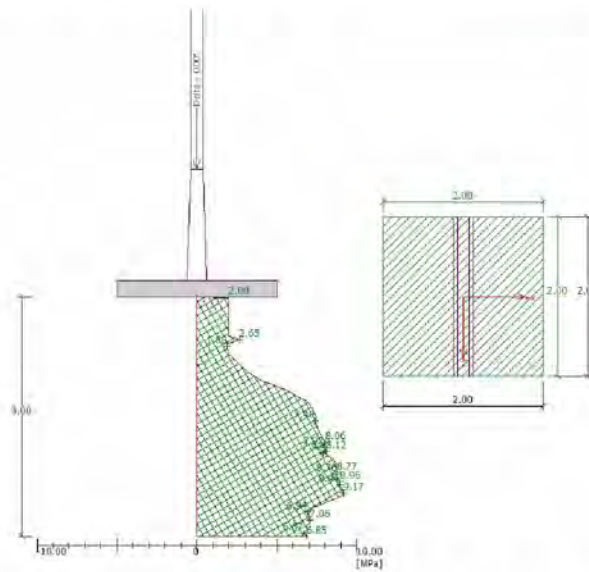
Advies is dan ook om CPT testen hier tussen uit te voeren zodat op basis hiervan een nieuwe berekening kan worden uitgevoerd.

Wanneer op basis van sondering 1418 genomen t.p.v. het nieuwe opslagterrein wordt gerekend volgt er uit dat deze momenteel ruim zal voldoen:



Projectno. : 4922005  
Doc. no. : M1101  
Project : Piperacks CCS

revision : -  
Date : 15-dec-22  
Page no. : MEM - 2



**Overall verification**  
Max. eccentricity in direction of base length  $e_x = 0.000 < 0.333$   
Max. eccentricity in direction of base width  $e_y = 0.000 < 0.333$   
Max. overall eccentricity  $e_z = 0.000 < 0.333$   
Foundation type is SATISFACTORY  
Most unfavorable load case No. 1. (Load No. 1)  
Analysis for : 1418  
Contact stress  $\sigma = 80.24 \text{ kPa}$   
Bearing capacity of foundation soil  $R_d = 1410.05 \text{ kPa}$   
Foundation settlement  $s_f = 9.85 \text{ mm}$   
Safety factor = 17.57 > 3.00  
Bearing capacity in the vertical direction is SATISFACTORY  
**Horizontal bearing capacity check**  
Most unfavorable load case No. 1. (Load No. 1)  
Angle of friction base-soil  $\psi = 20.00^\circ$   
Horizontal bearing capacity  $R_{dH} = 116.82 \text{ kN}$   
Extreme horizontal force  $H = 0.00 \text{ kN}$   
Safety factor = 1800.00 > 1.50  
Bearing capacity in the horizontal direction is SATISFACTORY  
Spread footing is SATISFACTORY

Hierbij zal nog wel horizontaal belasting bij komen, capaciteit hiervoor bedraagt 116.82 kN.

Op deze locatie is de draagkracht 1410 kN/m<sup>2</sup> bij een contactdruk van 80.24 kN/m<sup>2</sup>

Voor de profielen is gerekend met een HEB200,  $q = 2 * 5 = 10 \text{ kN/m}$ , bij een overspanning van 5 m wordt dit een  $M = 31.25 \text{ kNm}$ , waarbij de uitvoering middels momentvaste portalen zal zijn en dus gunstiger wordt voor zowel de vervorming als het moment. HEB200 voor ontwerpfase daarom akkoord ( $M_{Rd} = 151 \text{ kNm}$ ).



15-12-2022

## Leidingbrug CCS Zone 17

### Aan

5.1.2.e  
5.1.2.e @yara.com

### Van

5.1.2.e  
5.1.2.e @konstruktis.com

### CC

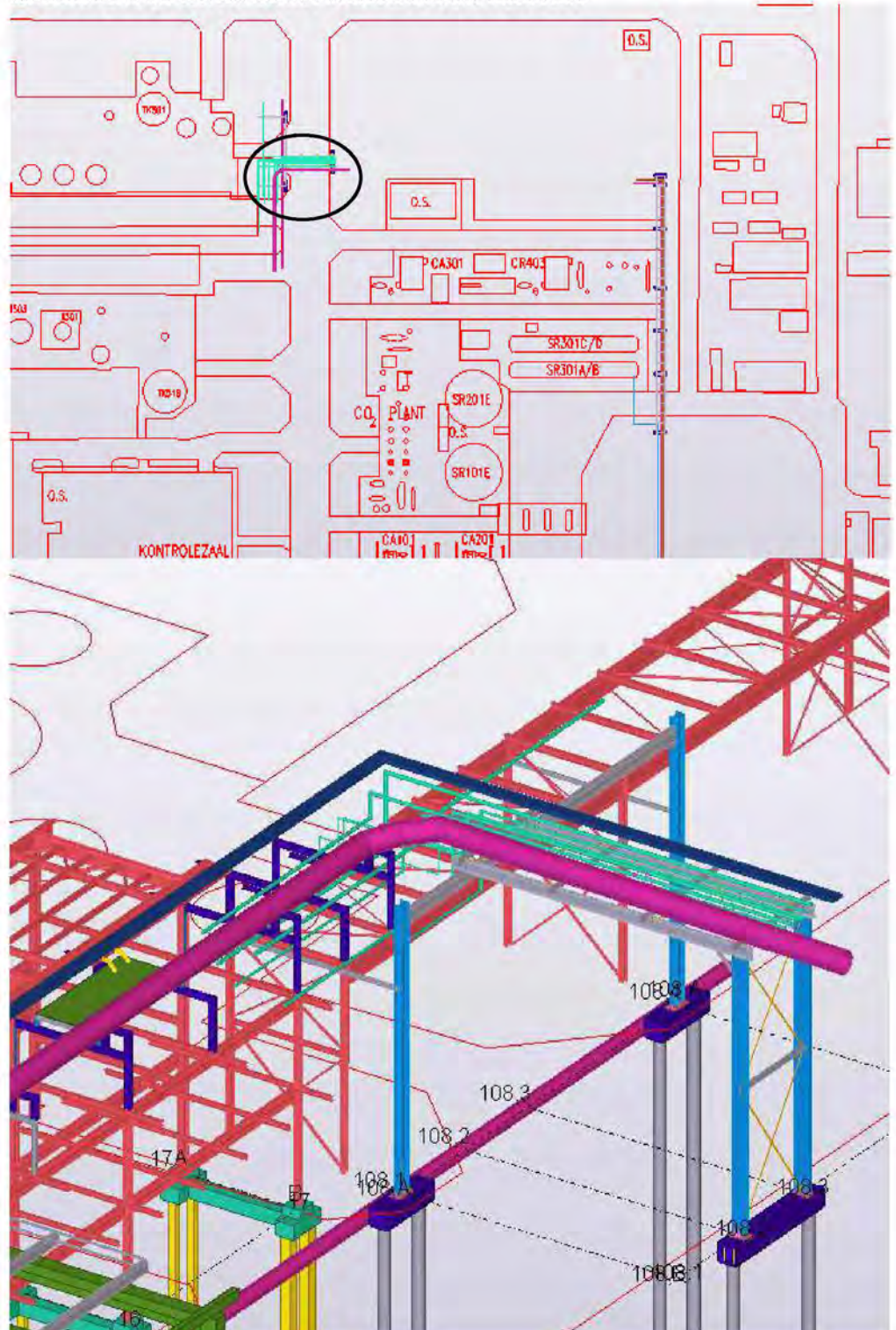
5.1.2.e  
5.1.2.e @konstruktis.com

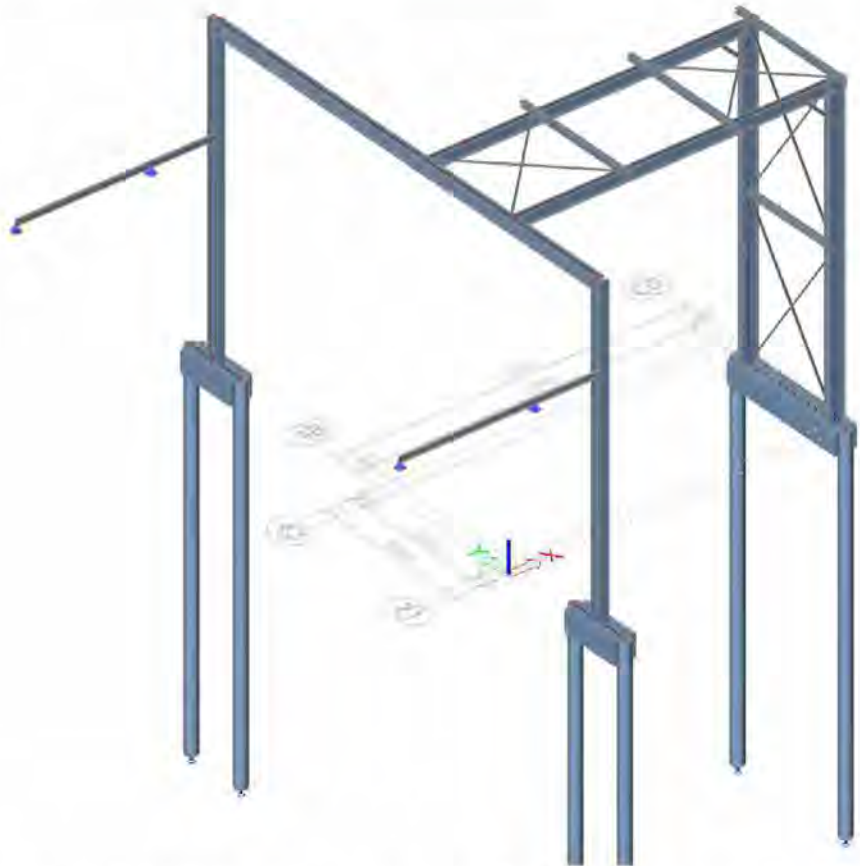
### Betreft

Leidingbrug CCS Zone 17

Beste 5.1.2.e

In deze memo word de basis toetsing gedaan van de brug die als koppeling dient tussen het CCS terrein en het WarmCo rack / rack 108.



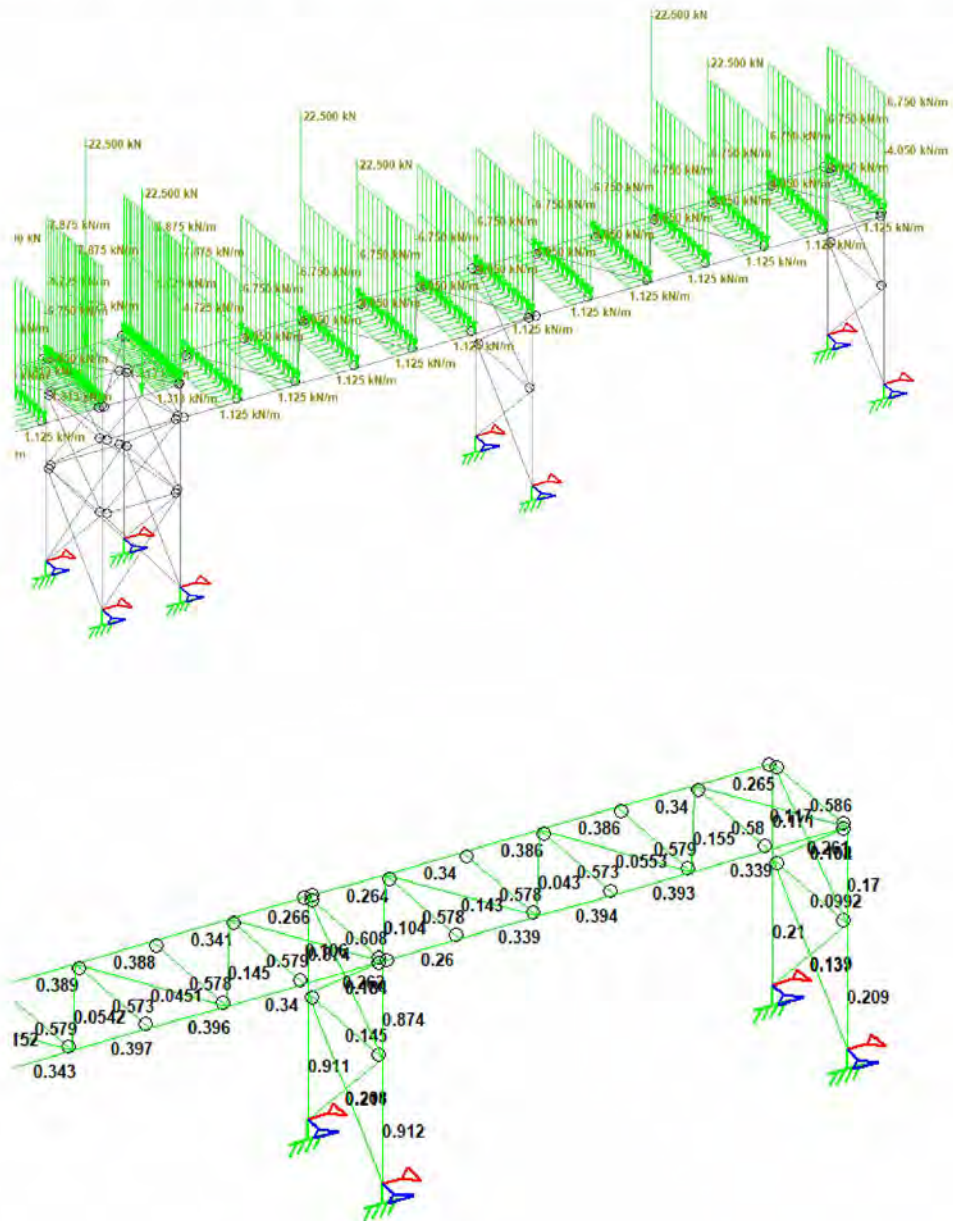


Op basis van de funderingsgegevens voor het Compressorhuis gedeelte zijn de palen hier ingeschat op een Fundex paal  $\varnothing 460$  met een lengte van 14 m.

In de bijgevoegde uitvoer van Scia is aangetoond dat deze brug voldoet aan de gevraagde eisen.

Voor de stabiliteit wordt gebruik gemaakt van het WarmCo rack, hiervan is daarom een aparte toetsing gemaakt.

De berekening is origineel opgesteld door Jacobs middels STAAD.pro.

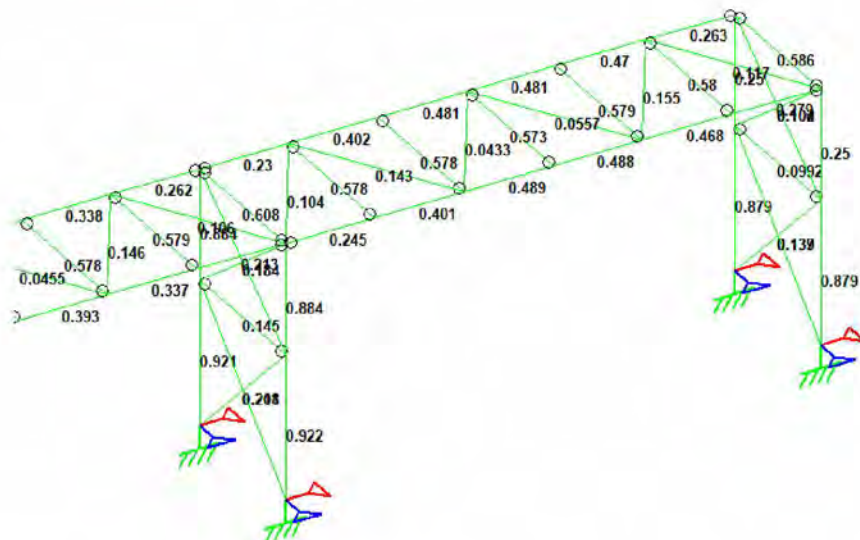
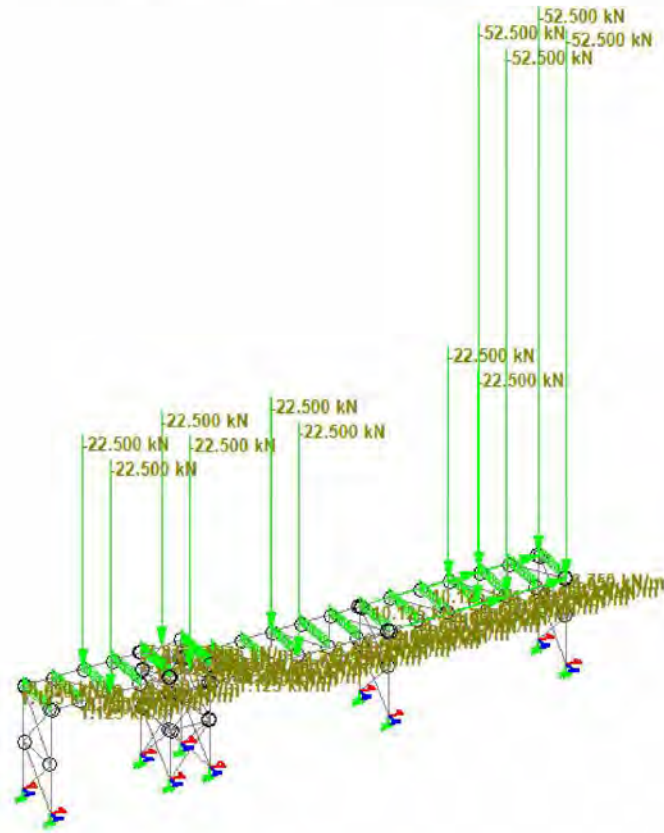


De bestaande constructie is daarbij als uitgangspunt genomen waarop de nieuwe lasten zijn toegevoegd. Voor de nieuwe lasten is gerekend met  $3 \text{ kN/m}^2$  aan veranderlijk +  $1.5 \text{ kN/m}^2$  als permanent, wat samengesteld  $4.5 \text{ kN/m}^2$  wordt wat als veranderlijk (conservatief) is gerekend over een oppervlak van  $6 \times 5 = 30 \text{ m}^2$  wat in 4 puntlasten van  $35 \text{ kN}$  (afgerond + staalgewicht) resulteert. Voor de horizontaalkrachten wordt met  $3 \times 30 \times 0.3 / 4 = 6.75 \text{ kN}$  resulteert.



Projectno. : 4922005  
Doc. no. : M1101  
Project : Piperacks CCS

revision : -  
Date : 15-dec-22  
Page no. : MEM - 4

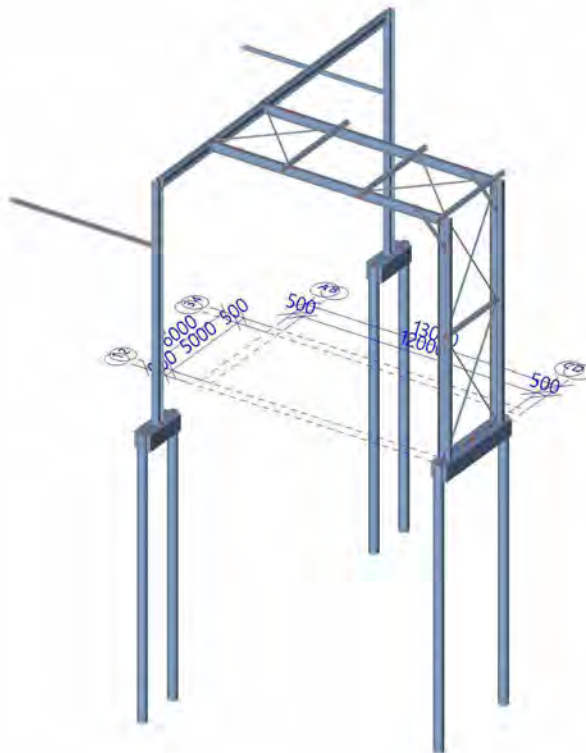


Het eindspant zal hierbij in de belasting toenemen van 21% naar 88% gebaseerd op de kniklengte. Voor de liggers is dit van 39.3% naar 48.9%. Gebaseerd op deze resultaten voldoet het bestaande rack aan alle eisen.



# Bijlage 1.

## Invoer Scia Rekenmodel







Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 2/36

## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Rekenmodel	3
2.1. Instellingen manager	3
2.2. Algemene model omschrijving	4
2.2.1. Isometric view	4
2.2.2. Isometric view	5
2.2.3. X view	6
2.2.4. Y view	7
2.2.5. Z view	8
2.2.6. Materialen	8
2.2.7. Doorsneden	9
2.2.8. Analysis model	13
2.2.9. Lagen	13
2.2.10. UCS	13
2.3. Model gegevens	14
2.3.1. Instellingen net	14
2.3.2. Instellingen solver	14
2.3.3. 1D	15
2.3.3.1. Knopen	15
2.3.3.2. Knopen	16
2.3.3.3. Staven	16
2.3.3.4. Staven	17
2.3.3.5. Scharnieren	18
2.3.3.6. Staaf niet-lineariteit	18
2.3.3.7. Kruisende staven	18
2.3.4. 2D	18
2.3.4.1. Platen	19
2.3.5. Supports	20
2.3.5.1. Steunpunten	20
2.3.5.2. Knoopondersteuning	20
2.3.5.3. Puntondersteuning op staaf	21
2.3.5.4. Lijnondersteuning op staven	21
3. Belastingen	25
3.1. Belastinggevallen	25
3.2. Belastinggevallen	25
3.2.1. Belastinggevallen - BG101	25
3.2.2. Belastinggevallen - BG102	26
3.2.3. Belastinggevallen - BG111	27
3.2.4. Belastinggevallen - BG112	28
3.2.5. Belastinggevallen - BG121	29
3.3. Belastinggroepen	30
3.4. Combinaties	30
3.5. Niet-lineaire combinaties	30
3.6. Resultaatklassen	32
4. Berekeningsverslag	33
5. Berekeningsverslag	33



## 2. Rekenmodel

### 2.1. Instellingen manager

#### Combinatie Instellingen

Categorie H lasten moeten niet gecombineerd worden met sneeuw of wind

#### Psi factoren

Belasting	Psi0	Psi1	Psi2
CategoryA	0.4	0.5	0.3
CategoryB	0.5	0.5	0.3
CategoryC	0.6	0.7	0.6
CategoryD	0.4	0.7	0.6
CategoryE	1	0.9	0.8
CategoryF	0.7	0.7	0.6
CategoryG	0.7	0.5	0.3
CategoryH	0	0	0
Sneeuw	0	0.2	0
Wind	0	0.2	0
Temperatuur	0	0.5	0
Regenwater	0	0	0
Constructiebelasting	1	0	0.2

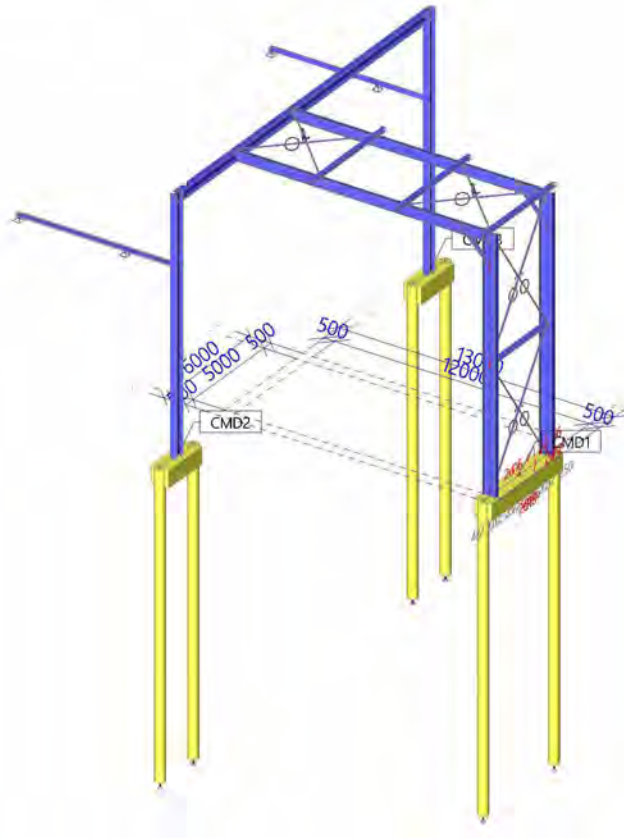
#### Belastingfactoren

Permanente actie - ongunstig	1.35
Permanente actie - gunstig [-]	0.90
Variabele last	1.50
Begeleidende variabele actie	1.50
Reductie factor ksi [-]	0.89
Permanente actie - ongunstig	1.00
Permanente actie - gunstig	1.00
Variabele last	1.30
Begeleidende variabele actie	1.30



## 2.2. Algemene model omschrijving

### 2.2.1. Isometric view





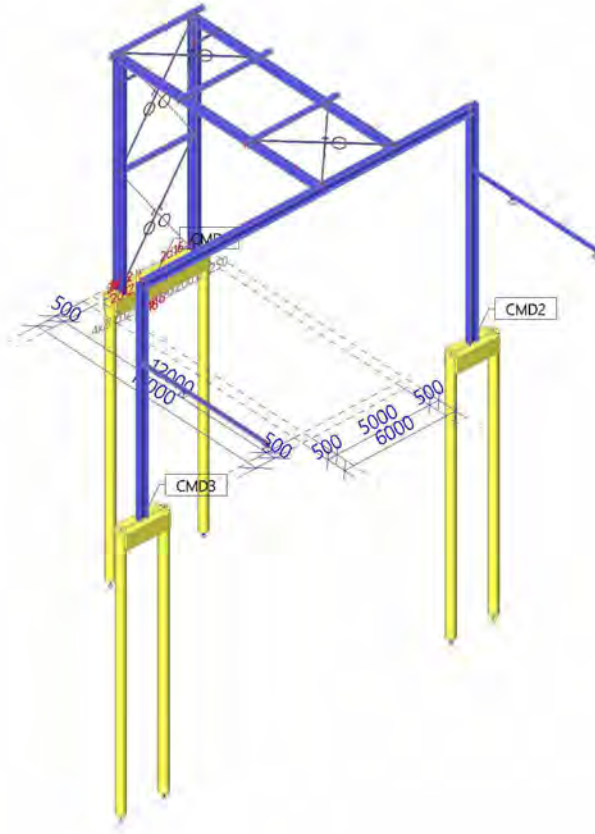
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

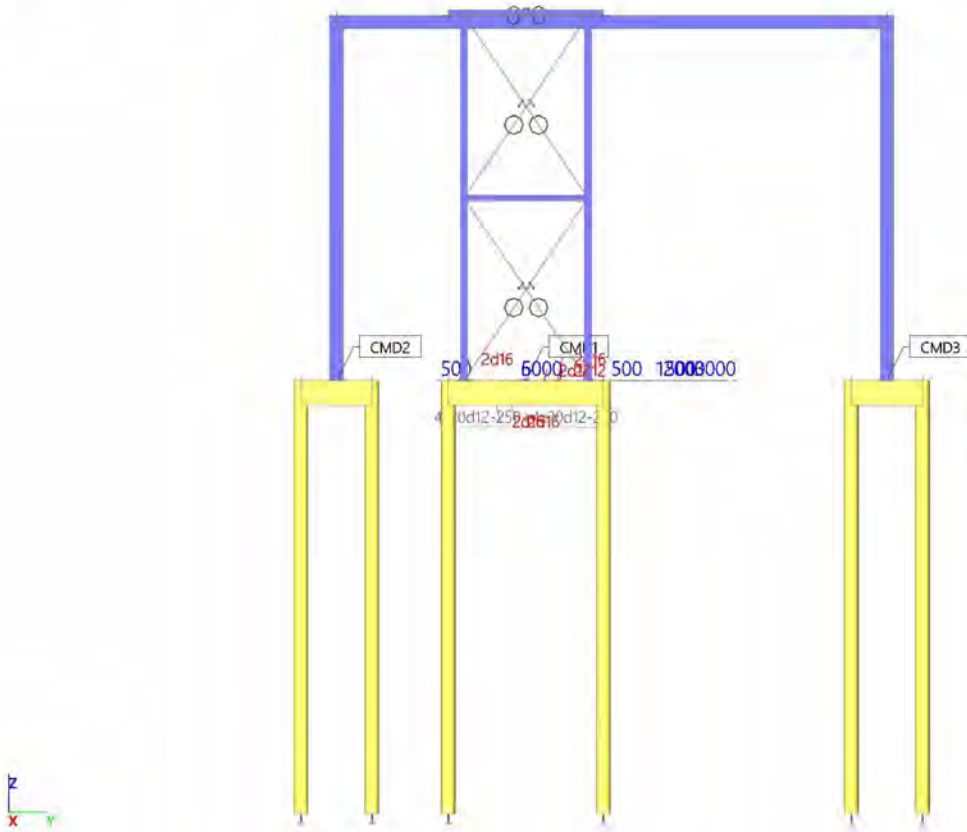
15.12.2022  
Algemeen XYZ  
S.1.2.e  
5/36

## 2.2.2. Isometric view





## 2.2.3. X view





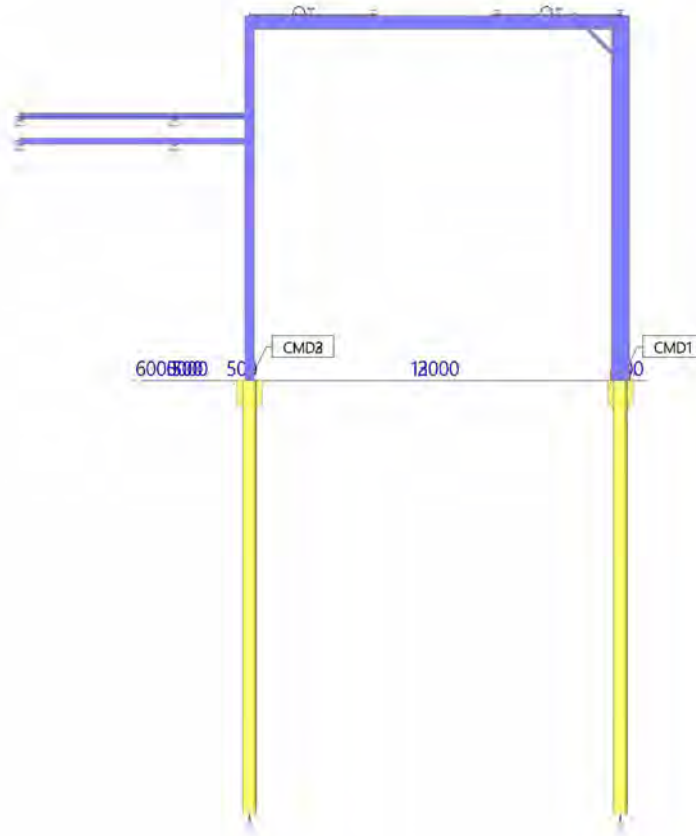
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

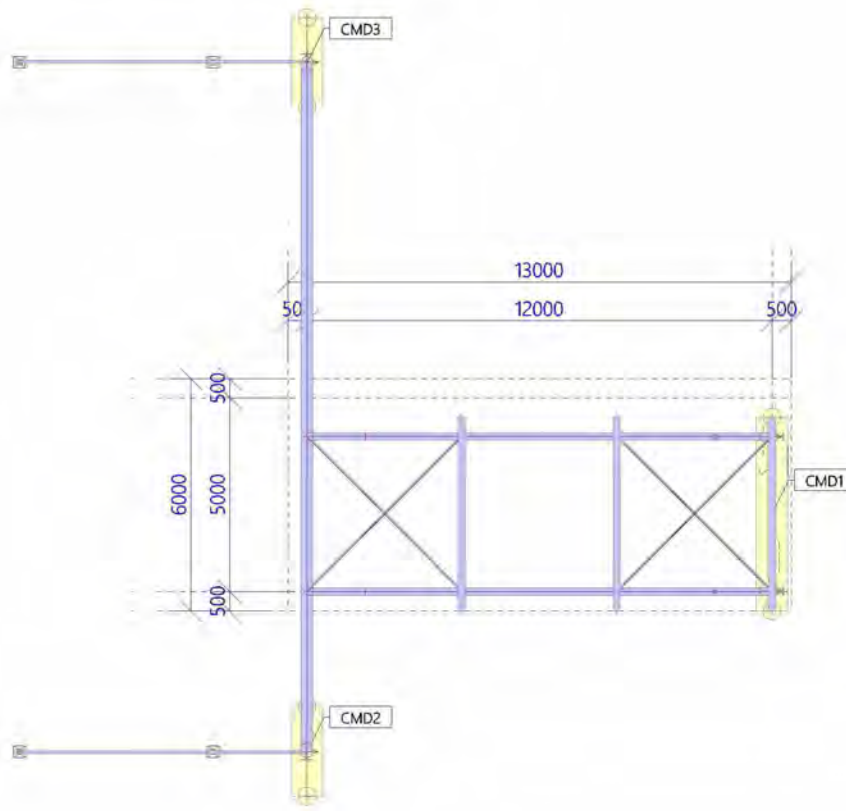
15.12.2022  
Algemeen XYZ  
S.12.8  
7/36

## 2.2.4. Y view





## 2.2.5. Z view



## 2.2.6. Materialen

### Staal EC3

Naam	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa] G-mod [MPa]	Poisson - nu Thermisch uitz. [m/mK]	Onderlimiet	Bovenlimiet	Fy (bereik) [MPa]	Fu (bereik) [MPa]
				[mm]	[mm]		
S 235 JR (EN 10025-2)	8000.0	2.1000e+05 8.0769e+04	0.3 0.00	0	3	235.0	360.0
				3	16	235.0	360.0
				16	40	225.0	360.0
				40	63	215.0	360.0
				63	80	215.0	360.0
				80	100	215.0	360.0
				100	150	195.0	350.0
				150	200	185.0	340.0
				200	250	175.0	340.0

### Beton EC2

Naam	Type	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa]	Poisson - nu	Thermisch uitz. [m/mK]	Karakteristieke cilinderdruksterkte f <sub>ck</sub> (28) [MPa]
C35/45	Beton	2500.0	3.4100e+04	0.2	0.00	35.00



## Wapening EC2

Naam	Type	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa]	G-mod [MPa]	Thermisch uitz. [m/mK]	Karakteristieke vloeisterkte fyk [MPa]
B 500B	Betonstaal	7850.0	2.0000e+05	8.3333e+04	0.00	500.0

Naam	E-mod [MPa]	Poisson - nu	Massa eenheid [kg/m <sup>3</sup> ]	Log. decrement (niet-uniforme demping enkel)	Specifieke hitte [J/gK]
Type	G-mod [MPa]				
Rigid	1.0000e+12	0.3	0.0	0.15	6.0000e-01
Algemeen materiaal	3.8462e+11				

### Verklaring van symbolen

Log. decrement (niet-uniforme demping enkel)	Deze materiaal dempingeigenschap is enkel toegepast in het geval van het niet-uniform is demping is geactiveerd voor dynamische analyse (zie project functionaliteit). Gelieve op te merken, dat niet-uniforme demping een specifieke licentie benodigd, welke geen deel uit maakt van het standaard dynamische pakket.
--	--

## 2.2.7. Doorsneden

BT-11		
Type	Cirkel	
Gedetailleerd	460	
Vorm type	Dikke wanden	
Onderdeelmateriaal	C35/45	
Bouwwijze	beton	
A [m <sup>2</sup> ]	1.6619e-01	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.4936e-01	1.4936e-01
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	2.1979e-03	2.1979e-03
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	9.5559e-03	9.5559e-03
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	1.6223e-02	1.6223e-02
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	6.1807e-15	4.4047e-03
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	230	230
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	0.00e+00	0.00e+00
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	0.00e+00	0.00e+00
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.4451e+00	1.4451e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		
BT-12		
Type	Rechthoek	
Gedetailleerd	800; 800	
Vorm type	Dikke wanden	
Onderdeelmateriaal	C35/45	

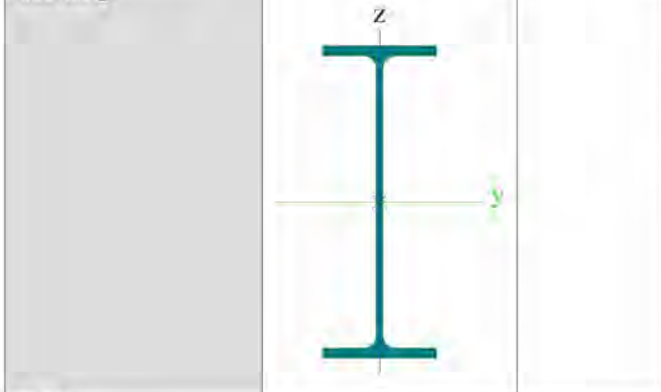
BT-11		
Bouwwijze	beton	
A [m <sup>2</sup> ]	6.4000e-01	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	5.3391e-01	5.3391e-01
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	3.4133e-02	3.4133e-02
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	8.5333e-02	8.5333e-02
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	0.0000e+00	0.0000e+00
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	3.3063e-05	5.7500e-02
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	400	400
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	0.00e+00	0.00e+00
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	0.00e+00	0.00e+00
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	3.2000e+00	3.2000e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		
ST-11		
Type	IPE600	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	a	b
A [m <sup>2</sup> ]	1.5600e-02	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	8.6202e-03	7.2722e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	9.2080e-04	3.3870e-05
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	3.0700e-03	3.0800e-04





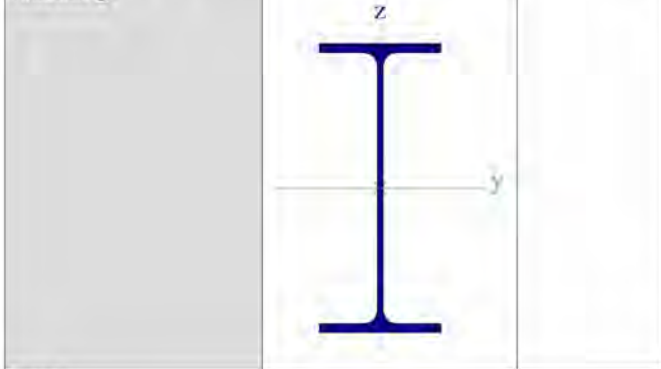
Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.12a 10/36

$W_{ply}$ [m <sup>3</sup> ], $W_{plz}$ [m <sup>3</sup> ]	3.5120e-03	4.8600e-04
$I_w$ [m <sup>6</sup> ], $I_t$ [m <sup>4</sup> ]	2.8460e-06	1.6500e-06
$d_y$ [mm], $d_z$ [mm]	0	0
$c_{yucs}$ [mm], $c_{zucs}$ [mm]	110	300
$\alpha$ [deg]	0.00	
$M_{ply+}$ [Nm], $M_{ply-}$ [Nm]	8.26e+05	8.26e+05
$M_{plz+}$ [Nm], $M_{plz-}$ [Nm]	1.14e+05	1.14e+05
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.0146e+00	2.0146e+00
$\beta_y$ [mm], $\beta_z$ [mm]	0	0
Afbeelding		



### ST-12

Type	IPE450	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	a	b
A [m <sup>2</sup> ]	9.8800e-03	
$A_y$ [m <sup>2</sup> ], $A_z$ [m <sup>2</sup> ]	5.5856e-03	4.3051e-03
$I_y$ [m <sup>4</sup> ], $I_z$ [m <sup>4</sup> ]	3.3740e-04	1.6760e-05
$W_{ely}$ [m <sup>3</sup> ], $W_{elz}$ [m <sup>3</sup> ]	1.5000e-03	1.7600e-04
$W_{ply}$ [m <sup>3</sup> ], $W_{plz}$ [m <sup>3</sup> ]	1.7020e-03	2.7600e-04
$I_w$ [m <sup>6</sup> ], $I_t$ [m <sup>4</sup> ]	7.9100e-07	6.6900e-07
$d_y$ [mm], $d_z$ [mm]	0	0
$c_{yucs}$ [mm], $c_{zucs}$ [mm]	95	225
$\alpha$ [deg]	0.00	
$M_{ply+}$ [Nm], $M_{ply-}$ [Nm]	4.00e+05	4.00e+05
$M_{plz+}$ [Nm], $M_{plz-}$ [Nm]	6.50e+04	6.50e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.6050e+00	1.6050e+00
$\beta_y$ [mm], $\beta_z$ [mm]	0	0
Afbeelding		



### ST-13

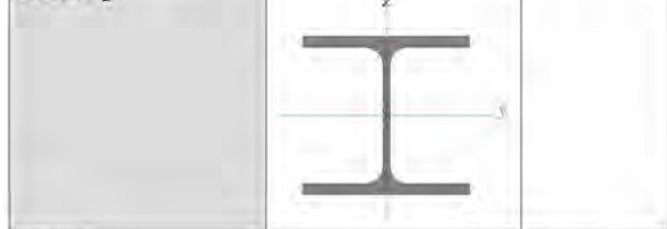
Type	HEA180	
Vormnorm	1 - I-doorsnede	

Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	b	c
A [m <sup>2</sup> ]	4.5300e-03	
$A_y$ [m <sup>2</sup> ], $A_z$ [m <sup>2</sup> ]	3.2772e-03	1.0992e-03
$I_y$ [m <sup>4</sup> ], $I_z$ [m <sup>4</sup> ]	2.5100e-05	9.2500e-06
$W_{ely}$ [m <sup>3</sup> ], $W_{elz}$ [m <sup>3</sup> ]	2.9400e-04	1.0300e-04
$W_{ply}$ [m <sup>3</sup> ], $W_{plz}$ [m <sup>3</sup> ]	3.2500e-04	1.5667e-04
$I_w$ [m <sup>6</sup> ], $I_t$ [m <sup>4</sup> ]	6.0211e-08	1.4800e-07
$d_y$ [mm], $d_z$ [mm]	0	0
$c_{yucs}$ [mm], $c_{zucs}$ [mm]	90	86
$\alpha$ [deg]	0.00	
$M_{ply+}$ [Nm], $M_{ply-}$ [Nm]	7.64e+04	7.64e+04
$M_{plz+}$ [Nm], $M_{plz-}$ [Nm]	3.68e+04	3.68e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.0200e+00	1.0241e+00
$\beta_y$ [mm], $\beta_z$ [mm]	0	0
Afbeelding		



### ST-14

Type	HEA120	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	b	c
A [m <sup>2</sup> ]	2.5300e-03	
$A_y$ [m <sup>2</sup> ], $A_z$ [m <sup>2</sup> ]	1.8775e-03	6.1698e-04
$I_y$ [m <sup>4</sup> ], $I_z$ [m <sup>4</sup> ]	6.0600e-06	2.3100e-06
$W_{ely}$ [m <sup>3</sup> ], $W_{elz}$ [m <sup>3</sup> ]	1.0600e-04	3.8500e-05
$W_{ply}$ [m <sup>3</sup> ], $W_{plz}$ [m <sup>3</sup> ]	1.1958e-04	5.8750e-05
$I_w$ [m <sup>6</sup> ], $I_t$ [m <sup>4</sup> ]	6.4719e-09	5.9900e-08
$d_y$ [mm], $d_z$ [mm]	0	0
$c_{yucs}$ [mm], $c_{zucs}$ [mm]	60	57
$\alpha$ [deg]	0.00	
$M_{ply+}$ [Nm], $M_{ply-}$ [Nm]	2.81e+04	2.81e+04
$M_{plz+}$ [Nm], $M_{plz-}$ [Nm]	1.38e+04	1.38e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	6.7700e-01	6.7730e-01
$\beta_y$ [mm], $\beta_z$ [mm]	0	0
Afbeelding		



### ST-15

Type	FLA80/10	
Vormnorm	7 - Volledig rechthoekige doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	



Knik y-y, Knik z-z		
A [m <sup>2</sup> ]	8.0000e-04	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	6.6667e-04	6.6667e-04
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	6.6667e-09	4.2667e-07
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	1.3333e-06	1.0667e-05
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	2.0000e-06	1.6000e-05
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	0.0000e+00	2.6667e-08
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	40	5
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	4.70e+02	4.70e+02
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	3.76e+03	3.76e+03
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.8000e-01	1.8000e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

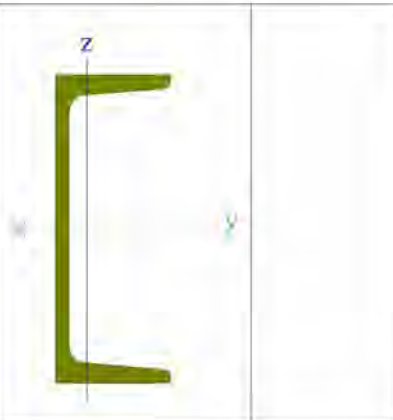
<b>ST-16</b>		
Type	L60X6	
Vormnorm	4 - L-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	b	b
A [m <sup>2</sup> ]	6.9100e-04	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	5.7999e-04	5.8516e-04
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	3.6100e-07	9.4300e-08
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	8.5150e-06	3.9562e-06
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	1.3551e-05	6.9893e-06
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	2.1441e-41	8.6400e-09
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	-20	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	17	17
α [deg]	45.00	
I <sub>yzcs</sub> [m <sup>4</sup> ]	-1.3344e-07	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	3.18e+03	3.18e+03
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	1.64e+03	1.64e+03
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.3300e-01	2.3310e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	79
Afbeelding		

<b>ST-17</b>		
Type	HEA450	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	a	b
A [m <sup>2</sup> ]	1.7800e-02	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.2141e-02	5.2398e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	6.3700e-04	9.4700e-05
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	2.9000e-03	6.3100e-04
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	3.2167e-03	9.6667e-04
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	4.1476e-06	2.4400e-06
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	150	220
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	7.56e+05	7.56e+05
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	2.27e+05	2.27e+05
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.0100e+00	2.0104e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

<b>ST-18</b>		
Type	UNP200	
Vormnorm	5 - Kanaaldoorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	c	c
A [m <sup>2</sup> ]	3.2200e-03	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.6758e-03	1.6900e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	1.9100e-05	1.4800e-06
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	1.9100e-04	2.7000e-05
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	2.2800e-04	5.1800e-05
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	1.0499e-08	1.2000e-07
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	-44	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	20	100
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	5.35e+04	5.35e+04
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	1.22e+04	1.22e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	6.6100e-01	6.6027e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	217



Afbeelding



#### Verklaring van symbolen

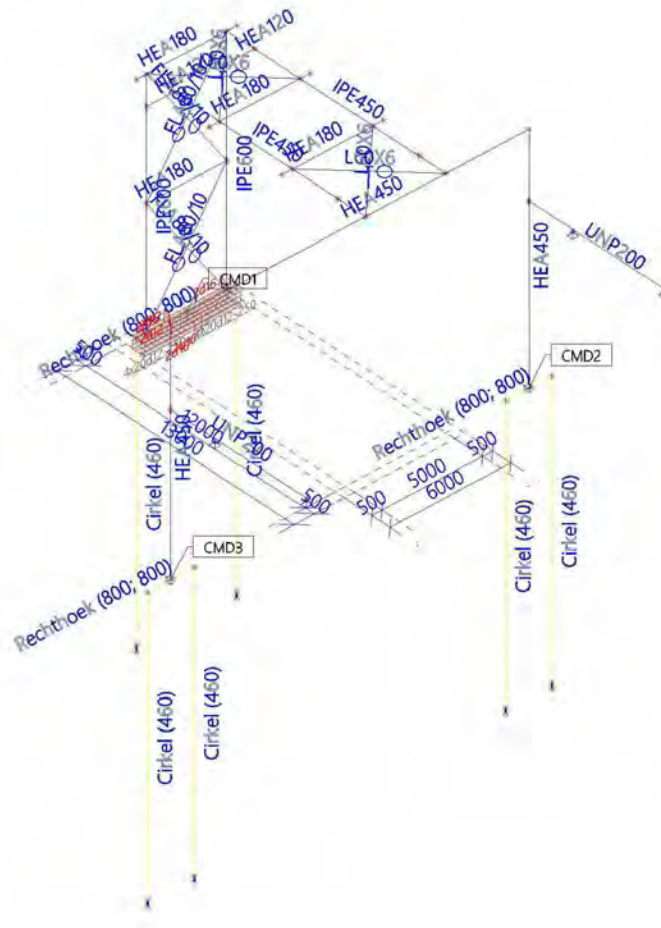
A	Gebied
$A_y$	Afschuifoppervlak in hoofd y-richting - Berekend door 2D EEM analyse
$A_z$	Afschuifoppervlak in hoofd z-richting - Berekend door 2D EEM analyse
$I_y$	Tweede moment van het gebied rond de hoofd y-as
$I_z$	Tweede moment van het gebied rond de hoofd z-as
$W_{ely}$	Elastische doorsnede modulus rond de hoofd y-as
$W_{elz}$	Elastische doorsnede modulus rond de hoofd z-as
$W_{ply}$	Plastische doorsnede modulus rond de hoofd y-as
$W_{plz}$	Plastische doorsnede modulus rond de hoofd z-as
$I_w$	Welvings constante - Berekend door 2D EEM analyse
$I_t$	Torsie constante - Berekend door 2D EEM analyse
$d_y$	Afschuif middencoördinaat in hoofd y-richting gemeten vanaf het zwaartepunt - Berekend door 2D EEM analyse
$d_z$	Afschuif middencoördinaat in hoofd z-richting gemeten vanaf het zwaartepunt - Berekend door 2D EEM analyse

#### Verklaring van symbolen

$c_{yucs}$	Zwaartepunt coördinaten in Y-richting van het invoer assen systeem
$c_{zucs}$	Zwaartepunt coördinaten in Z-richting van het invoer assen systeem
$\alpha$	Rotatiehoek van het hoofd assen systeem
$I_{yzlcs}$	Product moment van het gebied in het LCS systeem
$M_{ply+}$	Plastisch moment rond de hoofd y-as voor een positief $M_y$ moment
$M_{ply-}$	Plastisch moment rond de hoofd y-as voor een negatief $M_y$ moment
$M_{plz+}$	Plastisch moment rond de hoofd z-as voor een positief $M_z$ moment
$M_{plz-}$	Plastisch moment rond de hoofd z-as voor een negatief $M_z$ moment
AL	Omtrek per eenheidslengte
AD	Uithardingsoppervlakte per eenheidslengte
$\beta_y$	Mono-symmetrische constante rond de hoofd y-as
$\beta_z$	Mono-symmetrische constante rond de hoofd z-as



## 2.2.8. Analysis model



## 2.2.9. Lagen

Naam	enkel	Constructiemodel
Laag1	*	

## 2.2.10. UCS

Huidig UCS			
Type	vector		
X [mm], Y [mm], Z [mm]	0.000	0.000	0.000
X-X, X-Y, X-Z	1	0	0
Y-X, Y-Y, Y-Z	0	1	0
Z-X, Z-Y, Z-Z	0	0	1



## 2.3. Model gegevens

### 2.3.1. Instellingen net

Naam	NetInstelling1
Minimumafstand tussen definitiepunt en -lijn [m]	0.001
Gemiddeld aantal 1D-netelementen op rechte 1D-elementen	1
Gemiddelde grootte van 2D-netelement [mm]	1000.000
Definitie van netelementen afmetingen voor panelen	Handmatig
Gemiddelde afmeting van paneelelement [mm]	1000.000
Elastisch net	✓
Pas automatische netverfijning toe	✗
Minimum lengte van staafelement [mm]	100.000
Maximum lengte van staafelement [mm]	1000000.000
Gemiddelde grootte van voorspankabels, elementen op elastische bedding, niet-lineaire grondveer [mm]	1000.000
Generatie van knopen op staven	✗
Generatie van variabele excentriciteiten op elementen in plaats van constante excentriciteiten	✗
Verdeling op consoles en variabele staven	5
Verdeling voor integratiestrook en 2D-1D upgrade	50
Netverfijning volgens het liggertype	Geen
Maximale hoek uit het vlak van vierhoekig element [mrad]	30.0
Verh. voorgedefinieerd net	1.5

### 2.3.2. Instellingen solver

Naam	SolverSetup1
Negeer dwarskrachtvervormingen ( Ay, Az >> A )	✗
Initiële spanning	✗
Pas IRS (Improved Reduced System) methode toe	✗
Pas massa- en stijfheidsfactoren toe	✓
Aantal diktes van plaatrib	20
Maximumaantal bodeminteractie-iteraties	10
Maximum aantal iteraties	20
Aantal incrementen	1
Aantal knikvormen	2
Aantal sneden op gemiddelde staaf	10
Aantal eigenmodes	10
Stap voor grond/waterdruk [mm]	500.000
C1x [MN/m <sup>3</sup> ]	1.0000e-01
C1y [MN/m <sup>3</sup> ]	1.0000e-01
C1z [MN/m <sup>3</sup> ]	1.0000e+01
C2x [MN/m]	5.0000e+00
C2y [MN/m]	5.0000e+00
Wapeningscoëfficiënt	1
Waarschuwing als de maximale translatie groter is dan [mm]	1000.0
Waarschuwing als de maximale rotatie groter is dan [mrad]	100.0
Tolerantie van parallelisme [deg]	10.00
Overspanningslengteverhouding Le/beff,max (1 kant) [-]	8.00
Enkelvoudig opgelegde ligger [-]	1.00
Inwendige overspanning [-]	0.70
Eind overspanning [-]	0.85
Uitkraging [-]	2.00
Solver nauwkeurigheid ratio	1
Grond combinatie	Geen
Plastische scharnieren norm	Geen norm
Buigtheorie van plaat/schaal berekening	Mindlin
Type solver	Direct
Type van eigenwaarde solver	Lanczos
Type van eigenwaarde solver	Lanczos
Berekeningsmethode	Picard



### 2.3.3. 1D

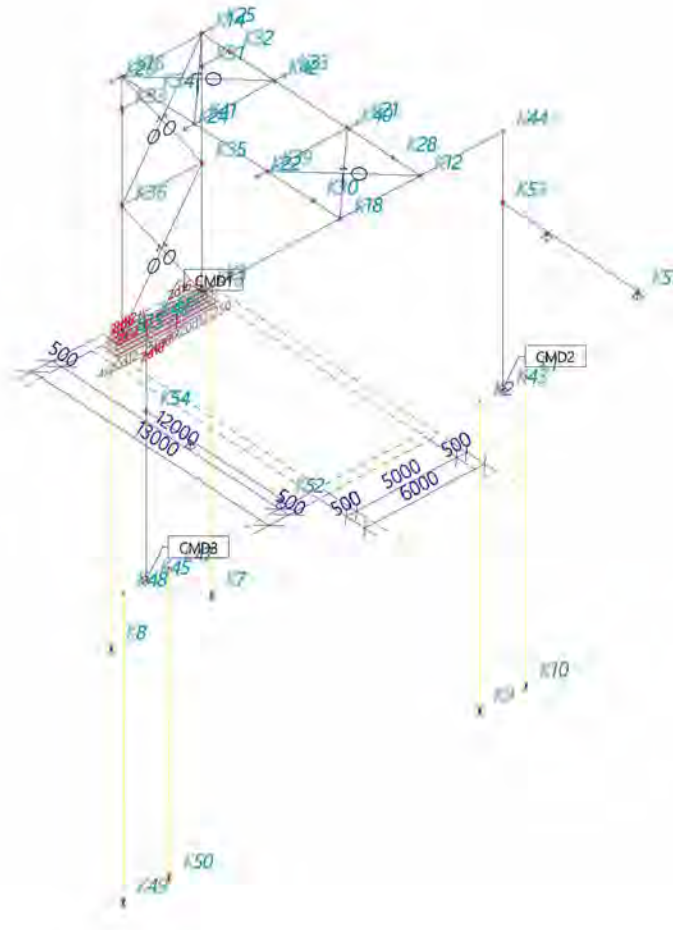
#### 2.3.3.1. Knopen

Naam	Coördinaat X [mm]	Coördinaat Y [mm]	Coördinaat Z [mm]
K1	500.000	-4767.000	0.000
K2	500.000	-2467.000	0.000
K3	12500.000	0.000	0.000
K4	12500.000	5000.000	0.000
K6	12500.000	2500.000	0.000
K7	12500.000	0.000	-14000.000
K8	12500.000	5000.000	-14000.000
K9	500.000	-2467.000	-14000.000
K10	500.000	-4767.000	-14000.000
K12	500.000	500.000	11820.000
K13	12500.000	500.000	0.000
K14	12500.000	500.000	11820.000
K15	12500.000	4500.000	0.000
K16	12500.000	4500.000	11820.000
K18	500.000	4500.000	11820.000
K21	4500.000	0.000	11820.000
K22	4500.000	5000.000	11820.000
K23	8500.000	0.000	11820.000
K24	8500.000	5000.000	11820.000
K25	12500.000	0.000	11820.000
K26	12500.000	5000.000	11820.000
K28	2000.000	500.000	11820.000
K30	2000.000	4500.000	11820.000

Naam	Coördinaat X [mm]	Coördinaat Y [mm]	Coördinaat Z [mm]
K31	12500.000	500.000	10320.000
K32	11000.000	500.000	11820.000
K33	12500.000	4500.000	10320.000
K34	11000.000	4500.000	11820.000
K35	12500.000	500.000	5910.000
K36	12500.000	4500.000	5910.000
K39	4500.000	4500.000	11820.000
K40	4500.000	500.000	11820.000
K41	8500.000	4500.000	11820.000
K42	8500.000	500.000	11820.000
K43	500.000	-3617.000	0.000
K44	500.000	-3617.000	11820.000
K45	500.000	14173.000	0.000
K46	500.000	14173.000	11820.000
K47	500.000	13023.000	0.000
K48	500.000	15323.000	0.000
K49	500.000	15323.000	-14000.000
K50	500.000	13023.000	-14000.000
K51	-6923.000	-3617.000	8550.000
K52	-6923.000	14173.000	7750.000
K53	500.000	-3617.000	8550.000
K54	500.000	14173.000	7750.000



### 2.3.3.2. Knopen



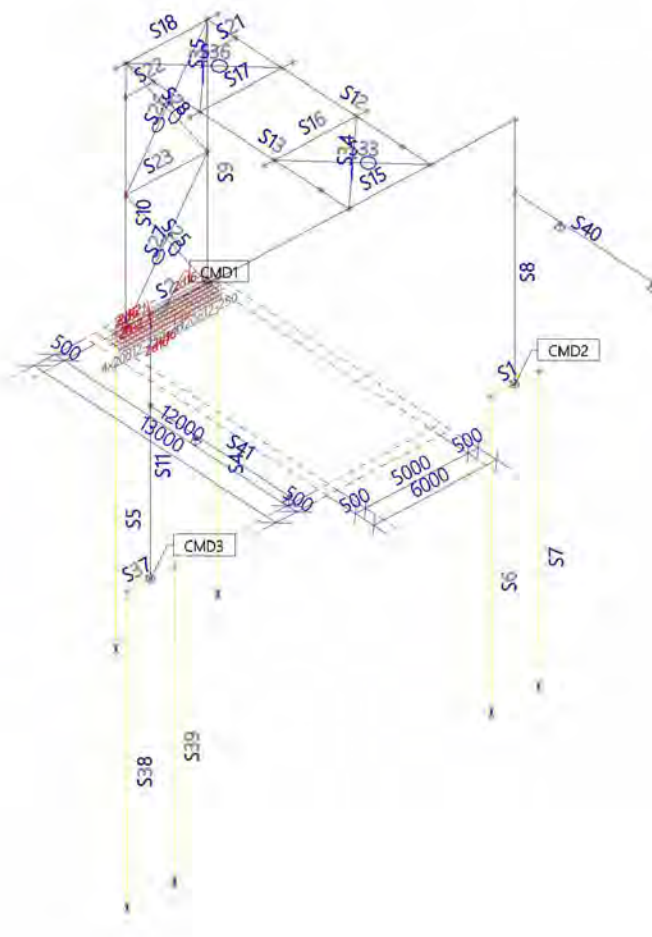
### 2.3.3.3. Staven

Naam	Doorsnede	Materiaal	Lengte [mm]	Beginknoop	Eindknoop	Type
S1	BT-12 - Rechthoek (800; 800)	C35/45	2300.000	K1	K2	Balk (80)
S2	BT-12 - Rechthoek (800; 800)	C35/45	5000.000	K3	K4	Balk (80)
S4	BT-11 - Cirkel (460)	C35/45	14000.000	K7	K3	Kolom (100)
S5	BT-11 - Cirkel (460)	C35/45	14000.000	K8	K4	Kolom (100)
S6	BT-11 - Cirkel (460)	C35/45	14000.000	K9	K2	Kolom (100)
S7	BT-11 - Cirkel (460)	C35/45	14000.000	K10	K1	Kolom (100)
S8	ST-17 - HEA450	S 235 JR (EN 10025-2)	11820.000	K43	K44	Kolom (100)
S9	ST-11 - IPE600	S 235 JR (EN 10025-2)	11820.000	K13	K14	Kolom (100)
S10	ST-11 - IPE600	S 235 JR (EN 10025-2)	11820.000	K15	K16	Kolom (100)
S11	ST-17 - HEA450	S 235 JR (EN 10025-2)	11820.000	K45	K46	Kolom (100)
S12	ST-12 - IPE450	S 235 JR (EN 10025-2)	12000.000	K12	K14	Balk (80)
S13	ST-12 - IPE450	S 235 JR (EN 10025-2)	12000.000	K18	K16	Balk (80)
S15	ST-17 - HEA450	S 235 JR (EN 10025-2)	17790.000	K44	K46	Balk (80)
S16	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K21	K22	Balk (80)
S17	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K23	K24	Balk (80)
S18	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K25	K26	Balk (80)
S21	ST-14 - HEA120	S 235 JR (EN 10025-2)	2121.320	K31	K32	Balk (80)
S22	ST-14 - HEA120	S 235 JR (EN 10025-2)	2121.320	K33	K34	Balk (80)
S23	ST-13 - HEA180	S 235 JR (EN 10025-2)	4000.000	K35	K36	Balk (80)
S25	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K13	K36	Balk (80)



Naam	Doorsnede	Materiaal	Lengte [mm]	Beginknoop	Eindknoop	Type
S26	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K36	K14	Balk (80)
S27	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K15	K35	Balk (80)
S28	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K35	K16	Balk (80)
S33	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K12	K39	Balk (80)
S34	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K18	K40	Balk (80)
S35	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K41	K14	Balk (80)
S36	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K42	K16	Balk (80)
S37	BT-12 - Rechthoek (800; 800)	C35/45	2300.000	K47	K48	Balk (80)
S38	BT-11 - Cirkel (460)	C35/45	14000.000	K49	K48	Kolom (100)
S39	BT-11 - Cirkel (460)	C35/45	14000.000	K50	K47	Kolom (100)
S40	ST-18 - UNP200	S 235 JR (EN 10025-2)	7423.000	K53	K51	Balk (80)
S41	ST-18 - UNP200	S 235 JR (EN 10025-2)	7423.000	K52	K54	Balk (80)

### 2.3.3.4. Staven







### 2.3.3.5. Scharnieren

Naam	Staal Positie	ux	uy	uz	phix	phiy	phiz
		Fun - ux	Fun - uy	Fun - uz	Fun - phix	Fun - phiy	Fun - phiz
		Stijf - ux [MN/m]	Stijf - uy [MN/m]	Stijf - uz [MN/m]	Stijf - phix [MNm/rad]	Stijf - phiy [MNm/rad]	Stijf - phiz [MNm/rad]
H5	S12 Beide	Vast	Vast	Vast	Vast	Vast	Vrij
H6	S13 Beide	Vast	Vast	Vast	Vast	Vast	Vrij
H7	S21 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H8	S22 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H12	S9 Begin	Vast	Vast	Vast	Vast	Vast	Vrij
H13	S10 Begin	Vast	Vast	Vast	Vast	Vast	Vrij
H16	S23 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H17	S41 Eind	Vast	Vast	Vast	Vast	Vrij	Vrij
H18	S40 Begin	Vast	Vast	Vast	Vast	Vrij	Vrij

### 2.3.3.6. Staal niet-lineariteit

Naam	Staal	Type
BN1	S25	Alleen trek
BN2	S26	Alleen trek

Naam	Staal	Type
BN3	S27	Alleen trek
BN4	S28	Alleen trek

Naam	Staal	Type
BN9	S33	Alleen trek
BN10	S34	Alleen trek

Naam	Staal	Type
BN11	S35	Alleen trek
BN12	S36	Alleen trek

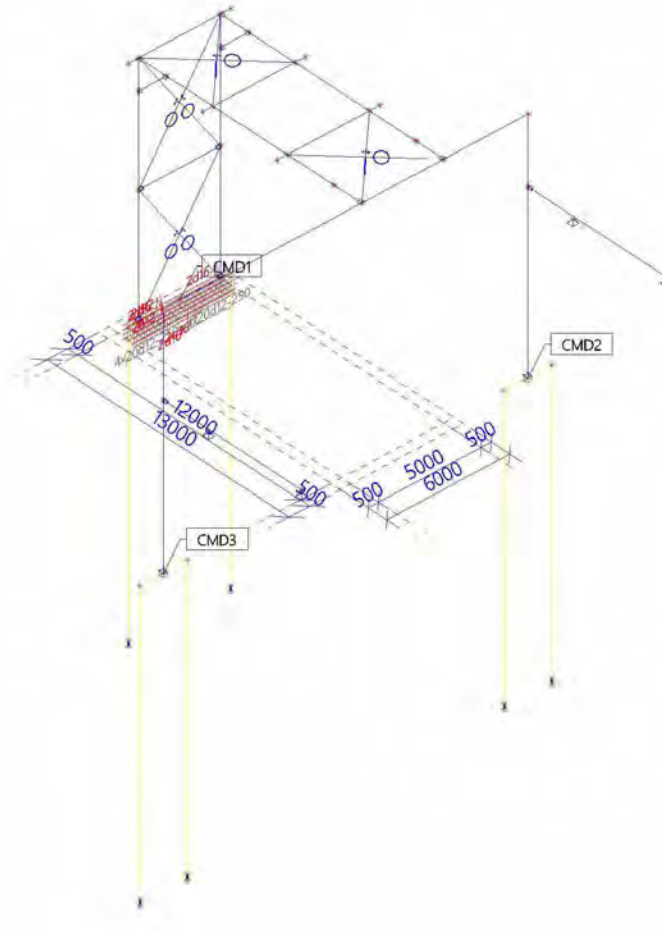
### 2.3.3.7. Kruisende staven

Naam	1e staaf	2e staaf	Type
Kruis1	S12	S16	Vast
Kruis2	S12	S17	Vast
Kruis3	S13	S16	Vast
Kruis4	S13	S17	Vast

### 2.3.4. 2D



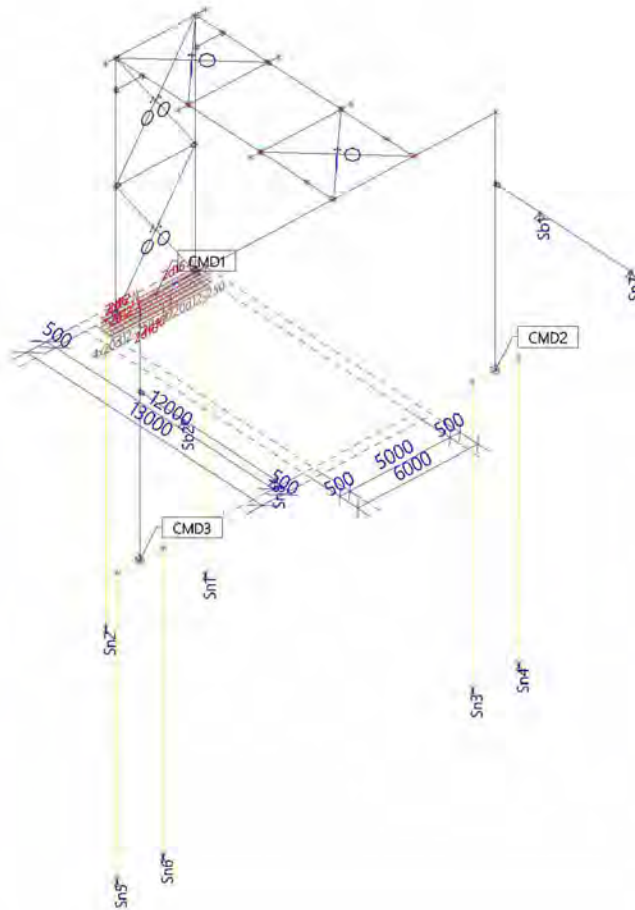
## 2.3.4.1. Platen





## 2.3.5. Supports

### 2.3.5.1. Steunpunten



### 2.3.5.2. Knoopondersteuningen

Naam Knoop	Systeem UCS	Type Hoek [deg]	X Stijfheid X [MN/m]	Y Stijfheid Y [MN/m]	Z Stijfheid Z [MN/m]	Rx Stijfheid Rx [MNm/rad]	Ry Stijfheid Ry [MNm/rad]	Rz Stijfheid Rz [MNm/rad]
Sn1 K7	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn2 K8	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn3 K9	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn4 K10	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn5 K49	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn6 K50	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn7 K51	GCS	Standaard	Vast	Vast	Vast	Vrij	Vrij	Vrij
Sn8 K52	GCS	Standaard	Vast	Vast	Vast	Vrij	Vrij	Vrij



### 2.3.5.3. Puntondersteuning op staaf

Naam	Type	Coör	Pos x [mm]	dx [mm]	X	Y	Z	Rx	Ry	Rz
		Systeem	Oors	Herh (n)						
Sb1	Standaard	Abso GCS	5000.000 Vanaf einde	1	Vast	Vast	Vast	Vrij	Vrij	Vrij
Sb2	Standaard	Abso GCS	5000.000 Vanaf begin	1	Vast	Vast	Vast	Vrij	Vrij	Vrij

### 2.3.5.4. Lijnondersteuning op staven

Naam	Type	Staat	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
Slb1	Lijn	S7 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb2	Lijn	S4 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb3	Lijn	S5 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb4	Lijn	S6 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb5	Lijn	S4 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb6	Lijn	S5 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb7	Lijn	S6 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb8	Lijn	S7 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb9	Lijn	S4 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb10	Lijn	S5 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb11	Lijn	S6 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb12	Lijn	S7 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb13	Lijn	S4 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb14	Lijn	S5 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb15	Lijn	S6 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb16	Lijn	S7 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb17	Lijn	S4 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb18	Lijn	S5 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb19	Lijn	S6 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb20	Lijn	S7 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb21	Lijn	S4 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb22	Lijn	S5 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb23	Lijn	S6 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb24	Lijn	S7 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij



Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
Slb25	Lijn	S4 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb26	Lijn	S5 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb27	Lijn	S6 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb28	Lijn	S7 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb29	Lijn	S4 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb30	Lijn	S5 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb31	Lijn	S7 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb32	Lijn	S6 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb33	Lijn	S4 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb34	Lijn	S5 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb35	Lijn	S7 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb36	Lijn	S6 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb37	Lijn	S4 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb38	Lijn	S5 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb39	Lijn	S7 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb40	Lijn	S6 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb41	Lijn	S4 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb42	Lijn	S5 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb43	Lijn	S7 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb44	Lijn	S6 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb45	Lijn	S4 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb46	Lijn	S5 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb47	Lijn	S7 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb48	Lijn	S6 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb49	Lijn	S4 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb50	Lijn	S5 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb51	Lijn	S7 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb52	Lijn	S6 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb53	Lijn	S4 GCS	13100.000 13400.000	Abso Vanaf einde	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
Slb54	Lijn	S5	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij



Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2e  
23/36

Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
		GCS	13400.000	Vanaf einde								
Slb55	Lijn	S6	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb56	Lijn	S7	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb57	Lijn	S4	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb58	Lijn	S5	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb59	Lijn	S6	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb60	Lijn	S7	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb61	Lijn	S4	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb62	Lijn	S5	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb63	Lijn	S6	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb64	Lijn	S7	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb65	Lijn	S38	1500.000	Abso	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	1650.000	Vanaf einde								
Slb66	Lijn	S38	1650.000	Abso	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	2660.000	Vanaf einde								
Slb67	Lijn	S38	2660.000	Abso	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	4960.000	Vanaf einde								
Slb68	Lijn	S38	4960.000	Abso	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	6120.000	Vanaf einde								
Slb69	Lijn	S38	6120.000	Abso	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	10600.000	Vanaf einde								
Slb70	Lijn	S38	10600.000	Abso	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	10700.000	Vanaf einde								
Slb71	Lijn	S38	10700.000	Abso	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11300.000	Vanaf einde								
Slb72	Lijn	S38	11300.000	Abso	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11600.000	Vanaf einde								
Slb73	Lijn	S38	11600.000	Abso	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11800.000	Vanaf einde								
Slb74	Lijn	S38	11800.000	Abso	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	12100.000	Vanaf einde								
Slb75	Lijn	S38	12100.000	Abso	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
		GCS	12500.000	Vanaf einde								
Slb76	Lijn	S38	12500.000	Abso	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
		GCS	12700.000	Vanaf einde								
Slb77	Lijn	S38	12700.000	Abso	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13100.000	Vanaf einde								
Slb78	Lijn	S38	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb79	Lijn	S38	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb80	Lijn	S38	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb81	Lijn	S39	1500.000	Abso	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	1650.000	Vanaf einde								
Slb82	Lijn	S39	1650.000	Abso	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	2660.000	Vanaf einde								
Slb83	Lijn	S39	2660.000	Abso	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	4960.000	Vanaf einde								



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Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
24/36

Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coörd	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
Slb84	Lijn	S39 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb85	Lijn	S39 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb86	Lijn	S39 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb87	Lijn	S39 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb88	Lijn	S39 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb89	Lijn	S39 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb90	Lijn	S39 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb91	Lijn	S39 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb92	Lijn	S39 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb93	Lijn	S39 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb94	Lijn	S39 GCS	13100.000 13400.000	Abso Vanaf einde	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
Slb95	Lijn	S39 GCS	13400.000 13500.000	Abso Vanaf einde	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb96	Lijn	S39 GCS	13500.000 13950.000	Abso Vanaf einde	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij



### 3. Belastingen

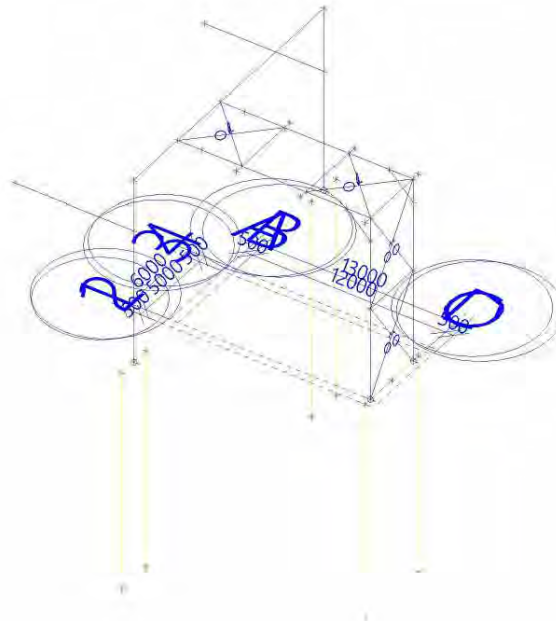
#### 3.1. Belastingsgevallen

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Richting	Duur	'Master' belastingsgeval
BG101	Eigen gewicht	Permanent	LG1	Eigen gewicht		-Z		
BG102	Permanent	Permanent	LG1	Standaard				
BG111	Wind x-as	Variabel	LG3	Statisch	Standaard		Kort	Geen
BG112	Wind y-as	Variabel	LG3	Statisch	Standaard		Kort	Geen
BG121	Veranderlijk + eq	Variabel	LG4	Statisch	Standaard		Kort	Geen

#### 3.2. Belastingsgevallen

##### 3.2.1. Belastingsgevallen - BG101

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Richting
BG101	Eigen gewicht	Permanent	LG1	Eigen gewicht	-Z

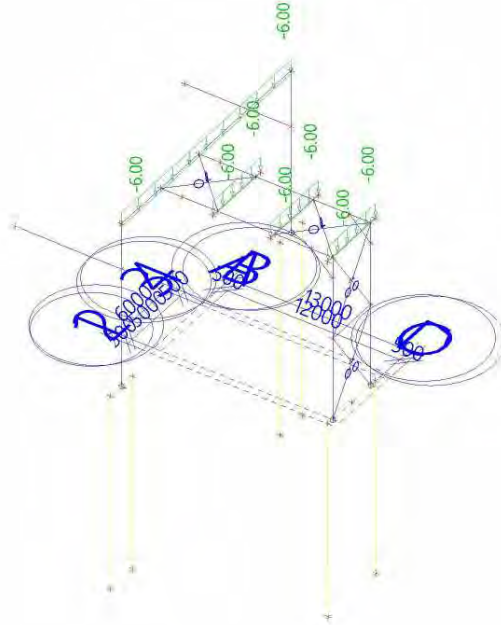






### 3.2.2. Belastingsgevallen - BG102

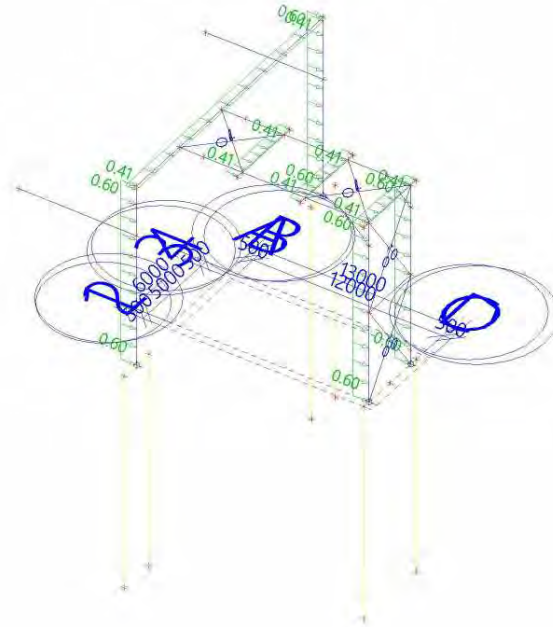
Naam	Omschrijving	Actie type	Lastgroep	Belastingtype
BG102	Permanent	Permanent	LG1	Standaard





### 3.2.3. Belastingsgevallen - BG111

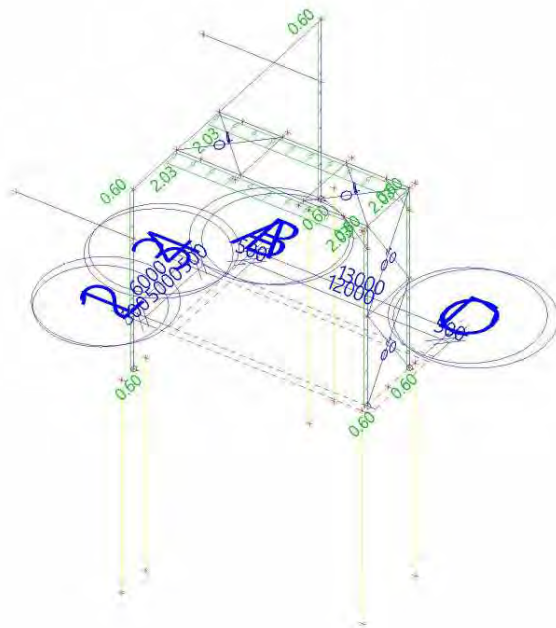
Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Duur	'Master' belastingsgeval
BG111	Wind x-as	Variabel	LG3	Statisch	Standaard	Kort	Geen





### 3.2.4. Belastinggevallen - BG112

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Duur	'Master' belastinggeval
BG112	Wind y-as	Variabel	LG3	Statisch	Standaard	Kort	Geen

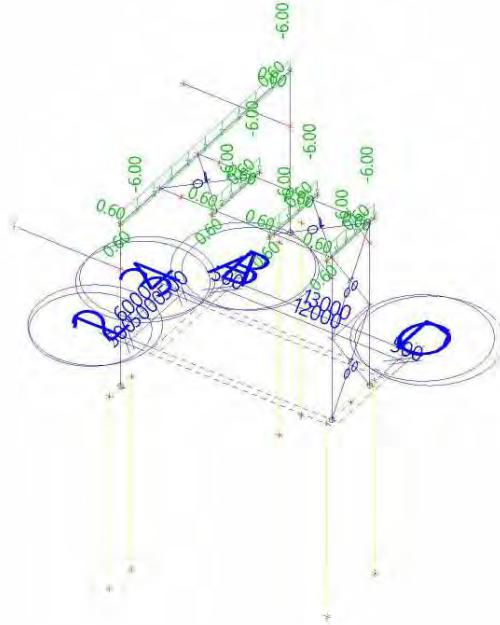




Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 29/36

### 3.2.5. Belastingsgevallen - BG121

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Duur	'Master' belastingsgeval
BG121	Veranderlijk + eq	Variabel	LG4	Statisch	Standaard	Kort	Geen





### 3.3. Belastinggroepen

Naam	Last	Relatie	Type
LG1	Permanent		
LG2	Variabel	Exclusief	Temperatuur
LG3	Variabel	Exclusief	Wind
LG4	Variabel	Standaard	Cat E : Opslagruimte

### 3.4. Combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
UGT-Set B	EN-UGT (STR/GEO) Set B	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00
BGT-kar	EN - BGT Karakteristiek	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00
BGT-quasi	EN-BGT Quasi-permanent	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00

### 3.5. Niet-lineaire combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
NC_UGT-Set B.1	Uiterste Grenstoestand	BG101 - Eigen gewicht	1.35
		BG102 - Permanent	1.35
NC_UGT-Set B.2	Uiterste Grenstoestand	BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.3	Uiterste Grenstoestand	BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.4	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.5	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.6	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.7	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.8	Uiterste Grenstoestand	BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.9	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.10	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.11	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	0.90



Naam	Type	Belastingsgevallen	Coëff. [-]
		BG102 - Permanent	0.90
NC_UGT-Set B.12	Uiterste Grenstoestand	BG112 - Wind y-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.50 1.50 0.90 0.90
NC_UGT-Set B.13	Uiterste Grenstoestand	BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.50 0.90 0.90
NC_UGT-Set B.14	Uiterste Grenstoestand	BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.50 1.35 1.35
NC_BGT-kar.1	Bruikbaarheidsgrenstoestand	BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00
NC_BGT-kar.2	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00
NC_BGT-kar.3	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00
NC_BGT-kar.4	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00 1.00
NC_BGT-kar.5	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00 1.00
NC_BGT-kar.6	Bruikbaarheidsgrenstoestand	BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00
NC_BGT-kar.7	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00
NC_BGT-kar.8	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00
NC_BGT-kar.9	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00 1.00
NC_BGT-kar.10	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00 1.00
NC_BGT-quasi.1	Bruikbaarheidsgrenstoestand	BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00
NC_BGT-quasi.2	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00
NC_BGT-quasi.3	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00
NC_BGT-quasi.4	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	0.00 0.80 1.00 1.00
NC_BGT-quasi.5	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	0.00 0.80 1.00 1.00
NC_BGT-quasi.6	Bruikbaarheidsgrenstoestand	BG121 - Veranderlijk + eq	0.80



Naam	Type	Belastingsgevallen	Coëff. [-]
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00

### 3.6. Resultaatklassen

Naam	Lijst
RK_NC_UGT-Set B	NC_UGT-Set B.1 NC_UGT-Set B.2 NC_UGT-Set B.3 NC_UGT-Set B.4 NC_UGT-Set B.5 NC_UGT-Set B.6 NC_UGT-Set B.7 NC_UGT-Set B.8 NC_UGT-Set B.9 NC_UGT-Set B.10 NC_UGT-Set B.11 NC_UGT-Set B.12 NC_UGT-Set B.13 NC_UGT-Set B.14
RK_NC_BGT-kar	NC_BGT-kar.1 NC_BGT-kar.2 NC_BGT-kar.3 NC_BGT-kar.4 NC_BGT-kar.5 NC_BGT-kar.6 NC_BGT-kar.7 NC_BGT-kar.8 NC_BGT-kar.9 NC_BGT-kar.10
RK_NC_BGT-quasi	NC_BGT-quasi.1 NC_BGT-quasi.2 NC_BGT-quasi.3 NC_BGT-quasi.4 NC_BGT-quasi.5 NC_BGT-quasi.6
GEO	UGT-Set B - EN-UGT (STR/GEO) Set B



## 4. Berekeningsverslag

### Lineaire berekening

Aantal 2D elementen	0
Aantal 1D-elementen	225
Aantal netknoten	211
Aantal vergelijkingen	1266
Buigtheorie	Mindlin
Belastingsgevallen	BG101, BG102, BG111, BG112, BG121
Start van de berekening	15.07.2022 16:22
Einde berekening	15.07.2022 16:22

### Som van lasten en reacties

Belastingsgeval	Waarde	X	Y	Z
		[kN]	[kN]	[kN]
BG101	Lasten	0.00	0.00	-612.85
	reactie in de knopen	2.22	0.00	612.85
	reactie op de lijnen	-2.22	0.00	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG102	Lasten	0.00	0.00	-196.74
	reactie in de knopen	8.39	0.03	196.74
	reactie op de lijnen	-8.39	-0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG111	Lasten	41.81	0.00	0.00
	reactie in de knopen	-26.72	-0.11	0.00
	reactie op de lijnen	-15.09	0.11	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG112	Lasten	0.00	77.09	0.00
	reactie in de knopen	0.51	-1.51	0.00
	reactie op de lijnen	-0.51	-75.58	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG121	Lasten	19.67	19.67	-196.74
	reactie in de knopen	-6.75	-0.65	196.74
	reactie op de lijnen	-12.92	-19.02	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00

## 5. Berekeningsverslag

### Niet-lineaire berekening

Aantal 2D elementen	0
Aantal 1D-elementen	225
Aantal netknoten	211
Aantal vergelijkingen	1266
Buigtheorie	Mindlin
Geometrische niet-lineariteit	2de orde (Timoshenko)
Berekeningsmethode	Picard
Aantal Incrementen	1
Maximum aantal iteraties	20

Niet-lineaire combinatie	Start van de berekening	Einde berekening	Aantal iteraties
NC_UGT-Set B.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.5	15.07.2022 16:22	15.07.2022 16:22	4
NC_UGT-Set B.6	15.07.2022 16:22	15.07.2022 16:22	7





Niet-lineaire combinatie	Start van de berekening	Einde berekening	Aantal iteraties
NC_UGT-Set B.7	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.8	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.9	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.10	15.07.2022 16:22	15.07.2022 16:22	4
NC_UGT-Set B.11	15.07.2022 16:22	15.07.2022 16:22	11
NC_UGT-Set B.12	15.07.2022 16:22	15.07.2022 16:22	11
NC_UGT-Set B.13	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.14	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.5	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.6	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.7	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.8	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.9	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.10	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-quasi.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.5	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.6	15.07.2022 16:22	15.07.2022 16:22	7

### Som van lasten en reacties

Niet-lineaire combinatie	Waarde	X [kN]	Y [kN]	Z [kN]
NC_UGT-Set B.1	Lasten	0.00	0.00	-1092.94
	reactie in de knopen	13.65	-0.05	1092.94
	reactie op de lijnen	-13.65	0.05	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.2	Lasten	0.00	0.00	-728.63
	reactie in de knopen	9.04	-0.02	728.63
	reactie op de lijnen	-9.04	0.02	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.3	Lasten	0.00	0.00	-973.12
	reactie in de knopen	12.13	-0.04	973.12
	reactie op de lijnen	-12.13	0.04	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.4	Lasten	62.72	0.00	-973.12
	reactie in de knopen	-28.49	-0.13	973.12
	reactie op de lijnen	-34.23	0.13	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.5	Lasten	0.00	115.63	-973.12
	reactie in de knopen	13.60	-1.15	973.12
	reactie op de lijnen	-13.60	-114.48	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.6	Lasten	92.23	29.51	-1268.23
	reactie in de knopen	-40.50	-1.04	1268.23
	reactie op de lijnen	-51.73	-28.47	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.7	Lasten	29.51	145.14	-1268.23
	reactie in de knopen	2.01	-2.02	1268.23
	reactie op de lijnen	-31.52	-143.13	0.00
	contact 1D	0.00	0.00	0.00



Niet-lineaire combinatie	Waarde	X [kN]	Y [kN]	Z [kN]
NC_UGT-Set B.8	contact 2D	0.00	0.00	0.00
	Lasten	29.51	29.51	-1268.23
	reactie in de knopen	0.69	-0.72	1268.23
	reactie op de lijnen	-30.20	-28.79	0.00
NC_UGT-Set B.9	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	62.72	0.00	-728.63
	reactie in de knopen	-31.48	-0.13	728.63
NC_UGT-Set B.10	reactie op de lijnen	-31.24	0.13	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	0.00	115.63	-728.63
NC_UGT-Set B.11	reactie in de knopen	10.51	-1.17	728.63
	reactie op de lijnen	-10.51	-114.46	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.12	Lasten	92.23	29.51	-1023.74
	reactie in de knopen	-43.44	-1.04	1023.74
	reactie op de lijnen	-48.79	-28.47	0.00
	contact 1D	0.00	0.00	0.00
NC_UGT-Set B.13	contact 2D	0.00	0.00	0.00
	Lasten	29.51	145.14	-1023.74
	reactie in de knopen	-1.06	-2.04	1023.74
	reactie op de lijnen	-28.45	-143.11	0.00
NC_UGT-Set B.14	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	29.51	29.51	-1388.05
	reactie in de knopen	2.20	-0.73	1388.05
NC_BGT-kar.1	reactie op de lijnen	-31.71	-28.78	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	0.00	0.00	-809.59
NC_BGT-kar.2	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.3	Lasten	41.81	0.00	-809.59
	reactie in de knopen	-16.95	-0.08	809.59
	reactie op de lijnen	-24.87	0.08	0.00
	contact 1D	0.00	0.00	0.00
NC_BGT-kar.4	contact 2D	0.00	0.00	0.00
	Lasten	0.00	77.09	-809.59
	reactie in de knopen	11.04	-0.79	809.59
	reactie op de lijnen	-11.04	-76.30	0.00
NC_BGT-kar.5	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	61.49	19.67	-1006.33
	reactie in de knopen	-24.77	-0.62	1006.33
NC_BGT-kar.5	reactie op de lijnen	-36.72	-19.05	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	19.67	96.76	-1006.33
NC_BGT-kar.5	reactie in de knopen	3.40	-1.30	1006.33
	reactie op de lijnen	-23.08	-95.46	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00

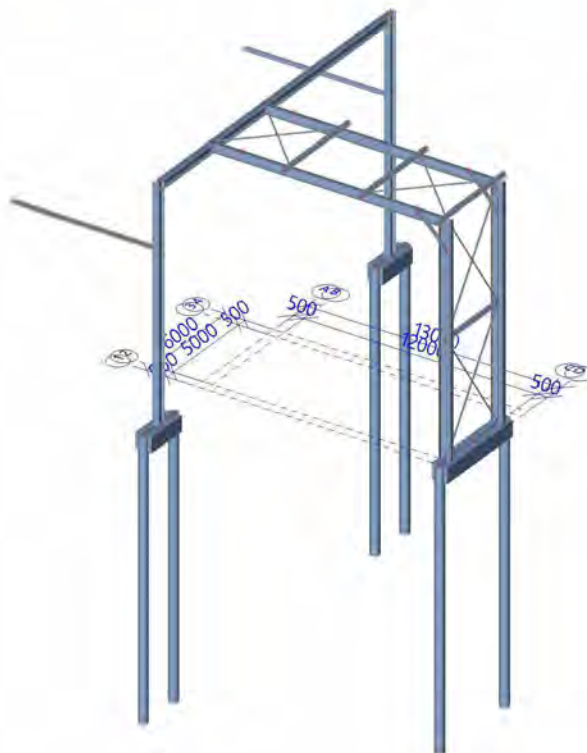


Niet-lineaire combinatie	Waarde	X [kN]	Y [kN]	Z [kN]
NC_BGT-kar.6	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.7	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.8	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.9	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.10	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.1	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.2	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.3	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.4	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.5	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.6	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00



# Bijlage 2.

## Uitvoer Resultaten Scia





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Resultaten	3
2.1. Vervormingen	3
2.1.1. Knoopverplaatsingen	3
2.1.1.1. Verplaatsing van knopen	3
2.1.1.2. Resultaten - $U_x$	3
2.1.1.3. Resultaten - $U_y$	4
2.1.1.4. Resultaten - $U_z$	4
2.1.1.5. Resultaten - $\Phi_x$	5
2.1.1.6. Resultaten - $\Phi_y$	5
2.1.1.7. Resultaten - $\Phi_z$	6
2.1.1.8. Resultaten - $U_{total}$	6
2.1.2. 3D verplaatsingen	7
2.1.2.1. 3D verplaatsing	7
2.1.2.2. Resultaten - $u_x$	7
2.1.2.3. Resultaten - $u_y$	8
2.1.2.4. Resultaten - $u_z$	8
2.1.2.5. Resultaten - $\phi_x$	9
2.1.2.6. Resultaten - $\phi_y$	9
2.1.2.7. Resultaten - $\phi_z$	10
2.1.2.8. Resultaten - $U_{total}$	10
2.1.3. 1D-vervormingen Algemeen	11
2.1.3.1. 1D-vervormingen	11
2.1.3.2. Resultaten - $u_x$	11
2.1.3.3. Resultaten - $u_y$	12
2.1.3.4. Resultaten - $u_z$	12
2.1.3.5. Resultaten - $\phi_x$	13
2.1.3.6. Resultaten - $\phi_y$	13
2.1.3.7. Resultaten - $\phi_z$	14
2.1.3.8. Resultaten - $U_{total}$	14
2.2. Krachten	15
2.2.1. Reactiekrachten	15
2.2.1.1. Reacties	15
2.2.1.2. Resultaten - $R_x$	16
2.2.1.3. Resultaten - $R_y$	16
2.2.1.4. Resultaten - $R_z$	17
2.2.1.5. Resultaten - $M_x$	17
2.2.1.6. Resultaten - $M_y$	18
2.2.1.7. Resultaten - $M_z$	18
2.2.2. Interne staafkrachten	19
2.2.2.1. Interne 1D-krachten	19
2.2.2.2. Resultaten - $N$	22
2.2.2.3. Resultaten - $V_y$	23
2.2.2.4. Resultaten - $V_z$	23
2.2.2.5. Resultaten - $M_x$	24
2.2.2.6. Resultaten - $M_y$	24
2.2.2.7. Resultaten - $M_z$	25
2.2.2.8. Resultaten - $V_r$	25
2.2.3. 3D stress	26
2.2.3.1. 3D spanning	26
2.2.3.2. Resultaten - $\sigma_1$	27
2.2.3.3. Resultaten - $\sigma_2$	27
2.2.3.4. Resultaten - $\sigma_E$	28
2.2.3.5. Resultaten - $\tau_{max,b}$ (2D)	28
2.2.3.6. Resultaten - $\tau_{tot}$ (1D)	29
2.2.4. 1D stress	30
2.2.4.1. 1D-spanningen	30
2.2.4.2. Resultaten - $\sigma_1$	31
2.2.4.3. Resultaten - $\sigma_2$	31
2.2.4.4. Resultaten - $\sigma_E$	32
2.2.4.5. Resultaten - $\tau_{tot}$	32



## 2. Resultaten

### 2.1. Vervormingen

#### 2.1.1. Knoopverplaatsingen

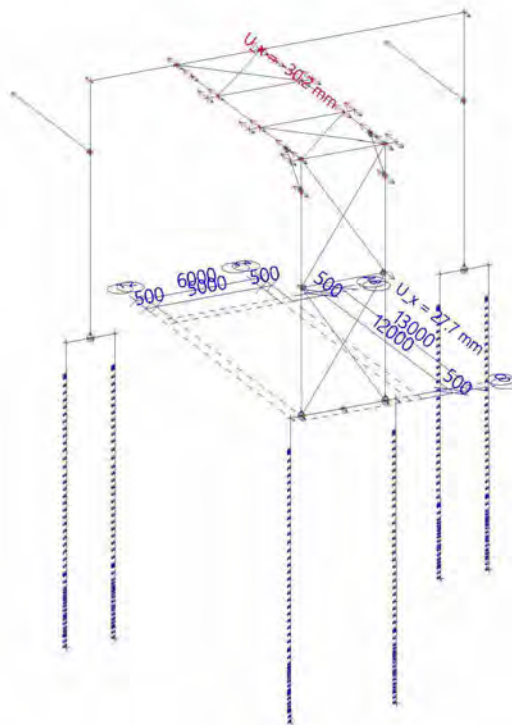
##### 2.1.1.1. Verplaatsing van knopen

Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle

Naam	Belasting	U <sub>x</sub> [mm]	U <sub>y</sub> [mm]	U <sub>z</sub> [mm]	Φ <sub>x</sub> [mrad]	Φ <sub>y</sub> [mrad]	Φ <sub>z</sub> [mrad]	U <sub>total</sub> [mm]
K41	NC_BGT-kar.1	<b>-30.2</b>	0.1	-19.6	2.0	-4.9	0.0	36.0
K36	NC_BGT-kar.4	<b>27.7</b>	2.1	-0.9	-0.8	1.5	-0.3	27.8
K53	NC_BGT-kar.1	0.0	<b>-8.0</b>	-0.5	-1.1	-2.5	3.6	8.0
K18	NC_BGT-kar.5	-13.9	42.0	<b>-73.0</b>	-0.5	-3.3	-2.9	<b>85.4</b>
K25	NC_BGT-kar.5	-22.5	19.9	<b>0.6</b>	-2.1	-5.1	-2.6	30.0
K44	NC_BGT-kar.5	-11.3	<b>44.4</b>	-0.9	<b>-10.9</b>	-3.9	3.2	45.8
K46	NC_BGT-kar.6	7.6	12.2	-0.9	<b>7.2</b>	2.2	-2.0	14.4
K24	NC_BGT-kar.6	-18.0	7.5	-27.3	4.2	<b>-8.1</b>	-1.1	33.6
K46	NC_BGT-kar.4	18.2	14.5	-0.9	6.9	<b>5.2</b>	2.7	23.3
K52	NC_BGT-kar.5	0.0	0.0	0.0	-3.4	0.1	<b>-5.9</b>	0.0
K44	NC_BGT-kar.1	-11.4	1.3	-0.6	-4.9	-3.9	<b>4.9</b>	11.5

##### 2.1.1.2. Resultaten - U<sub>x</sub>

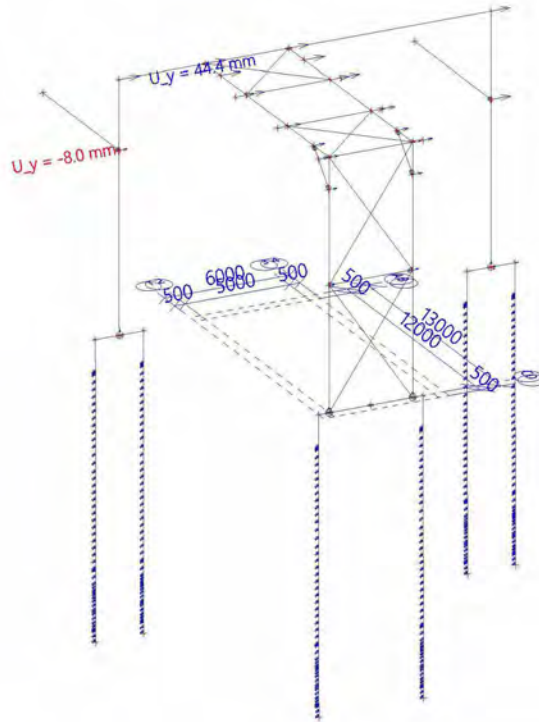
Waardes: U<sub>x</sub>  
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





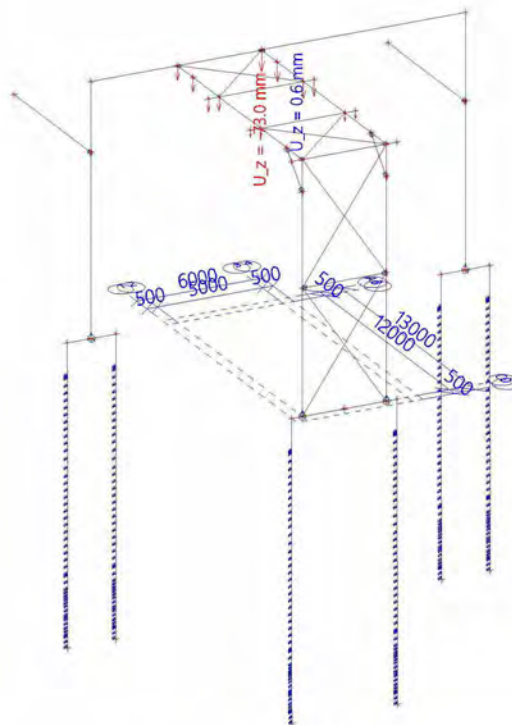
### 2.1.1.3. Resultaten - $U_y$

Waardes:  $U_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.4. Resultaten - $U_z$

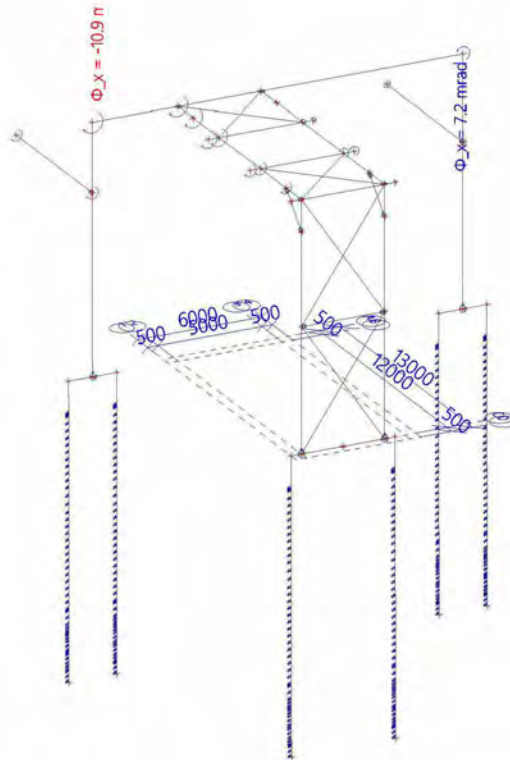
Waardes:  $U_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





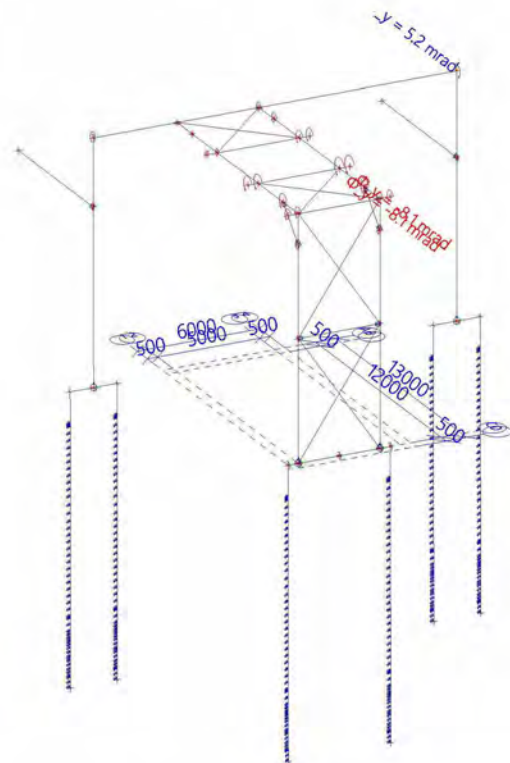
### 2.1.1.5. Resultaten - $\Phi_x$

Waardes:  $\Phi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.6. Resultaten - $\Phi_y$

Waardes:  $\Phi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle

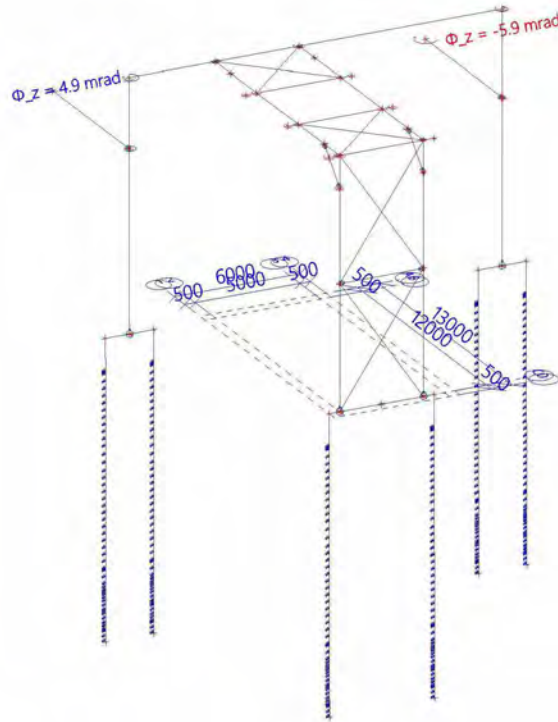






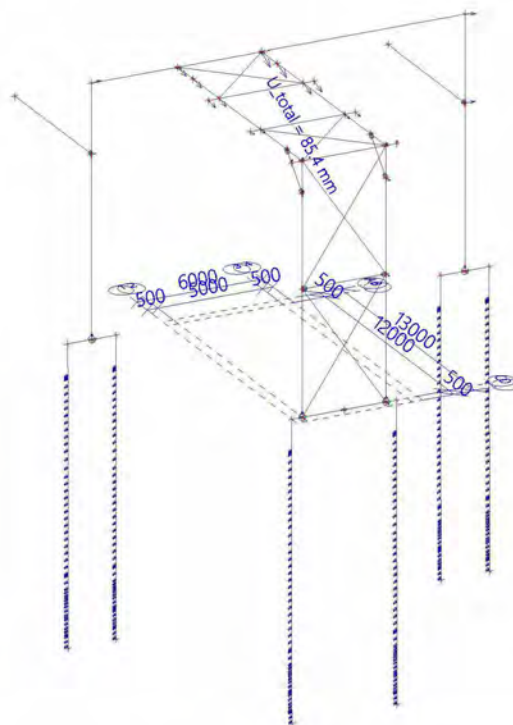
### 2.1.1.7. Resultaten - $\Phi_z$

Waardes:  $\Phi_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur 5.1.2.e  
7/32

## 2.1.2. 3D verplaatsingen

### 2.1.2.1. 3D verplaatsing

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Selectie: Alle

Locatie: In knooppunten gem. bij macro. Systeem: LCS net element

**Resultaten op 1D-element:**

Extreme 1D: Globaal

Naam	dx [mm]	Vezel	Belasting	$u_x$ [mm]	$u_y$ [mm]	$u_z$ [mm]	$\phi_x$ [mrad]	$\phi_y$ [mrad]	$\phi_z$ [mrad]	$U_{total}$ [mm]
S39	500.000-	1	NC_BGT-kar.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S15	8117.000-	13	NC_BGT-kar.5	42.5	13.9	-73.5	-3.3	0.5	-2.9	86.0

### 2.1.2.2. Resultaten - $u_x$

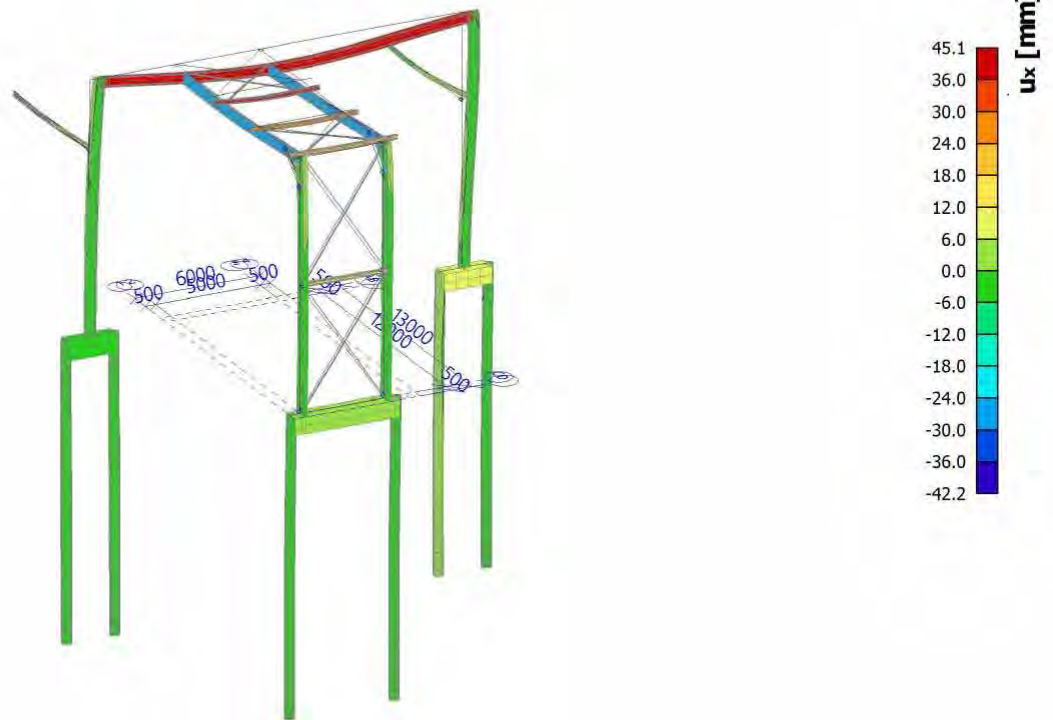
Waardes:  $u_x$

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Selectie: Alle

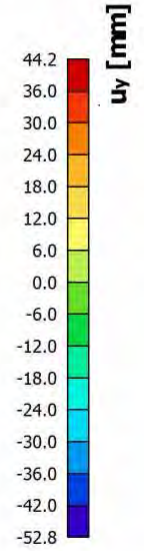
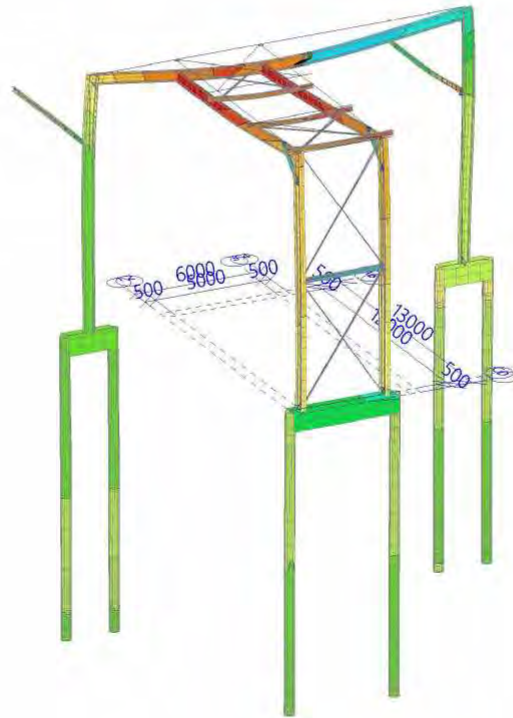
Locatie: In knooppunten gem. bij macro. Systeem: LCS net element





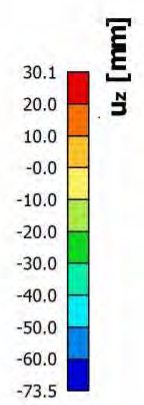
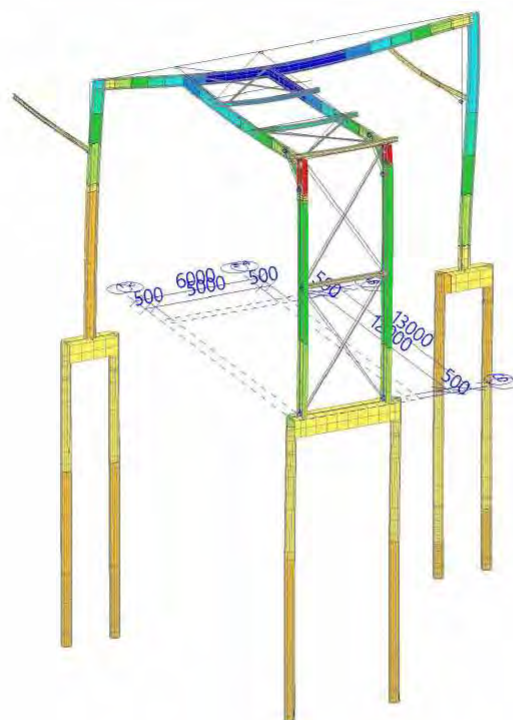
### 2.1.2.3. Resultaten - $u_y$

Waardes:  $u_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element



### 2.1.2.4. Resultaten - $u_z$

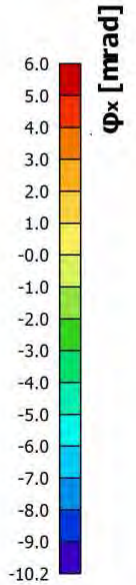
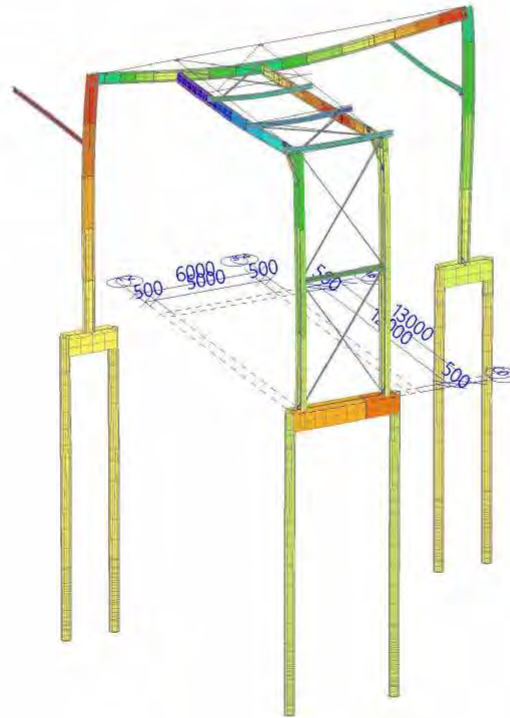
Waardes:  $u_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element





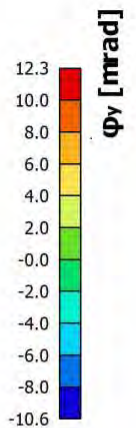
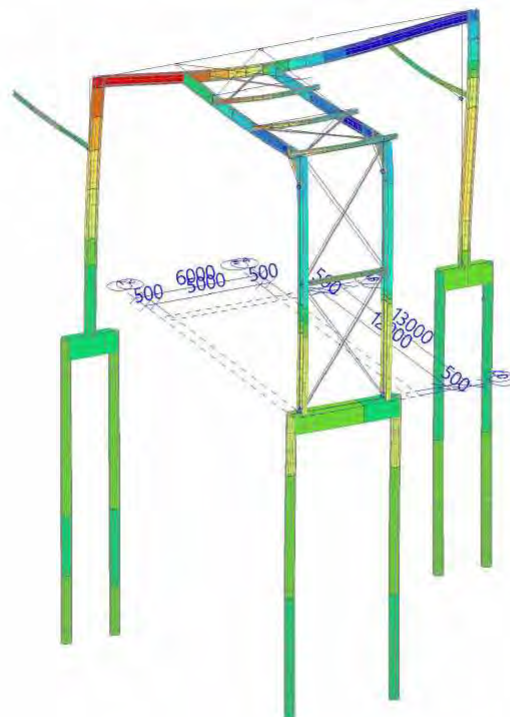
### 2.1.2.5. Resultaten - $\varphi_x$

Waardes:  $\varphi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element



### 2.1.2.6. Resultaten - $\varphi_y$

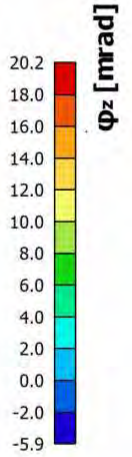
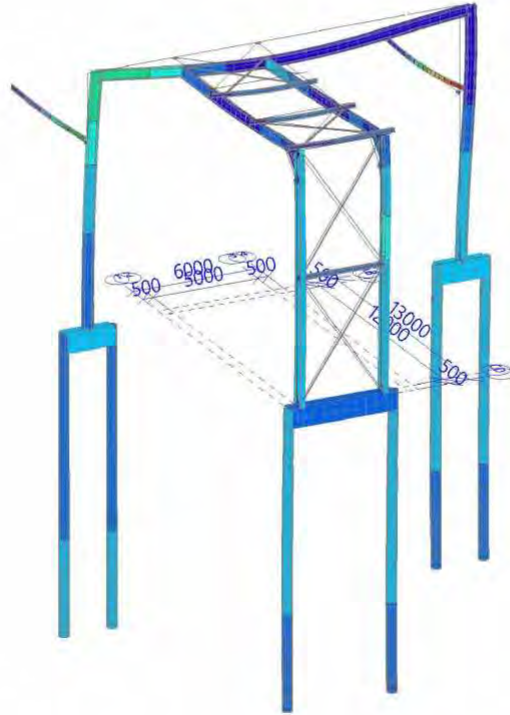
Waardes:  $\varphi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element





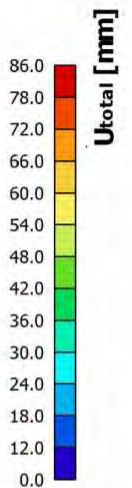
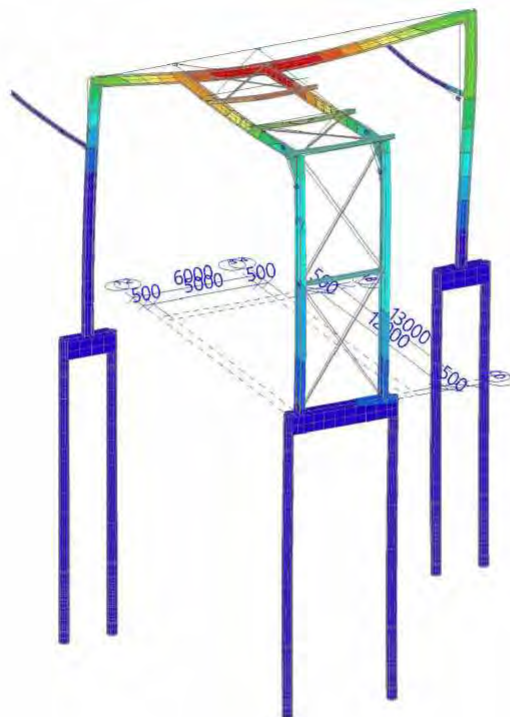
### 2.1.2.7. Resultaten - $\varphi_z$

Waardes:  $\varphi_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element



### 2.1.2.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element





## 2.1.3. 1D-ervormingen Algemeen

### 2.1.3.1. 1D-ervormingen

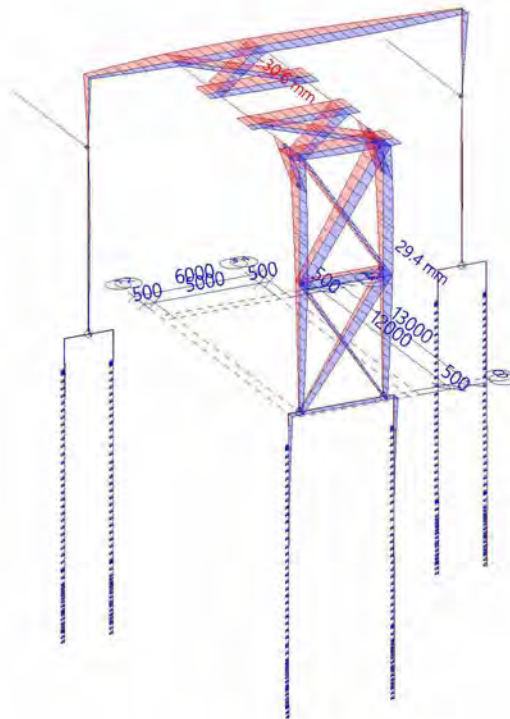
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle

#### Vervormingen

Naam	dx [mm]	Belasting	$u_x$ [mm]	$u_y$ [mm]	$u_z$ [mm]	$\phi_x$ [mrad]	$\phi_y$ [mrad]	$\phi_z$ [mrad]	$U_{total}$ [mm]
S17	4500.000-	NC_BGT-kar.1	<b>-30.6</b>	-0.1	-19.6	2.0	-4.9	0.0	36.3
S10	8115.000-	NC_BGT-kar.4	<b>29.4</b>	4.1	-0.9	-0.8	-0.1	-0.3	29.7
S41	3000.000	NC_BGT-kar.5	0.0	<b>-11.3</b>	-0.1	-3.4	-0.1	0.5	11.3
S11	9785.000-	NC_BGT-kar.5	4.3	<b>46.0</b>	-0.9	0.2	2.5	-1.1	46.2
S18	0.000	NC_BGT-kar.5	-22.9	20.1	<b>0.6</b>	-2.1	-5.1	-2.6	30.5
S15	1543.875	NC_BGT-kar.5	-15.2	42.0	-19.6	<b>-12.3</b>	-2.4	2.8	48.8
S15	14888.100	NC_BGT-kar.6	0.9	13.8	-29.4	<b>10.6</b>	0.6	-2.4	32.5
S13	8500.000	NC_BGT-kar.6	-16.7	8.0	-25.3	3.7	<b>-8.2</b>	-1.0	31.3
S11	11820.000	NC_BGT-kar.4	18.2	14.5	-0.9	6.9	<b>5.2</b>	2.7	23.3
S41	0.000	NC_BGT-kar.5	0.0	0.0	0.0	-3.4	0.1	<b>-5.9</b>	0.0
S41	7423.000	NC_BGT-kar.5	0.0	42.2	-0.8	-3.4	0.4	<b>20.2</b>	42.2
S34	0.000	NC_BGT-kar.5	-13.9	42.0	<b>-73.0</b>	0.0	0.0	0.0	<b>85.4</b>

### 2.1.3.2. Resultaten - $u_x$

Waardes:  $u_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle

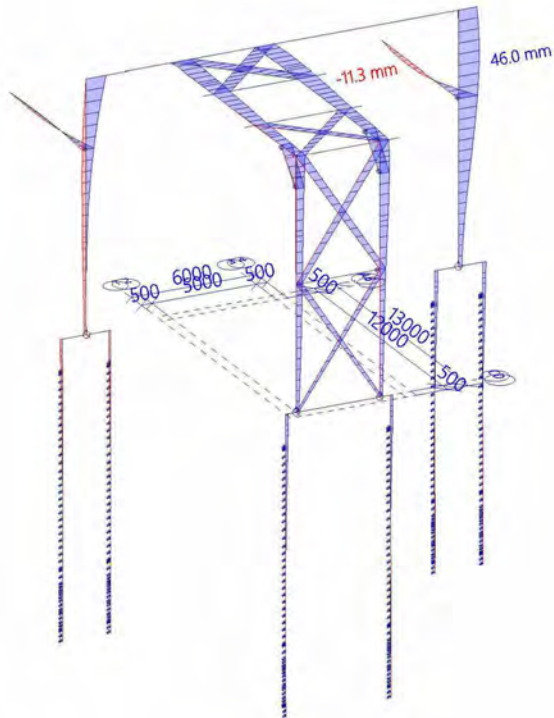




### 2.1.3.3. Resultaten - $u_y$

Waardes:  $u_y$

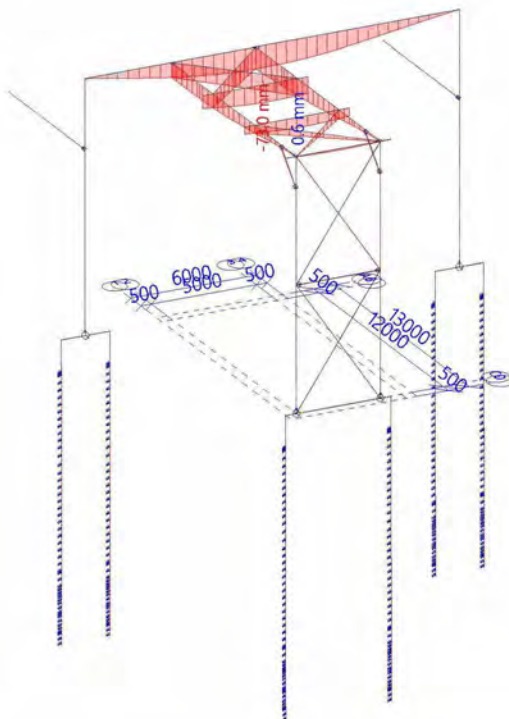
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle



### 2.1.3.4. Resultaten - $u_z$

Waardes:  $u_z$

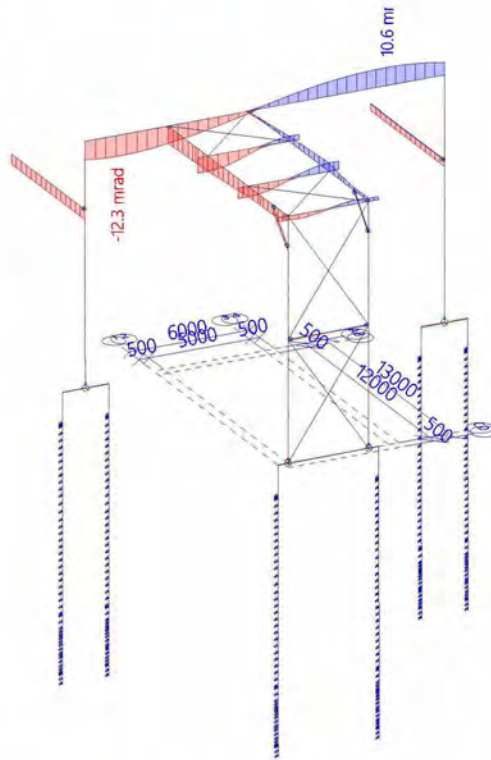
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle





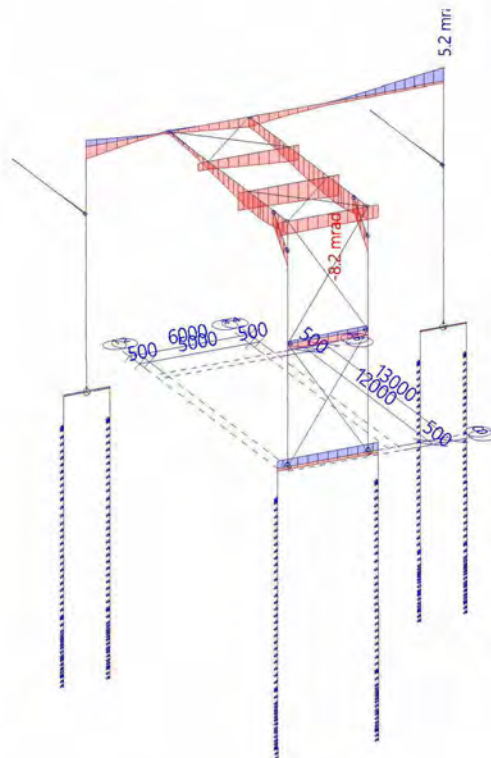
### 2.1.3.5. Resultaten - $\varphi_x$

Waardes:  $\varphi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle



### 2.1.3.6. Resultaten - $\varphi_y$

Waardes:  $\varphi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle







### 2.1.3.7. Resultaten - $\varphi_z$

Waardes:  $\varphi_z$

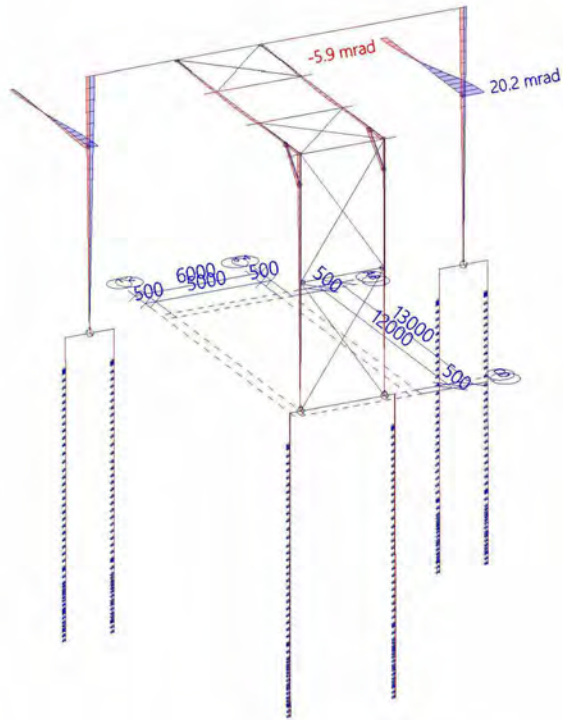
Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Globaal

Extreme 1D: Globaal

Selectie: Alle



### 2.1.3.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$

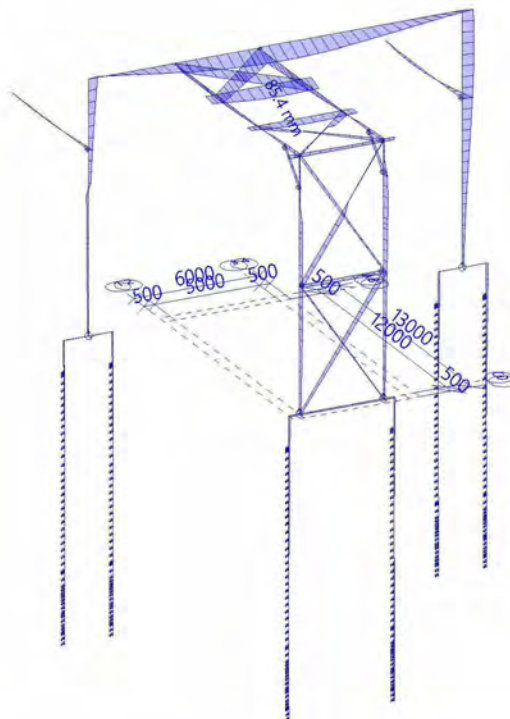
Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Globaal

Extreme 1D: Globaal

Selectie: Alle





## 2.2. Krachten

### 2.2.1. Reactiekrachten

#### 2.2.1.1. Reacties

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle  
**Knoopreacties**

Naam	Belasting	R <sub>x</sub> [kN]	R <sub>y</sub> [kN]	R <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [mm]	ε <sub>y</sub> [mm]
Sb2/S41	NC_UGT-Set B.11	<b>-21.91</b>	-1.30	1.51	0.00	0.00	0.00	0.0	0.0
Sb1/S40	NC_UGT-Set B.5	<b>13.49</b>	-0.57	1.82	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.0	0.0
Sb2/S41	NC_UGT-Set B.7	-8.08	<b>-2.16</b>	1.97	0.00	0.00	0.00	0.0	0.0
Sn8/K52	NC_UGT-Set B.7	0.00	<b>0.64</b>	0.49	0.00	0.00	0.00	0.0	0.0
Sn6/K50	NC_UGT-Set B.12	0.00	0.00	<b>-86.18</b>	0.00	0.00	0.00	0.0	0.0
Sn5/K49	NC_UGT-Set B.7	0.00	0.00	<b>461.60</b>	0.00	0.00	0.00	0.0	0.0

#### Lineaire intensiteit

Naam	dx [mm]	Belasting	R <sub>x</sub> [kN/m]	R <sub>y</sub> [kN/m]	R <sub>z</sub> [kN/m]	M <sub>x</sub> [kNm/m]	M <sub>y</sub> [kNm/m]	M <sub>z</sub> [kNm/m]
Slb3/S5	12500.000	NC_UGT-Set B.11	<b>-51.06</b>	-3.53	0.00	0.00	0.00	0.00
Slb65/S38	12500.000	NC_UGT-Set B.11	<b>4.00</b>	-23.37	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Slb65/S38	12500.000	NC_UGT-Set B.7	3.58	<b>-38.21</b>	0.00	0.00	0.00	0.00
Slb1/S7	12500.000	NC_UGT-Set B.14	-3.58	<b>19.26</b>	0.00	0.00	0.00	0.00

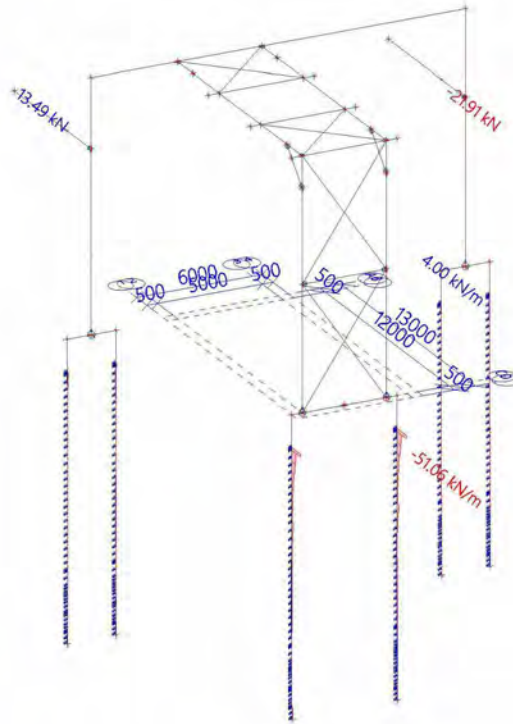
#### Reacties op lijnondersteuning

Naam	dx [mm]	Belasting	R <sub>x</sub> [kN]	R <sub>y</sub> [kN]	R <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	e [mm]
Slb6/S5	11845.000	NC_UGT-Set B.6	<b>-9.84</b>	-0.92	0.00	0.00	0.00	0.00	0.0
Slb18/S5	6088.000	NC_UGT-Set B.11	<b>3.52</b>	-0.02	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.0
Slb66/S38	11845.000	NC_UGT-Set B.7	0.67	<b>-8.19</b>	0.00	0.00	0.00	0.00	0.0
Slb8/S7	11845.000	NC_UGT-Set B.14	-0.67	<b>4.17</b>	0.00	0.00	0.00	0.00	0.0



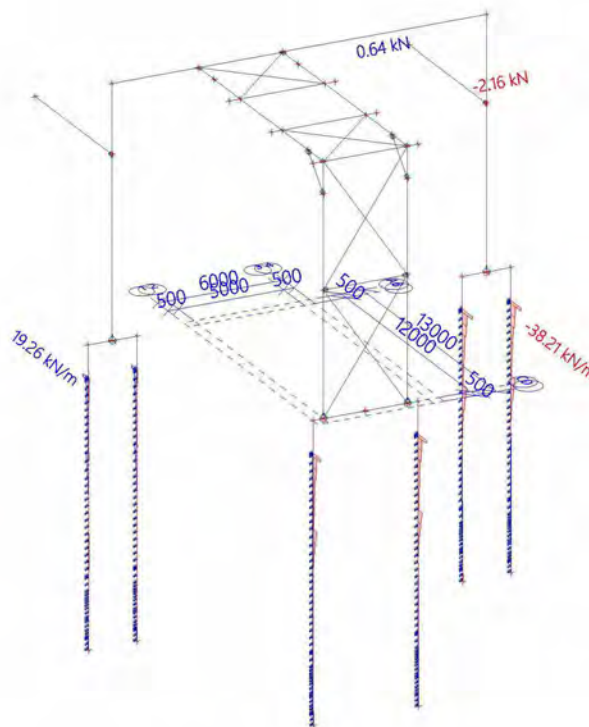
### 2.2.1.2. Resultaten - $R_x$

Waardes:  $R_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.3. Resultaten - $R_y$

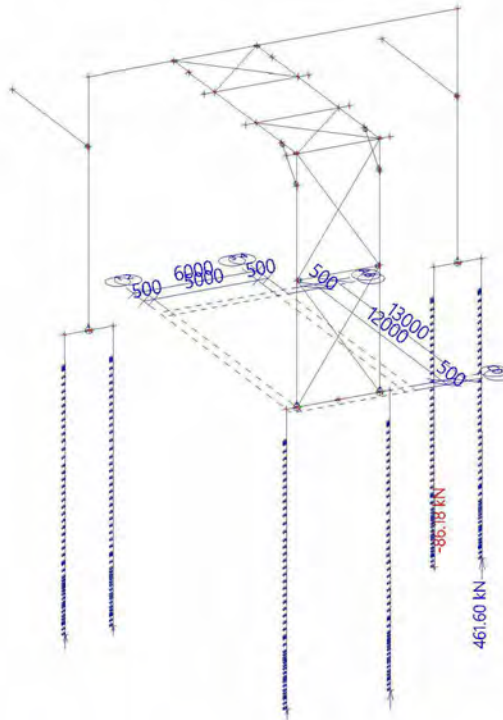
Waardes:  $R_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle





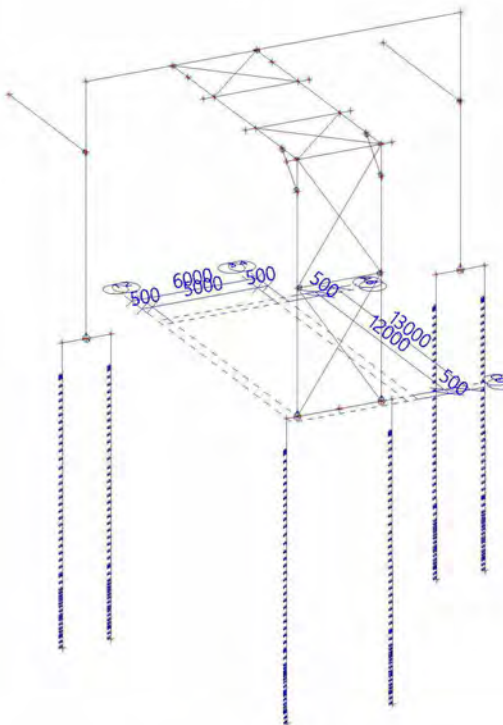
### 2.2.1.4. Resultaten - $R_z$

Waardes:  $R_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.5. Resultaten - $M_x$

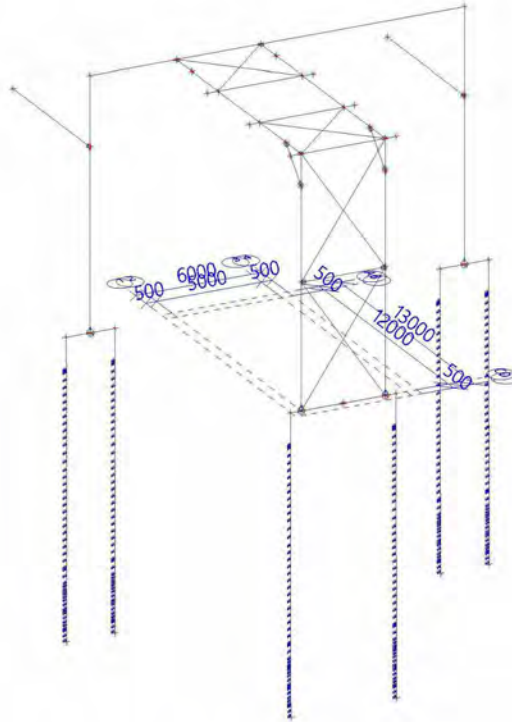
Waardes:  $M_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle





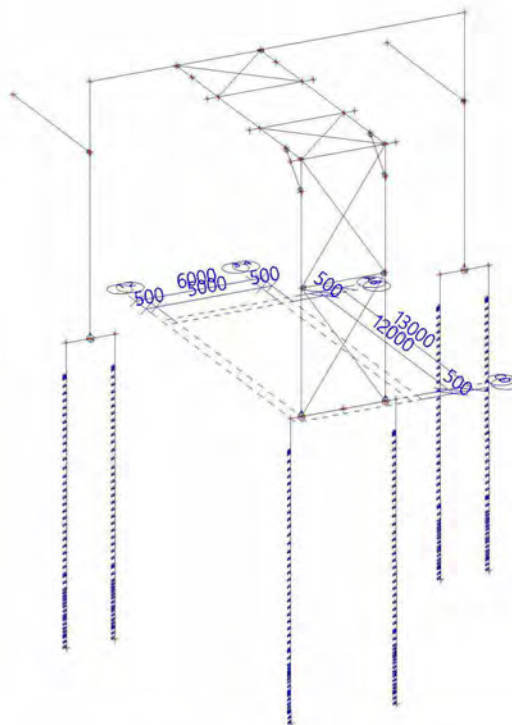
### 2.2.1.6. Resultaten - $M_y$

Waardes:  $M_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.7. Resultaten - $M_z$

Waardes:  $M_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle





## 2.2.2. Interne staafkrachten

### 2.2.2.1. Interne 1D-krachten

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle

Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S37	0.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>43.94</b>	-1.20	-135.82	3.68	77.08	-0.31
S2	5000.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.51	<b>-32.79</b>	-204.43	9.16	-15.79	-0.03
S2	0.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	1.93	<b>25.55</b>	153.11	-21.84	1.54	-0.03
S37	2300.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	-43.07	3.01	<b>-392.98</b>	-3.86	-82.89	0.33
S1	0.000	NC_UGT-Set B.14	BT-12 - Rechthoek (800; 800)	-24.20	1.01	<b>235.71</b>	-3.21	-46.08	0.14
S2	4500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	-3.02	-5.38	-132.87	<b>-35.61</b>	59.30	2.62
S2	0.000	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	0.06	3.95	121.50	<b>32.66</b>	-1.68	0.10
S37	1150.000-	NC_UGT-Set B.12	BT-12 - Rechthoek (800; 800)	40.66	-1.23	-153.81	3.72	<b>-96.86</b>	-1.70
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>-43.11</b>	3.00	-371.28	-3.85	<b>356.56</b>	<b>-3.13</b>
S2	4500.000+	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.52	-32.74	-195.00	9.13	84.06	<b>16.35</b>
S38	0.000	NC_UGT-Set B.7	BT-11 - Cirkel (460)	<b>-461.59</b>	-1.35	1.41	0.00	0.00	0.00
S39	14000.000	NC_UGT-Set B.12	BT-11 - Cirkel (460)	<b>137.68</b>	-40.26	-1.65	0.04	3.21	-86.99
S38	12500.000+	NC_UGT-Set B.7	BT-11 - Cirkel (460)	-400.14	<b>-44.81</b>	-1.78	0.02	5.43	-33.14
S7	12500.000+	NC_UGT-Set B.14	BT-11 - Cirkel (460)	-244.01	<b>23.65</b>	1.73	0.01	-5.43	20.36
S5	6984.000+	NC_UGT-Set B.11	BT-11 - Cirkel (460)	-196.51	0.59	<b>-15.77</b>	0.00	-29.11	2.87
S5	13500.000	NC_UGT-Set B.6	BT-11 - Cirkel (460)	-206.77	-6.16	<b>33.41</b>	-0.07	-13.16	-14.94
S5	14000.000	NC_UGT-Set B.12	BT-11 - Cirkel (460)	-323.20	-37.28	18.79	<b>-0.12</b>	26.12	-92.60
S5	14000.000	NC_UGT-Set B.5	BT-11 - Cirkel (460)	-270.72	-32.89	5.88	<b>0.09</b>	32.80	-81.70
S5	10573.333-	NC_UGT-Set B.11	BT-11 - Cirkel (460)	-186.36	-2.28	-5.36	-0.01	<b>-70.60</b>	-0.36
S5	14000.000	NC_UGT-Set B.14	BT-11 - Cirkel (460)	-228.15	-8.73	20.02	-0.02	<b>40.35</b>	-24.52
S38	14000.000	NC_UGT-Set B.7	BT-11 - Cirkel (460)	-392.85	-44.25	-1.83	0.05	2.72	<b>-100.02</b>
S7	14000.000	NC_UGT-Set	BT-11 -	-235.77	23.49	1.72	0.03	-2.85	<b>55.74</b>



Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
		B.14	Cirkel (460)						
S8	0.000	NC_UGT-Set B.14	ST-17 - HEA450	<b>-229.28</b>	3.12	-45.91	-0.12	116.74	-5.98
S15	0.000	NC_UGT-Set B.10	ST-17 - HEA450	<b>-2.97</b>	-7.80	66.34	-0.55	-70.48	0.61
S15	4117.000-	NC_UGT-Set B.7	ST-17 - HEA450	-27.56	<b>-10.90</b>	109.19	-0.78	321.25	-36.59
S8	8550.000+	NC_UGT-Set B.11	ST-17 - HEA450	-164.69	<b>13.29</b>	-30.71	0.75	-208.21	-35.50
S15	17790.000	NC_UGT-Set B.14	ST-17 - HEA450	-61.84	-3.54	<b>-195.06</b>	1.04	-483.80	-0.23
S15	0.000	NC_UGT-Set B.14	ST-17 - HEA450	-43.82	-7.29	<b>207.64</b>	-1.97	-409.38	3.00
S11	11820.000	NC_UGT-Set B.6	ST-17 - HEA450	-181.57	9.58	60.19	<b>-4.02</b>	469.45	4.29
S15	0.000	NC_UGT-Set B.11	ST-17 - HEA450	-30.20	10.34	160.70	<b>2.71</b>	-300.11	-1.14
S15	17790.000	NC_UGT-Set B.7	ST-17 - HEA450	-76.35	-4.80	-194.72	0.36	<b>-557.26</b>	-0.85
S11	11820.000	NC_UGT-Set B.7	ST-17 - HEA450	-194.48	5.38	76.93	-2.65	<b>574.36</b>	0.50
S11	7750.000-	NC_UGT-Set B.11	ST-17 - HEA450	-163.34	-9.30	54.66	-1.02	191.61	<b>-41.95</b>
S8	8550.000+	NC_UGT-Set B.5	ST-17 - HEA450	-98.13	-9.49	-6.86	-0.34	-102.87	<b>28.59</b>
S10	0.000	NC_UGT-Set B.7	ST-11 - IPE600	<b>-310.08</b>	-1.63	20.70	0.02	3.19	0.00
S10	11820.000	NC_UGT-Set B.11	ST-11 - IPE600	<b>34.74</b>	-2.25	-127.36	-0.10	56.64	-10.07
S10	5910.000+	NC_UGT-Set B.7	ST-11 - IPE600	-198.57	<b>-5.90</b>	20.14	0.34	124.29	6.45
S9	11820.000	NC_UGT-Set B.7	ST-11 - IPE600	1.29	<b>3.72</b>	-96.48	0.12	42.67	7.45
S10	0.000	NC_UGT-Set B.6	ST-11 - IPE600	-158.23	0.49	<b>33.91</b>	0.00	-29.83	0.01
S10	11820.000	NC_UGT-Set B.6	ST-11 - IPE600	33.01	-2.51	<b>-138.92</b>	<b>-0.12</b>	61.25	-11.40
S9	10320.000+	NC_UGT-Set B.7	ST-11 - IPE600	-0.99	2.31	-96.49	<b>0.37</b>	187.40	2.99
S10	0.000	NC_UGT-Set B.11	ST-11 - IPE600	-137.82	0.43	32.44	0.01	<b>-37.47</b>	0.01
S10	10320.000+	NC_UGT-Set B.6	ST-11 - IPE600	30.63	-2.45	-137.61	-0.11	<b>268.62</b>	-7.69
S10	11820.000	NC_UGT-Set B.14	ST-11 - IPE600	-0.73	-2.45	-116.38	-0.05	50.53	<b>-12.25</b>
S9	11820.000	NC_UGT-Set B.14	ST-11 - IPE600	-3.66	2.27	-95.57	0.08	40.40	<b>10.66</b>
S12	8000.000+	NC_UGT-Set B.7	ST-12 - IPE450	<b>-48.04</b>	-7.79	-62.10	-0.23	60.52	7.22
S13	12000.000	NC_UGT-Set B.6	ST-12 - IPE450	<b>118.53</b>	0.84	88.10	0.20	-88.32	-0.22
S13	8000.000+	NC_UGT-Set B.7	ST-12 - IPE450	-17.21	<b>-8.15</b>	-62.23	0.02	20.20	6.14
S13	10500.000-	NC_UGT-Set B.6	ST-12 - IPE450	-41.75	0.28	<b>-71.16</b>	0.63	-185.49	-1.08
S12	4000.000-	NC_UGT-Set B.7	ST-12 - IPE450	-45.74	6.34	28.26	<b>-0.49</b>	125.99	0.58
S13	10500.000-	NC_UGT-Set B.7	ST-12 - IPE450	-17.29	-0.11	-64.57	<b>0.69</b>	-138.36	-3.82
S13	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	118.24	0.71	<b>89.88</b>	0.56	<b>-221.72</b>	-1.11



Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S12	4000.000+	NC_UGT-Set B.14	ST-12 - IPE450	-18.03	1.40	-14.23	-0.26	<b>126.94</b>	-3.85
S12	2000.000	NC_UGT-Set B.7	ST-12 - IPE450	-45.69	0.11	30.19	-0.18	67.52	<b>-6.04</b>
S13	8000.000-	NC_UGT-Set B.7	ST-12 - IPE450	23.36	<b>8.71</b>	-22.17	-0.17	10.69	<b>9.10</b>
S23	3000.000	NC_UGT-Set B.7	ST-13 - HEA180	<b>-59.12</b>	0.00	-0.44	0.00	0.65	0.00
S16	500.000+	NC_UGT-Set B.14	ST-13 - HEA180	<b>1.62</b>	1.03	34.79	0.02	-1.72	<b>0.44</b>
S18	4500.000-	NC_UGT-Set B.11	ST-13 - HEA180	-30.89	<b>-3.09</b>	-29.90	0.01	-14.40	-0.30
S18	4500.000-	NC_UGT-Set B.14	ST-13 - HEA180	-30.50	-1.64	<b>-35.77</b>	0.00	-17.08	-0.11
S17	500.000+	NC_UGT-Set B.14	ST-13 - HEA180	-17.82	0.64	<b>35.41</b>	0.02	-4.13	0.40
S18	500.000+	NC_UGT-Set B.6	ST-13 - HEA180	-29.57	2.90	32.95	<b>0.06</b>	-14.52	-0.02
S18	4500.000-	NC_UGT-Set B.7	ST-13 - HEA180	-50.08	-1.70	-34.10	0.03	<b>-17.33</b>	-0.10
S16	2500.000-	NC_UGT-Set B.14	ST-13 - HEA180	-0.62	-0.56	-0.36	0.02	<b>32.74</b>	0.98
S16	500.000+	NC_UGT-Set B.11	ST-13 - HEA180	-2.08	<b>3.80</b>	29.50	<b>-0.02</b>	-2.47	<b>-3.40</b>
S18	2500.000-	NC_UGT-Set B.6	ST-13 - HEA180	-31.48	-0.07	-0.42	0.03	18.09	<b>2.96</b>
S22	0.000	NC_UGT-Set B.6	ST-14 - HEA120	<b>-227.36</b>	0.00	0.19	0.00	0.00	0.00
S21	2121.320	NC_UGT-Set B.2	ST-14 - HEA120	<b>-41.80</b>	0.00	-0.14	0.00	0.00	0.00
S21	2121.320	NC_UGT-Set B.14	ST-14 - HEA120	-152.18	<b>-0.01</b>	-0.21	-0.01	0.00	0.00
S22	2121.320	NC_UGT-Set B.8	ST-14 - HEA120	-183.02	<b>0.00</b>	-0.19	0.00	0.00	0.00
S22	2121.320	NC_UGT-Set B.14	ST-14 - HEA120	-191.47	0.00	<b>-0.21</b>	<b>0.01</b>	0.00	0.00
S22	0.000	NC_UGT-Set B.14	ST-14 - HEA120	-191.87	0.00	<b>0.21</b>	0.01	0.00	0.00
S21	2121.320	NC_UGT-Set B.6	ST-14 - HEA120	-185.46	0.00	-0.19	<b>-0.01</b>	0.00	0.00
S21	0.000	NC_UGT-Set B.7	ST-14 - HEA120	-154.09	0.00	0.19	-0.01	<b>0.00</b>	0.00
S22	1060.660	NC_UGT-Set B.14	ST-14 - HEA120	-191.67	0.00	0.00	0.01	<b>0.11</b>	0.00
S22	1590.990	NC_UGT-Set B.7	ST-14 - HEA120	-183.19	0.00	-0.10	0.00	0.08	<b>0.00</b>
S21	530.330	NC_UGT-Set B.7	ST-14 - HEA120	-154.00	0.00	0.09	-0.01	0.08	<b>0.00</b>
S25	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	<b>122.97</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
S25	0.000	NC_UGT-Set B.4	ST-15 - FLA80/10	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>
S35	0.000	NC_UGT-Set B.7	ST-16 - L60X6	<b>53.49</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
S33	0.000	NC_UGT-Set B.1	ST-16 - L60X6	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>
S40	2423.000-	NC_UGT-Set B.5	ST-18 - UNP200	<b>-13.49</b>	-0.43	-0.83	-0.01	-1.12	-1.13
S41	7423.000	NC_UGT-Set B.11	ST-18 - UNP200	<b>21.92</b>	-0.64	0.17	0.00	0.00	0.00
S41	5000.000+	NC_UGT-Set	ST-18 -	8.11	<b>-1.39</b>	0.93	-0.02	-1.35	3.20





Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S41	5000.000-	B.7 NC_UGT-Set B.14	ST-18 - UNP200	0.00	0.35	-1.15	-0.01	-1.49	1.75
S40	2423.000+	NC_UGT-Set B.14	ST-18 - UNP200	0.00	-0.04	1.15	0.00	-1.48	0.23
S41	5000.000-	B.7 NC_UGT-Set	ST-18 - UNP200	-0.01	<b>0.64</b>	-1.03	<b>-0.02</b>	-1.35	<b>3.20</b>
S40	2423.000+	B.1 NC_UGT-Set	ST-18 - UNP200	0.00	-0.11	1.10	<b>0.00</b>	-1.23	0.56
S41	5000.000+	B.14 NC_UGT-Set	ST-18 - UNP200	6.37	-0.75	1.03	-0.01	<b>-1.49</b>	1.75
S41	2000.000	B.1 NC_UGT-Set	ST-18 - UNP200	0.00	0.11	-0.07	0.00	<b>0.53</b>	0.23
S40	2423.000+	B.12 NC_UGT-Set	ST-18 - UNP200	0.00	0.33	0.79	-0.01	-1.08	<b>-1.62</b>

### 2.2.2.2. Resultaten - N

Waardes: N

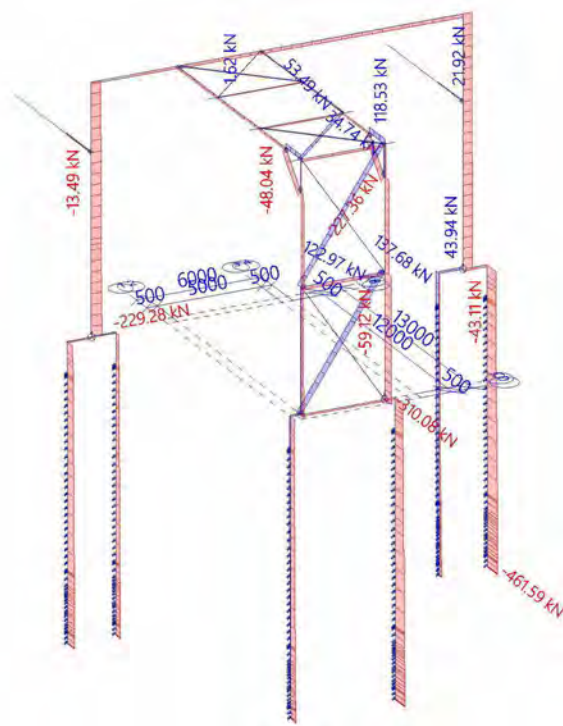
Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Hoofd

Extreme 1D: Doorsnede

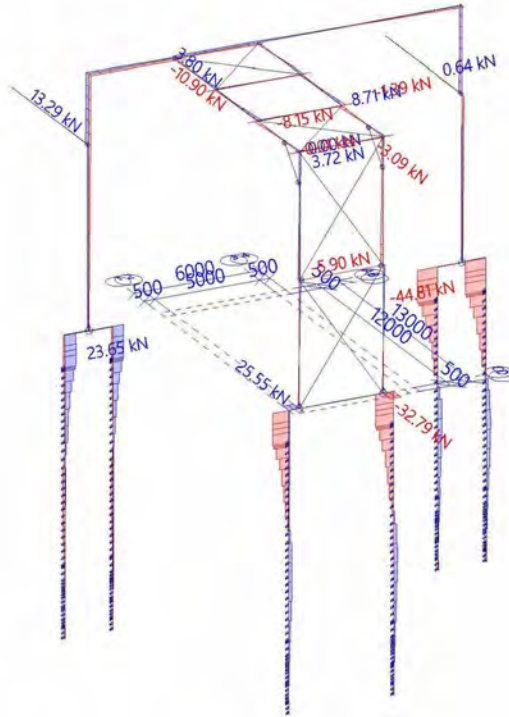
Selectie: Alle





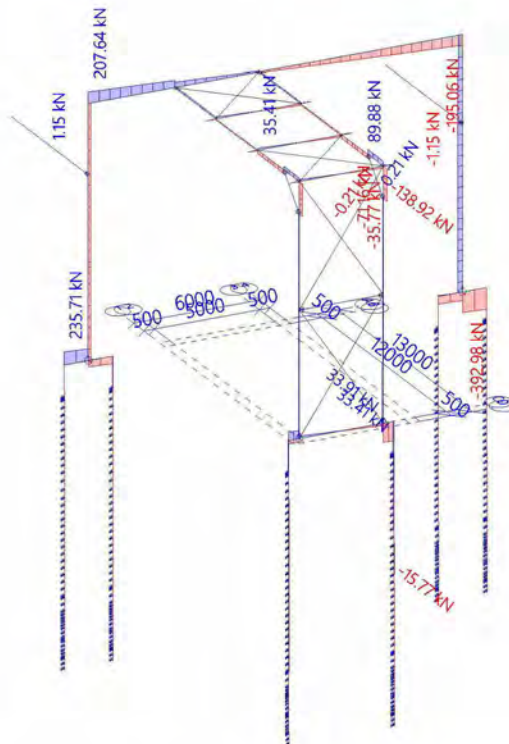
### 2.2.2.3. Resultaten - $V_y$

Waardes:  $V_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.2.4. Resultaten - $V_z$

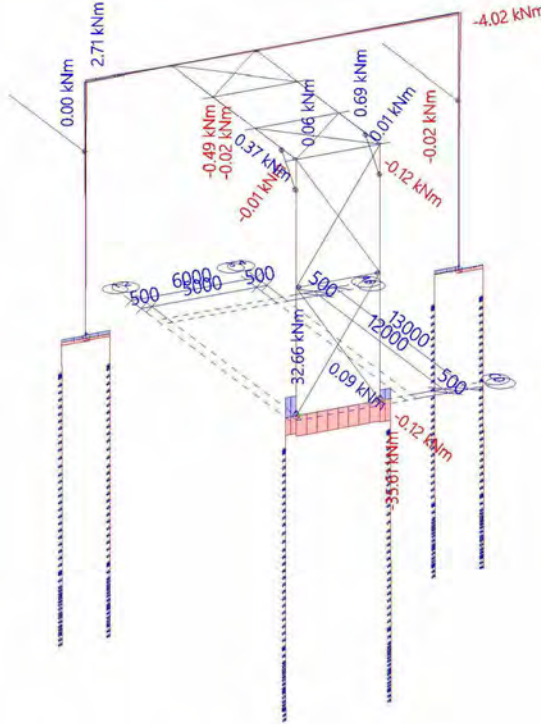
Waardes:  $V_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





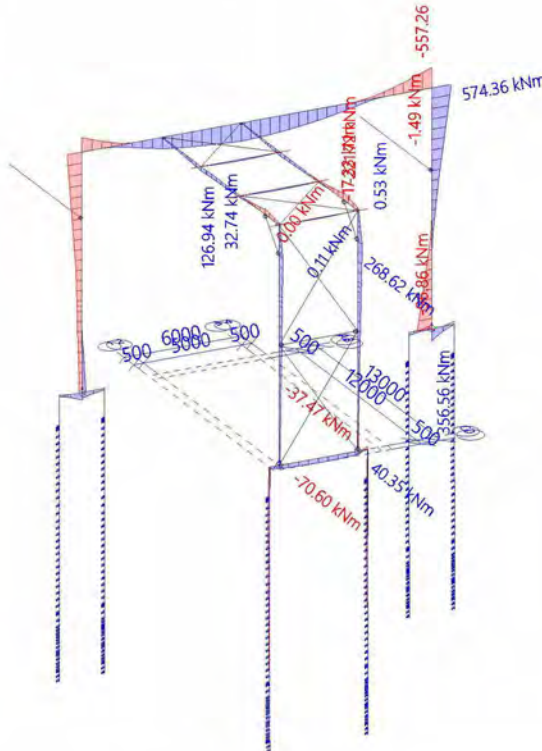
### 2.2.2.5. Resultaten - $M_x$

Waardes:  $M_x$   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle



### 2.2.2.6. Resultaten - $M_y$

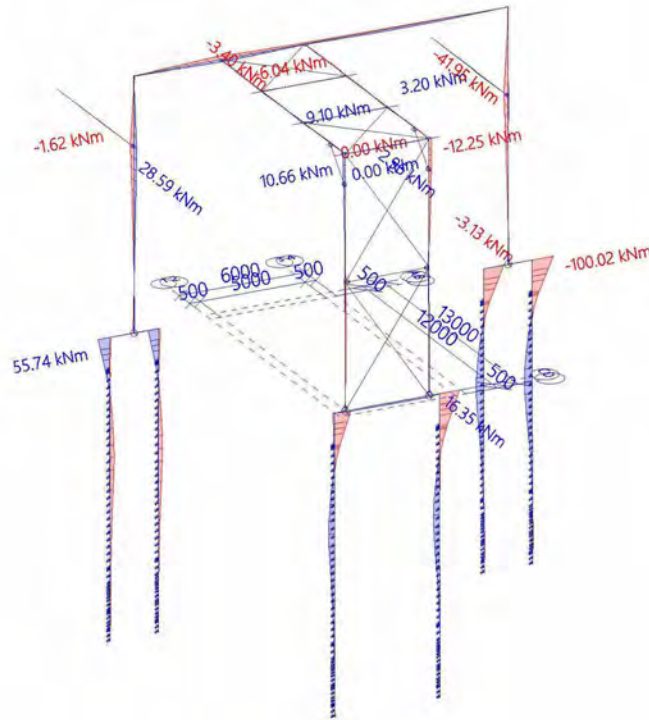
Waardes:  $M_y$   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle





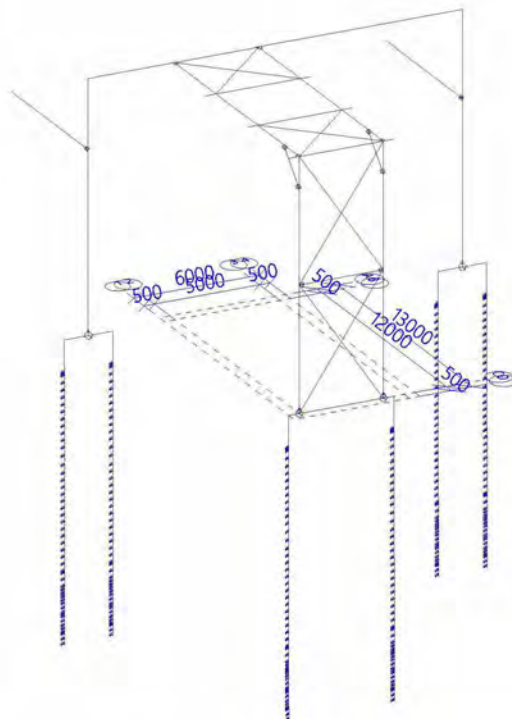
### 2.2.2.7. Resultaten - $M_z$

Waardes:  $M_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.2.8. Resultaten - $V_r$

Waardes:  $V_r$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





## 2.2.3. 3D stress

### 2.2.3.1. 3D spanning

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Selectie: Alle

Locatie: In knooppunten geen gem., Systeem: LCS net element

Hoofd grootheden

#### Resultaten op 1D-element

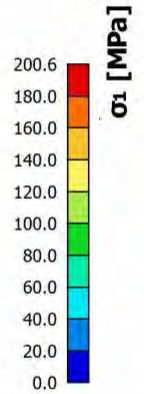
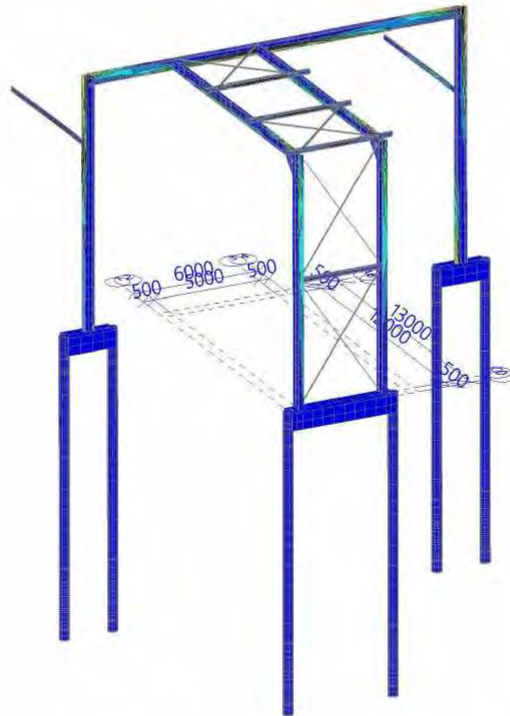
Extreme 1D: Doorsnede

Naam	dx [mm]	Vezel	Belasting	Doorsnede	$\sigma_1$ [MPa]	$\sigma_2$ [MPa]	$T_{tot}$ [MPa]	$\sigma_E$ [MPa]
S37	1150.000+	5	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	0.0	-4.3	0.0	<b>4.3</b>
S38	14000.000	16	NC_UGT-Set B.7	BT-11 - Cirkel (460)	0.0	-12.8	0.0	<b>12.8</b>
S11	11820.000	14	NC_UGT-Set B.7	ST-17 - HEA450	3.5	-212.6	27.4	<b>214.4</b>
S10	10320.000-	15	NC_UGT-Set B.6	ST-11 - IPE600	0.0	-120.8	1.3	<b>120.8</b>
S13	10500.000+	13	NC_UGT-Set B.6	ST-12 - IPE450	166.8	-0.9	12.2	<b>167.3</b>
S16	2500.000-	13	NC_UGT-Set B.14	ST-13 - HEA180	0.0	-121.1	1.3	<b>121.1</b>
S22	1060.660	15	NC_UGT-Set B.6	ST-14 - HEA120	0.0	-90.6	0.6	<b>90.6</b>
S25	7136.393	1	NC_UGT-Set B.7	ST-15 - FLA80/10	153.7	0.0	0.0	<b>153.7</b>
S35	0.000	1	NC_UGT-Set B.7	ST-16 - L60X6	77.4	0.0	0.0	<b>77.4</b>
S41	5000.000-	5	NC_UGT-Set B.7	ST-18 - UNP200	0.4	-126.3	6.7	<b>126.5</b>



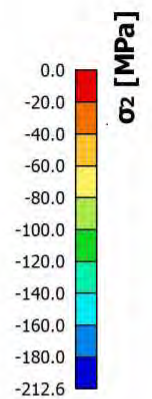
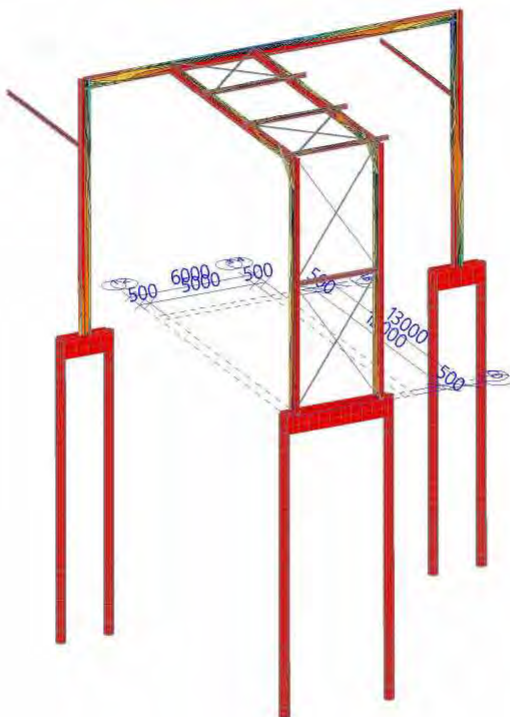
### 2.2.3.2. Resultaten - $\sigma_1$

Waardes:  $\sigma_1$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden



### 2.2.3.3. Resultaten - $\sigma_2$

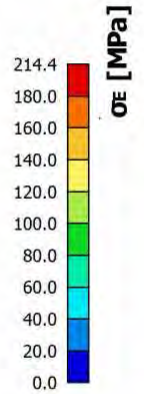
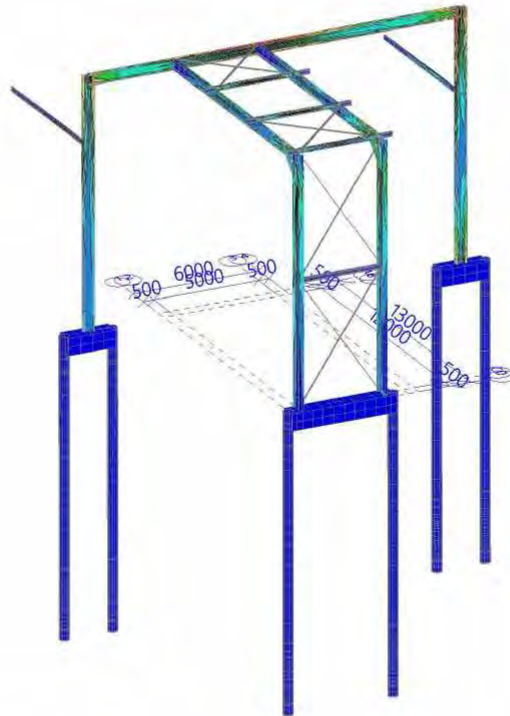
Waardes:  $\sigma_2$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden





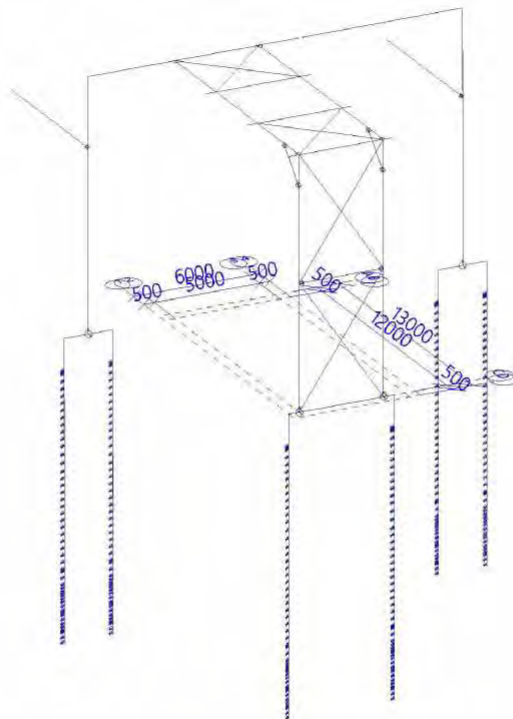
### 2.2.3.4. Resultaten - $\sigma_E$

Waardes:  $\sigma_E$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden



### 2.2.3.5. Resultaten - $\tau_{max,b}$ (2D)

Waardes:  $\tau_{max,b}$  (2D)  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

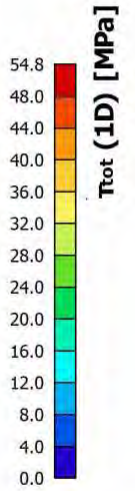
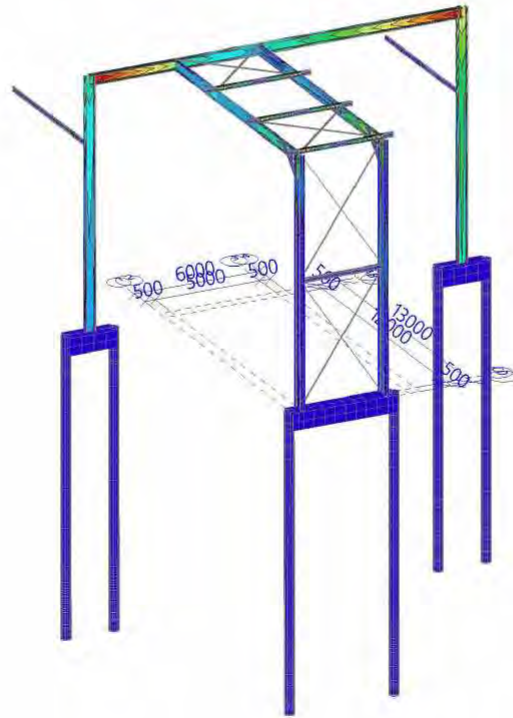
Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.6  
29/32

### 2.2.3.6. Resultaten - $\tau_{tot}$ (1D)

Waardes:  $\tau_{tot}$  (1D)

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden







## 2.2.4. 1D stress

### 2.2.4.1. 1D-spanningen

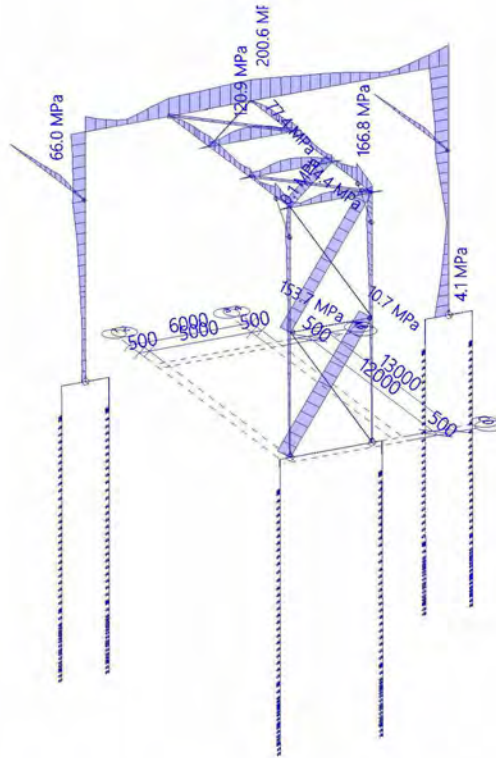
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle

Naam	dx [mm]	Vezel	Belasting	Doorsnede	$\sigma_1$ [MPa]	$\sigma_2$ [MPa]	T <sub>tot.</sub> [MPa]	$\sigma_E$ [MPa]
S37	1150.000+	5	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	0.0	-4.3	0.0	<b>4.3</b>
S38	14000.000	16	NC_UGT-Set B.7	BT-11 - Cirkel (460)	0.0	-12.8	0.0	<b>12.8</b>
S11	11820.000	14	NC_UGT-Set B.7	ST-17 - HEA450	3.5	-212.6	27.4	<b>214.4</b>
S10	10320.000-	15	NC_UGT-Set B.6	ST-11 - IPE600	0.0	-120.8	1.3	<b>120.8</b>
S13	10500.000+	13	NC_UGT-Set B.6	ST-12 - IPE450	166.8	-0.9	12.2	<b>167.3</b>
S16	2500.000-	13	NC_UGT-Set B.14	ST-13 - HEA180	0.0	-121.1	1.3	<b>121.1</b>
S22	1060.660	15	NC_UGT-Set B.6	ST-14 - HEA120	0.0	-90.6	0.6	<b>90.6</b>
S25	7136.393	1	NC_UGT-Set B.7	ST-15 - FLA80/10	153.7	0.0	0.0	<b>153.7</b>
S35	0.000	1	NC_UGT-Set B.7	ST-16 - L60X6	77.4	0.0	0.0	<b>77.4</b>
S41	5000.000-	5	NC_UGT-Set B.7	ST-18 - UNP200	0.4	-126.3	6.7	<b>126.5</b>



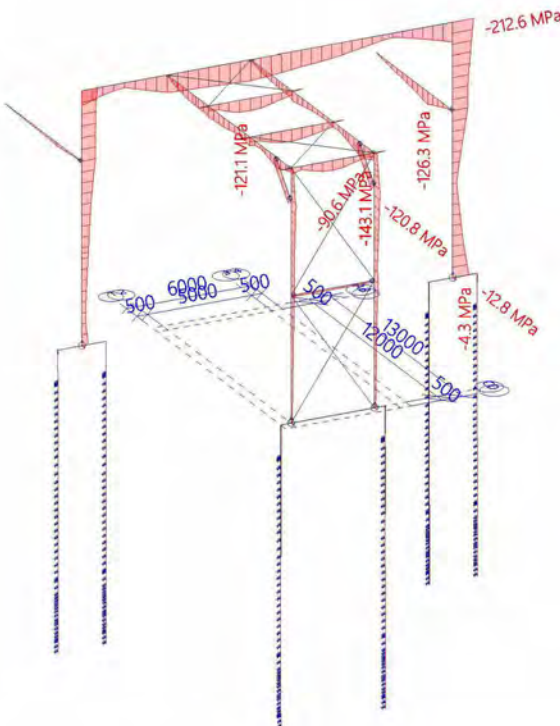
### 2.2.4.2. Resultaten - $\sigma_1$

Waardes:  $\sigma_1$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.4.3. Resultaten - $\sigma_2$

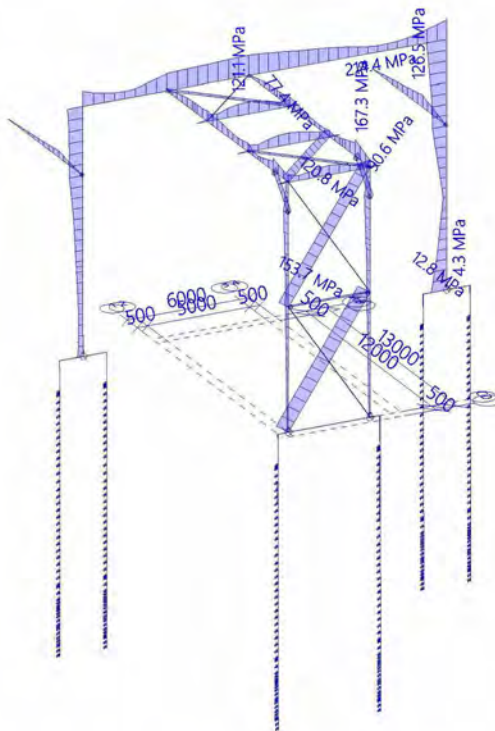
Waardes:  $\sigma_2$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





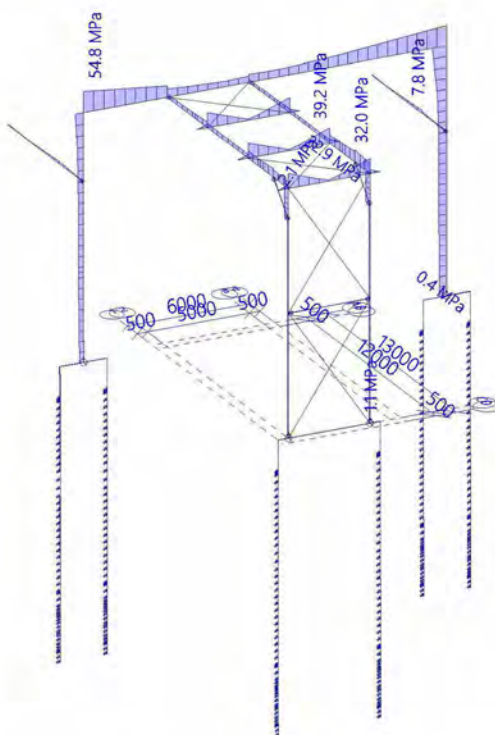
### 2.2.4.4. Resultaten - $\sigma_E$

Waardes:  $\sigma_E$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.4.5. Resultaten - $\tau_{tot}$

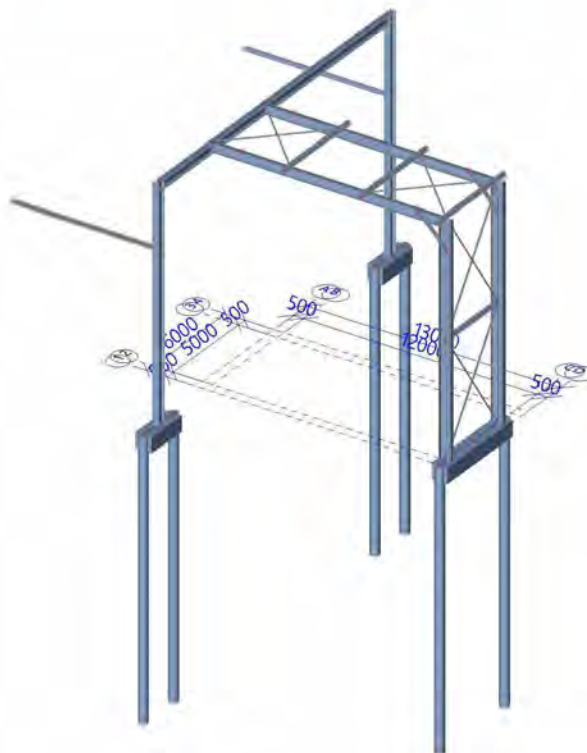
Waardes:  $\tau_{tot}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





# Bijlage 3.

## Uitvoer Staalcontrole





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Staal	3
2.1. Slangheid staal	3
2.2. Iy	5
2.3. Iz	6
2.4. EC-EN 1993 UGT: staalcontrole	6
2.5. EC-EN 1993 UGT: staalcontrole	9
2.6. EC-EN 1993 BGT staalcontrole	33



## 2. Staal

### 2.1. Slankheid staal

Lineaire berekening

Staal	CS Naam	Onderdeel	Ongesch. y		Ly	ky	ly	Lam y	lyz	I kip
			Ja	Nee	[mm]	[-]	[mm]	[-]	[mm]	
			Ongesch. z		Lz	kz	lz	Lam z		
			Ja	Nee	[mm]	[-]	[mm]	[-]		
S8	ST-17	1	Ja	Nee	11820.000	1.45	17163.403	90.73	8550.000	8550.000
					8550.000	0.58	4934.604	67.65		
S8	ST-17	2	Ja	Nee	11820.000	1.45	17163.403	90.73	3270.000	3270.000
					3270.000	0.86	2806.197	38.47		
S9	ST-11	1	Ja	Nee	10320.000	3.06	31619.955	130.15	5910.000	5910.000
					5910.000	0.85	5005.589	107.43		
S9	ST-11	2	Ja	Nee	10320.000	3.06	31619.955	130.15	5910.000	5910.000
					5910.000	0.72	4272.646	91.70		
S9	ST-11	3	Ja	Nee	1500.000	7.08	10625.702	43.74	5910.000	5910.000
					5910.000	0.72	4272.646	91.70		
S10	ST-11	1	Ja	Nee	10320.000	3.05	31427.763	129.36	5910.000	5910.000
					5910.000	0.85	5006.286	107.44		
S10	ST-11	2	Ja	Nee	10320.000	3.05	31427.763	129.36	5910.000	5910.000
					5910.000	0.72	4253.747	91.29		
S10	ST-11	3	Ja	Nee	1500.000	8.23	12338.969	50.79	5910.000	5910.000
					5910.000	0.72	4253.747	91.29		
S11	ST-17	1	Ja	Nee	11820.000	1.62	19147.516	101.22	7750.000	7750.000
					7750.000	0.61	4761.195	65.28		
S11	ST-17	2	Ja	Nee	11820.000	1.62	19147.516	101.22	4070.000	4070.000
					4070.000	0.78	3193.537	43.78		
S12	ST-12	1	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
					4000.000	0.78	3133.085	76.07		
S12	ST-12	2	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
					4000.000	0.78	3133.085	76.07		
S12	ST-12	3	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
					4000.000	0.54	2149.664	52.19		
S12	ST-12	4	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
					4000.000	0.77	3070.091	74.54		
S12	ST-12	5	Ja	Nee	1500.000	3.77	5648.894	30.57	4000.000	4000.000
					4000.000	0.77	3070.091	74.54		
S13	ST-12	1	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
					4000.000	0.79	3146.298	76.39		
S13	ST-12	2	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
					4000.000	0.79	3146.298	76.39		
S13	ST-12	3	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
					4000.000	0.54	2159.187	52.42		
S13	ST-12	4	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
					4000.000	0.77	3083.137	74.86		
S13	ST-12	5	Ja	Nee	1500.000	4.59	6884.252	37.25	4000.000	4000.000
					4000.000	0.77	3083.137	74.86		
S15	ST-17	1	Ja	Nee	17790.001	1.35	24031.170	127.03	4117.000	4117.000
					4117.000	0.87	3575.907	49.03		
S15	ST-17	2	Ja	Nee	17790.001	1.35	24031.170	127.03	4000.000	4000.000
					4000.000	0.75	2992.277	41.02		
S15	ST-17	3	Ja	Nee	17790.001	1.35	24031.170	127.03	9673.000	9673.000
					9673.000	0.81	7818.268	107.19		
S16	ST-13	1	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
					500.000	1.00	499.988	11.06		
S16	ST-13	2	Ja	Nee	5000.000	1.00	5000.000	67.17	4000.000	4000.000
					4000.000	0.55	2212.633	48.97		
S16	ST-13	3	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
					500.000	1.00	499.988	11.06		
S17	ST-13	1	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
					500.000	1.00	499.988	11.06		

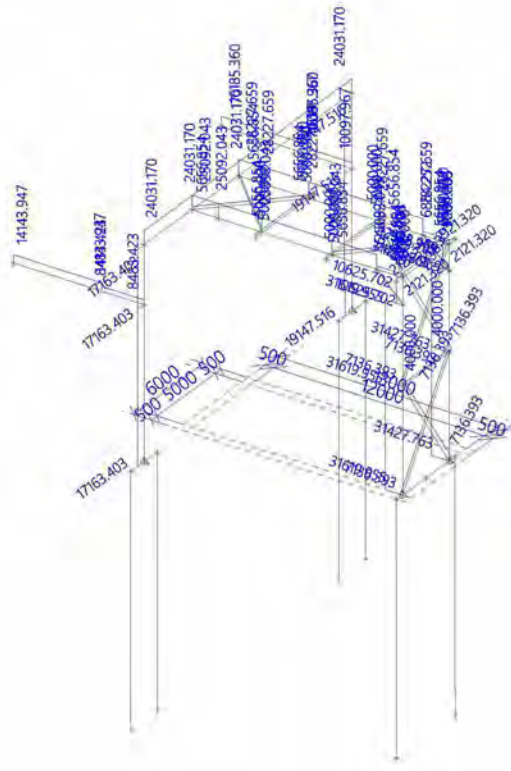


Staal	CS Naam	Onderdeel	Ongesch. y	ly	ky	ly	Lam y	lyz	I kip
				[mm]	[-]	[mm]	[-]	[mm]	
			Ongesch. z	Lz	kz	lz	Lam z		
				[mm]	[-]	[mm]	[-]		
S17	ST-13	2	Ja	5000.000	1.00	5000.000	67.17	4000.000	4000.000
			Nee	4000.000	0.52	2084.736	46.13		
S17	ST-13	3	Ja	5000.000	1.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S18	ST-13	1	Ja	5000.000	10.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S18	ST-13	2	Ja	4000.000	1.82	7284.203	97.86	4000.000	4000.000
			Nee	4000.000	0.99	3967.218	87.79		
S18	ST-13	3	Ja	500.000	10.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S21	ST-14	1	Ja	2121.320	1.00	2121.320	43.34	2121.320	2121.320
			Nee	2121.320	1.00	2121.267	70.20		
S22	ST-14	1	Ja	2121.320	1.00	2121.320	43.34	2121.320	2121.320
			Nee	2121.320	1.00	2121.267	70.20		
S23	ST-13	1	Ja	4000.000	1.00	4000.000	53.74	4000.000	4000.000
			Nee	4000.000	1.00	3999.900	88.52		
S25	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S26	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S27	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S28	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S33	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S34	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S35	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S36	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S40	ST-18	1	Ja	2423.000	3.50	8483.423	110.15	2423.000	2423.000
			Nee	2423.000	0.89	2158.816	100.70		
S40	ST-18	2	Ja	5000.000	2.83	14143.947	183.65	5000.000	5000.000
			Nee	5000.000	0.84	4210.659	196.40		
S41	ST-18	1	Ja	5000.000	3.24	16185.360	210.15	5000.000	5000.000
			Nee	5000.000	0.84	4210.456	196.39		
S41	ST-18	2	Ja	2423.000	4.17	10097.967	131.11	2423.000	2423.000
			Nee	2423.000	0.89	2158.719	100.69		



Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e
			5/39

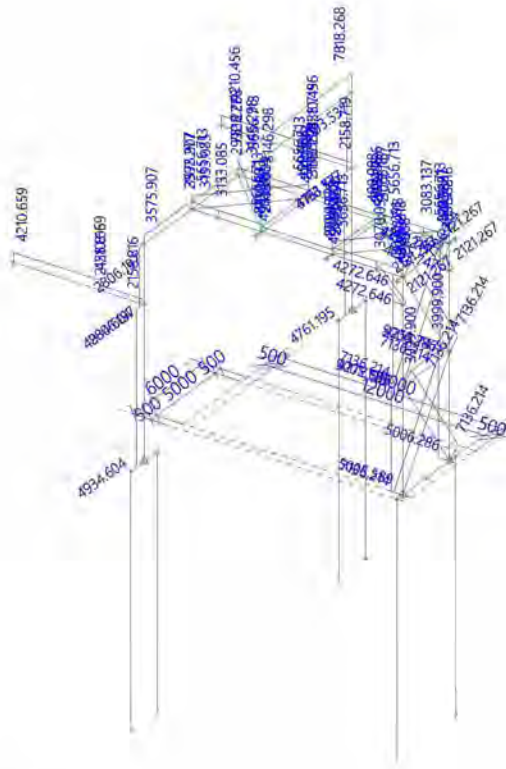
## 2.2. ly







## 2.3. IZ



## 2.4. EC-EN 1993 UGT: staalcontrole

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle

### Algehele eenheidscontrole

Naam	dx [mm]	Belasting	Doorsnede	Materiaal	Algehele eenh. controle [-]	Doorsnede controle [-]	Stab. controle [-]
S8	0.000	NC_UGT-Set B.14	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.67</b>	0.16	0.67
S9	5910.000+	NC_UGT-Set B.6	ST-11 - IPE600	S 235 JR (EN 10025-2)	<b>0.50</b>	0.19	0.50
S10	5910.000+	NC_UGT-Set B.6	ST-11 - IPE600	S 235 JR (EN 10025-2)	<b>0.70</b>	0.20	0.70
S11	0.000	NC_UGT-Set B.7	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.89</b>	0.57	0.89
S12	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	S 235 JR (EN 10025-2)	<b>0.49</b>	0.42	0.49
S13	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	S 235 JR (EN 10025-2)	<b>0.66</b>	0.55	0.66
S15	8117.000-	NC_UGT-Set B.7	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.78</b>	0.68	0.78
S16	3000.000	NC_UGT-Set B.14	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.50</b>	0.40	0.50
S17	3000.000	NC_UGT-Set B.14	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.50</b>	0.38	0.50
S18	4500.000-	NC_UGT-Set B.7	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.34</b>	0.23	0.34
S21	0.000	NC_UGT-Set B.6	ST-14 - HEA120	S 235 JR (EN 10025-2)	<b>0.45</b>	0.31	0.45
S22	0.000	NC_UGT-Set B.6	ST-14 - HEA120	S 235 JR (EN 10025-2)	<b>0.55</b>	0.38	0.55



Naam	dx [mm]	Belasting	Doorsnede	Materiaal	Algehele eenh. controle [-]	Doorsnede controle [-]	Stab. controle [-]
S23	3000.000	NC_UGT-Set B.7	ST-13 - HEA180	10025-2) S 235 JR (EN 10025-2)	0.10	0.06	0.10
S25	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.65	0.65	0.00
S26	7136.393	NC_UGT-Set B.9	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.02	0.02	0.00
S27	7136.393	NC_UGT-Set B.9	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.02	0.02	0.00
S28	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.52	0.52	0.00
S33	0.000	NC_UGT-Set B.12	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.22	0.22	0.00
S34	0.000	NC_UGT-Set B.1	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.03	0.03	0.00
S35	0.000	NC_UGT-Set B.7	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.33	0.33	0.00
S36	0.000	NC_UGT-Set B.6	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.21	0.21	0.00
S40	2423.000-	NC_UGT-Set B.12	ST-18 - UNP200	S 235 JR (EN 10025-2)	0.16	0.16	0.12
S41	5000.000+	NC_UGT-Set B.7	ST-18 - UNP200	S 235 JR (EN 10025-2)	0.30	0.30	0.00

## Resultaten - Gehele controle

Waardes: **Algehele eenh. controle**

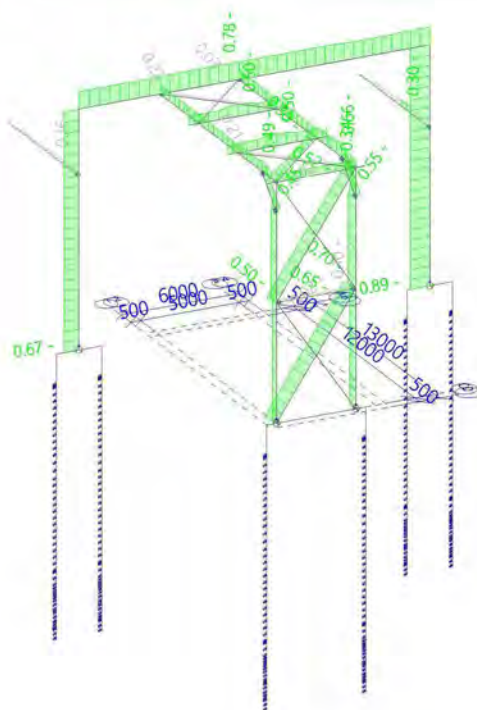
Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Hoofd

Extreme 1D: Element

Selectie: Alle





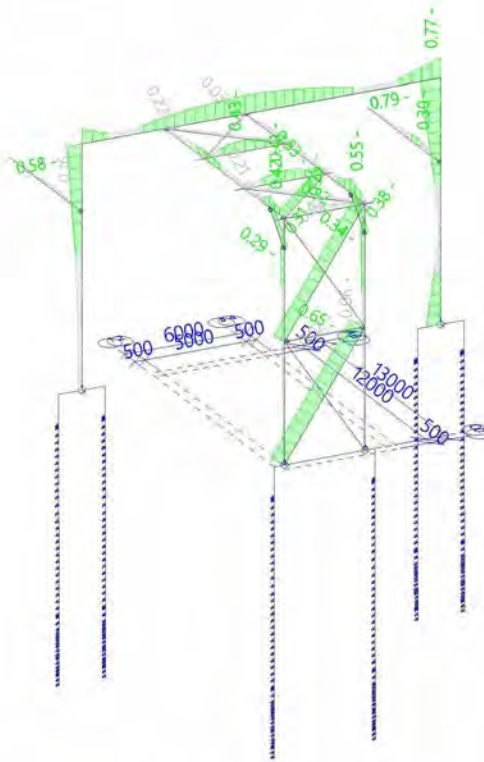
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur 5.1.2.e  
8/39

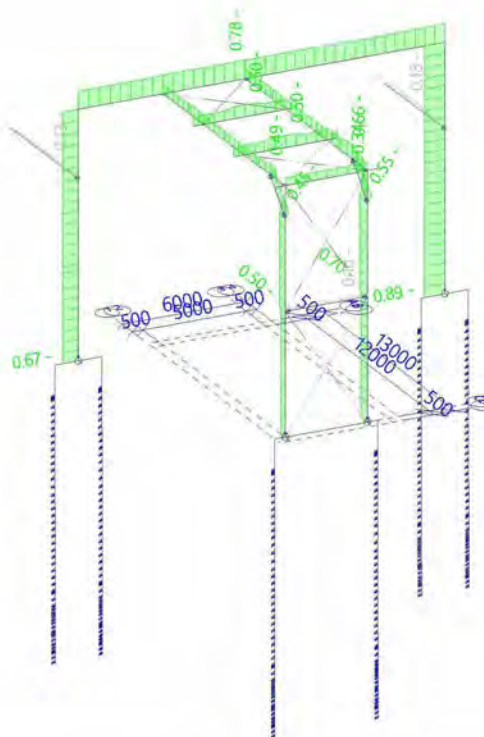
## Resultaten - Doorsnedecontrole

Waardes: **Doorsnede controle**  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - Stabiliteitscontrole

Waardes: **Stab. controle**  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





## 2.5. EC-EN 1993 UGT: staalcontrole

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme ID: Doorsnede  
 Selectie: Alle

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S10	5.910 / 11.820 m	IPE600	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.70 -
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Combinatiesleutel
RK_NC_UGT-Set B / NC_UGT-Set B.6

Partiële veiligheidsfactoren	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

Materiaal			
Vloeisterkte	$f_y$	225.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 5.910 m

Interne krachten		Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-136.05	kN
Dwarskracht	$V_{y,Ed}$	-2.39	kN
Dwarskracht	$V_{z,Ed}$	28.23	kN
Torsie	$T_{Ed}$	0.18	kNm
Buigend moment	$M_{y,Ed}$	154.23	kNm
Buigend moment	$M_{z,Ed}$	2.63	kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse	
										klasse 1	klasse 2	klasse 3		
											[-]	[-]	[-]	
1	SO	80	19	-4.226e+04	-4.848e+04									
3	SO	80	19	-3.759e+04	-3.137e+04									
4	I	514	12	-3.432e+04	5.176e+04	-0.66		0.55	42.83	63.76	74.32	91.82	1	
5	SO	80	19	5.970e+04	6.592e+04	0.91	0.44	1.00	4.21	9.20	10.22	14.19	1	
7	SO	80	19	5.503e+04	4.881e+04	0.89	0.47	1.00	4.21	9.20	10.22	14.73	1	

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.  
 De doorsnede is geclassificeerd als klasse 1

### Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	1.5600e-02	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	3510.00	kN
Eenheidscontrole		0.04	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.5120e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	790.20	kNm
Eenheidscontrole		0.20	-



### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	4.8600e-04	$m^3$
Plastisch buigend moment	$M_{pl,z,Rd}$	109.35	kNm
Eenhedscontrole		0.02	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	8.7920e-03	$m^2$
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	1142.11	kN
Eenhedscontrole		0.00	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	8.3800e-03	$m^2$
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	1088.59	kN
Eenhedscontrole		0.03	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	15	
Totaal torsiemoment	$T_{Ed}$	2.0	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	129.9	MPa
Eenhedscontrole		0.02	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	790.20	kNm
Exponent van buigingsratio $y$	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	109.35	kNm
Exponent van buigingsratio $z$	$\beta$	1.00	

Eenhedscontrole (6.41) =  $0.04 + 0.02 = 0.06$  -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

.....**STABILITEITSCONTROLE**.....

### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 0.985 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2



Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	80	19	8.623e+03	7.449e+03	0.86	0.48	1.00	4.21	9.20	10.22	14.87	1
3	SO	80	19	9.504e+03	1.068e+04	0.89	0.44	1.00	4.21	9.20	10.22	14.21	1
4	I	514	12	9.177e+03	1.092e+04	0.84		1.00	42.83	28.62	34.74	41.11	4
5	SO	80	19	1.148e+04	1.265e+04	0.91	0.44	1.00	4.21	9.20	10.22	14.19	1
7	SO	80	19	1.060e+04	9.421e+03	0.89	0.47	1.00	4.21	9.20	10.22	14.72	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 4

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

### Effectieve doorsnede N-

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_w$ [mm]	$b_{w1}$ [mm]	$b_{w2}$ [mm]
1	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
3	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
4	I	514	2.250e+05	2.250e+05	1.00	4.00	0.74	0.95	489	244	244
5	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
7	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		

### Effectieve doorsnede My+

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_e$ [mm]	$b_{e1}$ [mm]	$b_{e2}$ [mm]
1	SO	80	-2.250e+05	-2.250e+05							
3	SO	80	-2.250e+05	-2.250e+05							
4	I	514	1.991e+05	-1.991e+05	-1.00	23.90	0.30	1.00	257	103	154
5	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
7	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		

### Effectieve doorsnede Mz+

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_e$ [mm]	$b_{e1}$ [mm]	$b_{e2}$ [mm]
1	SO	80	-6.136e+04	-2.250e+05							
3	SO	80	2.250e+05	6.136e+04	0.27	0.52	0.20	1.00	80		
4	I	514	0.000e+00	0.000e+00							
5	SO	80	2.250e+05	6.136e+04	0.27	0.52	0.20	1.00	80		
7	SO	80	-6.136e+04	-2.250e+05							

### Effectieve eigenschappen

Effectieve oppervlakte	$A_{eff}$	1.5300e-02	m <sup>2</sup>				
Effectieve traagheidsmoment	$I_{eff,y}$	9.2100e-04	m <sup>4</sup>	$I_{eff,z}$	3.3874e-05	m <sup>4</sup>	
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>	$W_{eff,z}$	3.0795e-04	m <sup>3</sup>	
Verschuiving van het zwaartepunt	$e_{N,y}$	0	mm	$e_{N,z}$	0	mm	

### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)



Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	10.320	5.910	m
Knikfactor	k	3.05	0.72	
Kniklengte	$l_{cr}$	31.428	4.254	m
Kritische Euler last	$N_{cr}$	1932.22	3879.64	kN
Slankheid	$\lambda$	129.36	91.29	
Relatieve slankheid	$\lambda_{rel}$	1.33	0.94	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		a	b	
Imperfectie	$\alpha$	0.21	0.34	
Reductie factor	$\chi$	0.45	0.63	
Knikweerstand	$N_{b,Rd}$	1553.52	2183.05	kN

Buigingsknikverificatie			
Effectieve oppervlakte van de doorsnede	$A_{eff}$	1.5300e-02	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	1553.52	kN
Eenhedscontrole		0.09	-

### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	938.34	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.86	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		c	
Imperfectie	$\alpha_{LT}$	0.49	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.73	
Correctiefactor	$k_c$	0.91	
Correctiefactor	f	0.96	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.76	
Rekenwaarde knikweerstand	$M_{b,Rd}$	525.52	kNm
Eenhedscontrole		0.29	-

M <sub>cr</sub> parameters			
LTB lengte	$l_{LT}$	5.910	m
Vorklengte	$L_g$	5.910	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	858.55	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	C	5.70	
Factor	S	2118	mm
Kip moment factor	$C_1$	1.20	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Effectieve oppervlakte van de doorsnede	$A_{eff}$	1.5300e-02	m <sup>2</sup>
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>
Effectieve doorsnedemodulus	$W_{eff,z}$	3.0795e-04	m <sup>3</sup>



Buig- en axiale drukcontrole parameters			
Ontwerpdrukkracht	$N_{Ed}$	136.05	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	268.62	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	-11.40	kNm
Additioneel moment	$\Delta M_{y,Ed}$	0.00	kNm
Additioneel moment	$\Delta M_{z,Ed}$	0.00	kNm
Karakteristieke drukweerstand	$N_{Rk}$	3442.39	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	690.75	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	69.29	kNm
Reductie factor	$\chi_y$	0.45	
Reductie factor	$\chi_z$	0.63	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.76	
Interactiefactor	$k_{yy}$	0.95	
Interactiefactor	$k_{yz}$	0.77	
Interactiefactor	$k_{zy}$	1.00	
Interactiefactor	$k_{zz}$	0.77	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S10 positie 10.320 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S10 positie 11.820 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.2	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalent moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		puntlast F	
Uiteinde moment	$M_{h,z}$	-11.40	kNm
Veldmoment	$M_{s,z}$	-7.69	kNm
Factor	$\alpha_{s,z}$	0.67	
Ratio van uiteinde momenten	$\psi_z$	-0.23	
Equivalent moment factor	$C_{mz}$	0.74	
Resultierend belastingtype LT		puntlast F	
Uiteinde moment	$M_{h,LT}$	154.23	kNm
Veldmoment	$M_{s,LT}$	268.62	kNm
Factor	$\alpha_{h,LT}$	0.57	
Ratio van uiteinde momenten	$\psi_{LT}$	0.40	
Equivalent moment factor	$C_{mLT}$	0.96	

Eenhedscontrole (6.61) = 0.09 + 0.48 + 0.13 = 0.70 -

Eenhedscontrole (6.62) = 0.06 + 0.51 + 0.13 = 0.70 -

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	11.820	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	562	mm
Lijfdikte	t	12	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

Plooverificatie		
Lijf slankheid	$h_w/t$	46.83
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S11	0.000 / 11.820 m	HEA450	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.89 -
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### Combinatiesleutel

RK\_NC\_UGT-Set B / NC\_UGT-Set B.7

### Partiële veiligheidsfactoren

$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

### Materiaal

Vloei sterkte	$f_y$	225.0	MPa
Trek sterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 0.000 m

Interne krachten		Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-213.51	kN
Dwarskracht	$V_{y,Ed}$	-3.56	kN
Dwarskracht	$V_{z,Ed}$	87.68	kN
Torsie	$T_{Ed}$	-0.17	kNm
Buigend moment	$M_{y,Ed}$	-413.41	kNm
Buigend moment	$M_{z,Ed}$	5.90	kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\sigma$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	117	21	1.458e+05	1.385e+05	0.95	0.45	1.00	5.58	9.20	10.22	14.37	1
3	SO	117	21	1.499e+05	1.572e+05	0.95	0.43	1.00	5.58	9.20	10.22	14.13	1
4	I	344	12	1.236e+05	-9.958e+04	-0.81		0.62	29.91	53.44	63.03	104.02	1
5	SO	117	21	-1.219e+05	-1.146e+05								
7	SO	117	21	-1.259e+05	-1.332e+05								

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

### Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	4005.00	kN
Eenheidscontrole		0.05	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.2167e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	723.75	kNm
Eenheidscontrole		0.57	-

### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	9.6667e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	217.50	kNm
Eenheidscontrole		0.03	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.3043e-02	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	1694.30	kN
Eenheidscontrole		0.00	-

#### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	6.5755e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	854.18	kN
Eenheidscontrole		0.10	-

#### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	1.4	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	129.9	MPa
Eenheidscontrole		0.01	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

#### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	723.75	kNm
Exponent van buigingsratio $y$	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	217.50	kNm
Exponent van buigingsratio $z$	$\beta$	1.00	

Eenheidscontrole (6.41) = 0.33 + 0.03 = 0.35 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

#### .....STABILITEITSCONTROLE:.....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 4.359 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	117	21	2.658e+04	3.871e+04	0.69	0.46	1.00	5.58	9.20	10.22	14.54	1
3	SO	117	21	1.981e+04	7.677e+03	0.39	0.79	1.00	5.58	9.20	10.22	19.13	1
4	I	344	12	2.111e+04	1.984e+03	0.09		1.00	29.91	28.62	34.74	56.64	2
5	SO	117	21	-3.489e+03	-1.562e+04								
7	SO	117	21	3.287e+03	1.542e+04	0.21	0.53	1.00	5.58	9.20	10.22	15.60	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 2

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.



## Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	11.820	7.750	m
Knikfactor	k	1.62	0.61	
Kniklengte	$l_{cr}$	19.148	4.761	m
Kritische Euler last	$N_{cr}$	3601.09	8658.39	kN
Slankheid	$\lambda$	101.22	65.28	
Relatieve slankheid	$\lambda_{rel}$	1.05	0.68	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		a	b	
Imperfectie	$\alpha$	0.21	0.34	
Reductie factor	$\chi$	0.63	0.79	
Knikweerstand	$N_{b,Rd}$	2512.80	3183.25	kN

Buigingsknikverificatie			
Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	2512.80	kN
Eenheidscontrole		0.08	-

## Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

## Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Plastische doorsnedemodulus	$W_{pl,y}$	3.2167e-03	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	2425.10	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.55	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		b	
Imperfectie	$\alpha_{LT}$	0.34	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.94	
Correctiefactor	$k_c$	0.66	
Correctiefactor	f	0.85	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	1.00	
Rekenwaarde knikweerstand	$M_{b,Rd}$	723.75	kNm
Eenheidscontrole		0.57	-

Mcr parameters			
LTB lengte	$l_{LT}$	7.750	m
Vorklengte	$L_g$	7.750	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	575.00	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	C	9.49	
Factor	S	2102	mm
Kip moment factor	$C_1$	2.30	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

## Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)



Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Plastische doorsnedemodulus	W <sub>pl,y</sub>	3.2167e-03	m <sup>3</sup>
Plastische doorsnedemodulus	W <sub>pl,z</sub>	9.6667e-04	m <sup>3</sup>
Ontwerpdrukkracht	N <sub>Ed</sub>	213.51	kN
Ontwerp buigend moment (maximum)	M <sub>y,Ed</sub>	574.36	kNm
Ontwerp buigend moment (maximum)	M <sub>z,Ed</sub>	-20.91	kNm
Karakteristieke drukweerstand	N <sub>Rk</sub>	4005.00	kN
Karakteristieke momentweerstand	M <sub>y,Rk</sub>	723.75	kNm
Karakteristieke momentweerstand	M <sub>z,Rk</sub>	217.50	kNm
Reductie factor	χ <sub>y</sub>	0.63	
Reductie factor	χ <sub>z</sub>	0.79	
Gewijzigde reductiefactor	χ <sub>LT,mod</sub>	1.00	
Interactiefactor	k <sub>yy</sub>	0.96	
Interactiefactor	k <sub>yz</sub>	0.40	
Interactiefactor	k <sub>zy</sub>	0.58	
Interactiefactor	k <sub>zz</sub>	0.67	

Maximum moment M<sub>y,Ed</sub> is afgeleid van balk S11 positie 11.820 m.

Maximum moment M<sub>z,Ed</sub> is afgeleid van balk S11 positie 7.750 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.1	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalente moment factor	C <sub>my</sub>	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	M <sub>h,z</sub>	-20.91	kNm
Veldmoment	M <sub>s,z</sub>	-11.48	kNm
Factor	α <sub>s,z</sub>	0.55	
Ratio van uiteinde momenten	ψ <sub>z</sub>	-0.28	
Equivalente moment factor	C <sub>mz</sub>	0.64	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	M <sub>h,LT</sub>	-413.41	kNm
Veldmoment	M <sub>s,LT</sub>	-35.43	kNm
Factor	α <sub>s,LT</sub>	0.09	
Ratio van uiteinde momenten	ψ <sub>LT</sub>	-0.60	
Equivalente moment factor	C <sub>mLT</sub>	0.40	

Eenheidscontrole (6.61) = 0.08 + 0.76 + 0.04 = 0.89 -

Eenheidscontrole (6.62) = 0.07 + 0.46 + 0.06 = 0.59 -

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	11.820	m
Lijf		niet-verstijfd	
Lijfhoogte	h <sub>w</sub>	398	mm
Lijfdikte	t	12	mm
Materiaal coëfficiënt	ε	1.00	
Correctiefactor voor dwarskracht	η	1.20	

Plooi verificatie		
Lijf slankheid	h <sub>w</sub> /t	34.61
Lijfslankheid IImlet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S13	10.500 / 12.000 m	IPE450	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.66 -
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<b>Combinatiesleutel</b>	
RK_NC_UGT-Set B / NC_UGT-Set B.6	

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>			
Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 10.500 m

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	118.24 kN
Dwarskracht	$V_{y,Ed}$	0.71 kN
Dwarskracht	$V_{z,Ed}$	89.88 kN
Torsie	$T_{Ed}$	0.56 kNm
Buigend moment	$M_{y,Ed}$	-221.72 kNm
Buigend moment	$M_{z,Ed}$	-1.11 kNm

#### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	69	15	1.327e+05	1.373e+05	0.97	0.43	1.00	4.75	9.00	10.00	13.81	1
3	SO	69	15	1.294e+05	1.248e+05	0.96	0.44	1.00	4.75	9.00	10.00	13.98	1
4	I	379	9	1.125e+05	-1.364e+05	-1.21		0.43	40.30	83.85	96.66	151.08	1
5	SO	69	15	-1.567e+05	-1.612e+05								
7	SO	69	15	-1.533e+05	-1.487e+05								

**Opmerking:** De classificatielimiets zijn ingesteld volgens Semi-Comp+. De doorsnede is geclassificeerd als klasse 1

#### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	9.8800e-03	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	2321.80	kN
Uiterste trekweerstand	$N_{u,Rd}$	2560.90	kN
Trekweerstand	$N_{t,Rd}$	2321.80	kN
Eenhedscontrole		0.05	-

#### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	1.7020e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	399.97	kNm
Eenhedscontrole		0.55	-

#### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	2.7600e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	64.86	kNm
Eenhedscontrole		0.02	-

#### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)



Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	5.8338e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	791.51	kN
Eenheidscontrole		0.00	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	5.0824e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	689.57	kN
Eenheidscontrole		0.13	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	12.2	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	135.7	MPa
Eenheidscontrole		0.09	-

### Controle van gecombineerde afschuiving en torsie voor $V_y$ en $\tau_{t,Ed}$

Volgens EN 1993-1-1 artikel 6.2.6 & 6.2.7 en formule (6.25),(6.26)

Plastische dwarskrachtweerstand voor $V_y$ en $T_{Ed}$	$V_{pl,T,y,Rd}$	762.53	kN
Eenheidscontrole		0.00	-

### Controle van gecombineerde afschuiving en torsie voor $V_z$ en $\tau_{t,Ed}$

Volgens EN 1993-1-1 artikel 6.2.6 & 6.2.7 en formule (6.25),(6.26)

Plastische dwarskrachtweerstand voor $V_z$ en $T_{Ed}$	$V_{pl,T,z,Rd}$	664.32	kN
Eenheidscontrole		0.14	-

### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	399.97	kNm
Exponent van buigingsratio $y$	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	64.86	kNm
Exponent van buigingsratio $z$	$\beta$	1.00	

Eenheidscontrole (6.41) = 0.31 + 0.02 = 0.32 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

### .....STABILITEITSCONTROLE:.....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 0.000 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2



Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_{\alpha}$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	69	15	1.162e+03	1.167e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.78	1
3	SO	69	15	1.158e+03	1.153e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.81	1
4	I	379	9	1.207e+03	1.841e+03	0.66		1.00	40.30	28.00	34.00	43.16	3
5	SO	69	15	1.887e+03	1.882e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.81	1
7	SO	69	15	1.891e+03	1.896e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 3

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

Eigenschappen Semi-Comp+			
Materiaal coëfficiënt	$\epsilon$	1.00	
Slankheidslimiet flensklasse 2	$\beta_{2,y,f}$	10.00	
Slankheidslimiet flensklasse 3	$\beta_{3,y,f}$	14.00	
Slankheidslimiet lijfklasse 2	$\beta_{2,y,w}$	83.00	
Slankheidslimiet lijfklasse 3	$\beta_{3,y,w}$	124.00	
Slankheidslimiet flensklasse 2	$\beta_{2,z,f}$	10.00	
Slankheidslimiet flensklasse 3	$\beta_{3,z,f}$	16.00	
Verhouding lijfslankheid	$c/t_w$	40.30	
Verhouding flensslankheid	$c/t_f$	4.75	
Verhouding referentieslankheid	$c/t_{ref,y}$	0.00	
Verhouding referentieslankheid	$c/t_{ref,z}$	0.00	
Geïnterpoleerde doorsnedemodulus	$W_{3,y}$	1.7020e-03	m <sup>3</sup>
Geïnterpoleerde doorsnedemodulus	$W_{3,z}$	2.7600e-04	m <sup>3</sup>

**Opmerking:** De weerstand voor deze semi-compacte doorsnede is berekend volgens Semi-Comp+.

### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Geïnterpoleerde doorsnedemodulus	$W_{3,y}$	1.7020e-03	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	725.92	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.74	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		c	
Imperfectie	$\alpha_{LT}$	0.49	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.80	
Correctiefactor	$k_c$	0.90	
Correctiefactor	f	0.95	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.84	
Rekenwaarde knikweerstand	$M_{b,Rd}$	337.25	kNm
Eenheidscontrole		0.66	-

Mcr parameters			
LTB lengte	$l_{LT}$	4.000	m
Vorklengte	$L_g$	4.000	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	2602.01	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	C	6.66	
Factor	S	1753	mm
Kip moment factor	$C_1$	1.25	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .



## Buig- en axiale trekcontrole

Volgens EN 1993-1-3 artikel 6.3

Normaalkracht	$N_{Ed}$	118.24	kN
Buigend moment	$M_{y,Ed}$	-221.72	kNm
Buigend moment	$M_{z,Ed}$	-1.11	kNm
Trekweerstand	$N_{t,Rd}$	2321.80	kN
Buigweerstand	$M_{b,y,Rd}$	337.25	kNm
Vezel		1	
Elastische doorsnedemodulus	$W_{el,z,com}$	2.7600e-04	m <sup>3</sup>
Buigweerstand	$M_{c,z,Rd,com}$	64.86	kNm

Eenheidscontrole =  $0.66 + 0.02 - 0.05 = 0.62$  -

## Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	12.000	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	421	mm
Lijfdikte	t	9	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

Plooi verificatie		
Lijf slankheid	$h_w/t$	44.77
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

## EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S17	3.000 / 5.000 m	HEA180	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.50 -
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Combinatiesleutel	
RK_NC_UGT-Set B / NC_UGT-Set B.14	

Partiële veiligheidsfactoren	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

Materiaal			
Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 3.000 m

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-20.37 kN
Dwarskracht	$V_{y,Ed}$	-1.17 kN
Dwarskracht	$V_{z,Ed}$	-8.75 kN
Torsie	$T_{Ed}$	0.03 kNm
Buigend moment	$M_{y,Ed}$	29.29 kNm
Buigend moment	$M_{z,Ed}$	-0.02 kNm

## Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2





Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	72	10	-8.967e+04	-8.950e+04								
3	SO	72	10	-8.975e+04	-8.992e+04								
4	I	122	6	-6.667e+04	7.567e+04	-0.88		0.56	20.33	60.71	70.90	109.42	1
5	SO	72	10	9.866e+04	9.850e+04	1.00	0.43	1.00	7.58	9.00	10.00	13.80	1
7	SO	72	10	9.875e+04	9.892e+04	1.00	0.43	1.00	7.58	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+. De doorsnede is geclassificeerd als klasse 1

#### Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	4.5300e-03	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	1064.55	kN
Eenheidscontrole		0.02	-

#### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	76.38	kNm
Eenheidscontrole		0.38	-

#### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	1.5667e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	36.82	kNm
Eenheidscontrole		0.00	-

#### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	3.5460e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	481.11	kN
Eenheidscontrole		0.00	-

#### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.4520e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	197.00	kN
Eenheidscontrole		0.04	-

#### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	1.7	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	135.7	MPa
Eenheidscontrole		0.01	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

#### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	76.38	kNm
Exponent van buigingsratio y	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	36.82	kNm
Exponent van buigingsratio z	$\beta$	1.00	

Eenhedencontrole (6.41) = 0.15 + 0.00 = 0.15 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

....:STABILITEITSCONTROLE:....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 2.500 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\sigma$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	72	10	-9.774e+04	-1.018e+05								
3	SO	72	10	-9.573e+04	-9.171e+04								
4	I	122	6	-7.200e+04	8.081e+04	-0.89		0.56	20.33	60.91	71.12	110.52	1
5	SO	72	10	1.065e+05	1.106e+05	0.96	0.43	1.00	7.58	9.00	10.00	13.81	1
7	SO	72	10	1.045e+05	1.005e+05	0.96	0.44	1.00	7.58	9.00	10.00	13.99	1

**Opmerking:** De classificatielimiets zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

#### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	5.000	4.000	m
Knikfactor	k	1.00	0.52	
Kniklengte	$l_{cr}$	5.000	2.085	m
Kritische Euler last	$N_{cr}$	2080.91	4411.22	kN
Slankheid	$\lambda$	67.17	46.13	
Relatieve slankheid	$\lambda_{rel}$	0.72	0.49	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	

**Opmerking:** De slankheid of compressie kracht is zodanig dat Buigknik effecten kunnen worden genegeerd volgens EN 1993-1-1 artikel 6.3.1.2(4).

#### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

#### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methodie voor Kipcurve		Alternatief geval	
Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	176.02	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.66	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		b	
Imperfectie	$\alpha_{LT}$	0.34	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.89	



Kip parameters			
Correctiefactor	$k_c$	0.93	
Correctiefactor	$f$	0.97	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.92	
Rekenwaarde knikweerstand	$M_{b,Rd}$	70.15	kNm
Eenhedscontrole		0.42	-

Mcr parameters			
LTB lengte	$l_{LT}$	4.000	m
Vorklengte	$L_g$	4.000	m
Inloed van lastpositie		geen invloed	
Factor	$\alpha$	2611.40	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	$C$	4.62	
Factor	$S$	1028	mm
Kip moment factor	$C_1$	1.14	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{Cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

#### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	$A$	4.5300e-03	m <sup>2</sup>
Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Plastische doorsnedemodulus	$W_{pl,z}$	1.5667e-04	m <sup>3</sup>
Ontwerpdrukkracht	$N_{Ed}$	20.37	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	31.45	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	-2.98	kNm
Karakteristieke drukweerstand	$N_{Rk}$	1064.55	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	76.38	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	36.82	kNm
Reductie factor	$\chi_y$	1.00	
Reductie factor	$\chi_z$	1.00	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.92	
Interactiefactor	$k_{yy}$	0.91	
Interactiefactor	$k_{yz}$	0.24	
Interactiefactor	$k_{zy}$	1.00	
Interactiefactor	$k_{zz}$	0.40	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S17 positie 2.500 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S17 positie 4.500 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.2	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalent moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	$M_{h,z}$	-2.98	kNm
Veldmoment	$M_{s,z}$	0.52	kNm
Factor	$\alpha_{s,z}$	-0.17	
Ratio van uiteinde momenten	$\psi_z$	-0.13	
Equivalent moment factor	$C_{mz}$	0.40	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	$M_{h,LT}$	-4.13	kNm
Veldmoment	$M_{s,LT}$	31.45	kNm
Factor	$\alpha_{h,LT}$	-0.13	
Ratio van uiteinde momenten	$\psi_{LT}$	0.90	
Equivalent moment factor	$C_{mLT}$	0.94	



Eenhedencontrole (6.61) =  $0.02 + 0.41 + 0.02 = 0.45$  -  
 Eenhedencontrole (6.62) =  $0.02 + 0.45 + 0.03 = 0.50$  -

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	5.000	m
Lijf		niet-verstijfd	
Lijfhoogte	h <sub>w</sub>	152	mm
Lijfdikte	t	6	mm
Materiaal coëfficiënt	ε	1.00	
Correctiefactor voor dwarskracht	η	1.20	

Plooi verificatie		
Lijf slankheid	h <sub>w</sub> /t	25.33
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S22	0.000 / 2.121 m	HEA120	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.55 -
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Combinatiesleutel	
RK_NC_UGT-Set B / NC_UGT-Set B.6	

Partiële veiligheidsfactoren	
γ <sub>M0</sub> voor weerstand van doorsneden	1.00
γ <sub>M1</sub> voor weerstand tegen instabiliteit	1.00
γ <sub>M2</sub> voor weerstand van nettosecties	1.25

Materiaal			
Vloei sterkte	f <sub>y</sub>	235.0	MPa
Trek sterkte	f <sub>u</sub>	360.0	MPa
Bouwwijze		Gewalst	

### ....:DOORSNEDECONTROLE:....

De kritische controle is op positie 0.000 m

Interne krachten	Berekende	Eenheid
Normaalkracht	N <sub>Ed</sub>	-227.36 kN
Dwarskracht	V <sub>y,Ed</sub>	0.00 kN
Dwarskracht	V <sub>z,Ed</sub>	0.19 kN
Torsie	T <sub>Ed</sub>	0.00 kNm
Buigend moment	M <sub>y,Ed</sub>	0.00 kNm
Buigend moment	M <sub>z,Ed</sub>	0.00 kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	σ <sub>1</sub> [kN/m <sup>2</sup> ]	σ <sub>2</sub> [kN/m <sup>2</sup> ]	ψ [-]	k <sub>σ</sub> [-]	α [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1
3	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
4	I	74	5	8.972e+04	8.972e+04	1.00		1.00	14.80	28.00	34.00	38.00	1
5	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
7	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1



Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.12.6  
26/39

## Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Drukweerstand	N <sub>c,Rd</sub>	594.55	kN
Eenheidscontrole		0.38	-

## Controle buigend moment voor M<sub>z</sub>

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	W <sub>pl,z</sub>	5.8750e-05	m <sup>3</sup>
Plastisch buigend moment	M <sub>pl,z,Rd</sub>	13.81	kNm
Eenheidscontrole		0.00	-

## Dwarskrachtcontrole voor V<sub>y</sub>

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	η	1.20	
Afschuifoppervlak	A <sub>v</sub>	2.0050e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor V <sub>y</sub>	V <sub>pl,y,Rd</sub>	272.03	kN
Eenheidscontrole		0.00	-

## Dwarskrachtcontrole voor V<sub>z</sub>

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	η	1.20	
Afschuifoppervlak	A <sub>v</sub>	8.4200e-04	m <sup>2</sup>
Plastische dwarskrachtweerstand voor V <sub>z</sub>	V <sub>pl,z,Rd</sub>	114.24	kN
Eenheidscontrole		0.00	-

## Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	T <sub>Ed</sub>	0.6	MPa
Elastische dwarskrachtweerstand	T <sub>Rd</sub>	135.7	MPa
Eenheidscontrole		0.00	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

De staaf voldoet aan de doorsnedecontrole.

## ....:STABILITEITSCONTROLE:....

### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 1.061 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	σ <sub>1</sub> [kN/m <sup>2</sup> ]	σ <sub>2</sub> [kN/m <sup>2</sup> ]	ψ [-]	k <sub>σ</sub> [-]	α [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	46	8	8.874e+04	8.874e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1
3	SO	46	8	8.874e+04	8.874e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
4	I	74	5	8.901e+04	9.028e+04	0.99		1.00	14.80	28.00	34.00	38.19	1
5	SO	46	8	9.055e+04	9.055e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
7	SO	46	8	9.055e+04	9.055e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)



Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	2.121	2.121	m
Knikfactor	k	1.00	1.00	
Kniklengte	$l_{cr}$	2.121	2.121	m
Kritische Euler last	$N_{cr}$	2791.12	1064.00	kN
Slankheid	$\lambda$	43.34	70.20	
Relatieve slankheid	$\lambda_{rel}$	0.46	0.75	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		b	c	
Imperfectie	$\alpha$	0.34	0.49	
Reductie factor	$\chi$	0.90	0.70	
Knikweerstand	$N_{b,Rd}$	535.61	413.26	kN

Buigingsknikverificatie			
Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	413.26	kN
Eenhedscontrole		0.55	-

#### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

#### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Plastische doorsnedemodulus	$W_{pl,y}$	1.1958e-04	m <sup>3</sup>
Plastische doorsnedemodulus	$W_{pl,z}$	5.8750e-05	m <sup>3</sup>
Ontwerpdrukkracht	$N_{Ed}$	227.36	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	0.10	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	0.00	kNm
Karakteristieke drukweerstand	$N_{Rk}$	594.55	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	28.10	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	13.81	kNm
Reductie factor	$\chi_y$	0.90	
Reductie factor	$\chi_z$	0.70	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	1.00	
Interactiefactor	$k_{yy}$	1.00	
Interactiefactor	$k_{yz}$	0.84	
Interactiefactor	$k_{zy}$	0.60	
Interactiefactor	$k_{zz}$	1.40	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S22 positie 1.061 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S22 positie 1.591 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.1	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalent moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	$M_{h,z}$	0.00	kNm
Veldmoment	$M_{s,z}$	0.00	kNm
Factor	$\alpha_{h,z}$	-0.23	
Ratio van uiteinde momenten	$\psi_z$	0.97	
Equivalent moment factor	$C_{mz}$	0.94	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	$M_{h,LT}$	0.00	kNm
Veldmoment	$M_{s,LT}$	0.10	kNm
Factor	$\alpha_{h,LT}$	0.00	
Ratio van uiteinde momenten	$\psi_{LT}$	1.00	



Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.6  
28/39

### Interactie methode 2 parameters

Equivalente moment factor	$C_{mLT}$	0.95	
---------------------------	-----------	------	--

Eenhedscontrole (6.61) =  $0.42 + 0.00 + 0.00 = 0.43$  -

Eenhedscontrole (6.62) =  $0.55 + 0.00 + 0.00 = 0.55$  -

### Plooi controle

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooi parameters			
Knik veldlengte	a	2.121	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	98	mm
Lijfdikte	t	5	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

### Plooi verificatie

Lijf slankheid	$h_w/t$	19.60
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S25	7.136 / 7.136 m	FLA80/10	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.65 -
-------------	-----------------	----------	-----------------------	-----------------	--------

### Combinatiesleutel

RK\_NC\_UGT-Set B / NC\_UGT-Set B.7

### Partiële veiligheidsfactoren

$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

### Materiaal

Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

### ....:DOORSNEDECONTROLE:....

De kritische controle is op positie 7.136 m

Asdefinitie:

- y-hoofdas in deze normcontrole verwijst naar de z-hoofdas in SCIA Engineer

- z-hoofdas in deze normcontrole verwijst naar de y-hoofdas in SCIA Engineer

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	122.97 kN
Dwarskracht	$V_{y,Ed}$	0.00 kN
Dwarskracht	$V_{z,Ed}$	0.00 kN
Torsie	$T_{Ed}$	0.00 kNm
Bulgend moment	$M_{y,Ed}$	0.00 kNm
Bulgend moment	$M_{z,Ed}$	0.00 kNm

### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	8.0000e-04	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	188.00	kN
Uiterste trekweerstand	$N_{u,Rd}$	207.36	kN
Trekweerstand	$N_{t,Rd}$	188.00	kN
Eenhedscontrole		0.65	-



De staaf voldoet aan de doorsnedecontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S35	0.000 / 5.657 m	L60X6	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.33 -
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<b>Combinatiesleutel</b>
RK_NC_UGT-Set B / NC_UGT-Set B.7

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>		
Vloeisterkte $f_y$	235.0	MPa
Treksterkte $f_u$	360.0	MPa
Bouwwijze	Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 0.000 m

Interne krachten	Berekende	Eenheid
Normaalkracht $N_{Ed}$	53.49	kN
Dwarskracht $V_{y,Ed}$	0.00	kN
Dwarskracht $V_{z,Ed}$	0.00	kN
Torsie $T_{Ed}$	0.00	kNm
Buigend moment $M_{y,Ed}$	0.00	kNm
Buigend moment $M_{z,Ed}$	0.00	kNm

### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede $A$	6.9100e-04	m <sup>2</sup>
Plastische trekweerstand $N_{pl,Rd}$	162.38	kN
Uiterste trekweerstand $N_{u,Rd}$	179.11	kN
Trekweerstand $N_{t,Rd}$	162.38	kN
Eenheidscontrole	0.33	-

De staaf voldoet aan de doorsnedecontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S41	5.000 / 7.423 m	UNP200	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.30 -
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<b>Combinatiesleutel</b>
RK_NC_UGT-Set B / NC_UGT-Set B.7

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>		
Vloeisterkte $f_y$	235.0	MPa
Treksterkte $f_u$	360.0	MPa
Bouwwijze	Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 5.000 m





Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	8.11 kN
Dwarskracht	$V_{y,Ed}$	-1.39 kN
Dwarskracht	$V_{z,Ed}$	0.93 kN
Torsie	$T_{Ed}$	-0.02 kNm
Buigend moment	$M_{y,Ed}$	-1.35 kNm
Buigend moment	$M_{z,Ed}$	3.20 kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_o$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	UO	55	12	5.985e+02	1.033e+05	0.01	0.57	1.00	4.78	9.00	10.00	15.84	1
3	I	154	9	-3.000e+04	-4.057e+04								
5	UO	55	12	-1.233e+04	9.040e+04	-0.14	0.60	0.88	4.78	10.23	11.36	16.27	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geïnclassificeerd als klasse 1

### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	3.2200e-03	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	756.70	kN
Uiterste trekweerstand	$N_{u,Rd}$	834.62	kN
Trekweerstand	$N_{t,Rd}$	756.70	kN
Eenheidscontrole		0.01	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	2.2800e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	53.58	kNm
Eenheidscontrole		0.03	-

### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	5.1800e-05	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	12.17	kNm
Eenheidscontrole		0.26	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.7250e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	234.04	kN
Eenheidscontrole		0.01	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.7250e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	234.04	kN
Eenheidscontrole		0.00	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)



Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 31/39

Vezelindex	Vezel	3	
Totaal torsiemoment	$T_{Ed}$	2.2	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	135.7	MPa
Eenheidscontrole		0.02	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0,05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

#### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.1 en formule (6.2)

Plastische trekweerstand	$N_{pl,Rd}$	756.70	kN
Plastisch buigend moment	$M_{pl,y,Rd}$	53.58	kNm
Plastisch buigend moment	$M_{pl,z,Rd}$	12.17	kNm

Eenheidscontrole (6.2) = 0.01 + 0.03 + 0.26 = 0.30 -

**Opmerking:** Er is geen specifieke interactieformule volgens EN 1993-1-1 artikel 6.2.9.1 van toepassing.

Daarom wordt de plastisch lineaire som volgens EN 1993-1-1 artikel 6.2.1(7) getoetst.

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

De staaf voldoet aan de doorsnedecontrole.

#### .....STABILITEITSCONTROLE:.....

#### Classificatie voor staafknikontwerp

Bestissende positie voor stabiliteitsclassificatie: 5.000 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	UO	55	12	3.068e+03	1.058e+05	0.03	0.56	1.00	4.78	9.00	10.00	15.77	1
3	I	154	9	-2.753e+04	-3.810e+04								
5	UO	55	12	-9.862e+03	9.287e+04	-0.11	0.59	0.90	4.78	9.96	11.06	16.17	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

#### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.2 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Algemeen geval	
Plastische doorsnedemodulus	$W_{pl,y}$	2.2800e-04	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	185.95	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.54	
Limiet slankheid	$\lambda_{rel,LT,0}$	0.20	

**Opmerking:** De slankheid of het buigend moment is zo dat de kipeffecten genegeerd kunnen worden volgens EN 1993-1-1 artikel 6.3.2.2(4).

**Opmerking:** L/h is buiten de limieten, de gewijzigde ontwerpregel voor kip van U-profielen kan niet worden toegepast.

**Opmerking:** L/h is buiten de limieten, de gewijzigde ontwerpregel voor kip van U-profielen kan niet worden toegepast.

Mcr parameters			
LTB lengte	$l_{LT}$	2.423	m
Invloed van lastpositie		geen invloed	
Correctiefactor	k	1.00	
Correctiefactor	$k_w$	1.00	
Kip moment factor	$C_1$	2.22	
Kip moment factor	$C_2$	0.12	
Kip moment factor	$C_3$	1.00	
Afschuifmiddenpuntafstand	$d_z$	0	mm
Afstand tot lastoepassing	$z_g$	0	mm
Mono-symmetrische constante	$\beta_y$	0	mm



Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.12.e 32/39

#### Mcr parameters

Mono-symmetrische constante	$z_j$	0	mm
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**Waarschuwing:** Er wordt niet voldaan aan alle voorwaarden van de Nederlandse NEN-EN NA (Art. NB.NB.1) en daarom wordt de standaard EC-EN-benadering gebruikt.

**Opmerking:** C parameters zijn bepaald volgens de ECCS 119 2006 / Galea 2002.

De staaf voldoet aan de stabiliteitscontrole.



## 2.6. EC-EN 1993 BGT staalcontrole

Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-quasi  
 Assenstelsel: Hoofd  
 Extreme 1D: Element  
 Selectie: Alle

### Algehele eenheidscontrole

Naam	dx [mm]	Belasting	$U_{y,max}$		Limiet van		Controle van		Controle van		Zaag de $u_r$ (mm) Zaag [mm]	Check [-]
			[mm]	[mm]	$U_{y,max}$ [mm]	$U_{y,ver}$ [mm]	$U_{y,max}$ [-]	$U_{y,ver}$ [-]	$U_{z,max}$ [-]	$U_{z,ver}$ [-]		
S8	11820.000	NC_BGT-quasi.1	11.4	-	21.8	21.8	0.52	-	-	-	-	<b>0.52</b>
			0.0	-	39.4	39.4	0.00	-	-	-	-	
S9	0.000	NC_BGT-quasi.1	0.0	-	19.7	19.7	0.00	-	-	-	-	<b>0.31</b>
			-21.2	-	68.8	68.8	0.31	-	-	-	-	
S10	0.000	NC_BGT-quasi.1	0.0	-	19.7	19.7	0.00	-	-	-	-	<b>0.33</b>
			-22.4	-	68.8	68.8	0.33	-	-	-	-	
S11	11820.000	NC_BGT-quasi.4	-5.3	-8.6	27.1	27.1	0.20	0.32	-	-	-	<b>0.32</b>
			0.0	0.0	39.4	39.4	0.00	0.00	-	-	-	
S12	1000.000	NC_BGT-quasi.4	0.1	0.0	13.3	13.3	0.01	0.00	-	-	-	<b>0.51</b>
			-35.4	-14.7	70.0	70.0	0.51	0.21	-	-	-	
S13	0.000	NC_BGT-quasi.4	0.0	0.0	13.3	13.3	0.00	0.00	-	-	-	<b>0.82</b>
			-57.2	-23.1	70.0	70.0	0.82	0.33	-	-	-	
S15	8600.650	NC_BGT-quasi.4	-0.9	-0.4	64.5	64.5	0.01	0.01	-	-	-	<b>1.11</b>
			-65.6	-22.3	59.3	59.3	1.11	0.38	-	-	-	
S16	2500.000+	NC_BGT-quasi.4	-0.4	-0.3	13.3	13.3	0.03	0.02	-	-	-	<b>0.55</b>
			-9.2	-3.6	16.7	16.7	0.55	0.21	-	-	-	
S17	2500.000+	NC_BGT-quasi.4	-0.1	-0.2	13.3	13.3	0.01	0.01	-	-	-	<b>0.52</b>
			-8.7	-3.7	16.7	16.7	0.52	0.22	-	-	-	
S18	0.000	NC_BGT-quasi.4	0.5	0.8	3.3	3.3	0.15	0.23	-	-	-	<b>0.28</b>
			0.9	0.3	3.3	3.3	0.28	0.10	-	-	-	
S21	1060.660	NC_BGT-quasi.4	0.0	0.0	7.1	7.1	0.00	0.00	-	-	-	<b>0.00</b>
			0.0	0.0	7.1	7.1	0.00	0.00	-	-	-	
S22	1060.660	NC_BGT-quasi.4	0.0	0.0	7.1	7.1	0.00	0.00	-	-	-	<b>0.00</b>
			0.0	0.0	7.1	7.1	0.00	0.00	-	-	-	
S23	2000.000	NC_BGT-quasi.4	0.0	0.0	13.3	13.3	0.00	0.00	-	-	-	<b>0.02</b>
			-0.2	0.0	13.3	13.3	0.02	0.00	-	-	-	
S25	3568.196+	NC_BGT-quasi.1	0.0	-	23.8	23.8	0.00	-	-	-	-	<b>0.00</b>
			0.0	-	23.8	23.8	0.00	-	-	-	-	
S26	0.000	NC_BGT-quasi.4	20.9	4.0	47.6	47.6	0.44	0.08	-	-	-	<b>0.44</b>
			0.0	0.0	23.8	23.8	0.00	0.00	-	-	-	
S27	3568.196-	NC_BGT-quasi.1	0.0	-	23.8	23.8	0.00	-	-	-	-	<b>0.00</b>
			0.0	-	23.8	23.8	0.00	-	-	-	-	
S28	0.000	NC_BGT-quasi.1	-18.9	-	47.6	47.6	0.40	-	-	-	-	<b>0.40</b>
			0.0	-	23.8	23.8	0.00	-	-	-	-	
S33	5656.854	NC_BGT-quasi.4	-8.3	-4.2	37.7	37.7	0.22	0.11	-	-	-	<b>0.22</b>
			-5.4	3.4	37.7	37.7	0.14	0.09	-	-	-	
S34	5656.854	NC_BGT-quasi.4	16.4	3.3	37.7	37.7	0.44	0.09	-	-	-	<b>0.52</b>
			19.4	11.0	37.7	37.7	0.52	0.29	-	-	-	
S35	0.000	NC_BGT-quasi.4	-17.5	-1.5	37.7	37.7	0.46	0.04	-	-	-	<b>0.54</b>
			-20.5	-8.6	37.7	37.7	0.54	0.23	-	-	-	
S36	0.000	NC_BGT-quasi.4	-14.7	-1.6	37.7	37.7	0.39	0.04	-	-	-	<b>0.47</b>
			-17.6	-9.0	37.7	37.7	0.47	0.24	-	-	-	
S40	0.000	NC_BGT-quasi.1	8.0	-	16.2	16.2	0.50	-	-	-	-	<b>0.50</b>
			0.0	-	8.1	8.1	0.00	-	-	-	-	
S41	7423.000	NC_BGT-quasi.4	20.2	11.0	16.2	16.2	1.25	0.68	-	-	-	<b>1.25</b>
			0.0	0.0	8.1	8.1	0.00	0.00	-	-	-	



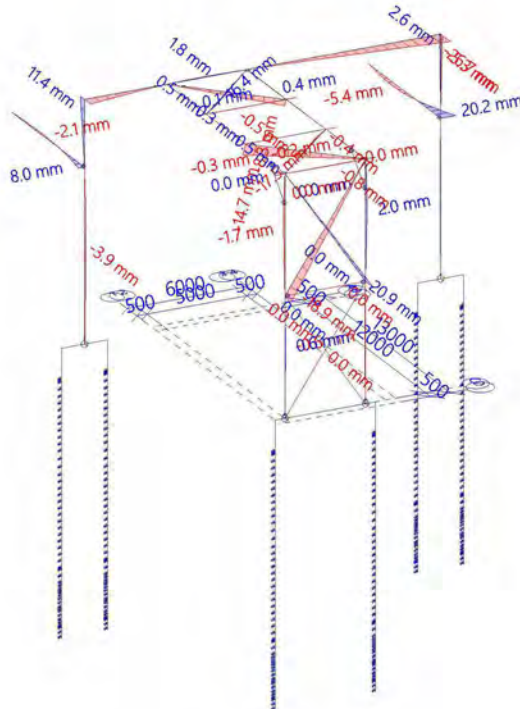
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.12.e  
34/39

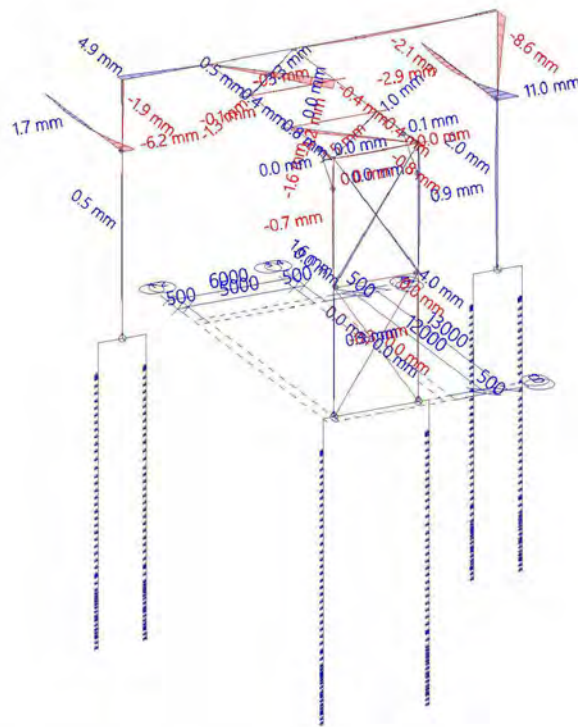
### Resultaten - $u_{y,max}$

Waardes:  $u_{y,max}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



### Resultaten - $u_{y,var}$

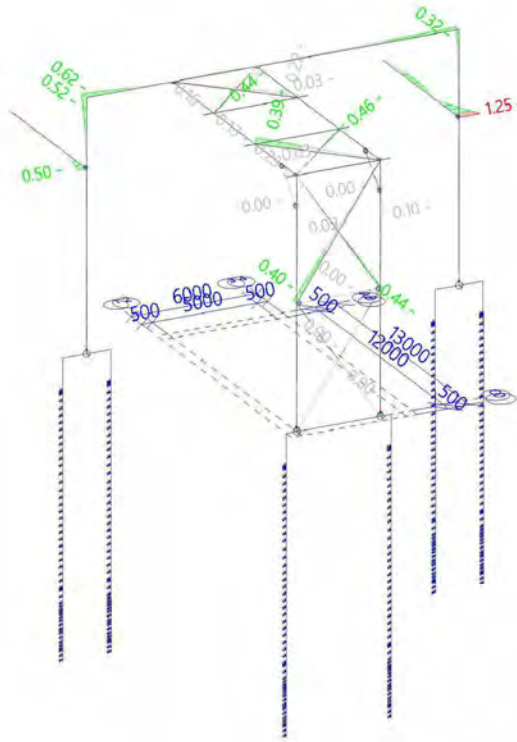
Waardes:  $u_{y,var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





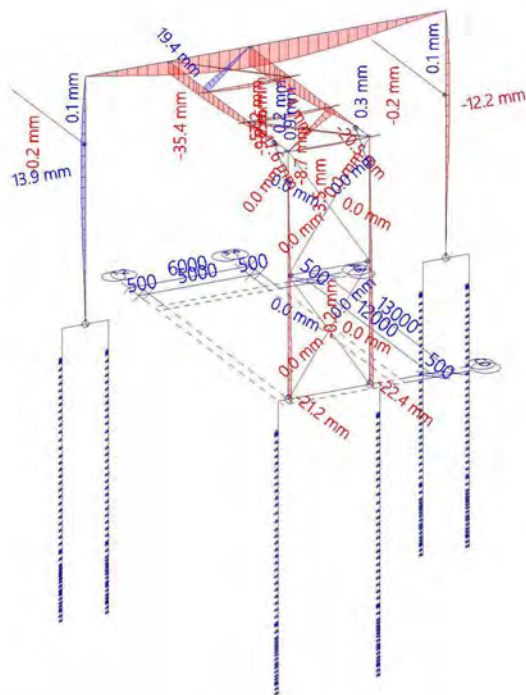
## Resultaten - Controle $u_y$

Waardes: **Controle  $u_y$**   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - $u_{z,max}$

Waardes:  **$u_{z,max}$**   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle

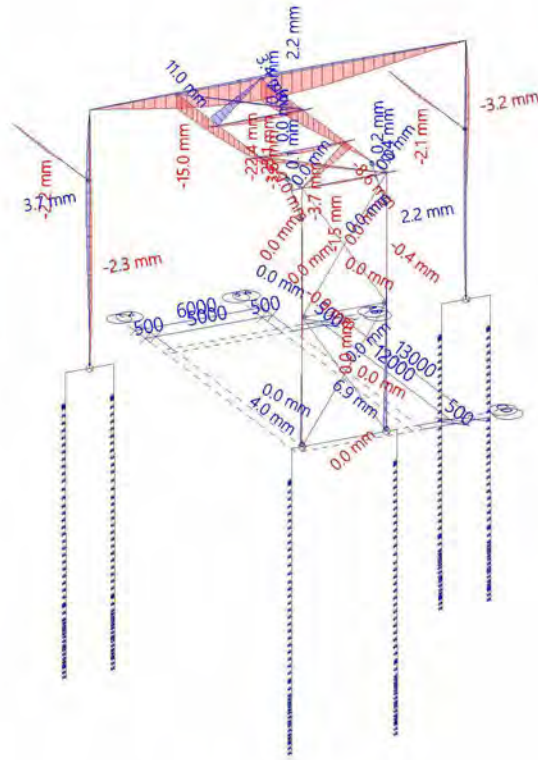




Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 36/39

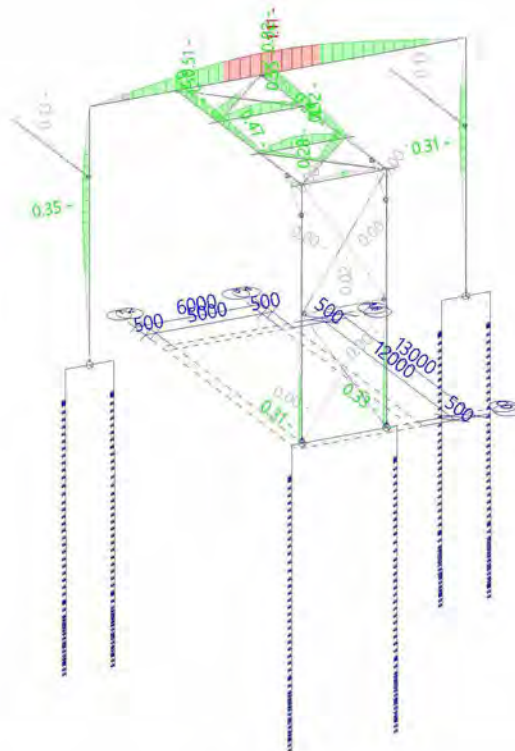
### Resultaten - $u_z, var$

Waardes:  $u_z, var$   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-quasi  
 Assenstelsel: Hoofd  
 Extreme 1D: Element  
 Selectie: Alle



### Resultaten - Controle $u_z$

Waardes: **Controle  $u_z$**   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-quasi  
 Assenstelsel: Hoofd  
 Extreme 1D: Element  
 Selectie: Alle





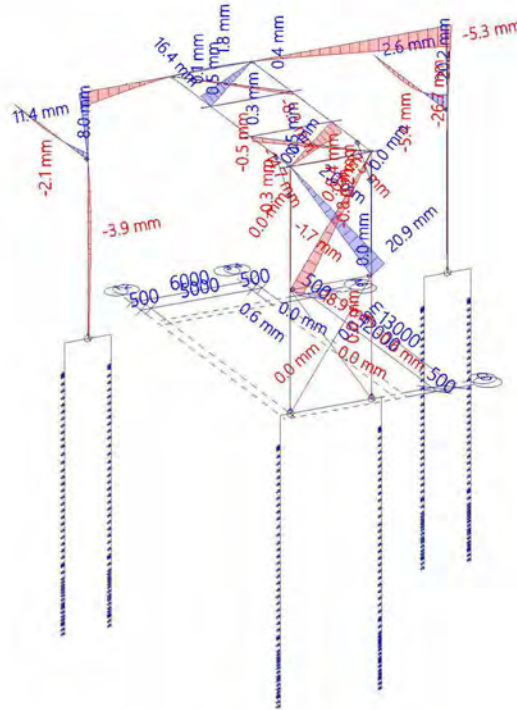
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.e  
37/39

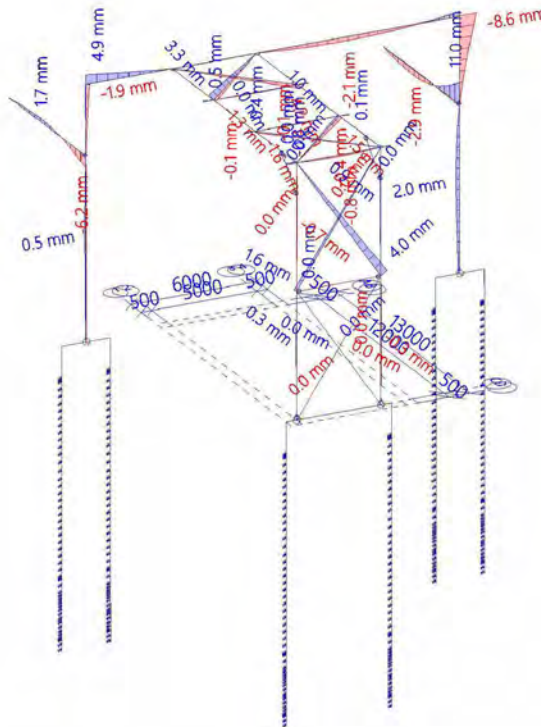
## Resultaten - $u_{y,max}$

Waardes:  $u_{y,max}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - $u_{y,var}$

Waardes:  $u_{y,var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle

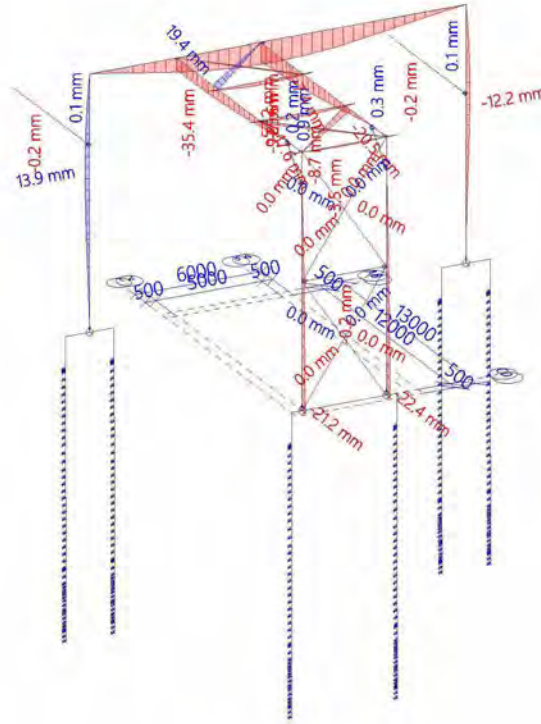






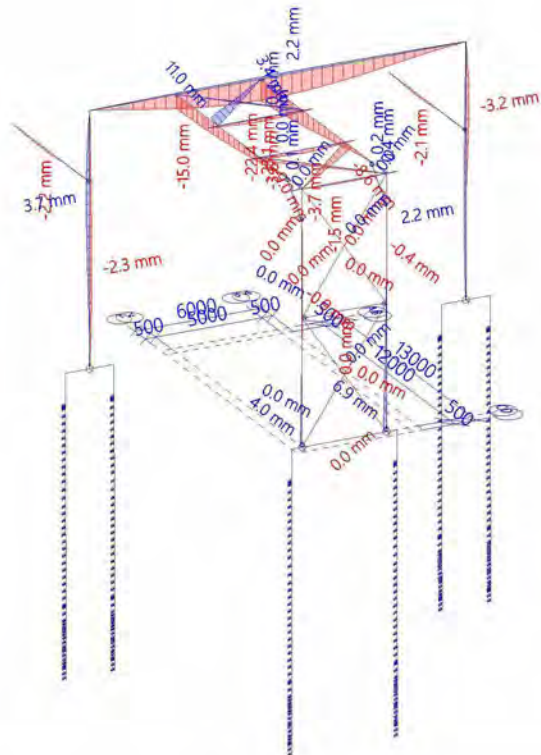
### Resultaten - $u_z,_{max}$

Waardes:  $u_z,_{max}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



### Resultaten - $u_z,_{var}$

Waardes:  $u_z,_{var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



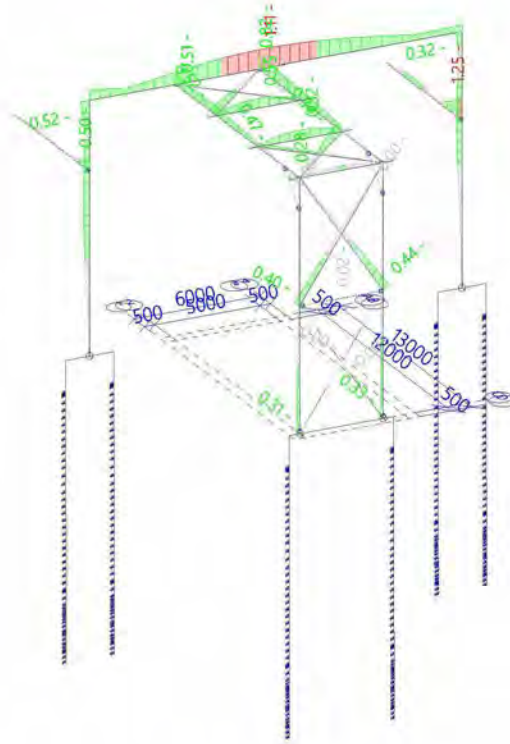


Project 4922005  
Omschrijving Statische berekening  
Onderdeel Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.e  
39/39

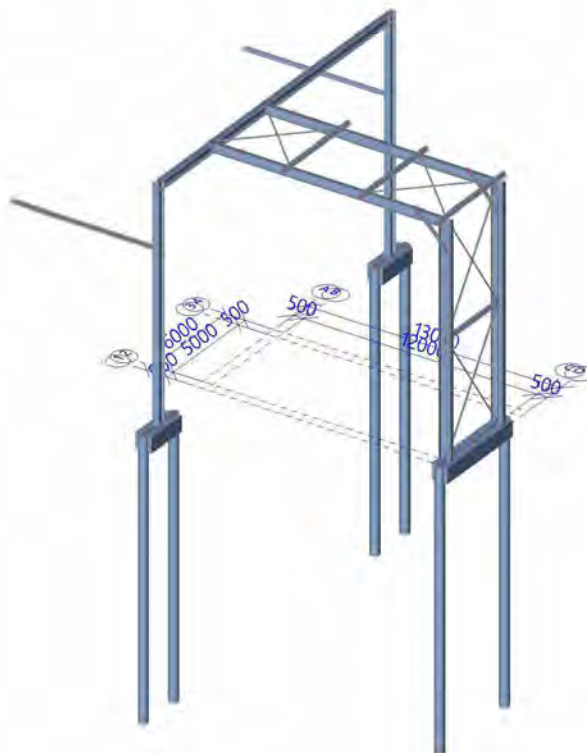
## Resultaten - Check Overall

Waardes: **Check Overall**  
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





# Bijlage 4. Betoncontrole





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Betoncontrole	3
2.1. Liggers	3
2.1.1. Ontwerpkrachten	3
2.1.1.1. Interne krachten (Ontwerp)	3
2.1.1.2. Rekenmodel - N	4
2.1.1.3. Rekenmodel - NEd	4
2.1.1.4. Rekenmodel - M	5
2.1.1.5. Rekenmodel - M-MEd	5
2.1.1.6. Rekenmodel - MEd	6
2.1.1.7. Rekenmodel - Mx	6
2.1.1.8. Rekenmodel - MEdx	7
2.1.1.9. Rekenmodel - V	7
2.1.1.10. Rekenmodel - V-VEd	8
2.1.1.11. Rekenmodel - VEd	8
2.1.2. Slankheid(Controle)	9
2.1.3. Voorstelling van stijfheid	9
2.1.4. Wapeningscontrole UGT	9
2.1.5. Controle capaciteits-response	10
2.1.6. Controle capaciteits-interactie diagram	15
2.1.7. Controleer afschuiving+torsie (UGT)	19
2.1.8. Controle limietspanning	29
2.1.9. Controle scheurwijdte (BGT)	33



## 2. Betoncontrole

### 2.1. Liggers

#### 2.1.1. Ontwerpkrachten

##### 2.1.1.1. Interne krachten (Ontwerp)

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Staaf

Extremes 1D: Globaal

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

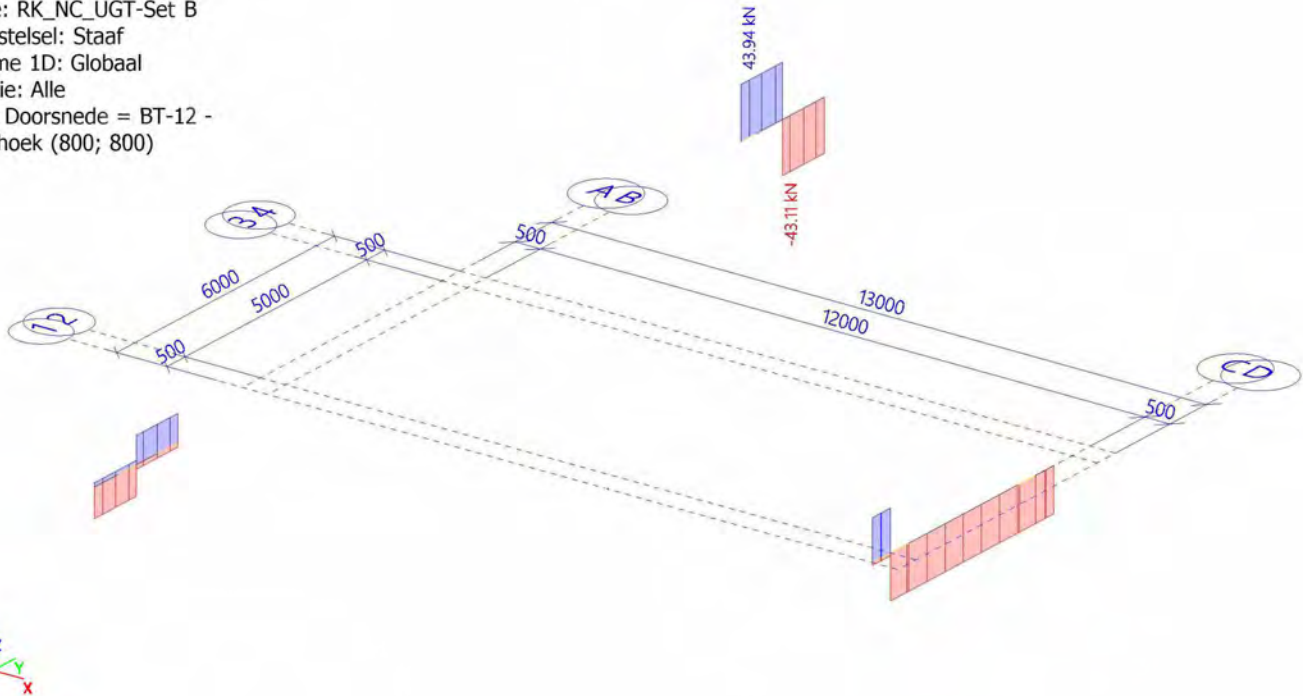
Naam	dx [mm]	Belasting	Doorsnede	N	V <sub>y</sub>	V <sub>z</sub>	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>
				[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
				N <sub>Ed</sub>	V <sub>Edy</sub>	V <sub>Edz</sub>	M <sub>Edx</sub>	M <sub>Edy</sub>	M <sub>Edz</sub>
				[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
S37	0.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>43.94</b> <b>43.94</b>	-1.20 0.00	-135.82 -135.82	3.68 3.68	77.08 77.08	-0.31 0.00
S2	5000.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.51 -5.51	<b>-32.79</b> <b>-32.79</b>	-204.43 -27.91	9.16 9.16	-15.79 -15.79	-0.03 -0.03
S2	0.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	1.93 1.93	<b>25.55</b> <b>25.55</b>	153.11 30.58	-21.84 -21.84	1.54 59.11	-0.03 -0.03
S37	2300.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	-43.07 -43.07	3.01 0.00	<b>-392.98</b> <b>-375.05</b>	-3.86 -3.86	-82.89 -82.89	0.33 0.00
S1	0.000	NC_UGT-Set B.14	BT-12 - Rechthoek (800; 800)	-24.20 -24.20	1.01 0.00	<b>235.71</b> <b>215.57</b>	-3.21 -3.21	-46.08 -46.08	0.14 0.00
S2	4500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	-3.02 -3.02	-5.38 0.00	-132.87 -32.43	<b>-35.61</b> <b>-35.61</b>	59.30 73.67	2.62 0.00
S2	0.000	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	0.06 0.06	3.95 0.00	121.50 33.26	<b>32.66</b> <b>32.66</b>	-1.68 -1.68	0.10 0.00
S37	1150.000-	NC_UGT-Set B.12	BT-12 - Rechthoek (800; 800)	40.66 40.66	-1.23 0.00	-153.81 -153.81	3.72 3.72	<b>-96.86</b> <b>-96.86</b>	-1.70 0.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>-43.11</b> <b>-43.11</b>	3.00 0.00	-371.28 -371.28	-3.85 -3.85	<b>356.56</b> <b>356.56</b>	<b>-3.13</b> 0.00
S2	4500.000+	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.52 -5.52	-32.74 -32.74	-195.00 -27.91	9.13 9.13	84.06 96.67	<b>16.35</b> <b>16.35</b>
S37	950.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	30.22 30.22	-1.32 -1.32	-67.63 -67.63	5.44 5.44	-1.82 -15.02	-1.47 <b>-1.74</b>



### 2.1.1.2. Rekenmodel - N

Waardes: **N**

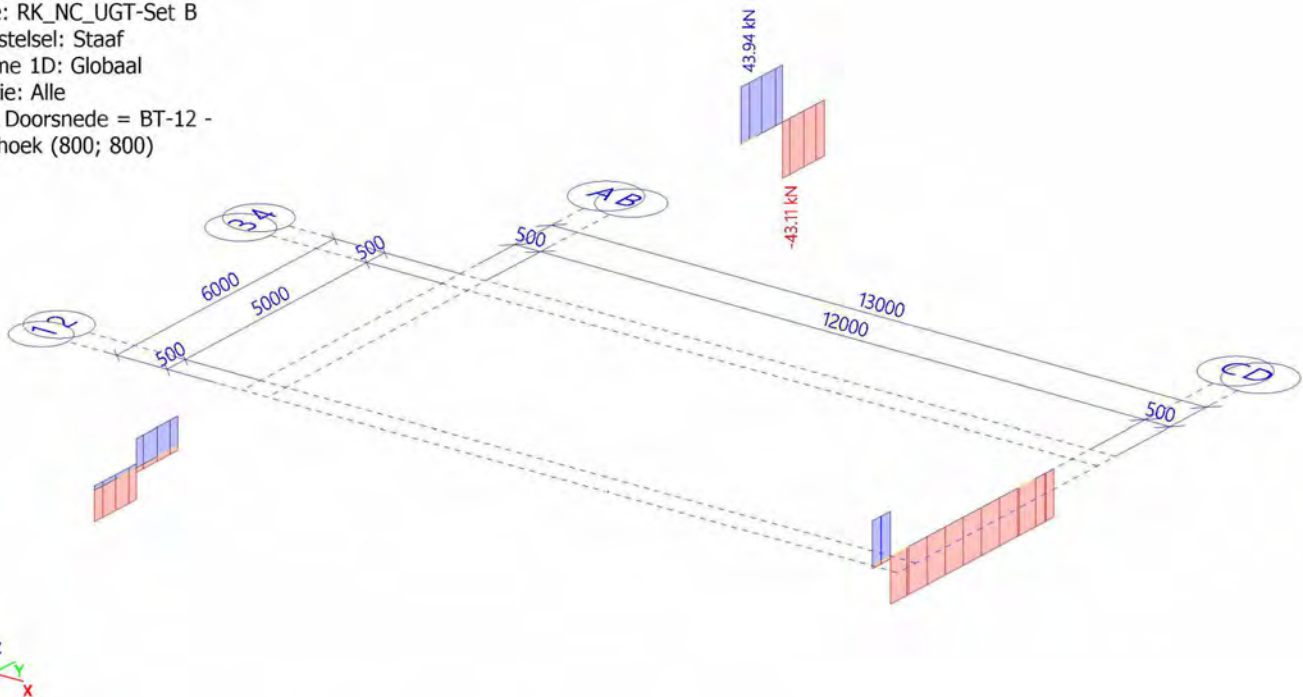
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.3. Rekenmodel - NEd

Waardes: **NEd**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

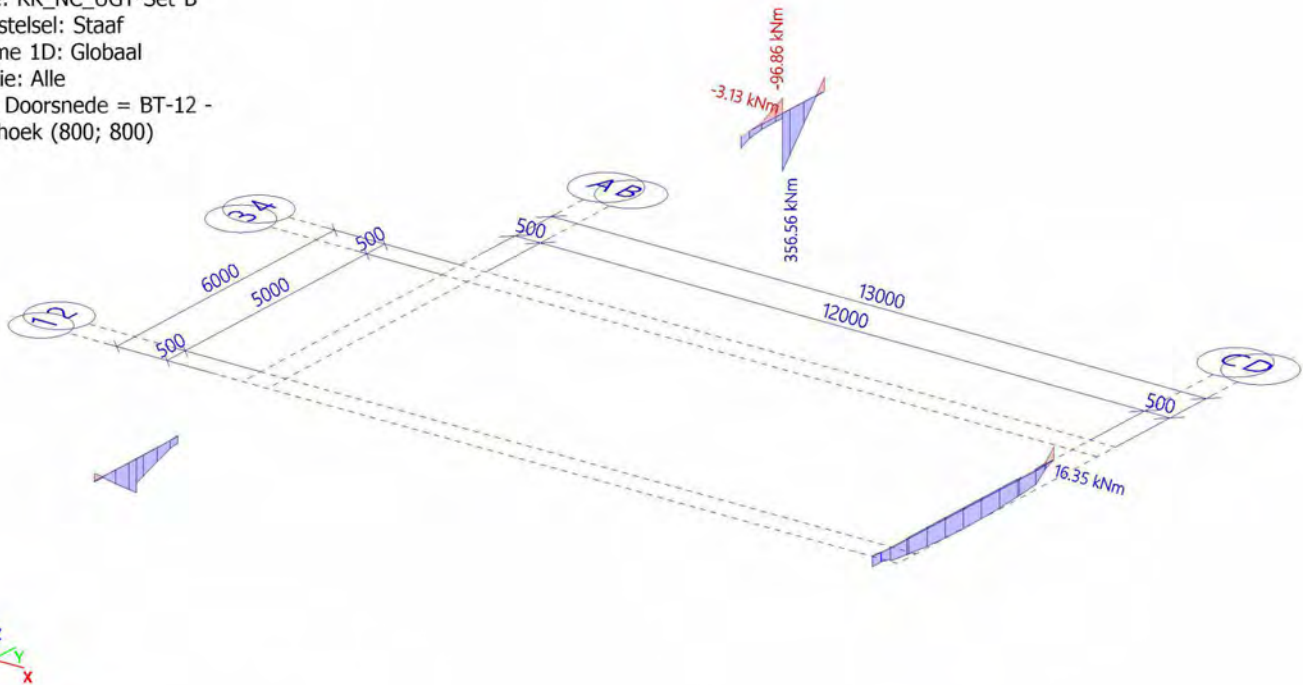




### 2.1.1.4. Rekenmodel - M

Waardes: **M**

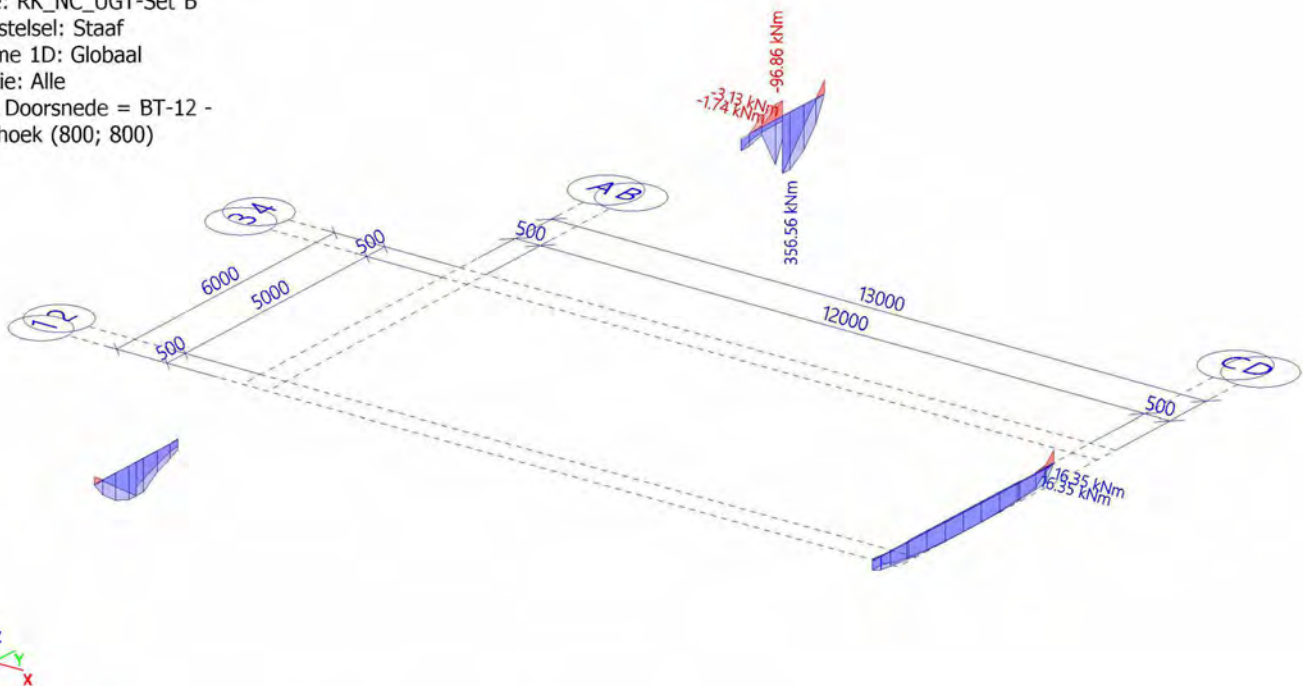
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.5. Rekenmodel - M-MEd

Waardes: **M-MEd**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

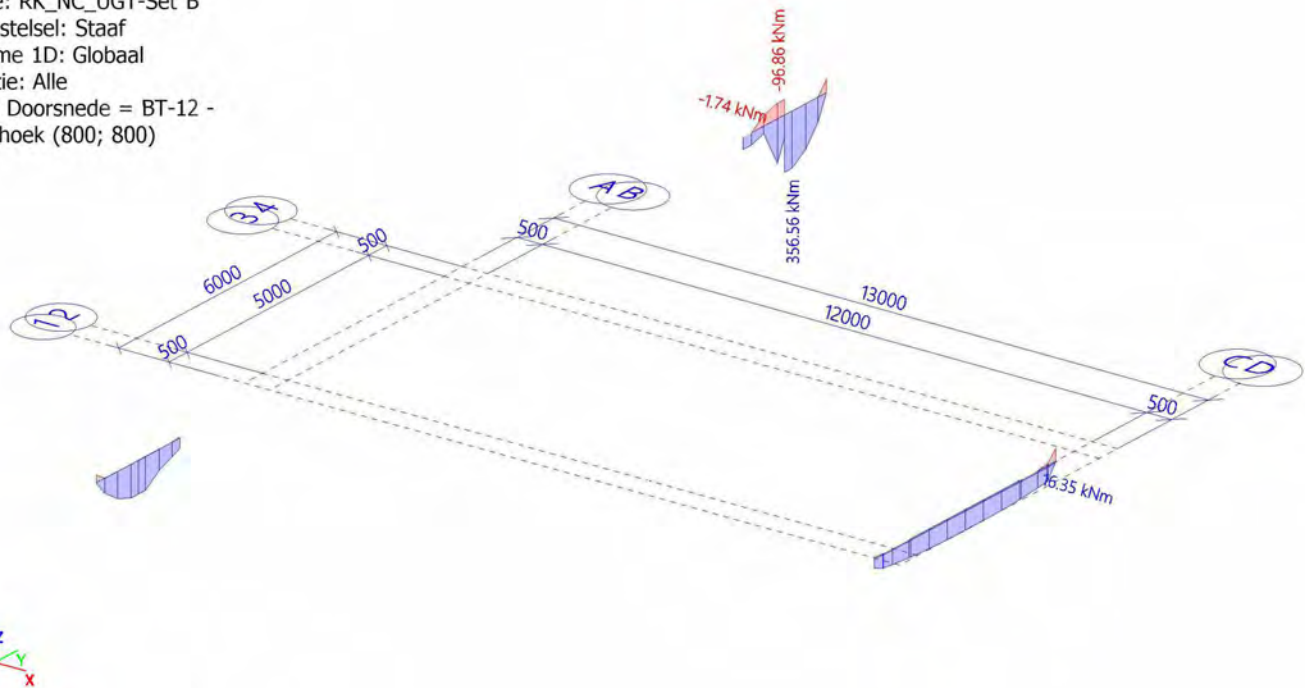




### 2.1.1.6. Rekenmodel - MEd

Waardes: **MEd**

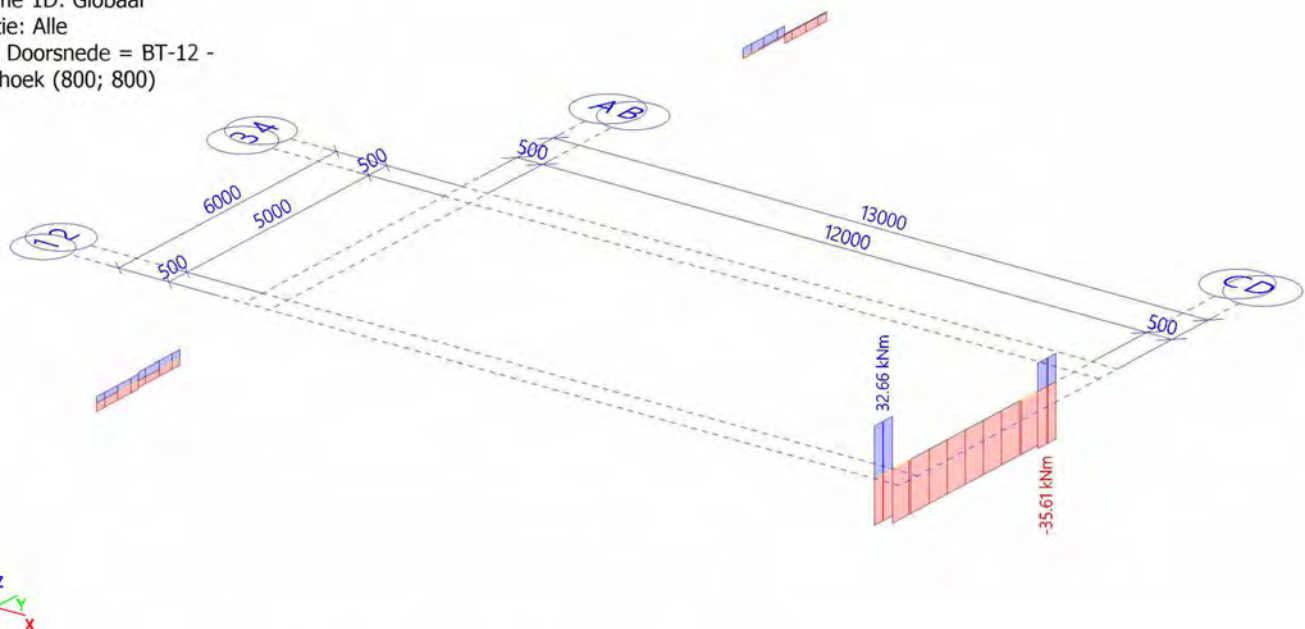
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.7. Rekenmodel - Mx

Waardes: **Mx**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



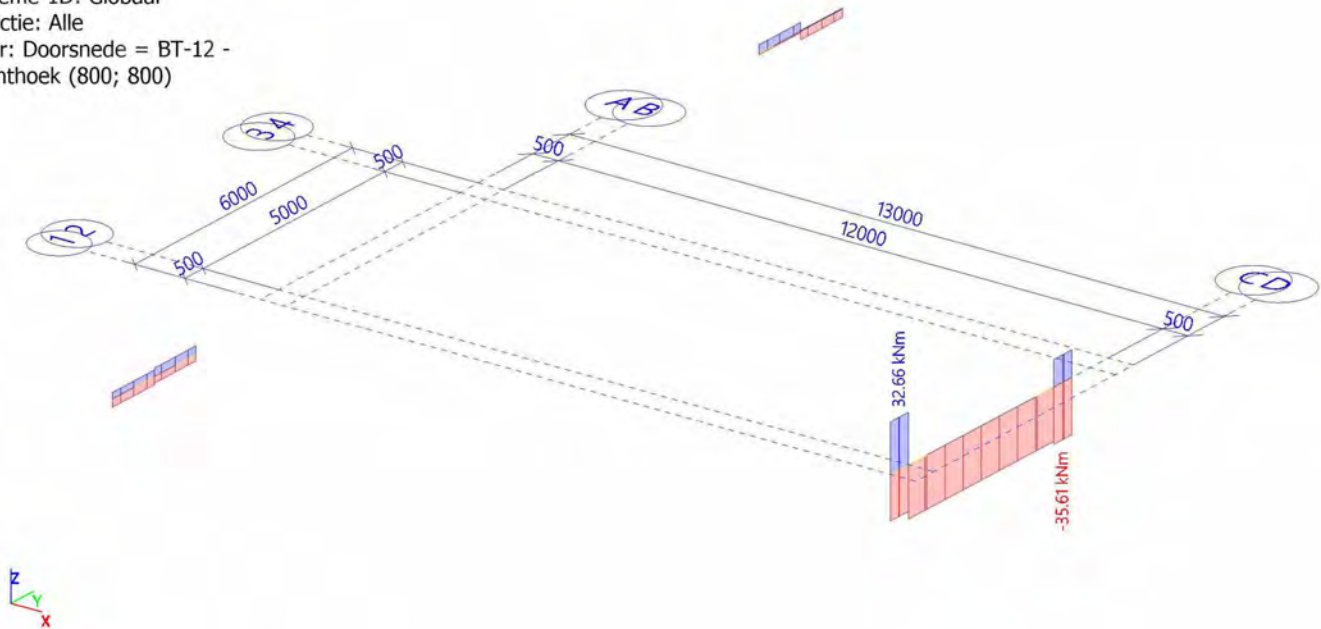




### 2.1.1.8. Rekenmodel - MEdx

Waardes:  $M_{Edx}$

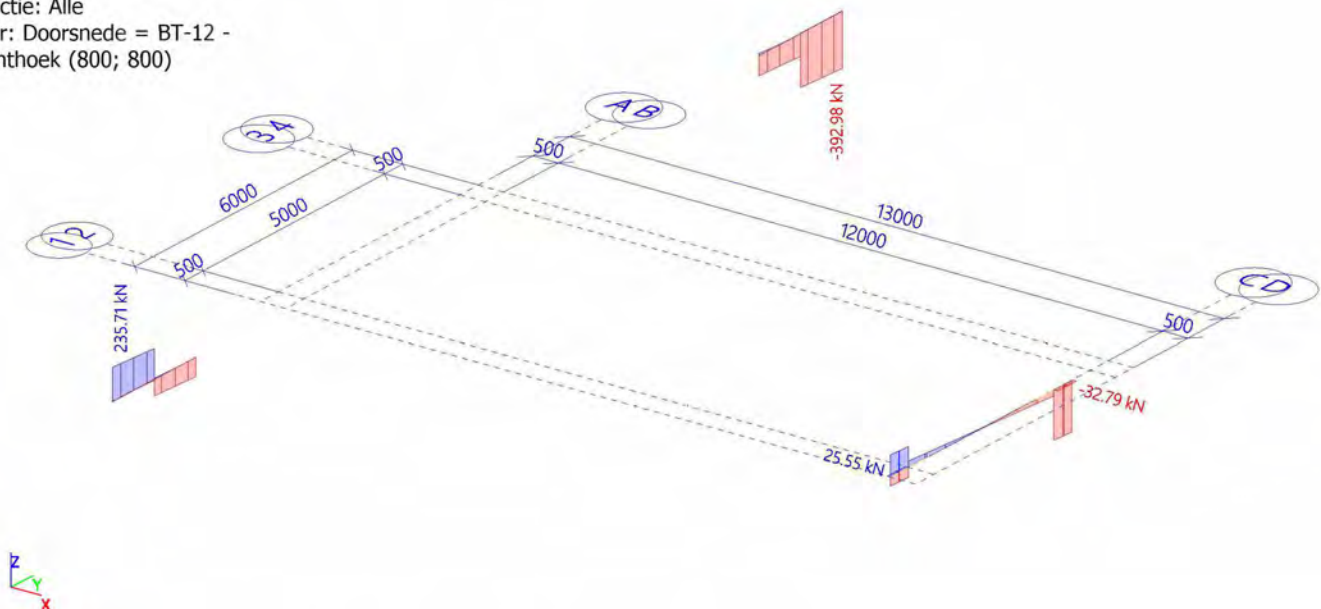
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.9. Rekenmodel - V

Waardes:  $V$

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

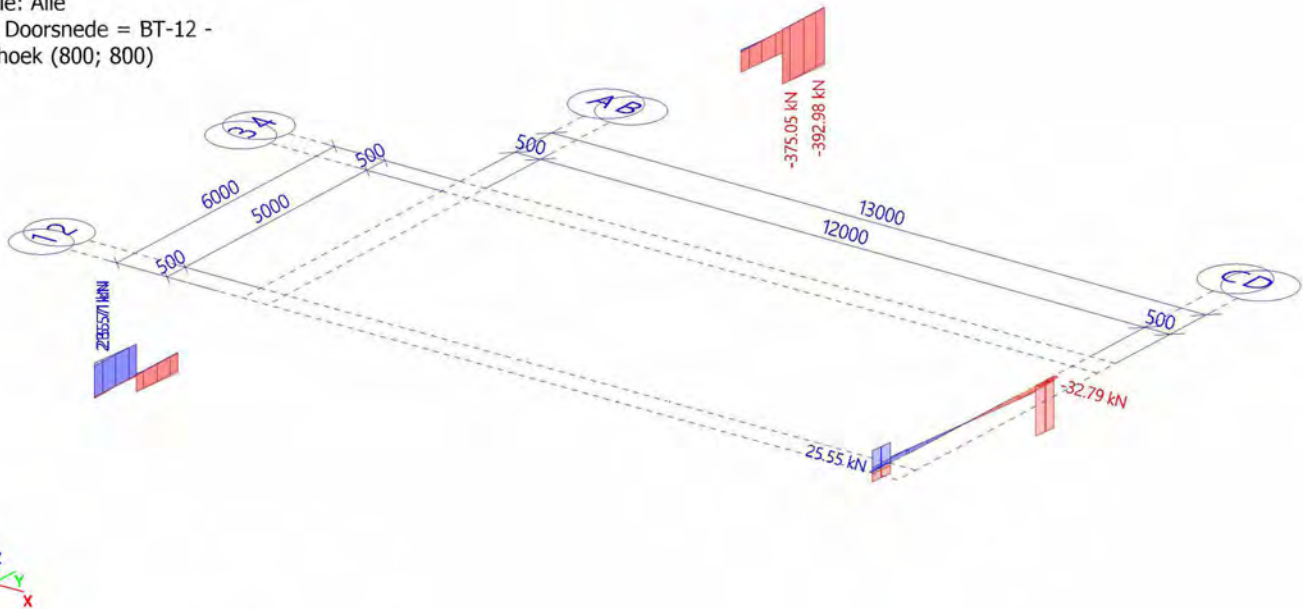




### 2.1.1.10. Rekenmodel - V-VEd

Waardes: **V-VEd**

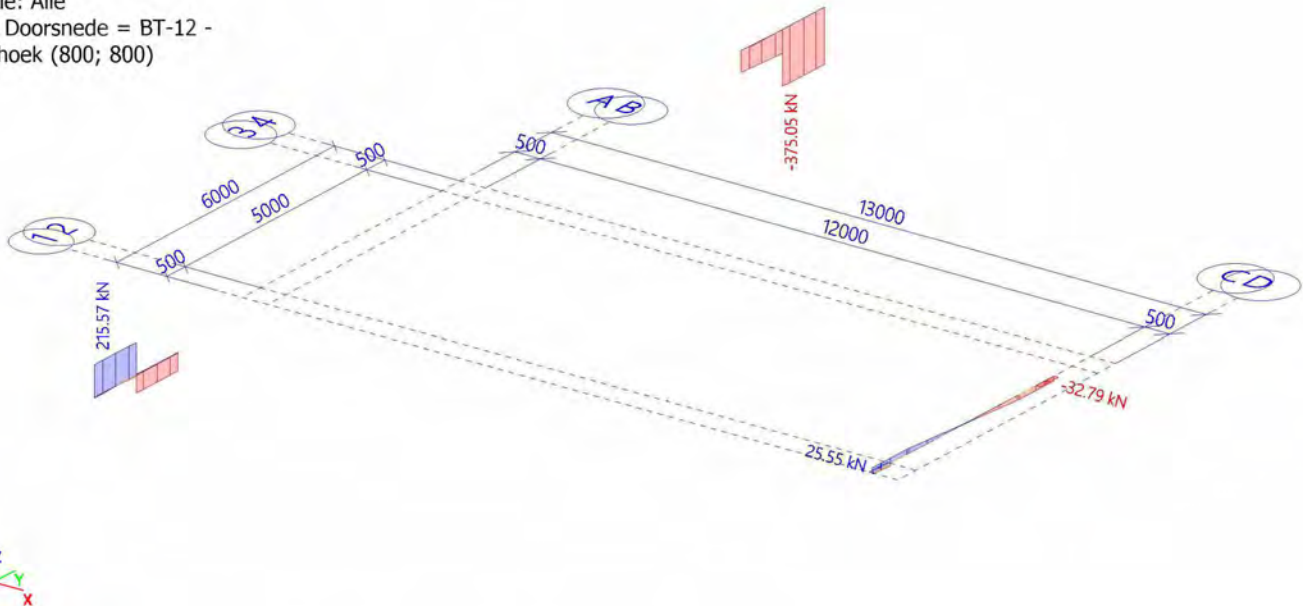
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.11. Rekenmodel - VEd

Waardes: **VEd**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)





## 2.1.2. Slankheid(Controle)

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Globaal  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$L_y$	$\beta_{zz}$	$i_{oy}$	$i_{oy}$	$\lambda_y$	$\lambda_{limy}$
				$L_z$	$\beta_{yy}$	$i_{oz}$	$i_{oz}$	$\lambda_z$	$\lambda_{limz}$
				[mm]	[-]	[mm]	[m]	[-]	[-]
S2	500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	4000.000	1.00	40000.000	2.3094e-01	173.21	724.97
				5000.000	10.00	5000.000	2.3094e-01	21.65	724.97
S1	1150.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	1150.000	1.00	11500.000	2.3094e-01	49.80	0.00
				2300.000	10.00	2300.000	2.3094e-01	9.96	0.00
S1	2300.000	NC_UGT-Set B.5	BT-12 - Rechthoek (800; 800)	1150.000	1.00	11500.000	2.3094e-01	49.80	4277.63
				2300.000	10.00	2300.000	2.3094e-01	9.96	4277.63

## 2.1.3. Voorstelling van stijfheid

Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-kar  
 Assenstelsel: Staaf  
 Extreme 1D: Globaal  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$N_{cr}$	$M_{y,cr}$	State	$f_{\sigma,eff}$	$\sigma_s$	$x_{l,cr}$	EA [MN]	$EI_y$
				[kN]	[kNm]		$\sigma_{cc}$	$\sigma_{sr}$	$\zeta$		[MNm <sup>2</sup> ]
				$N_{char}$	$M_{y,char}$		[MPa]	[MPa]	[-]		$EI_z$
S1	0.000	NC_BGT-kar.1	BT-12 - Rechthoek (800; 800)	0.00	0.00	Korte termijn	3.20	0.0	0	2.2236e+04	1.1968e+03
				-12.15	-22.65		0.00	0.0	0.00		1.1915e+03

## 2.1.4. Wapeningscontrole UGT

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Doorsnede  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$UC_{trep}$	$UC_{lmt}$	$UC_{VT}$	$UC_{vpress}$	$UC_{crack}$	$UC_{diff}$	$UC_{det}$	$UC$
				[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
S37	1350.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	1.00	0.98	0.16	-	-	-	-	1.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	1.00	0.98	0.89	-	-	-	-	1.00

## Gehele controle

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Doorsnede  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Datum  
Constructie  
Auteur

08. 03. 2019  
Algemeen XYZ  
5.12.8  
10/35

Naam	dx [mm]	Belasting	Doorsnede	UC <sub>resp</sub> [-]	UC <sub>int</sub> [-]	UC <sub>vr</sub> [-]	UC <sub>stress</sub> [-]	UC <sub>crack</sub> [-]	UC <sub>defl</sub> [-]	UC <sub>det</sub> [-]	UC [-]
S37	1350.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>1.00</b>	<b>0.98</b>	0.16	-	-	-	-	1.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	1.00	0.98	<b>0.89</b>	-	-	-	-	<b>1.00</b>

## Rekenmodel - UC

Waardes: **UC**

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

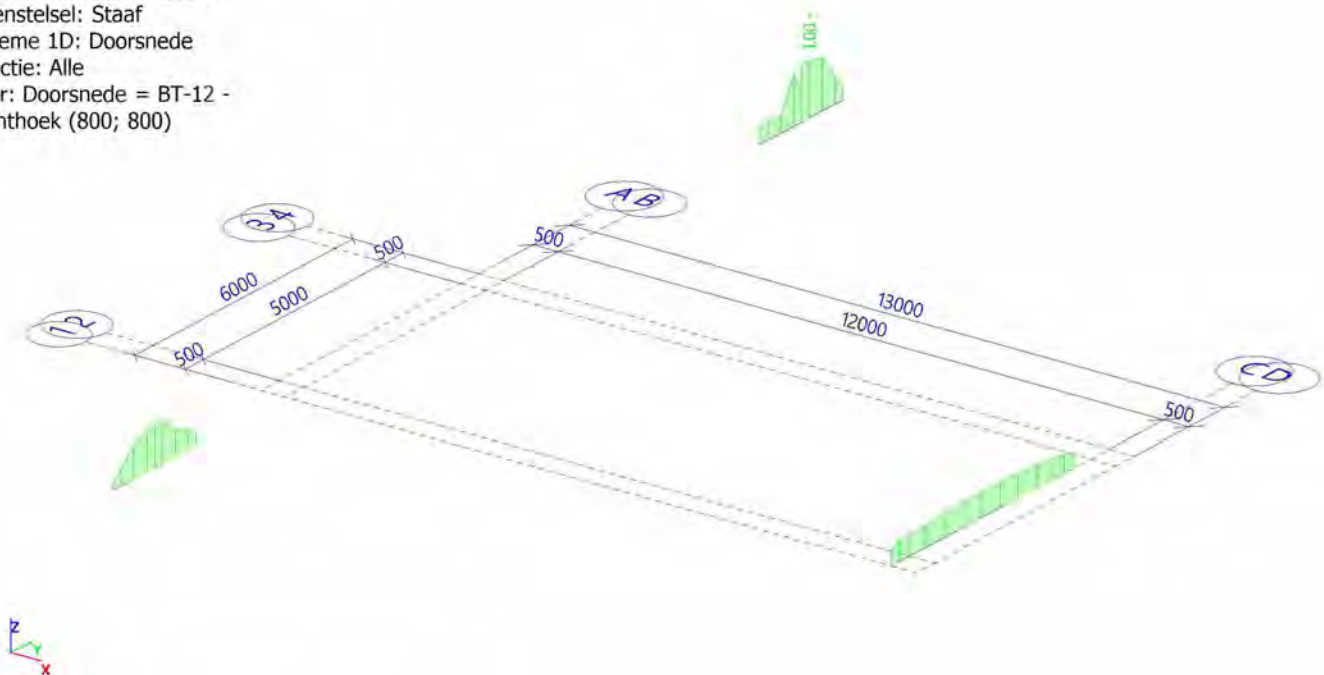
Assenstelsel: Staaf

Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 -

Rechthoek (800; 800)



## 2.1.5. Controle capaciteits-response

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Staaf

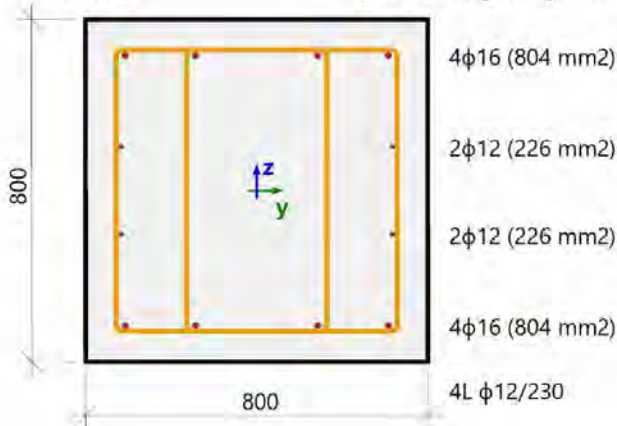
Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 7 [dx = 1.35 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y $\perp$	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z $\perp$	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4 $\phi$ 12+8 $\phi$ 16 (2061 mm <sup>2</sup> )
		$\rho_l = 0.322\%$ (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L $\phi$ 12/230 (452 mm <sup>2</sup> )
		$\rho_w = 0.246\%$ (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Materiaalkarakteristieken

Ontwerpbetondruksterkte

$$f_{cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$$

Ontwerpvloei spanning van langswapening

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa} \quad (3.15)$$

## Krachten

Inhoud van de combinatie: NC\_UGT-SetB.7

Van EEM analyse:

$$N = -43.1 \text{ kN} \quad M_y = 281 \text{ kNm} \quad M_z = -2.53 \text{ kNm}$$

## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0.1 \cdot (23.3 \cdot 10^6 \cdot 0.64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -43 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).

Herberekende buigmomenten:

Momentreductie boven steunpunt: Nee

Reductie van afschuifkrachten boven steunpunt: Nee

Verschuivingsregel gebruiken: Ja

$$N_{Ed} = -43.1 \text{ kN} \quad M_{Edy} = 357 \text{ kNm} \quad M_{Edz} = 0 \text{ kNm}$$



## Status van scheuren in buiging

$$\sigma_{ct,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow \text{doorsnede gescheurd bij buiging}$$

## Toetsing van beperkte hoogte van drukzone gebaseerd op 6.1(9) van NEN EN 1992-1-1

Grenswaarde van ontwerpnormaalkracht

$$N_{lim} = 0.1 \cdot A_c \cdot f_{cd} = 0.1 \cdot 0.64 \cdot 23.3 = 1493 \text{ kN}$$

Ontwerpwaarde van normaalkracht

$$N_{Ed} = -43.1 \text{ kN}$$

De waarde  $x_u$  berekend op basis van de weerstanden uit het interactiediagram

$$N_{Rd} = -43.9 \text{ kN}$$

$$M_{Rdy} = 363 \text{ kN}$$

$$M_{Rdz} = 0 \text{ kN}$$

Beperkte hoogte van drukzone

$$x_{u,lim} = \frac{500 \cdot 10^6 \cdot d}{500 \cdot 10^6 + f} = \frac{500 \cdot 10^6 \cdot 0.456}{500 \cdot 10^6 + 435 \cdot 10^6} = 0.244 \text{ m}$$

$$x_u < x_{u,lim} \Rightarrow 60.4 \text{ mm} < 244 \text{ mm}$$

Controlewaarde gerelateerd aan de beperking van de drukzone

$$UC_{x_u} = \frac{x_u}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248$$

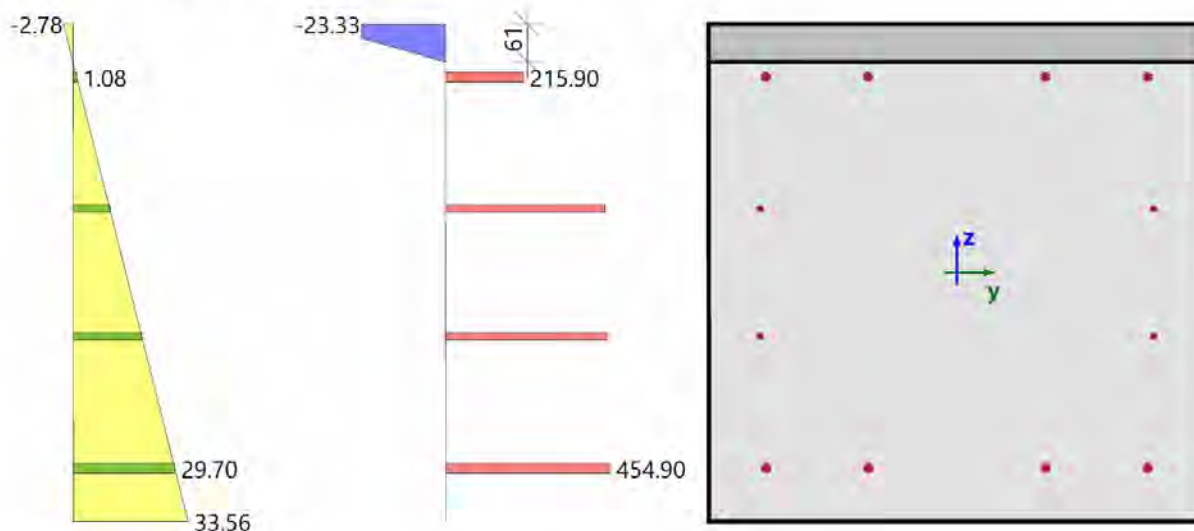
## Overzicht van controle

Type component	Vezel / Staaf	$\epsilon_{extr}$ [‰]	$\sigma_{extr}$ [MPa]	Controle rek [-]	Controle spanning [-]	$UC_{x_u}$ [-]	E.C. [-]	Grenswaarde [-]	Status
Beton	3	-2.78	-23.3	0.79	1.00	0.25	1.00	1	OK
Wapening	3	29.7	455	0.66	0.98				



Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

## Spanning en rek verdeling



## Extreme waarden van spanning/rek in component

Type component	Vezel / StAAF	$\epsilon$ [‰]	$\epsilon_{lim}$ [‰]	$\sigma$ [MPa]	$\sigma_{lim}$ [MPa]	E.C. [-]	Status
Beton - druk	3	-2.78	-3.5	-23.3	-23.3	1.00	OK
Beton - trek	1	33.6	0	0	0	0.00	OK
Wapening - druk	1	0	0	0	0	0.00	OK
Wapening - trek	3	29.7	45	455	466	0.98	OK

## Vlak van vervorming

Rek in het midden van het zwaartepunt

$$\epsilon_x = 15.4 \text{ ‰}$$

Kromming rond y-as

$$\epsilon_y = -45.4 \text{ ‰}$$

Kromming rond z-as

$$\epsilon_z = 0 \text{ ‰}$$

Hoogte van de drukzone

$$x = 61 \text{ mm}$$

Evenwichtshoogte van drukzone

$$x_{bal} = 289 \text{ mm}$$

Grenswaarde hoogte van drukzone

$$x_{lim} = 35 \text{ mm}$$

Helling van de neutrale as

$$\alpha_{NA} = 0^\circ$$

Hoogte van de doorsnede loodrecht op neutrale as

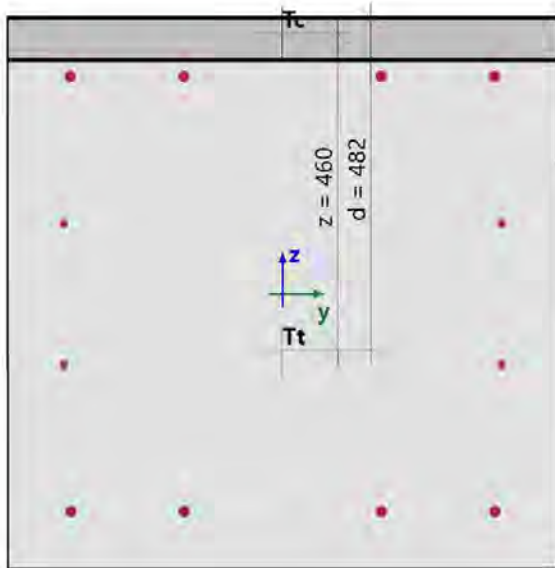
$$h = 800 \text{ mm}$$

Effectieve diepte van de doorsnede loodrecht op de neutrale as

$$d = 482 \text{ mm}$$

Hefboomsarm van de doorsnede loodrecht op neutrale as

$$z = 460 \text{ mm}$$



## Doorsnedekarakteristieken

Type component	$t_y$ [m]	$t_z$ [m]	A [m <sup>2</sup> ]	$I_y$ [m <sup>4</sup> ]	$I_z$ [m <sup>4</sup> ]
Beton - druk	0	0.369	0.049	$6.7 \cdot 10^{-3}$	$2.61 \cdot 10^{-3}$
Beton - trek	0	-0.031	0.591	0.0274	0.0315
Wapening - druk	0	0	0	0	0
Wapening - trek	0	0	$2.06 \cdot 10^{-3}$	$164 \cdot 10^{-6}$	$138 \cdot 10^{-6}$
Volledig beton	0	0	0.64	0.0341	0.0341
Alle wapeningsstaven	0	0	$2.06 \cdot 10^{-3}$	$164 \cdot 10^{-6}$	$138 \cdot 10^{-6}$

## Krachten in alle doorsnedecomponenten

Type component	$N_{res}$ [kN]	$M_{res,y}$ [kNm]	$M_{res,z}$ [kNm]	$e_y$ [m]	$e_z$ [m]
Beton - druk	-784	296	0	0	0.378
Beton - trek	0	0	0	0	0
Wapening - druk	0	0	0	0	0
Wapening - trek	741	60.7	0	0	-0.082
Alles onder druk	-784	296	0	0	0.378
Alles onder trek	741	60.7	0	0	-0.082
Overzicht	-43.1	357	0		





### Gedetailleerde resultaten van spanningen en rekken in betonvezels

Vezel	Materiaal	$y_i$	$z_i$	$\epsilon$	$\epsilon_{lim}$	$\sigma$	$\sigma_{lim}$	$\epsilon / \epsilon_{lim}$	$\sigma / \sigma_{lim}$	Controle
		[m]	[m]	[‰]	[‰]	[MPa]	[MPa]	[-]	[-]	
1	C35/45	0.4	-0.4	33.6	0	0	0	0	0	OK
2	C35/45	0.4	0	15.4	0	0	0	0	0	OK
3	C35/45	0.4	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
4	C35/45	0	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
5	C35/45	-0.4	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
6	C35/45	-0.4	0	15.4	0	0	0	0	0	OK
7	C35/45	-0.4	-0.4	33.6	0	0	0	0	0	OK
8	C35/45	0	-0.4	33.6	0	0	0	0	0	OK

### Gedetailleerde resultaten van spanningen en rekken in wapeningsstaven

StAAF	Materiaal	$d_s$	$y_i$	$z_i$	$\epsilon$	$\epsilon_{lim}$	$\sigma$	$\sigma_{lim}$	$\epsilon / \epsilon_{lim}$	$\sigma / \sigma_{lim}$	Controle
		[mm]	[m]	[m]	[‰]	[‰]	[MPa]	[MPa]	[-]	[-]	
1	B 500B	16	0.143	0.315	1.08	45	216	466	0.02	0.46	OK
2	B 500B	16	-0.307	0.315	1.08	45	216	466	0.02	0.46	OK
3	B 500B	16	-0.307	-0.315	29.7	45	455	466	0.66	0.98	OK
4	B 500B	16	0.143	-0.315	29.7	45	455	466	0.66	0.98	OK
5	B 500B	16	-0.143	-0.315	29.7	45	455	466	0.66	0.98	OK
6	B 500B	16	0.307	-0.315	29.7	45	455	466	0.66	0.98	OK
7	B 500B	12	-0.317	0.102	10.7	45	441	466	0.24	0.95	OK
8	B 500B	12	-0.317	-0.102	20.1	45	448	466	0.45	0.96	OK
9	B 500B	12	0.317	-0.102	20.1	45	448	466	0.45	0.96	OK
10	B 500B	12	0.317	0.102	10.7	45	441	466	0.24	0.95	OK
11	B 500B	16	0.307	0.315	1.08	45	216	466	0.02	0.46	OK
12	B 500B	16	-0.143	0.315	1.08	45	216	466	0.02	0.46	OK

### Verklaring van fouten, waarschuwingen en opmerkingen

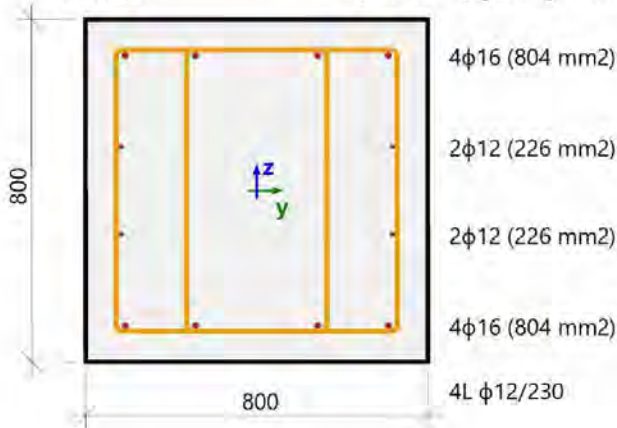
Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

#### 2.1.6. Controle capaciteits-interactie diagram

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Doorsnede  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 7 [dx = 1.35 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y $\perp$	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z $\perp$	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4 $\phi$ 12+8 $\phi$ 16 (2061 mm <sup>2</sup> )
		$\rho_l = 0.322\%$ (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L $\phi$ 12/230 (452 mm <sup>2</sup> )
		$\rho_w = 0.246\%$ (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Materiaalkarakteristieken

Ontwerpbetondruksterkte

$$f_{cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$$

Ontwerpvloei spanning van langswapening

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa} \quad (3.15)$$

## Krachten

Van EEM analyse

$$N = -43.1 \text{ kN} \quad M_y = 281 \text{ kNm} \quad M_z = -2.53 \text{ kNm}$$

Inhoud van de combinatie:

NC\_UGT-SetB.7

## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0.1 \cdot (23.3 \cdot 10^6 \cdot 0.64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -43 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).



Herberekende buigmomenten:

Momentreductie boven steunpunt: Nee

Reductie van afschuifkrachten boven steunpunt: Nee

Verschuivingsregel gebruiken: Ja

$N_{Ed} = -43.1 \text{ kN}$   $M_{Edy} = 357 \text{ kNm}$   $M_{Edz} = 0 \text{ kNm}$

### Invoergegevens voor het genereren van interactiediagrammen

Methode van interactieve diagramma controle	$N_u M_u$
Verdeling van verticale rekken	250
Aantal verticale snedes	18
Resultante waarde van buigmoment	$M_{res} = 357 \text{ kNm}$
Hoek van resulterend buigmoment is gerelateerd aan $M_y$ richting in horizontaal vlak $M_y$ - $M_z$	$\alpha_{M_y M_z} = 180^\circ$
Hoek van resulterend buigmoment is gerelateerd aan $N$ richting in verticaal vlak $N$ - $M_{res}$	$\alpha_{NM} = -6.89^\circ$

### Status van scheuren in buiging

$\sigma_{ct,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow$  doorsnede gescheurd bij buiging

### Toetsing van beperkte hoogte van drukzone gebaseerd op 6.1(9) van NEN EN 1992-1-1

Grenswaarde van ontwerpnormaalkracht

$$N_{lim} = 0.1 \cdot A_c \cdot f_{cd} = 0.1 \cdot 0.64 \cdot 23.3 = 1493 \text{ kN}$$

Ontwerpwaarde van normaalkracht

$$N_{Ed} = -43.1 \text{ kN}$$

De waarde  $x_u$  berekend op basis van de weerstanden uit het interactiediagram

$$N_{Rd} = -43.9 \text{ kN}$$

$$M_{Rdy} = 363 \text{ kNm}$$

$$M_{Rdz} = 0 \text{ kNm}$$

Beperkte hoogte van drukzone

$$x_{u,lim} = \frac{500 \cdot 10^6 \cdot d}{500 \cdot 10^6 + f} = \frac{500 \cdot 10^6 \cdot 0.456}{500 \cdot 10^6 + 435 \cdot 10^6} = 0.244 \text{ m}$$

$$x_u < x_{u,lim} \Rightarrow 60.4 \text{ mm} < 244 \text{ mm}$$

Controlewaarde gerelateerd aan de beperking van de drukzone

$$UC_{x_u} = \frac{x_u}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248$$

### Berekening van weerstanden

Weerstanden in positieve richting  $N_{Rd+} = 41 \text{ kN}$   $M_{Rdy+} = 363 \text{ kNm}$   $M_{Rdz+} = 0 \text{ kNm}$

Weerstanden in negatieve richting  $N_{Rd-} = -44 \text{ kN}$   $M_{Rdy-} = -336 \text{ kNm}$   $M_{Rdz-} = 0 \text{ kNm}$



## Overzicht van controle

Krachten:  $N_{Ed} = -43.1 \text{ kN}$   $M_{Edy} = 357 \text{ kNm}$   $M_{Edz} = 0 \text{ kNm}$

Weerstand:  $N_{Rd} = -44 \text{ kN}$   $M_{Rdy} = 363 \text{ kNm}$   $M_{Rdz} = 0 \text{ kNm}$

Berekenen van de eenheidscontrole:

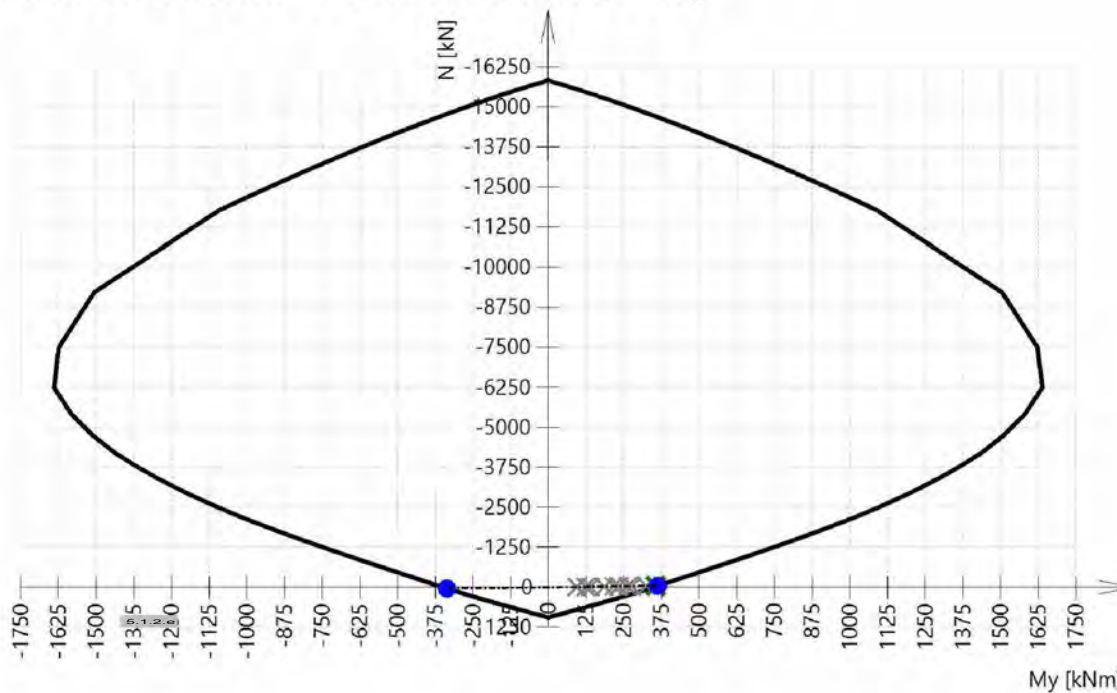
$$UC = \frac{\sqrt{N_{Ed}^2 + M_{Edy}^2 + M_{Edz}^2}}{\sqrt{N_{Rd}^2 + M_{Rdy}^2 + M_{Rdz}^2}} = \frac{\sqrt{-43.1^2 + 357^2 + 0^2}}{\sqrt{-43.9^2 + 363^2 + 0^2}} = 0.981$$

Eenheidscontrole gebaseerd op  $x_{u,lim}$  volgens 6.1(9) van NEN EN 1992-1-1

$$UC_{xu} = \frac{x}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248 \leq 1 \quad \text{OK}$$

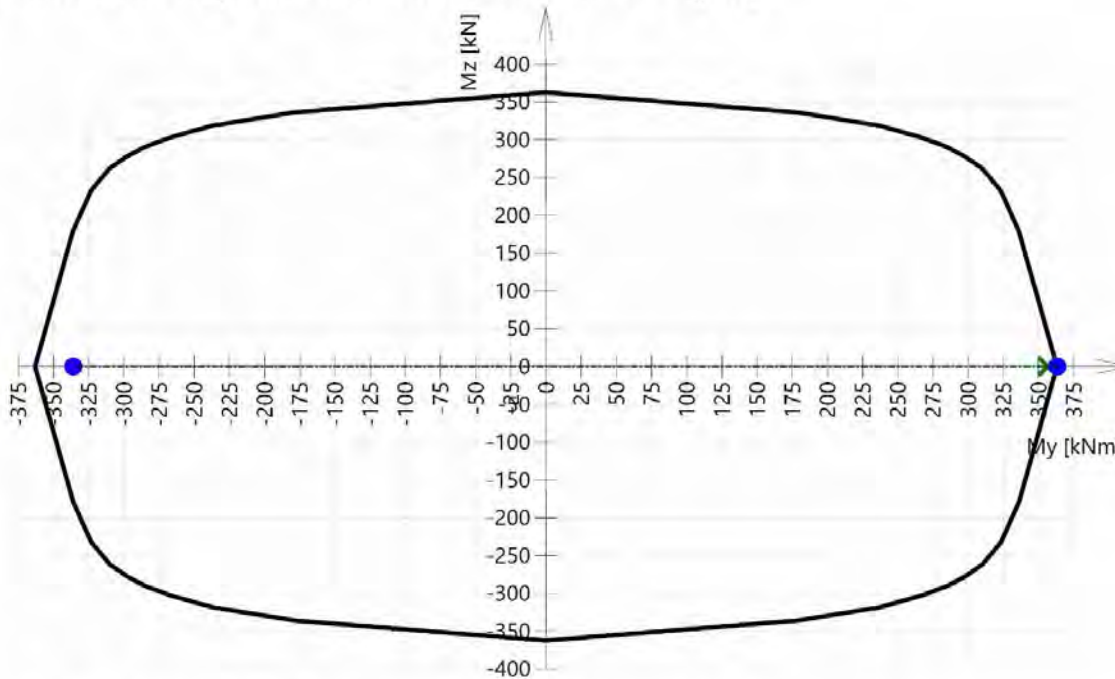
Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

## 3D-interactiediagram - Verticale doorsnede N- $M_y$





### 3D-interactiediagram - Horizontale doorsnede $M_y$ - $M_z$



### Verklaring van fouten, waarschuwingen en opmerkingen

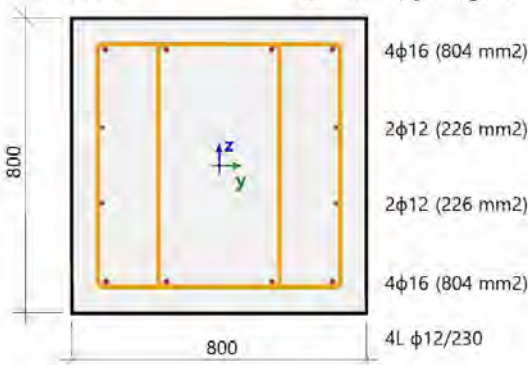
Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

### 2.1.7. Controleer afschuiving+torsie (UGT)

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Doorsnede  
Selectie: Alle  
Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 6 [dx = 1.15 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4φ12+8φ16 (2061 mm <sup>2</sup> )
		ρ <sub>l</sub> = 0.322 % (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L φ12/230 (452 mm <sup>2</sup> )
		ρ <sub>w</sub> = 0.246 % (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Instellingen

Methode voor berekening afschuifweerstand: Standaard

Grenswaarde van de hoek tussen buigende momenten en resultante afschuifkrachten voor het gebruik van de standaardmethode:  $\alpha_{VM,lim} = 15^\circ$

Equivalentente dunwandige doorsnede: Automatisch

De hoek tussen de betondrukschoor en de staaf: Gebruikersinvoer:  $\theta_{inp} = 40^\circ \Rightarrow \cot(\theta_{inp}) = 1.19$

## Krachten

Inhoud van de combinatie: NC\_UGT-SetB.7

$N_{Ed} = -43.1 \text{ kN}$   $M_{Edy} = 357 \text{ kNm}$   $M_{Edz} = 0 \text{ kNm}$   $V_{Edy} = 0 \text{ kN}$   $V_{Edz} = -371 \text{ kN}$   $T_{Ed} = -3.85 \text{ kNm}$

Hoek van gradiënt van rekvlak

$$\alpha_M = 90^\circ$$

Hoek van resultante van afschuiving

$$\alpha_V = -90^\circ$$

Resultante van dwarskracht

$$V_{Ed} = \sqrt{V_{Edy}^2 + V_{Edz}^2} = \sqrt{0^2 + (-371)^2} = 371 \text{ kN}$$

$$\alpha_V = \alpha_V + 180 = -90 + 180 = 90^\circ$$

Verschil tussen hoeken  $\alpha_M$  en  $\alpha_V$

$$\alpha_{MV} = \text{abs}(\alpha_M - \alpha_V) = \text{abs}(90 - 90) = 0^\circ$$

## Materiaalkarakteristieken

Ontwerpbetondruksterkte

$$f_{ctd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$$

Ontwerp betontreksterkte

$$f_{ctd} = \frac{\alpha_{ct} \cdot f_{ctk005}}{\gamma_c} = \frac{1 \cdot 2.2}{1.5} = 1.47 \text{ MPa} \quad (3.15, 3.16)$$



### Berekening van hoek tussen betondrukschoor en staafas

- minimale waarde:

$$\theta_{\min} = 21.8^\circ \Rightarrow \cot(\theta_{\min}) = 2.5 \quad (\S 6.2.3(2))$$

- maximale waarde:

$$\theta_{\max} = 45^\circ \Rightarrow \cot(\theta_{\max}) = 1 \quad (\S 6.2.3(2))$$

- invoer/berekende waarde:

$$\theta = \theta_{\text{inp}} = 40^\circ, \cot(\theta) = 1.19$$

Opm.: Automatische berekening van hoek is uitgeschakeld, gebruikerswaarde wordt in rekening genomen



## Controleer afschuiving en bereken afschuifweerstand

### Doorsnedeparameters

Minimale breedte van doorsnede in trekzone

$$y_{bw} = 0 \text{ mm} \quad z_{bw} = 339 \text{ mm} \quad b_w = 800 \text{ mm}$$

Opm.: Waarde  $b_w$  is berekend als de kleinste breedte van de doorsnede in het trekoppervlak loodrecht op de resultante van de afschuifkracht.

Minimale breedte van de doorsnede tussen trek- en drukschoor

$$y_{bw1} = 0 \text{ mm} \quad z_{bw1} = 378 \text{ mm} \quad b_{w1} = 800 \text{ mm}$$

Opm.: Waarde  $b_{w1}$  is berekend als de kleinste breedte van de doorsnede tussen het trek- en drukkoord loodrecht op de resultante van de afschuifkracht.

Hoogte van doorsnede is herberekend in de richting van de resultante van de dwarskracht

$$h = 800 \text{ mm}$$

Opm.: De waarde  $h$  wordt berekend als de breedte van de doorsnede op het zwaartepunt in de richting van de resultante van de dwarskracht.

Oppervlakte betondoorsnede

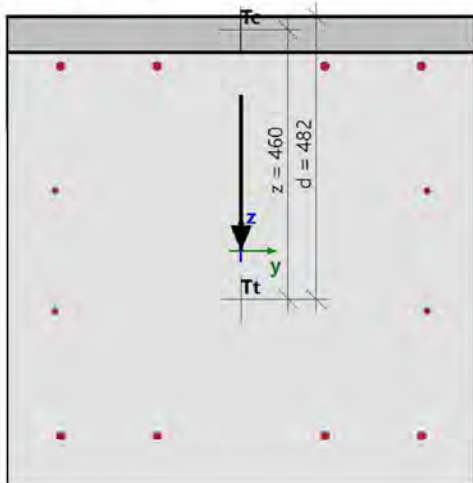
$$A_c = 0.64 \text{ m}^2$$

Effectieve diepte omgerekend naar richting van resultante van dwarskracht

$$d = 482 \text{ mm}$$

Hefboomsarm van interne krachten omgerekend naar richting van resultante van dwarskracht

$$z = 460 \text{ mm}$$







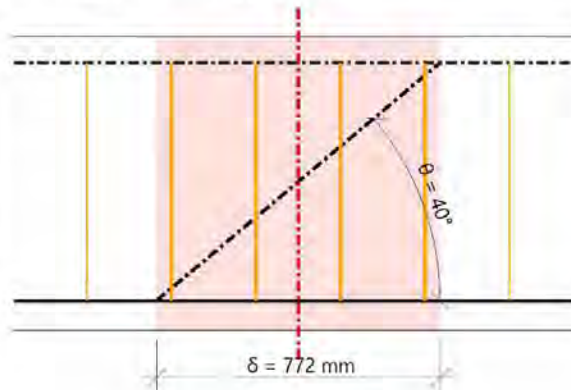
## Parameters van dwarswapening

### Invoerparameters

Beugels over de lengte van scheurafschuifprojectie  $\delta = z \cdot \cot(\theta) = 772 \text{ mm}$ , interval (-386; 386)

$$z = \text{Coeff}_d \cdot \text{Coeff}_z \cdot h = 0.9 \cdot 0.9 \cdot 0.8 = 648 \text{ mm} \quad \delta = z \cdot \cotg(\theta) = 0.648 \cdot \cotg(40) = 772 \text{ mm}$$

ID	Zone	$x_s$ [mm]	$\phi_s$ [mm]	$s_s$ [mm]	$n_s$ []	$\alpha_s$ [°]	$f_{ywk}$ [MPa]
1	1	-345	12	230	4	90	500
2	1	-115	12	230	4	90	500
3	1	115	12	230	4	90	500
4	1	345	12	230	4	90	500
Avg.	-	-	12	230	4	90	500



Aantal snedes per beugel

Diameter van de wapening

Hart - op - hartafstand van beugel in langsrichting

Hoek van beugels van staafas

Karakteristieke vloeigrens

Doorsnedeoppervlakte van dwarswapening

$$A_{sw} = n_s \cdot \pi \cdot \left(\frac{\phi_s}{2}\right)^2 = 4 \cdot 3.14 \cdot \left(\frac{12}{2}\right)^2 = 452 \text{ mm}^2$$

Maximale longitudinale tussenafstand van beugelwapening

$$s_l = s_{inp} = 230 \text{ mm}$$

Doorsnedeoppervlak per meter

$$A_{swm} = \frac{A_{sw}}{s_l} = \frac{452 \cdot 10^{-6}}{0.23} = 1967 \text{ mm}^2/\text{m}$$

$$n_s = 4$$

$$\phi_s = 12 \text{ mm}$$

$$s_{inp} = 0.23 \text{ m}$$

$$\alpha_s = 90^\circ$$

$$f_{ywk} = 500 \text{ MPa}$$

## Parameters van langswapening

Het oppervlak van de trekwapening

$$A_{sl} = 2061 \text{ mm}^2$$



## Berekening van afschuifweerstand

### Ontwerpschuifweerstand van de staaf zonder dwarswapening

$$\sigma_{cl,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow \text{doorsnede gescheurd bij buiging}$$

Berekening ontwerp dwarskrachtweerstand van de staaf zonder dwarskrachtwapening volgens artikel 6.2.2(1).

Coëfficiënt voor hoogte van de doorsnede

$$k = \min\left(1 + \left(\frac{200}{d}\right)^{\frac{1}{2}}; 2\right) = \min\left(1 + \left(\frac{200}{482}\right)^{\frac{1}{2}}; 2\right) = 1.64 \quad (\$6.2.2(1))$$

Geometrische wapeningsverhouding

$$\rho_1 = \min\left(\frac{A_{sl}}{b_w \cdot d}; 0.02\right) = \min\left(\frac{2.06 \cdot 10^{-3}}{0.8 \cdot 0.482}; 0.02\right) = 5.34 \cdot 10^{-3} \quad (\$6.2.2(1))$$

Axiale spanning in de doorsnede

$$\sigma_{cp} = \min\left(\frac{-N_{Ed}}{A_c}; 0.2 \cdot f_{cd}\right) = \min\left(\frac{-43.1}{0.64}; 0.2 \cdot 23.3\right) = 0.0674 \text{ MPa} \quad (\$6.2.2(1))$$

Andere coëfficiënten

$$C_{Rdc} = 0.12 \quad v_{min} = 0.437 \text{ MPa} \quad k_1 = 0.15$$

Berekening van de rekenwaarde

$$\begin{aligned} V_{Rdc} &= 10^6 \cdot \left( C_{Rdc} \cdot k \cdot \left( 100 \cdot \rho_1 \cdot f_{ck} \right)^{\frac{1}{3}} + k_1 \cdot \sigma_{cp} \right) \cdot b_w \cdot d \quad (6.2.a) \\ &= 10^6 \cdot \left( 0.12 \cdot 1.64 \cdot \left( 100 \cdot 5.34 \cdot 10^{-3} \cdot 35 \right)^{\frac{1}{3}} + 0.15 \cdot 0.0674 \right) \cdot 0.8 \cdot 0.482 = 206 \text{ kN} \end{aligned}$$

$$\begin{aligned} V_{Rdcmin} &= 10^6 \cdot \left( v_{min} + k_1 \cdot \sigma_{cp} \right) \cdot b_w \cdot d \quad (6.2.b) \\ &= 10^6 \cdot \left( 0.437 + 0.15 \cdot 0.0674 \right) \cdot 0.8 \cdot 0.482 = 172 \text{ kN} \end{aligned}$$

$$V_{Rdc} = \max(V_{Rdc}; V_{Rdcmin}; 0) = \max(205851; 172222; 0) = 206 \text{ kN}$$

Opm.: Ontwerp afschuifweerstand van de staaf zonder de afschuifwapening is berekend volgens Artikel 6.2.2(1), omdat de doorsnede is gescheurd in flexure in UGT of de doorsnede is niet belast door normaalkracht en buigmomenten.



## Ontwerpafschuifweerstand van de staaf met dwarswapening

Ontwerpspanning van dwarswapening

$$A_{sw} = n_s \cdot \pi \cdot \left(\frac{\phi_s}{2}\right)^2 = 4 \cdot 3.14 \cdot \left(\frac{12}{2}\right)^2 = 452 \text{ mm}^2$$

$$\sigma_{swd} = \frac{\frac{V_{Ed}}{z} \cdot s_i}{A_{sw} \cdot (\cotg(\theta) + \cotg(\alpha_s) \cdot \sin(\alpha_s))} = \frac{\frac{371276}{0.46} \cdot 0.23}{452 \cdot 10^{-6} \cdot (\cotg(40) + \cotg(90) \cdot \sin(90))} = 345 \text{ MPa}$$

Ontwerpvloei spanning van dwarswapening

$$f_{ywd} = 0.8 \cdot f_{ywk} = 0.8 \cdot 500 = 400 \text{ MPa} \quad , \text{ omdat } \sigma_{swd} < 0.8 \cdot f_{ywk}$$

Opm.: Ontwerp vloeisterkte van de dwarswapening is gereduceerd tot 0.8 x  $f_{ywk}$  (EN 1992-1-1, Artikel 6.2.3(3)), omdat de ontwerpspanning van de dwarswapening onder de 80% van de karakteristieke vloei spanning  $f_{yk}$  is.

Ontwerpafschuifweerstand van de staaf met dwarswapening

$$V_{Rds} = \frac{A_{sw}}{s_i} \cdot z \cdot f_{ywd} \cdot \cotg(\theta) = \frac{452 \cdot 10^{-6}}{0.23} \cdot 0.46 \cdot 400 \cdot 10^6 \cdot \cotg(40) = 431 \text{ kN} \quad (6.8)$$

## Rekenwaarde van de max. afschuifkracht welke kan worden verdragen door de staaf

Sterktereductiefactor voor beton gescheurd in afschuiving - waarde  $v$

$$v = 0.6 \cdot \left(1 - \frac{f_{ck}}{250}\right) = 0.6 \cdot \left(1 - \frac{35}{250}\right) = 0.516 \quad (6.6N)$$

Sterktereductiefactor voor beton gescheurd in afschuiving - waarde  $v_1$

$$\sigma_{cp} = \min\left(\frac{-N_{Ed}}{A_c}; 0.2 \cdot f_{cd}\right) = \min\left(\frac{-43.1}{0.64}; 0.2 \cdot 23.3\right) = 0.0674 \text{ MPa}$$

$$v_1 = 0.6 \quad (6.10.aN)$$

Coëfficiënt voor de bepaling van de spanning in de drukdiagonaal

$$\alpha_{cw} = 1 \quad (\text{voor niet-voorgespannen element}) \quad (6.2.3(3)N3)$$

Rekenwaarde van de max. afschuifkracht welke kan worden verdragen door de staaf

$$V_{Rdmax} = \frac{\alpha_{cw} \cdot b_{w1} \cdot z \cdot v_1 \cdot f_{cd}}{(\cotg(\theta) + \tg(\theta))} = \frac{1 \cdot 0.8 \cdot 0.46 \cdot 0.6 \cdot 23.3 \cdot 10^6}{(\cotg(40) + \tg(40))} = 2534 \text{ kN} \quad (6.9)$$

Maximale dwarskracht bij het steunpunt (zonder gebruik van factor  $\beta$ )

$$V_{Edmax} = 0.5 \cdot b_{w1} \cdot d \cdot v \cdot f_{cd} = 0.5 \cdot 0.8 \cdot 0.482 \cdot 0.516 \cdot 23.3 \cdot 10^6 = 2321 \text{ kN} \quad (6.5)$$

Afschuifweerstand van de staaf

$$V_{Rd} = \min(V_{Rds} + V_{cctd}; V_{td}; V_{Rdmax} + V_{cctd} + V_{td}; V_{Edmax} + V_{cctd} + V_{td}) = \min(431 + 0 + 0; 2534 + 0 + 0; 2321 + 0 + 0) = 431 \text{ kN}$$



## Afschuifcontrole

Controle  $V_{Rdmax}$

$$V_{Ed} = 371 \text{ kN} \leq V_{Rdmax} + V_{ccd} + V_{td} = 2534 \text{ kN}$$

Opm.: De controle voldoet voor het verbrijzelen van de drukschoor ( $V_{Ed} \leq V_{Rd,max} + V_{td} + V_{ccd}$ ).

Controle  $V_{Edmax}$

$$V_{Ed} = 371 \text{ kN} \leq V_{Edmax} + V_{ccd} + V_{td} = 2321 \text{ kN}$$

Opm.: De controle voldoet voor dwarskracht nabij de ondersteuning ( $V_{Ed} \leq V_{Ed,max} + V_{td} + V_{ccd}$ ).

Controle  $V_{Rdc}$  en  $V_{Rds}$

$$V_{Ed} = 371 \text{ kN} < V_{Rds} + V_{ccd} + V_{td} = 431 \text{ kN}$$

Opm.: De controle voldoet voor dwarswapening ( $V_{Ed} < V_{Rds} + V_{ccd} + V_{td}$ ).

## Eenh. Controle

$$UC = \frac{V_{Ed}}{V_{Rd}} = \frac{371 \text{ kN}}{431 \text{ kN}} = 0.862$$

## Controleer torsie en bereken torsieweerstand

Totale oppervlakte van doorsnede

$$A_c = 640000 \text{ mm}^2$$

Totale oppervlakte van doorsnede

$$u_c = 3200 \text{ mm}$$

De oppervlakte van langswapening voor torsie

$$A_{sl} = 1433 \text{ mm}^2$$

De minimum afstand tussen wapeningsstaven binnen beugel voor torsie en rand van doorsnede

$$a_{sl} = 83 \text{ mm}$$

Effectieve wanddikte

$$t_{ef} = \max\left(\frac{A_c}{u_c}; 2 \cdot a_{sl}\right) = \max\left(\frac{640000}{3200}; 2 \cdot 83\right) = 200 \text{ mm} \quad (\S 6.3.2(1))$$

Omtrek en oppervlakte van de zone binnen de centrale lijn van de effectieve doorsnede

$$u_k = 2071 \text{ mm}$$

$$A_k = 261300 \text{ mm}^2$$

Opm.: Torsieparameters [waardes van  $A_k$  en  $u_k$ ] zijn berekend volgens de automatisch ingestelde methode [Methode = Van torsiebeugel].



## Parameters voor afschuif/torsie wapening

Beugels over de lengte van scheurafschuifprojectie  $\delta = z \cdot \cot(\theta) = 772 \text{ mm}$ , interval (-386; 386)

$$z = \text{Coeff}_d \cdot \text{Coeff}_z \cdot h = 0.9 \cdot 0.9 \cdot 0.8 = 648 \text{ mm} \quad \delta = z \cdot \cotg(\theta) = 0.648 \cdot \cotg(40) = 772 \text{ mm}$$

ID	Zone	$x_s$ [mm]	$\phi_s$ [mm]	$s_s$ [mm]	$n_s$ []	$\alpha_s$ [°]	$f_{ywk}$ [MPa]
1	1	-345	12	230	2	90	500
2	1	-115	12	230	2	90	500
3	1	115	12	230	2	90	500
4	1	345	12	230	2	90	500
Avg.	-	-	12	230	2	90	500

## Invoerparameters

Diameter  $\phi_{st} = 12 \text{ mm}$

Hoek van beugels van staafas  $\alpha_{st} = 90^\circ$

Karakteristieke vloeigrens  $f_{ywk} = 500 \text{ MPa}$

Doorsnedeoppervlakte van dwarswapening

$$A_{swt} = \pi \cdot \left(\frac{\phi_{st}}{2}\right)^2 = 3.14 \cdot \left(\frac{12}{2}\right)^2 = 113 \text{ mm}^2$$

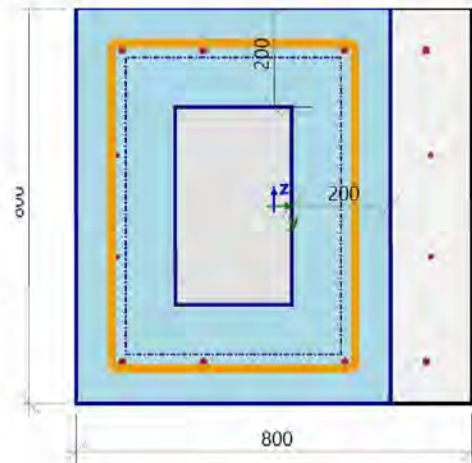
Maximale longitudinale tussenafstand van beugelwapening  $s_{lt} = 230 \text{ mm}$

Doorsnedeoppervlakte van dwarskrachtwapening per meter

$$A_{swtm} = \frac{A_{swt}}{s_{lt}} = \frac{113}{230} = 492 \text{ mm}^2/\text{m}$$

Ontwerpvloeispanning van dwarswapening

$$f_{ywd} = \frac{f_{ywk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa}$$



## Berekening van torsie weerstanden

### Ontwerp torsie scheurmoment

$$T_{Rdt} = 2 \cdot f_{ctd} \cdot t_{ef} \cdot A_k = 2 \cdot 1.47 \cdot 200 \cdot 261300 = 153 \text{ kNm}$$

### Ontwerp weerstandbiedend torsiemoment van torsiewapening

$$T_{Rds} = 2 \cdot A_k \cdot \frac{A_{swt}}{s_{lt}} \cdot f_{ywd} \cdot \cotg(\theta) = 2 \cdot 261300 \cdot \frac{113}{230} \cdot 435 \cdot \cotg(40) = 133 \text{ kNm}$$

## Maximaal ontwerptorsieweerstandsmoment

Sterkereductiefactor voor beton gescheurd in afschuiving – waarde v

$$v = 0.6 \cdot \left(1 - \frac{f_{ck}}{250}\right) = 0.6 \cdot \left(1 - \frac{35}{250}\right) = 0.516 \quad (6.6N)$$

$$v_1 = 0.6 \quad (6.10.aN)$$

Coëfficiënt voor de bepaling van de spanning in de drukdiagonaal

$$\alpha_{cw} = 1 \quad (\text{voor niet-voorgespannen element}) \quad (6.2.3(3)N3)$$

Maximaal ontwerptorsieweerstandsmoment

$$T_{Rdmax} = 2 \cdot v \cdot \alpha_{cw} \cdot f_{ctd} \cdot A_k \cdot t_{ef} \cdot \cos(\theta) \cdot \sin(\theta) \\ = 2 \cdot 0.516 \cdot 1 \cdot 23.3 \cdot 261300 \cdot 200 \cdot \cos(40) \cdot \sin(40) = 620 \text{ kNm}$$



Torsie weerstandsmoment van de staaf

$$T_{Rd} = \min(T_{Rdc}; T_{Rdmax}) = 153 \text{ kNm}$$

Additionele torsiekracht

Ontwerp additionele spanning

$$\sigma_{sdl} = \frac{\text{abs}(T_{Ed}) \cdot u_k \cdot \cotg(\theta)}{2 \cdot A_k \cdot A_{sl}} = \frac{\text{abs}(-3.85) \cdot 2071 \cdot \cotg(40)}{2 \cdot 261300 \cdot 1433} = 12.7 \text{ MPa} \quad (6.28)$$

Ontwerp vloeigrens

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa}$$

Ontwerp additionele trekkrachten

$$F_{sdl} = \sigma_{sdl} \cdot A_{sl} = 12.7 \cdot 1433 = 18.2 \text{ kN}$$

Maximale ontwerpkracht

$$F_{sdmax} = f_{yd} \cdot A_{sl} = 435 \cdot 1433 = 623 \text{ kN}$$

## Torsie controle

Controle  $T_{Rdmax}$

$$T_{Ed} = 3.85 \text{ kNm} \leq T_{Rdmax} = 620 \text{ kNm}$$

Opm.: De controle voldoet voor het bezwijken van de drukschoor ( $T_{Ed} < T_{Rd,max}$ ).

Controle  $T_{Rdc}$  en  $T_{Rds}$

$$T_{Ed} = -3.85 \text{ kNm} < T_{Rdc} = 153 \text{ kNm} \text{ and } T_{Ed} = 3.85 \text{ kNm} < T_{Rds} = 133 \text{ kNm}$$

Opm.: De controle voldoet, torsiemoment kan opgenomen worden door het beton ( $T_{Ed} \leq T_{Rdc}$ ), dwarswapening is niet nodig. Het is niet nodig om de torsieweerstand van de ingevoerde afschuifwapening ( $T_{Rds}$ ) te controleren. Daarom wordt de torsieweerstand berekend maar niet gecontroleerd.

Controleer  $F_{sdmax}$

$$F_{sd} = 18.2 \text{ kN} \leq F_{sdmax} = 623 \text{ kN}$$

Opm.: De controle van additionele trekkracht in langswapening is geslaagd.

## Eenh. Controle

$$UC = \max\left(\frac{\text{abs}(T_{Ed})}{T_{Rd}}, \frac{F_{sd}}{F_{sdmax}}\right) = \max\left(\frac{\text{abs}(-3.85 \text{ kNm})}{153 \text{ kNm}}, \frac{18.2 \text{ kN}}{623 \text{ kN}}\right) = 0.0292$$

## Interactie controle $V_y + V_z + T$

Interactiecontrole  $V_y + V_z + T$  (beton)

Controleer vergelijking  $(T_{Ed}/T_{Rdmax}) + (V_{Ed}/V_{Rdmax})$

$$\left(\frac{\text{abs}(T_{Ed})}{T_{Rdmax}}\right) + \left(\frac{\text{abs}(V_{Ed})}{V_{Rdmax}}\right) = \left(\frac{\text{abs}(-3.85)}{620}\right) + \left(\frac{\text{abs}(371)}{2534}\right) = 0.153 \leq 1 \quad (6.29)$$

Opm.: Interactie controle  $V_y + V_z + T$  for het bezwijken van de drukschoor voldoet.



Controleer vergelijking  $(T_{Ed}/T_{Rdc}) + (V_{Ed}/V_{Rdc})$

$$\left( \frac{\text{abs}(T_{Ed})}{T_{Rdc}} \right) + \left( \frac{\text{abs}(V_{Ed})}{V_{Rdc}} \right) = \left( \frac{\text{abs}(-3.85)}{153} \right) + \left( \frac{\text{abs}(371)}{206} \right) = 1.83 > 1 \text{ and } A_{sw} > 0 \quad (6.31)$$

Opm.: Afschuifkrachten en het torsiemoment kunnen niet worden gedragen door het beton, dwarswapening is benodigd.

Eenh. Controle

$$UC_{int,con} = 0.153$$

### Interactiecontrole $V_y + V_z + T$ (dwarswapening)

Ontwerpspanning

$$\sigma_{swd} = \left( \frac{\text{abs}(T_{Ed})}{2 \cdot A_k} + \frac{V_{Ed}}{n_s \cdot z} \right) \cdot \left( \frac{s_{lt}}{A_{swt} \cdot \cotg(\theta)} \right) = \left( \frac{\text{abs}(-3.85)}{2 \cdot 261300} + \frac{371}{4 \cdot 460} \right) \cdot \left( \frac{230}{113 \cdot \cotg(40)} \right) = 357 \text{ MPa}$$

Ontwerp vloeigrens

$$f_{ywd} = 0.8 \cdot f_{ywk} = 0.8 \cdot 500 = 400 \text{ MPa}, \text{ (omdat } \sigma_{swd} < 0.8 \cdot f_{ywk})$$

Opm.: Ontwerp vloeigrens van de dwarswapening is gereduceerd naar  $0.8 \times f_{ywk}$  (EN 1992-1-1, Artikel 6.2.3(3)) omdat de ontwerpspanning van de dwarswapening is onder 80% van de karakteristieke vloeispanning  $f_{yk}$ .

$$\sigma_{swd} = 357 \text{ MPa} < f_{ywd} = 400 \text{ MPa}$$

Opm.: Interactie controle  $V_y + V_z + T$  voor afschuifwapening voldoet.

Eenh. Controle

$$UC_{int,shear} = \frac{\sigma_{swd}}{f_{ywd}} = \frac{357}{400} = 0.893$$

### Totale eenheidscontrole van de interactie

$$UC_{int} = \max(UC_{int,con}; UC_{int,shear}) = \max(0.153; 0.893) = 0.893$$

### Totale waarde van eenheidscontrole

$$UC = \max(UC_{shear}; UC_{tor}; UC_{int,con}; UC_{int,shear}) = \max(0.862; 0.0292; 0.153; 0.893) = 0.893$$

### 2.1.8. Controle limietspanning

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Staaf

Extreme ID: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

**Balk S37**

NEN EN 1992-1-1+C2/NB+A1:2020

**Rechthoek (800; 800)**

Doorsnede 6 [dx = 1.15 m]



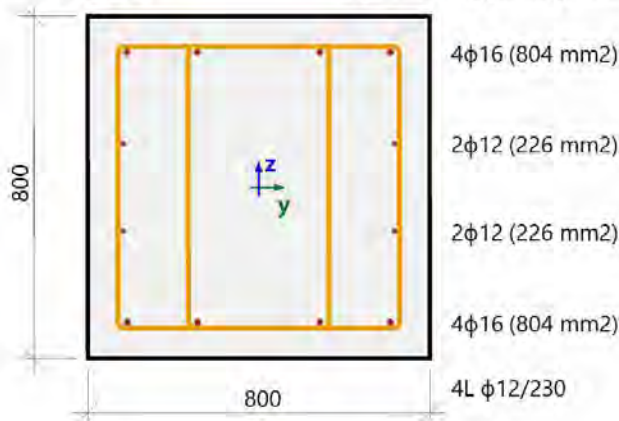
### Staaflengte:

"Knik  $y-y$   
Knik  $z-z$

$L = 2.3 \text{ m}$

$L_y = 11.5 \text{ m}$  (zijdelings flexibel)

$L_z = 2.3 \text{ m}$  (zijdelings flexibel)



### Beton: C35/45

Bilineair spanning-rekdiagram

Milieuklasse:

Boven: XC4, XD3, XF2, XA2

Onder: XC2, XD3, XF2, XA2

### Langswapening: B 500B

Bilineair met oplopende bovenvertakking

$4\phi 12 + 8\phi 16$  ( $2061 \text{ mm}^2$ )

$\rho_l = 0.322 \%$  ( $16.2 \text{ kg/m}$ )

### Dwarskrachtwapening: B 500B

Bilineair met oplopende bovenvertakking

$4L \phi 12/230$  ( $452 \text{ mm}^2$ )

$\rho_w = 0.246 \%$  ( $15.4 \text{ kg/m}$ )

### Dekking (beugel)

Bovenzijde: 65 mm

Onderzijde: 65 mm

Links: 65 mm

Rechts: 65 mm

## Materiaalkarakteristieken

Karakteristieke betondruksterkte Karakteristieke vloeisterkte van de langswapening

$f_{ck} = 35 \text{ MPa}$

$f_{yk} = 500 \text{ MPa}$

Gemiddelde betontreksterkte

$f_{ctm} = 3.2 \text{ MPa}$

Elasticiteitsmodulus van beton:

$E_c = 34 \text{ GPa}$

## Krachten

Van EEM analyse

Karakteristieke waarden:

NC\_BGT-kar.5

$N = -30.9 \text{ kN}$   $M_y = 258 \text{ kNm}$   $M_z = -1.96 \text{ kNm}$

Quasi-permanente waarden:

NC\_BGT-kar.5

$N_{qp} = -30.9 \text{ kN}$   $M_{y,qp} = 258 \text{ kNm}$   $M_{z,qp} = -1.96 \text{ kNm}$

Hoek van resultante van buigmoment:  $\alpha_M = 90.4^\circ$





## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0,1 \cdot (23,3 \cdot 10^6 \cdot 0,64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -31 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).

Karakteristieke waarden:  $N_{char,r} = -30,9 \text{ kN}$   $M_{y,char,r} = 258 \text{ kNm}$   $M_{z,char,r} = 0 \text{ kNm}$

Quasi-permanente waarden:  $N_{qp,r} = -30,9 \text{ kN}$   $M_{y,qp,r} = 258 \text{ kNm}$   $M_{z,qp,r} = 0 \text{ kNm}$

Hoek van resultante van buigmoment:  $\alpha_{M,r} = 90^\circ$

## Overzicht van controle

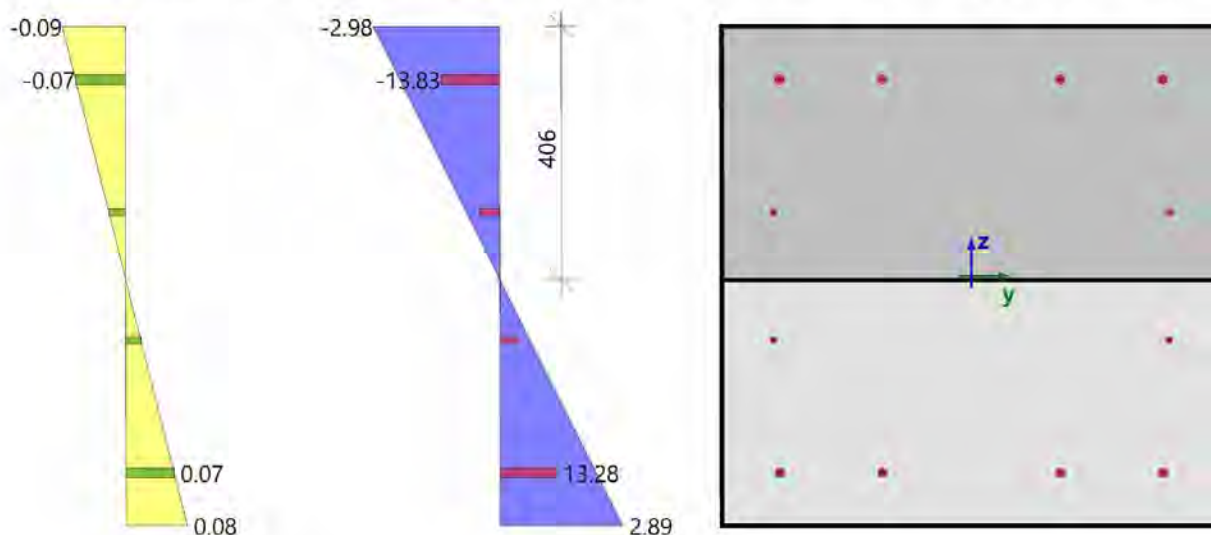
Belasting	E	$E_c$	UC	Status	UC	Status	UC	Status	UC	Grenswaarde	Status
type	[MPa]		$\$7.2(2)$	$\$7.2(2)$	$\$7.2(3)$	$\$7.2(3)$	$\$7.2(5)$	$\$7.2(5)$	[-]	[-]	
			[-]	Kar.	[-]	Q.-P.	[-]	Kar.			
Kort	$E_c$	34100	0.14	OK	0.19	OK	0.03	OK	0.19	1	OK

Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

## Controle van scheuren in doorsnede

Belasting	Type	$E_c$	Combi.	$N_{Ed}$	$M_{Edy}$	$M_{Edz}$	$\sigma_{ct}$	h	$f_{ct,eff}$	Scheur-
	module	[MPa]		[kN]	[kNm]	[kNm]	[MPa]	[mm]	[MPa]	vorming.
Kort	$E_c$	34100	Kar.	-30.9	258	0	2.89	800	3.2	NEE

## Spanning-rekverdeling voor scheurvorming (ongescheurde toestand) - kortetermijnbelasting

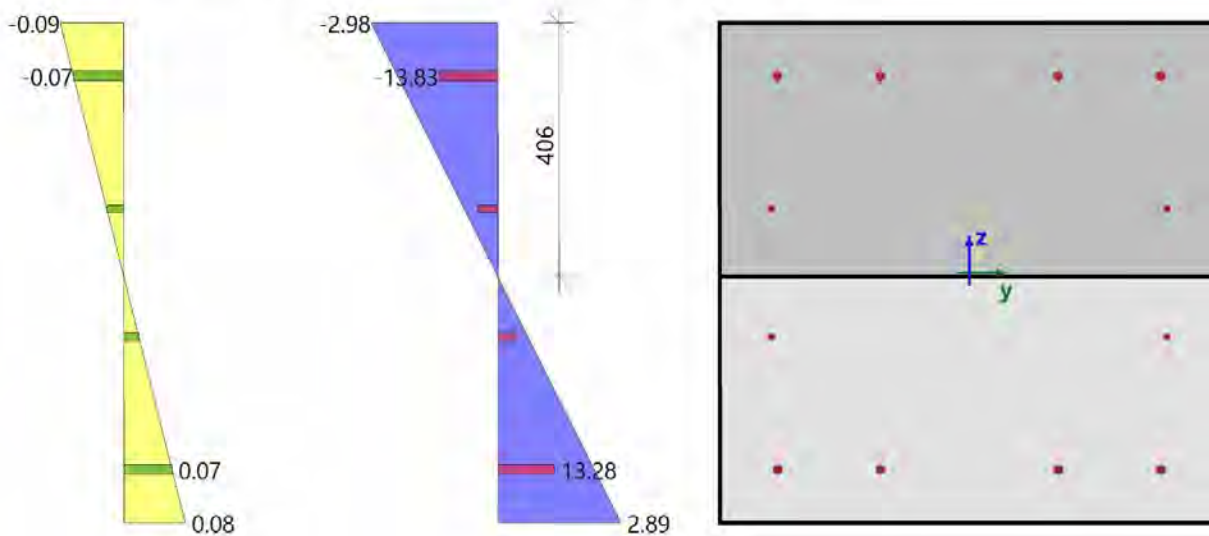




## Doorsnedekarakteristieken

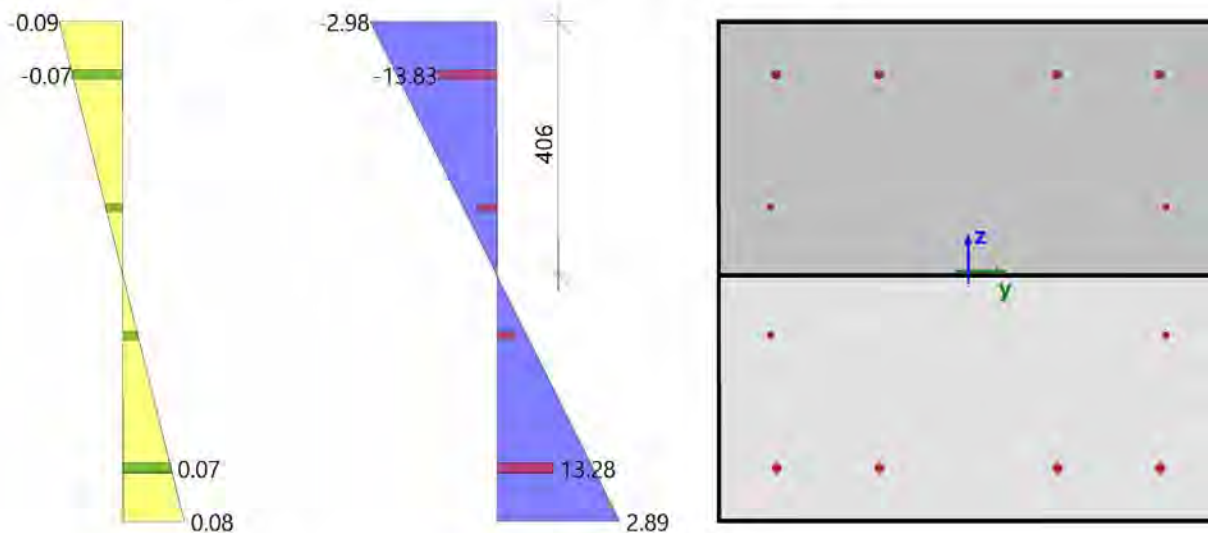
Belasting	Combi.	$t_{iy}$ [m]	$t_{iz}$ [m]	$A_i$ [m <sup>2</sup> ]	$I_{iy}$ [m <sup>4</sup> ]	$I_{iz}$ [m <sup>4</sup> ]	$x_i$ [m]	$\epsilon_{c,max}$ [‰]	$\epsilon_{c,min}$ [‰]	$\sigma_{c,max}$ [MPa]	$\sigma_{c,min}$ [MPa]
Kort	Kar.	0	0	0.652	0.0351	0.0349	0.406	0.085	-0.087	2.89	-2.98
Kort	Q.-P.	0	0	0.652	0.0351	0.0349	0.406	0.085	-0.087	2.89	-2.98

## Spanning-rekverdeling met betontreksterkte onder karakteristieke combinatie - kortetermijnbelasting





## Spanning-rekverdeling met betontreksterkte onder quasi-permanente combinatie - kortetermijnbelasting



### Spanningscontrole in beton

Controletype	Belasting	$N_{Ed}$ [kN]	$M_{Edy}$ [kNm]	$M_{Edz}$ [kNm]	$y_i$ [mm]	$z_i$ [mm]	$\sigma_c$ [MPa]	$\sigma_{c,lim}$ [MPa]	$\sigma_c/\sigma_{c,lim}$ [-]	Status
§7.2(2) Kar.	Kort	-30.9	258	0	0.4	0.4	-2.98	-21	0.142	OK
§7.2(3) Q.-P.	Kort	-30.9	258	0	0.4	0.4	-2.98	-15.8	0.189	OK

### Spanningscontrole in niet-voorgespannen wapening

Controletype	Belasting	$N_{Ed}$ [kN]	$M_{Edy}$ [kNm]	$M_{Edz}$ [kNm]	$y_i$ [mm]	$z_i$ [mm]	$\sigma_s$ [MPa]	$\sigma_{s,lim}$ [MPa]	$\sigma_s/\sigma_{s,lim}$ [-]	Status
§7.2(5) Kar.	Kort	-30.9	258	0	-0.31	-0.32	13.3	500	0.027	OK

### Verklaring van fouten, waarschuwingen en opmerkingen

Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

#### 2.1.9. Controle scheurwijdte (BGT)

Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Staaf  
Extreme 1D: Doorsnede  
Selectie: Alle  
Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



## Balk S37

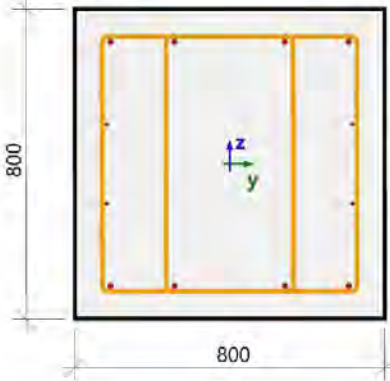
### Rechthoek (800; 800)

NEN EN 1992-1-1+C2/NB+A1:2020

Doorsnede 0 [dx = 0 m]

**Staaflengte:** L = 2.3 m  
"Knik y-y<sup>⊥</sup>: L<sub>y</sub> = 11.5 m (zijdelings flexibel)  
Knik z-z<sup>⊥</sup>: L<sub>z</sub> = 2.3 m (zijdelings flexibel)

**Beton: C35/45**  
Bilineair spanning-rekdiagram  
Milieuklasse:



4φ16 (804 mm<sup>2</sup>)

2φ12 (226 mm<sup>2</sup>)

2φ12 (226 mm<sup>2</sup>)

4φ16 (804 mm<sup>2</sup>)

4L φ12/230

Boven: XC4, XD3, XF2, XA2  
Onder: XC2, XD3, XF2, XA2

**Langswapening: B 500B**

Bilineair met oplopende bovenvertakking

4φ12+8φ16 (2061 mm<sup>2</sup>)

ρ<sub>l</sub> = 0.322 % (16.2 kg/m)

**Dwarskrachtwapening: B 500B**

Bilineair met oplopende bovenvertakking

4L φ12/230 (452 mm<sup>2</sup>)

ρ<sub>w</sub> = 0.246 % (15.4 kg/m)

**Dekking (beugel)**

Bovenzijde: 65 mm

Onderzijde: 65 mm

Links: 65 mm

Rechts: 65 mm

## Materiaalkarakteristieken

Effectieve sterkte van beton:

$$f_{ct,eff} = f_{ctm} = 3.2 \text{ MPa}$$

Betonsterkte bij scheurvorming:

$$\sigma_{cr} = 3.2 \text{ MPa}$$

Elasticiteitsmodulus van beton:

$$E_c = E_{cm} = 34.1 \text{ GPa}$$

## Krachten

Karakteristieke waarden

NC\_BGT-kar.1

$$N_{char} = 10.4 \text{ kN} \quad M_{y,char} = 19.1 \text{ kNm} \quad M_{z,char} = 0 \text{ kNm}$$

Frequente waarden

NC\_BGT-kar.1

$$N_{freq} = 10.4 \text{ kN} \quad M_{y,freq} = 19.1 \text{ kNm} \quad M_{z,freq} = 0 \text{ kNm}$$

Hoek van de buigendmoment resultante

$$\alpha_M = 90^\circ$$

## Doorsnedekarakteristieken

Type	Doorsnede niet-gescheurd	CSS gescheurd
t <sub>iy</sub> [m]	0	0
t <sub>iz</sub> [m]	0	0.303
A <sub>i</sub> [m <sup>2</sup> ]	0.652	0.0785
I <sub>iy</sub> [m <sup>4</sup> ]	0.0351	9.53·10 <sup>-3</sup>
I <sub>iz</sub> [m <sup>4</sup> ]	0.0349	4.35·10 <sup>-3</sup>

## Berekening van scheurkrachten (ongescheurde sectie)

Maximale spanning in beton

$$\sigma_{ct} = 0.233 \text{ MPa}$$

Scheurkrachten

$$N_{cr} = 142 \text{ kN} \quad M_{cry} = 262 \text{ kNm} \quad M_{crz} = 0 \text{ kNm}$$

$$\sigma_{ct} = 0.233 \text{ MPa} < \sigma_{cr} = 3.2 \text{ MPa} \Rightarrow \text{Geen scheurvorming}$$

Opm.: De scheur is niet verschenen, omdat de maximale trekspanning is minder dan de scheursterkte.

Berekening scheurwijdte

$$w = 0 \text{ mm}$$



Project	4922005	Datum	08. 03. 2019
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.8 35/35

## Eenh. Controle

Berekening eenheidscontrole

$$UC = \frac{w}{w_{\max}} = \frac{0 \text{ mm}}{0.2 \text{ mm}} = 0$$

Controle scheurwijdte

$$w = 0 \text{ mm} = < w_{\max} = 0.2 \text{ mm}$$

Opm.: Controle scheurwijdte voldoet, omdat de scheur kleiner is dan de limietwaarde.



15-12-2022

## Leidingbrug CCS Zone 17

### Aan

5.1.2.e  
5.1.2.e @yara.com

### Van

5.1.2.e  
5.1.2.e @konstruktis.com

### CC

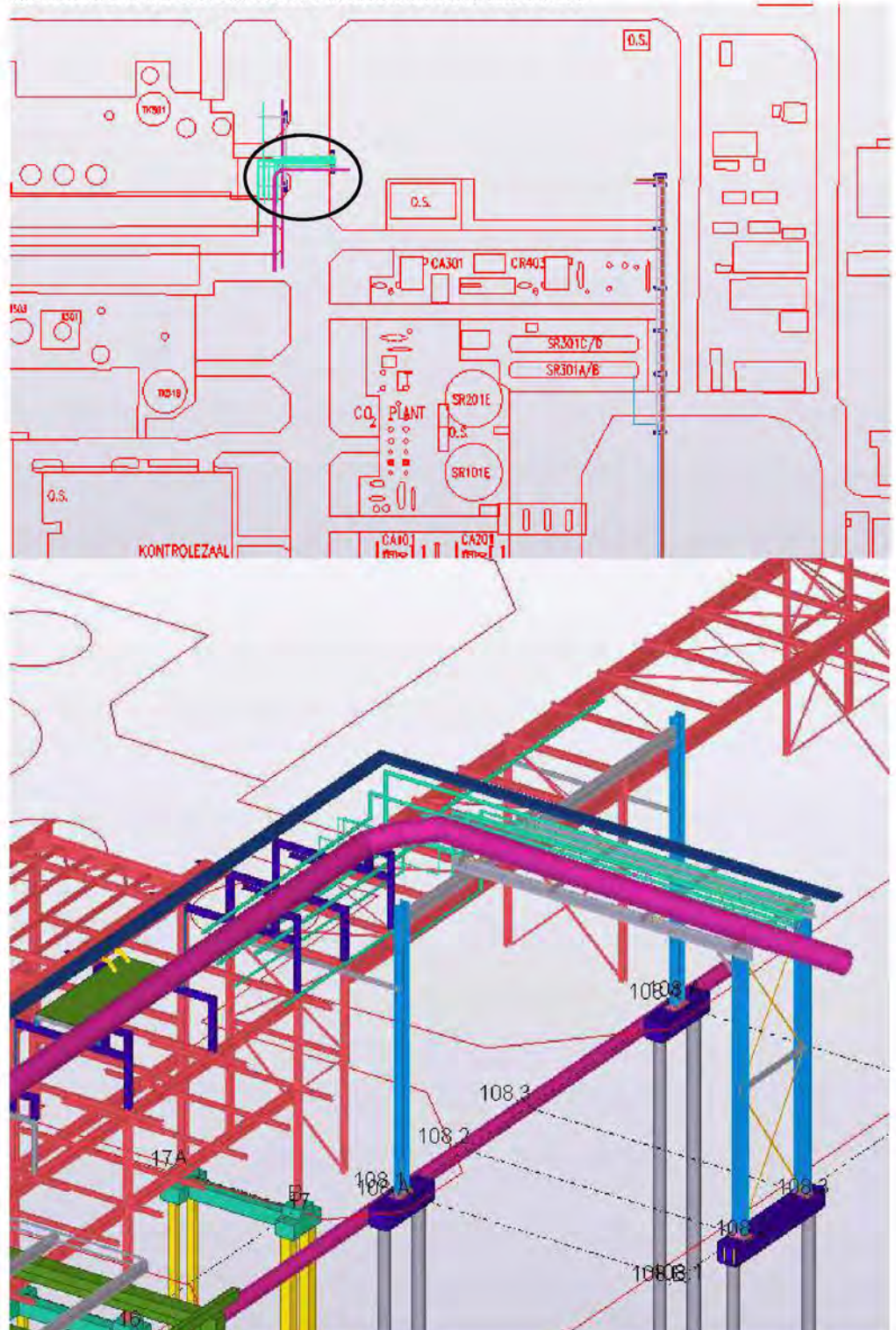
5.1.2.e  
5.1.2.e @konstruktis.com

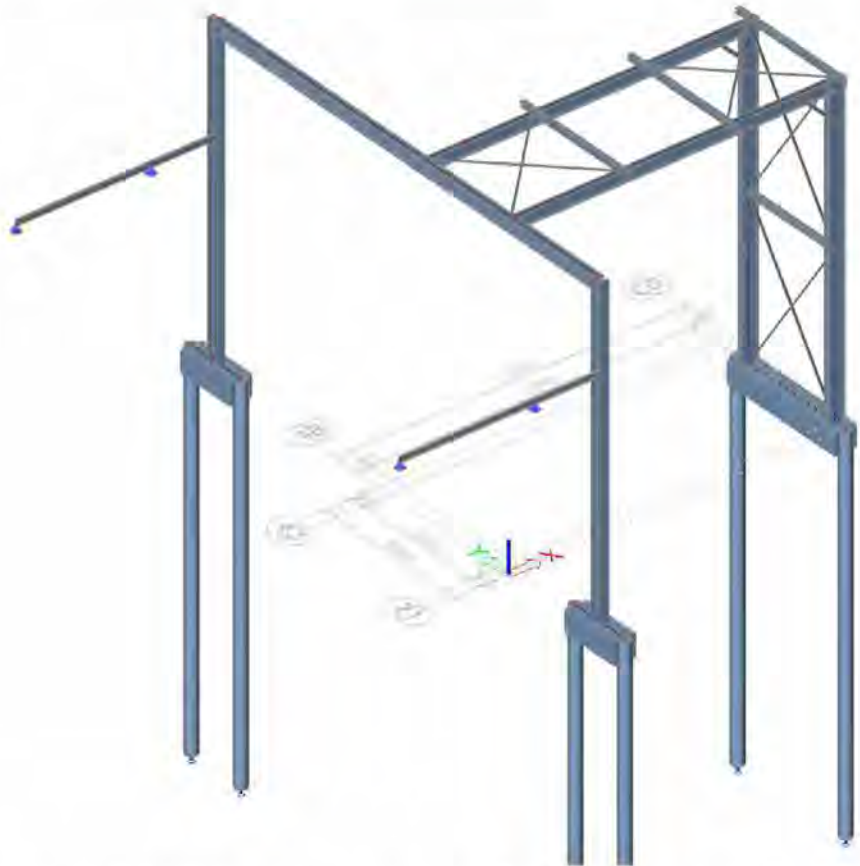
### Betreft

Leidingbrug CCS Zone 17

Beste 5.1.2.e

In deze memo word de basis toetsing gedaan van de brug die als koppeling dient tussen het CCS terrein en het WarmCo rack / rack 108.



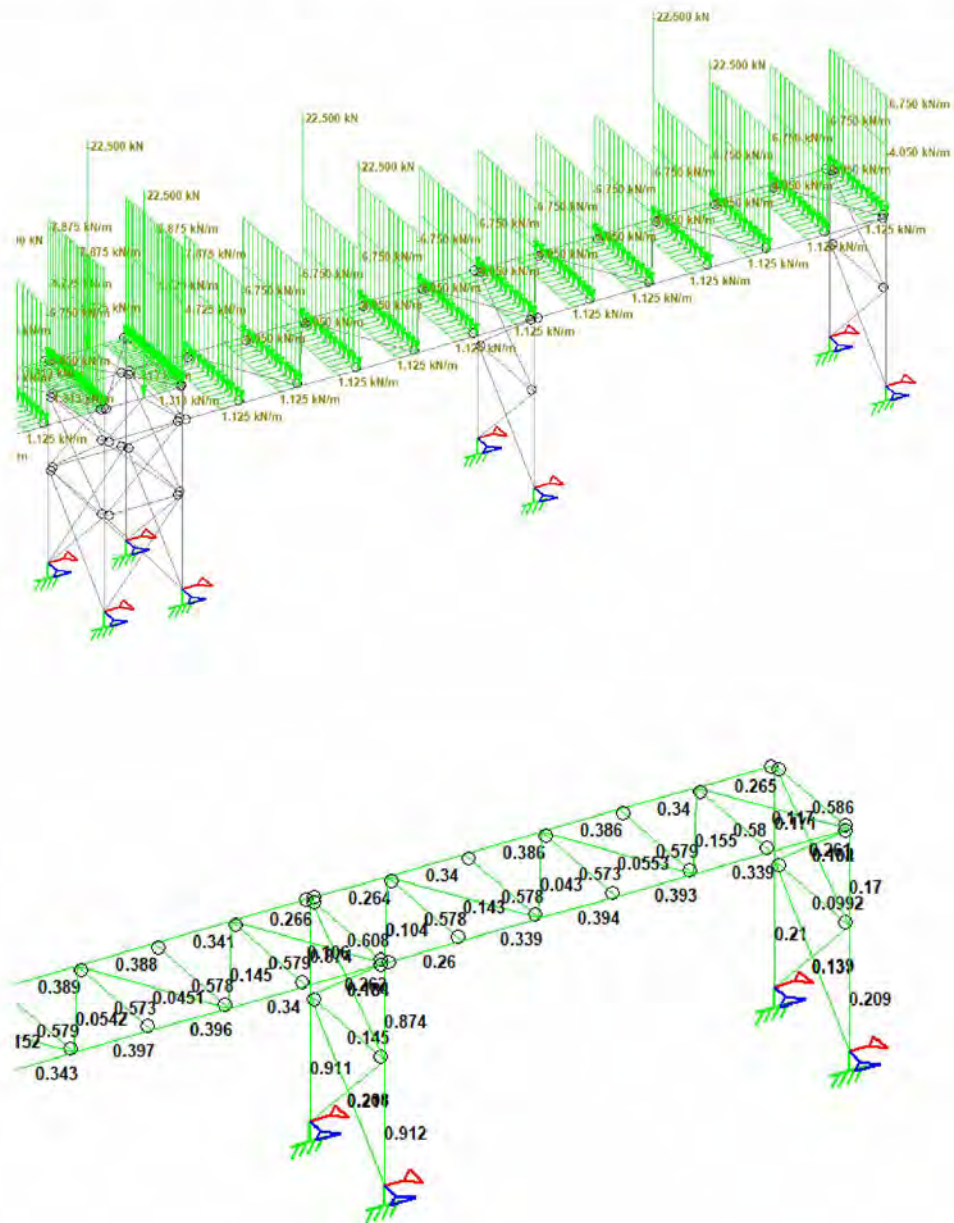


Op basis van de funderingsgegevens voor het Compressorhuis gedeelte zijn de palen hier ingeschat op een Fundex paal  $\varnothing 460$  met een lengte van 14 m.

In de bijgevoegde uitvoer van Scia is aangetoond dat deze brug voldoet aan de gevraagde eisen.

Voor de stabiliteit wordt gebruik gemaakt van het WarmCo rack, hiervan is daarom een aparte toetsing gemaakt.

De berekening is origineel opgesteld door Jacobs middels STAAD.pro.



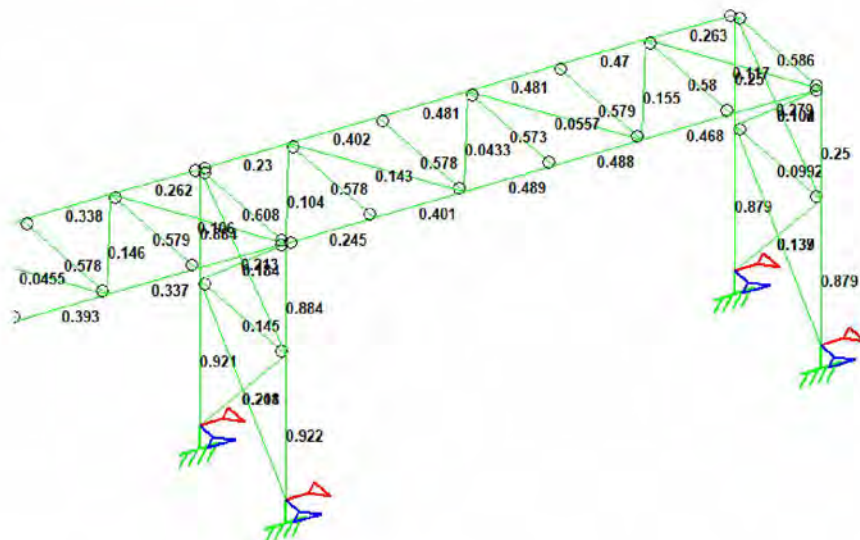
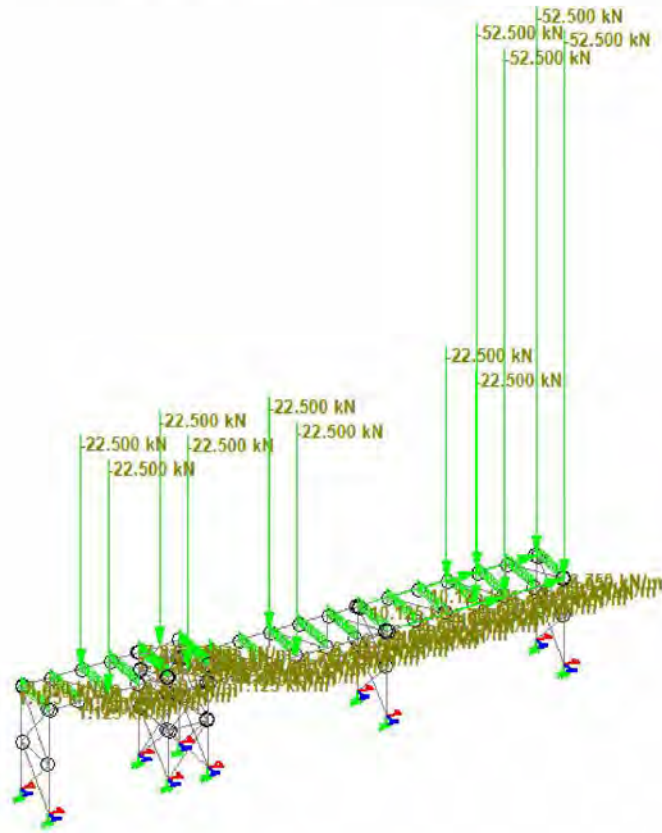
De bestaande constructie is daarbij als uitgangspunt genomen waarop de nieuwe lasten zijn toegevoegd. Voor de nieuwe lasten is gerekend met  $3 \text{ kN/m}^2$  aan veranderlijk +  $1.5 \text{ kN/m}^2$  als permanent, wat samengesteld  $4.5 \text{ kN/m}^2$  wordt wat als veranderlijk (conservatief) is gerekend over een oppervlak van  $6 \times 5 = 30 \text{ m}^2$  wat in 4 puntlasten van  $35 \text{ kN}$  (afgerond + staalgewicht) resulteert. Voor de horizontaalkrachten wordt met  $3 \times 30 \times 0.3 / 4 = 6.75 \text{ kN}$  resulteert.





Projectno. : 4922005  
Doc. no. : M1101  
Project : Piperacks CCS

revision : -  
Date : 15-dec-22  
Page no. : MEM - 4

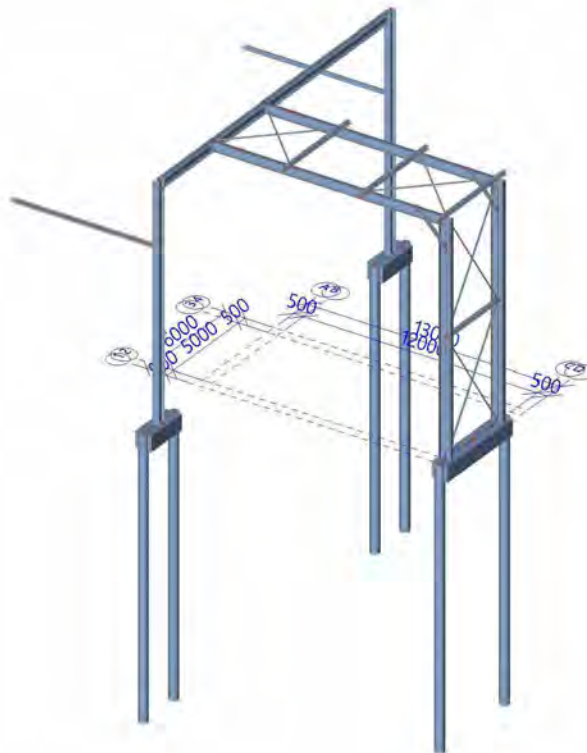


Het eindspant zal hierbij in de belasting toenemen van 21% naar 88% gebaseerd op de kniklengte. Voor de liggers is dit van 39.3% naar 48.9%. Gebaseerd op deze resultaten voldoet het bestaande rack aan alle eisen.



# Bijlage 1.

## Invoer Scia Rekenmodel





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Rekenmodel	3
2.1. Instellingen manager	3
2.2. Algemene model omschrijving	4
2.2.1. Isometric view	4
2.2.2. Isometric view	5
2.2.3. X view	6
2.2.4. Y view	7
2.2.5. Z view	8
2.2.6. Materialen	8
2.2.7. Doorsneden	9
2.2.8. Analysis model	13
2.2.9. Lagen	13
2.2.10. UCS	13
2.3. Model gegevens	14
2.3.1. Instellingen net	14
2.3.2. Instellingen solver	14
2.3.3. 1D	15
2.3.3.1. Knopen	15
2.3.3.2. Knopen	16
2.3.3.3. Staven	16
2.3.3.4. Staven	17
2.3.3.5. Scharnieren	18
2.3.3.6. Staaf niet-lineariteit	18
2.3.3.7. Kruisende staven	18
2.3.4. 2D	18
2.3.4.1. Platen	19
2.3.5. Supports	20
2.3.5.1. Steunpunten	20
2.3.5.2. Knoopondersteuning	20
2.3.5.3. Puntondersteuning op staaf	21
2.3.5.4. Lijnondersteuning op staven	21
3. Belastingen	25
3.1. Belastinggevallen	25
3.2. Belastinggevallen	25
3.2.1. Belastinggevallen - BG101	25
3.2.2. Belastinggevallen - BG102	26
3.2.3. Belastinggevallen - BG111	27
3.2.4. Belastinggevallen - BG112	28
3.2.5. Belastinggevallen - BG121	29
3.3. Belastinggroepen	30
3.4. Combinaties	30
3.5. Niet-lineaire combinaties	30
3.6. Resultaatklassen	32
4. Berekeningsverslag	33
5. Berekeningsverslag	33



## 2. Rekenmodel

### 2.1. Instellingen manager

#### Combinatie Instellingen

Categorie H lasten moeten niet gecombineerd worden met sneeuw of wind

#### Psi factoren

Belasting	Psi0	Psi1	Psi2
CategoryA	0.4	0.5	0.3
CategoryB	0.5	0.5	0.3
CategoryC	0.6	0.7	0.6
CategoryD	0.4	0.7	0.6
CategoryE	1	0.9	0.8
CategoryF	0.7	0.7	0.6
CategoryG	0.7	0.5	0.3
CategoryH	0	0	0
Sneeuw	0	0.2	0
Wind	0	0.2	0
Temperatuur	0	0.5	0
Regenwater	0	0	0
Constructiebelasting	1	0	0.2

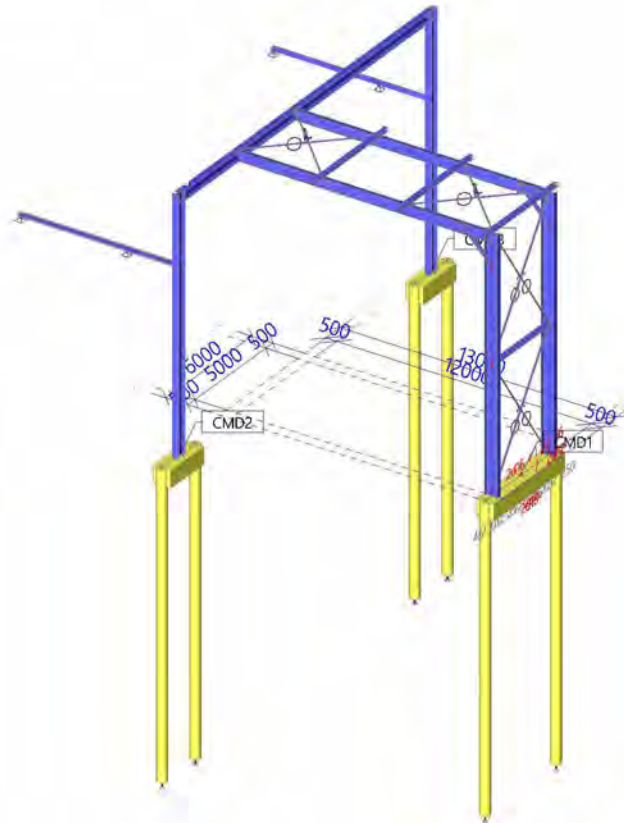
#### Belastingfactoren

Permanente actie - ongunstig	1.35
Permanente actie - gunstig [-]	0.90
Variabele last	1.50
Begeleidende variabele actie	1.50
Reductie factor ksi [-]	0.89
Permanente actie - ongunstig	1.00
Permanente actie - gunstig	1.00
Variabele last	1.30
Begeleidende variabele actie	1.30



## 2.2. Algemene model omschrijving

### 2.2.1. Isometric view





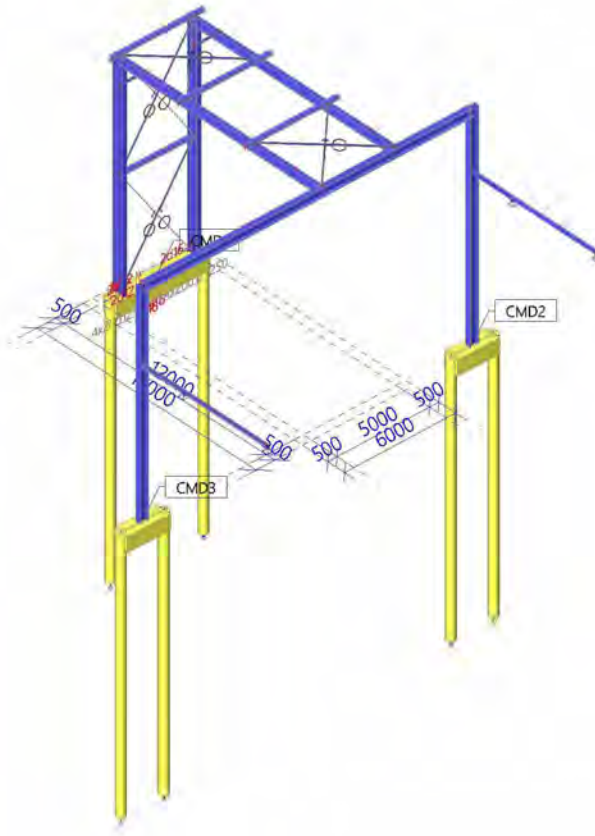
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
S.1.2.e  
5/36

## 2.2.2. Isometric view



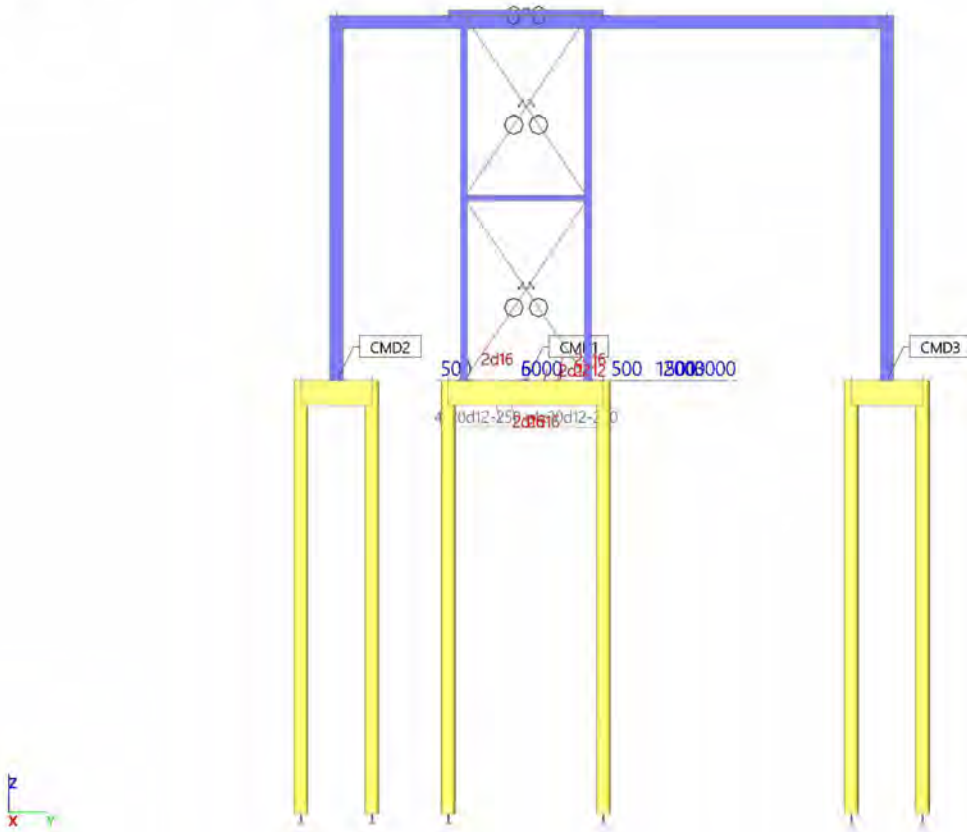


Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur S.1.2.e  
6/36

### 2.2.3. X view





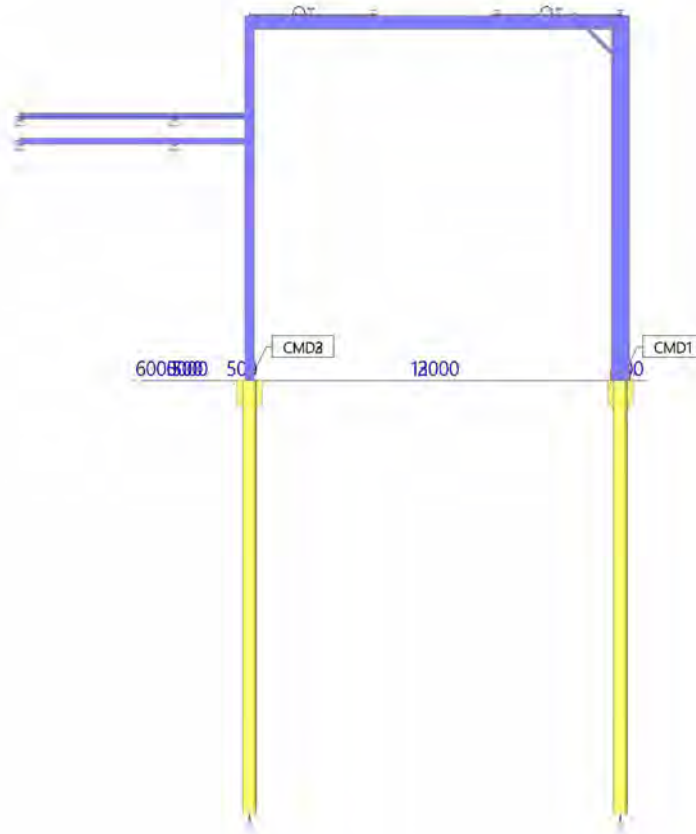
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
S.1.2.e  
7/36

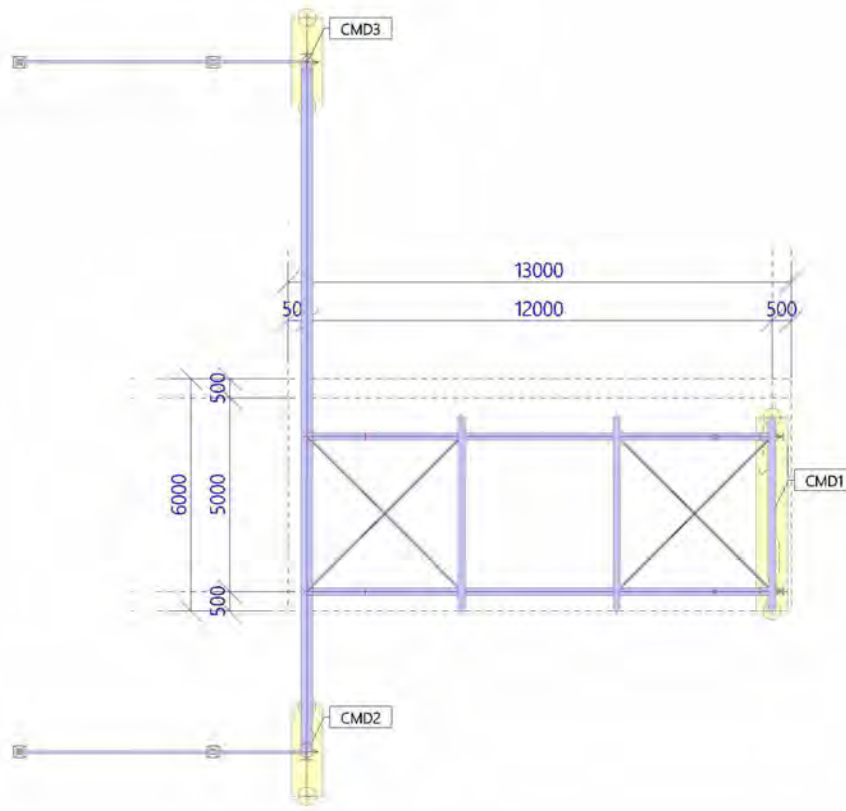
## 2.2.4. Y view







## 2.2.5. Z view



## 2.2.6. Materialen

### Staal EC3

Naam	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa]	Poisson - nu	Onderlimiet [mm]	Bovenlimiet [mm]	Fy (bereik) [MPa]	Fu (bereik) [MPa]
		G-mod [MPa]	Thermisch uitz. [m/mK]				
S 235 JR (EN 10025-2)	8000.0	2.1000e+05 8.0769e+04	0.3 0.00	0	3	235.0	360.0
				3	16	235.0	360.0
				16	40	225.0	360.0
				40	63	215.0	360.0
				63	80	215.0	360.0
				80	100	215.0	360.0
				100	150	195.0	350.0
				150	200	185.0	340.0
				200	250	175.0	340.0

### Beton EC2

Naam	Type	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa]	Poisson - nu	Thermisch uitz. [m/mK]	Karakteristieke cilinderdruksterkte f <sub>ck</sub> (28) [MPa]
C35/45	Beton	2500.0	3.4100e+04	0.2	0.00	35.00



## Wapening EC2

Naam	Type	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa]	G-mod [MPa]	Thermisch uitz. [m/mK]	Karakteristieke vloeisterkte fyk [MPa]
B 500B	Betonstaal	7850.0	2.0000e+05	8.3333e+04	0.00	500.0

Naam	E-mod [MPa]	Poisson - nu	Massa eenheid [kg/m <sup>3</sup> ]	Log. decrement (niet-uniforme demping enkel)	Specifieke hitte [J/gK]
Type	G-mod [MPa]				
Rigid	1.0000e+12	0.3	0.0	0.15	6.0000e-01
Algemeen materiaal	3.8462e+11				

### Verklaring van symbolen

Log. decrement (niet-uniforme demping enkel)	Deze materiaal dempingeigenschap is enkel toegepast in het geval van het niet-uniform is demping is geactiveerd voor dynamische analyse (zie project functionaliteit). Gelieve op te merken, dat niet-uniforme demping een specifieke licentie benodigd, welke geen deel uit maakt van het standaard dynamische pakket.
--	--

## 2.2.7. Doorsneden

BT-11		
Type	Cirkel	
Gedetailleerd	460	
Vorm type	Dikke wanden	
Onderdeelmateriaal	C35/45	
Bouwwijze	beton	
A [m <sup>2</sup> ]	1.6619e-01	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.4936e-01	1.4936e-01
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	2.1979e-03	2.1979e-03
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	9.5559e-03	9.5559e-03
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	1.6223e-02	1.6223e-02
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	6.1807e-15	4.4047e-03
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	230	230
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	0.00e+00	0.00e+00
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	0.00e+00	0.00e+00
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.4451e+00	1.4451e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		


BT-12		
Type	Rechthoek	
Gedetailleerd	800; 800	
Vorm type	Dikke wanden	
Onderdeelmateriaal	C35/45	

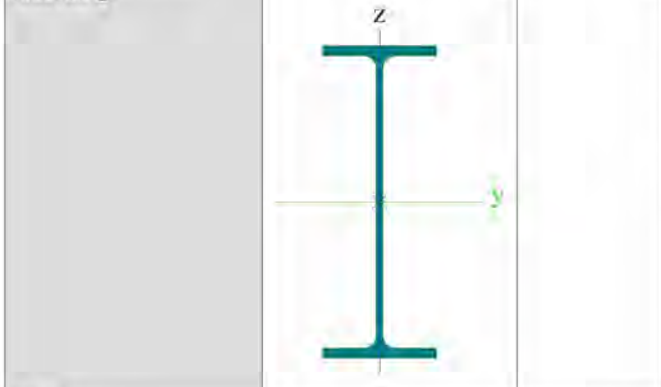
Bouwwijze beton		
A [m <sup>2</sup> ]	6.4000e-01	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	5.3391e-01	5.3391e-01
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	3.4133e-02	3.4133e-02
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	8.5333e-02	8.5333e-02
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	0.0000e+00	0.0000e+00
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	3.3063e-05	5.7500e-02
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	400	400
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	0.00e+00	0.00e+00
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	0.00e+00	0.00e+00
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	3.2000e+00	3.2000e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

ST-11		
Type	IPE600	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	a	b
A [m <sup>2</sup> ]	1.5600e-02	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	8.6202e-03	7.2722e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	9.2080e-04	3.3870e-05
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	3.0700e-03	3.0800e-04




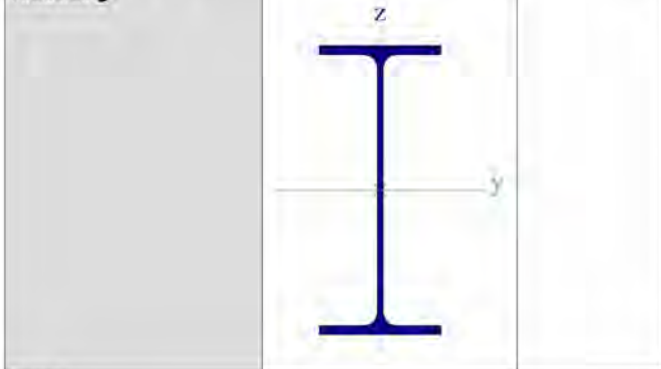
Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.12a 10/36

W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	3.5120e-03	4.8600e-04	
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	2.8460e-06	1.6500e-06	
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0	
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	110	300	
α [deg]	0.00		
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	8.26e+05	8.26e+05	
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	1.14e+05	1.14e+05	
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.0146e+00	2.0146e+00	
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0	
Afbeelding			




### ST-12

Type	IPE450		
Vormnorm	1 - I-doorsnede		
Vorm type	Dunwandig		
Onderdeelmateriaal	S 235 JR (EN 10025-2)		
Bouwwijze	gewalst		
Knik y-y, Knik z-z	a	b	
A [m <sup>2</sup> ]	9.8800e-03		
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	5.5856e-03	4.3051e-03	
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	3.3740e-04	1.6760e-05	
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	1.5000e-03	1.7600e-04	
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	1.7020e-03	2.7600e-04	
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	7.9100e-07	6.6900e-07	
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0	
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	95	225	
α [deg]	0.00		
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	4.00e+05	4.00e+05	
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	6.50e+04	6.50e+04	
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.6050e+00	1.6050e+00	
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0	
Afbeelding			



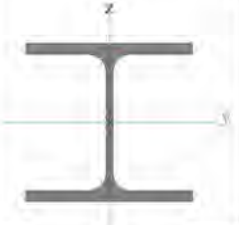
### ST-13

Type	HEA180		
Vormnorm	1 - I-doorsnede		

Vorm type	Dunwandig		
Onderdeelmateriaal	S 235 JR (EN 10025-2)		
Bouwwijze	gewalst		
Knik y-y, Knik z-z	b	c	
A [m <sup>2</sup> ]	4.5300e-03		
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	3.2772e-03	1.0992e-03	
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	2.5100e-05	9.2500e-06	
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	2.9400e-04	1.0300e-04	
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	3.2500e-04	1.5667e-04	
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	6.0211e-08	1.4800e-07	
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0	
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	90	86	
α [deg]	0.00		
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	7.64e+04	7.64e+04	
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	3.68e+04	3.68e+04	
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.0200e+00	1.0241e+00	
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0	
Afbeelding			



### ST-14

Type	HEA120		
Vormnorm	1 - I-doorsnede		
Vorm type	Dunwandig		
Onderdeelmateriaal	S 235 JR (EN 10025-2)		
Bouwwijze	gewalst		
Knik y-y, Knik z-z	b	c	
A [m <sup>2</sup> ]	2.5300e-03		
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.8775e-03	6.1698e-04	
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	6.0600e-06	2.3100e-06	
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	1.0600e-04	3.8500e-05	
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	1.1958e-04	5.8750e-05	
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	6.4719e-09	5.9900e-08	
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0	
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	60	57	
α [deg]	0.00		
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	2.81e+04	2.81e+04	
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	1.38e+04	1.38e+04	
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	6.7700e-01	6.7730e-01	
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0	
Afbeelding			



### ST-15

Type	FLA80/10		
Vormnorm	7 - Volledig rechthoekige doorsnede		
Vorm type	Dunwandig		
Onderdeelmateriaal	S 235 JR (EN 10025-2)		
Bouwwijze	gewalst		



Knik y-y, Knik z-z	c	c
A [m <sup>2</sup> ]	8.0000e-04	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	6.6667e-04	6.6667e-04
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	6.6667e-09	4.2667e-07
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	1.3333e-06	1.0667e-05
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	2.0000e-06	1.6000e-05
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	0.0000e+00	2.6667e-08
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	40	5
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	4.70e+02	4.70e+02
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	3.76e+03	3.76e+03
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.8000e-01	1.8000e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

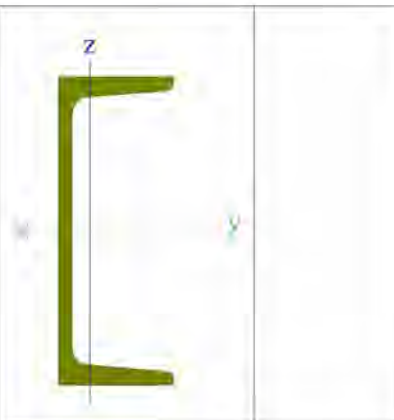
<b>ST-16</b>		
Type	L60X6	
Vormnorm	4 - L-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	b	b
A [m <sup>2</sup> ]	6.9100e-04	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	5.7999e-04	5.8516e-04
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	3.6100e-07	9.4300e-08
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	8.5150e-06	3.9562e-06
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	1.3551e-05	6.9893e-06
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	2.1441e-41	8.6400e-09
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	-20	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	17	17
α [deg]	45.00	
I <sub>yzcs</sub> [m <sup>4</sup> ]	-1.3344e-07	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	3.18e+03	3.18e+03
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	1.64e+03	1.64e+03
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.3300e-01	2.3310e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	79
Afbeelding		

<b>ST-17</b>		
Type	HEA450	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	a	b
A [m <sup>2</sup> ]	1.7800e-02	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.2141e-02	5.2398e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	6.3700e-04	9.4700e-05
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	2.9000e-03	6.3100e-04
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	3.2167e-03	9.6667e-04
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	4.1476e-06	2.4400e-06
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	150	220
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	7.56e+05	7.56e+05
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	2.27e+05	2.27e+05
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.0100e+00	2.0104e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

<b>ST-18</b>		
Type	UNP200	
Vormnorm	5 - Kanaaldoorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	c	c
A [m <sup>2</sup> ]	3.2200e-03	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.6758e-03	1.6900e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	1.9100e-05	1.4800e-06
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	1.9100e-04	2.7000e-05
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	2.2800e-04	5.1800e-05
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	1.0499e-08	1.2000e-07
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	-44	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	20	100
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	5.35e+04	5.35e+04
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	1.22e+04	1.22e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	6.6100e-01	6.6027e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	217



Afbeelding



#### Verklaring van symbolen

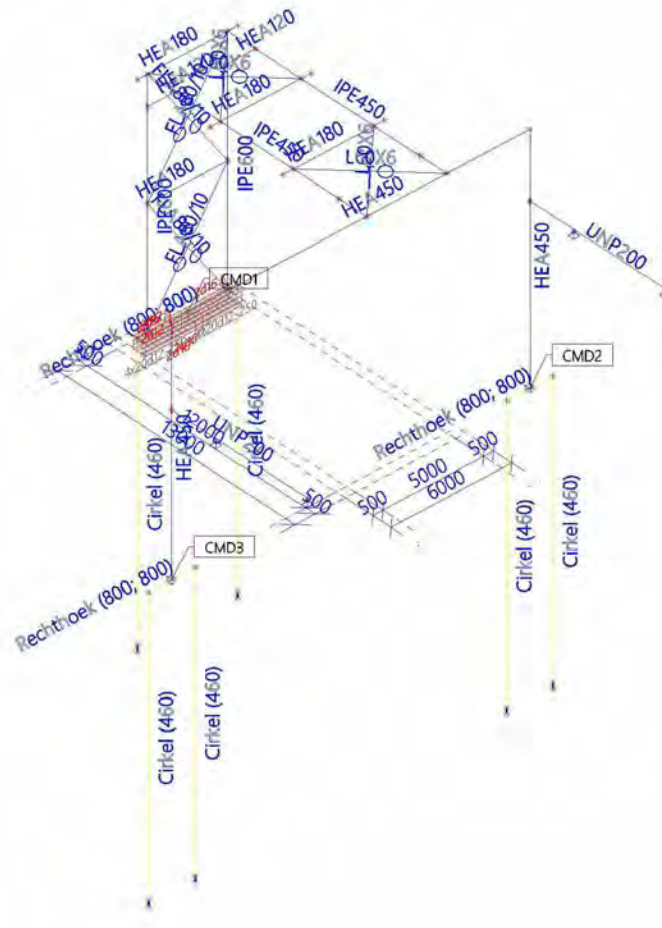
A	Gebied
$A_y$	Afschuifoppervlak in hoofd y-richting - Berekend door 2D EEM analyse
$A_z$	Afschuifoppervlak in hoofd z-richting - Berekend door 2D EEM analyse
$I_y$	Tweede moment van het gebied rond de hoofd y-as
$I_z$	Tweede moment van het gebied rond de hoofd z-as
$W_{ely}$	Elastische doorsnede modulus rond de hoofd y-as
$W_{elz}$	Elastische doorsnede modulus rond de hoofd z-as
$W_{ply}$	Plastische doorsnede modulus rond de hoofd y-as
$W_{plz}$	Plastische doorsnede modulus rond de hoofd z-as
$I_w$	Welvings constante - Berekend door 2D EEM analyse
$I_t$	Torsie constante - Berekend door 2D EEM analyse
$d_y$	Afschuif middencoördinaat in hoofd y-richting gemeten vanaf het zwaartepunt - Berekend door 2D EEM analyse
$d_z$	Afschuif middencoördinaat in hoofd z-richting gemeten vanaf het zwaartepunt - Berekend door 2D EEM analyse

#### Verklaring van symbolen

$c_{yucs}$	Zwaartepunt coördinaten in Y-richting van het invoer assen systeem
$c_{zucs}$	Zwaartepunt coördinaten in Z-richting van het invoer assen systeem
$\alpha$	Rotatiehoek van het hoofd assen systeem
$I_{yzlcs}$	Product moment van het gebied in het LCS systeem
$M_{ply+}$	Plastisch moment rond de hoofd y-as voor een positief $M_y$ moment
$M_{ply-}$	Plastisch moment rond de hoofd y-as voor een negatief $M_y$ moment
$M_{plz+}$	Plastisch moment rond de hoofd z-as voor een positief $M_z$ moment
$M_{plz-}$	Plastisch moment rond de hoofd z-as voor een negatief $M_z$ moment
AL	Omtrek per eenheidslengte
AD	Uithardingsoppervlakte per eenheidslengte
$\beta_y$	Mono-symmetrische constante rond de hoofd y-as
$\beta_z$	Mono-symmetrische constante rond de hoofd z-as



## 2.2.8. Analysis model



## 2.2.9. Lagen

Naam	enkel	Constructiemodel
Laag1	*	

## 2.2.10. UCS

Huidig UCS			
Type	vector		
X [mm], Y [mm], Z [mm]	0.000	0.000	0.000
X-X, X-Y, X-Z	1	0	0
Y-X, Y-Y, Y-Z	0	1	0
Z-X, Z-Y, Z-Z	0	0	1



## 2.3. Model gegevens

### 2.3.1. Instellingen net

Naam	NetInstelling1
Minimumafstand tussen definitiepunt en -lijn [m]	0.001
Gemiddeld aantal 1D-netelementen op rechte 1D-elementen	1
Gemiddelde grootte van 2D-netelement [mm]	1000.000
Definitie van netelementen afmetingen voor panelen	Handmatig
Gemiddelde afmeting van paneelelement [mm]	1000.000
Elastisch net	✓
Pas automatische netverfijning toe	* 100.000
Minimum lengte van staafelement [mm]	100.000
Maximum lengte van staafelement [mm]	1000000.000
Gemiddelde grootte van voorspankabels, elementen op elastische bedding, niet-lineaire grondveer [mm]	1000.000
Generatie van knopen op staven	*
Generatie van variabele excentriciteiten op elementen in plaats van constante excentriciteiten	*
Verdeling op consoles en variabele staven	5
Verdeling voor integratiestrook en 2D-1D upgrade	50
Netverfijning volgens het liggertype	Geen
Maximale hoek uit het vlak van vierhoekig element [mrad]	30.0
Verh. voorgedefinieerd net	1.5

### 2.3.2. Instellingen solver

Naam	SolverSetup1
Negeer dwarskrachtvervormingen ( Ay, Az >> A )	*
Initiële spanning	*
Pas IRS (Improved Reduced System) methode toe	*
Pas massa- en stijfheidsfactoren toe	✓
Aantal diktes van plaatrib	20
Maximumaantal bodeminteractie-iteraties	10
Maximum aantal iteraties	20
Aantal incrementen	1
Aantal knikvormen	2
Aantal sneden op gemiddelde staaf	10
Aantal eigenmodes	10
Stap voor grond/waterdruk [mm]	500.000
C1x [MN/m <sup>3</sup> ]	1.0000e-01
C1y [MN/m <sup>3</sup> ]	1.0000e-01
C1z [MN/m <sup>3</sup> ]	1.0000e+01
C2x [MN/m]	5.0000e+00
C2y [MN/m]	5.0000e+00
Wapeningscoëfficiënt	1
Waarschuwing als de maximale translatie groter is dan [mm]	1000.0
Waarschuwing als de maximale rotatie groter is dan [mrad]	100.0
Tolerantie van parallelisme [deg]	10.00
Overspanningslengteverhouding Le/beff,max (1 kant) [-]	8.00
Enkelvoudig opgelegde ligger [-]	1.00
Inwendige overspanning [-]	0.70
Eind overspanning [-]	0.85
Uitkraging [-]	2.00
Solver nauwkeurigheid ratio	1
Grond combinatie	Geen
Plastische scharnieren norm	Geen norm
Buigtheorie van plaat/schaal berekening	Mindlin
Type solver	Direct
Type van eigenwaarde solver	Lanczos
Type van eigenwaarde solver	Lanczos
Berekeningsmethode	Picard



### 2.3.3. 1D

#### 2.3.3.1. Knopen

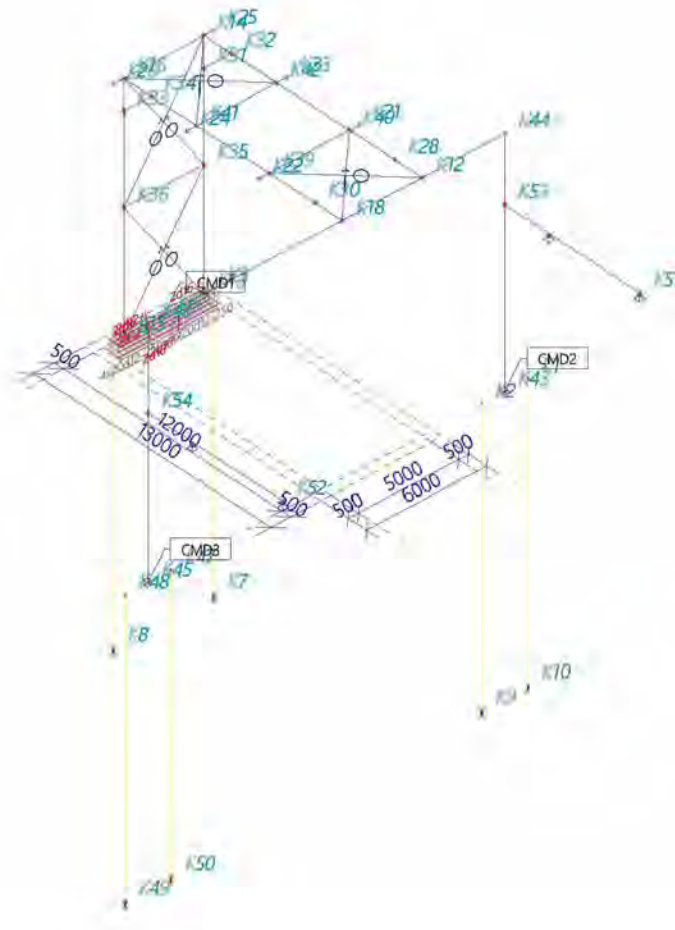
Naam	Coördinaat X [mm]	Coördinaat Y [mm]	Coördinaat Z [mm]
K1	500.000	-4767.000	0.000
K2	500.000	-2467.000	0.000
K3	12500.000	0.000	0.000
K4	12500.000	5000.000	0.000
K6	12500.000	2500.000	0.000
K7	12500.000	0.000	-14000.000
K8	12500.000	5000.000	-14000.000
K9	500.000	-2467.000	-14000.000
K10	500.000	-4767.000	-14000.000
K12	500.000	500.000	11820.000
K13	12500.000	500.000	0.000
K14	12500.000	500.000	11820.000
K15	12500.000	4500.000	0.000
K16	12500.000	4500.000	11820.000
K18	500.000	4500.000	11820.000
K21	4500.000	0.000	11820.000
K22	4500.000	5000.000	11820.000
K23	8500.000	0.000	11820.000
K24	8500.000	5000.000	11820.000
K25	12500.000	0.000	11820.000
K26	12500.000	5000.000	11820.000
K28	2000.000	500.000	11820.000
K30	2000.000	4500.000	11820.000

Naam	Coördinaat X [mm]	Coördinaat Y [mm]	Coördinaat Z [mm]
K31	12500.000	500.000	10320.000
K32	11000.000	500.000	11820.000
K33	12500.000	4500.000	10320.000
K34	11000.000	4500.000	11820.000
K35	12500.000	500.000	5910.000
K36	12500.000	4500.000	5910.000
K39	4500.000	4500.000	11820.000
K40	4500.000	500.000	11820.000
K41	8500.000	4500.000	11820.000
K42	8500.000	500.000	11820.000
K43	500.000	-3617.000	0.000
K44	500.000	-3617.000	11820.000
K45	500.000	14173.000	0.000
K46	500.000	14173.000	11820.000
K47	500.000	13023.000	0.000
K48	500.000	15323.000	0.000
K49	500.000	15323.000	-14000.000
K50	500.000	13023.000	-14000.000
K51	-6923.000	-3617.000	8550.000
K52	-6923.000	14173.000	7750.000
K53	500.000	-3617.000	8550.000
K54	500.000	14173.000	7750.000





### 2.3.3.2. Knopen



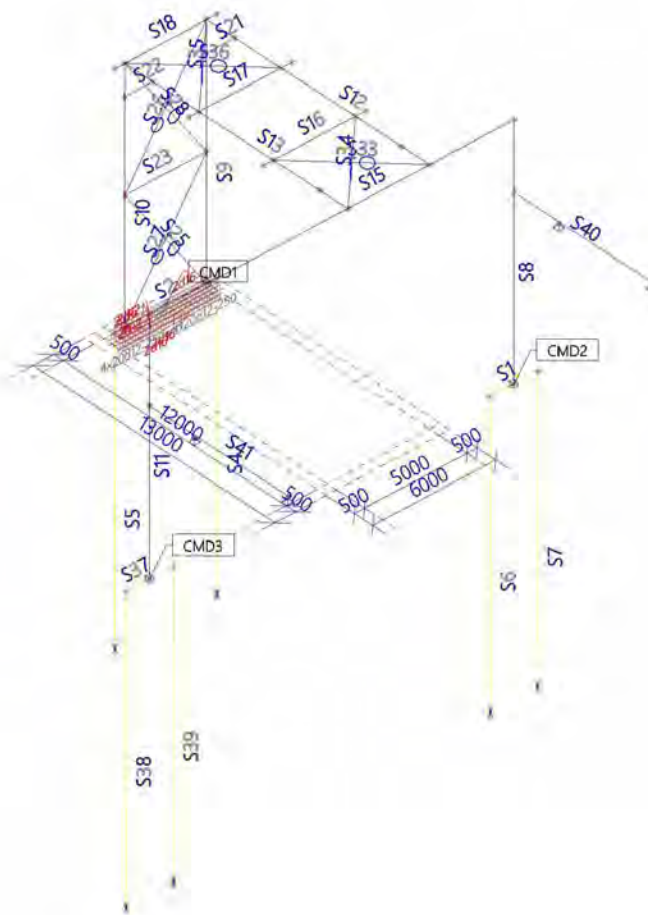
### 2.3.3.3. Staven

Naam	Doorsnede	Materiaal	Lengte [mm]	Beginknoop	Eindknoop	Type
S1	BT-12 - Rechthoek (800; 800)	C35/45	2300.000	K1	K2	Balk (80)
S2	BT-12 - Rechthoek (800; 800)	C35/45	5000.000	K3	K4	Balk (80)
S4	BT-11 - Cirkel (460)	C35/45	14000.000	K7	K3	Kolom (100)
S5	BT-11 - Cirkel (460)	C35/45	14000.000	K8	K4	Kolom (100)
S6	BT-11 - Cirkel (460)	C35/45	14000.000	K9	K2	Kolom (100)
S7	BT-11 - Cirkel (460)	C35/45	14000.000	K10	K1	Kolom (100)
S8	ST-17 - HEA450	S 235 JR (EN 10025-2)	11820.000	K43	K44	Kolom (100)
S9	ST-11 - IPE600	S 235 JR (EN 10025-2)	11820.000	K13	K14	Kolom (100)
S10	ST-11 - IPE600	S 235 JR (EN 10025-2)	11820.000	K15	K16	Kolom (100)
S11	ST-17 - HEA450	S 235 JR (EN 10025-2)	11820.000	K45	K46	Kolom (100)
S12	ST-12 - IPE450	S 235 JR (EN 10025-2)	12000.000	K12	K14	Balk (80)
S13	ST-12 - IPE450	S 235 JR (EN 10025-2)	12000.000	K18	K16	Balk (80)
S15	ST-17 - HEA450	S 235 JR (EN 10025-2)	17790.000	K44	K46	Balk (80)
S16	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K21	K22	Balk (80)
S17	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K23	K24	Balk (80)
S18	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K25	K26	Balk (80)
S21	ST-14 - HEA120	S 235 JR (EN 10025-2)	2121.320	K31	K32	Balk (80)
S22	ST-14 - HEA120	S 235 JR (EN 10025-2)	2121.320	K33	K34	Balk (80)
S23	ST-13 - HEA180	S 235 JR (EN 10025-2)	4000.000	K35	K36	Balk (80)
S25	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K13	K36	Balk (80)



Naam	Doorsnede	Materiaal	Lengte [mm]	Beginknoop	Eindknoop	Type
S26	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K36	K14	Balk (80)
S27	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K15	K35	Balk (80)
S28	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K35	K16	Balk (80)
S33	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K12	K39	Balk (80)
S34	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K18	K40	Balk (80)
S35	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K41	K14	Balk (80)
S36	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K42	K16	Balk (80)
S37	BT-12 - Rechthoek (800; 800)	C35/45	2300.000	K47	K48	Balk (80)
S38	BT-11 - Cirkel (460)	C35/45	14000.000	K49	K48	Kolom (100)
S39	BT-11 - Cirkel (460)	C35/45	14000.000	K50	K47	Kolom (100)
S40	ST-18 - UNP200	S 235 JR (EN 10025-2)	7423.000	K53	K51	Balk (80)
S41	ST-18 - UNP200	S 235 JR (EN 10025-2)	7423.000	K52	K54	Balk (80)

### 2.3.3.4. Staven





### 2.3.3.5. Scharnieren

Naam	Staal Positie	ux	uy	uz	phix	phiy	phiz
		Fun - ux	Fun - uy	Fun - uz	Fun - phix	Fun - phiy	Fun - phiz
		Stijf - ux [MN/m]	Stijf - uy [MN/m]	Stijf - uz [MN/m]	Stijf - phix [MNm/rad]	Stijf - phiy [MNm/rad]	Stijf - phiz [MNm/rad]
H5	S12 Beide	Vast	Vast	Vast	Vast	Vast	Vrij
H6	S13 Beide	Vast	Vast	Vast	Vast	Vast	Vrij
H7	S21 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H8	S22 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H12	S9 Begin	Vast	Vast	Vast	Vast	Vast	Vrij
H13	S10 Begin	Vast	Vast	Vast	Vast	Vast	Vrij
H16	S23 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H17	S41 Eind	Vast	Vast	Vast	Vast	Vrij	Vrij
H18	S40 Begin	Vast	Vast	Vast	Vast	Vrij	Vrij

### 2.3.3.6. Staal niet-lineariteit

Naam	Staal	Type
BN1	S25	Alleen trek
BN2	S26	Alleen trek

Naam	Staal	Type
BN3	S27	Alleen trek
BN4	S28	Alleen trek

Naam	Staal	Type
BN9	S33	Alleen trek
BN10	S34	Alleen trek

Naam	Staal	Type
BN11	S35	Alleen trek
BN12	S36	Alleen trek

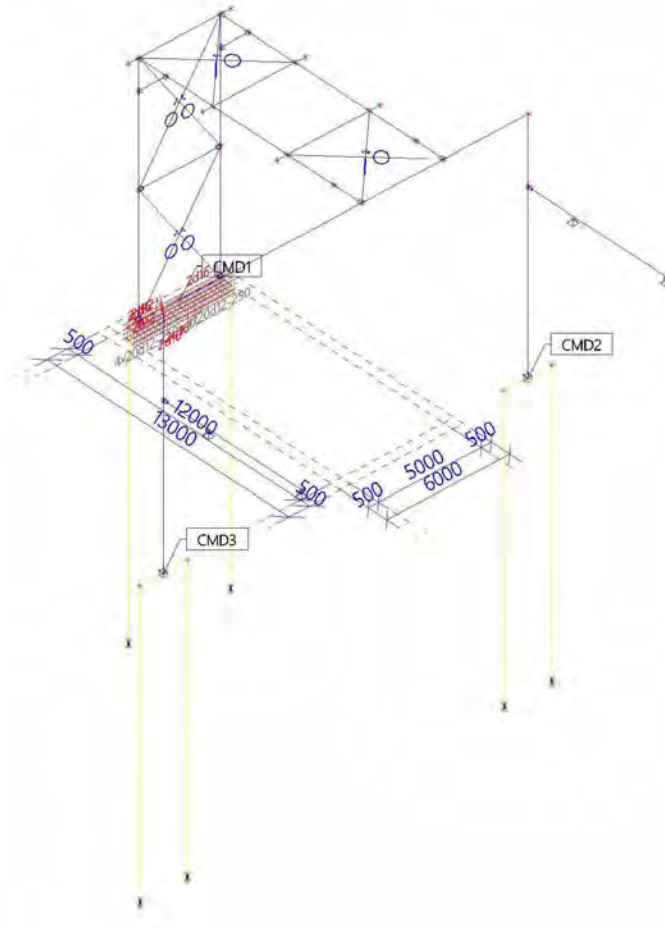
### 2.3.3.7. Kruisende staven

Naam	1e staaf	2e staaf	Type
Kruis1	S12	S16	Vast
Kruis2	S12	S17	Vast
Kruis3	S13	S16	Vast
Kruis4	S13	S17	Vast

### 2.3.4. 2D



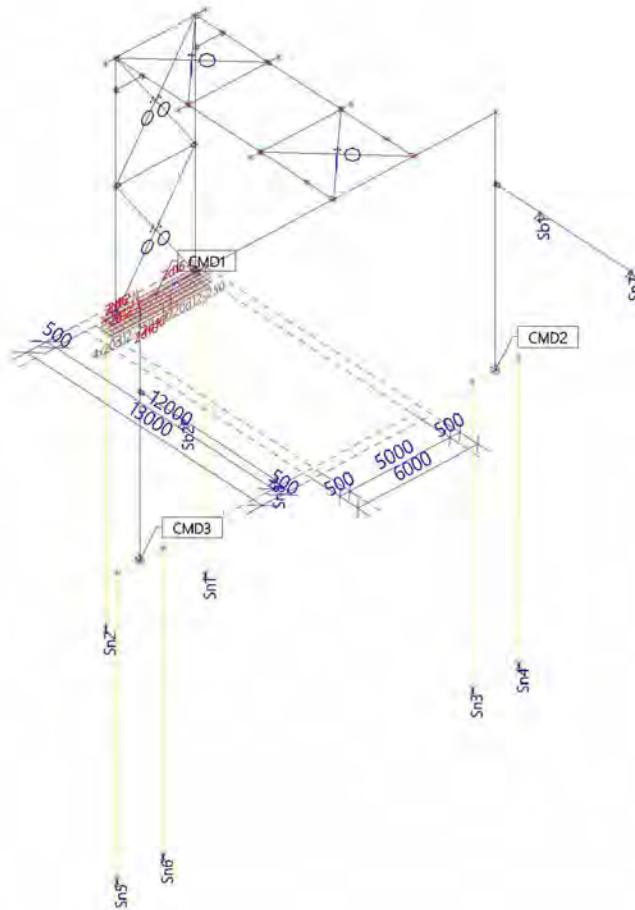
## 2.3.4.1. Platen





## 2.3.5. Supports

### 2.3.5.1. Steunpunten



### 2.3.5.2. Knoopondersteuningen

Naam Knoop	Systeem UCS	Type Hoek [deg]	X Stijfheid X [MN/m]	Y Stijfheid Y [MN/m]	Z Stijfheid Z [MN/m]	Rx Stijfheid Rx [MNm/rad]	Ry Stijfheid Ry [MNm/rad]	Rz Stijfheid Rz [MNm/rad]
Sn1 K7	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn2 K8	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn3 K9	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn4 K10	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn5 K49	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn6 K50	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn7 K51	GCS	Standaard	Vast	Vast	Vast	Vrij	Vrij	Vrij
Sn8 K52	GCS	Standaard	Vast	Vast	Vast	Vrij	Vrij	Vrij



### 2.3.5.3. Puntondersteuning op staaf

Naam	Type	Coör	Pos x [mm]	dx [mm]	X	Y	Z	Rx	Ry	Rz
		Systeem	Oors	Herh (n)						
Sb1	Standaard	Abso GCS	5000.000 Vanaf einde	1	Vast	Vast	Vast	Vrij	Vrij	Vrij
Sb2	Standaard	Abso GCS	5000.000 Vanaf begin	1	Vast	Vast	Vast	Vrij	Vrij	Vrij

### 2.3.5.4. Lijnondersteuning op staven

Naam	Type	Staat	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
Slb1	Lijn	S7 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb2	Lijn	S4 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb3	Lijn	S5 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb4	Lijn	S6 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb5	Lijn	S4 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb6	Lijn	S5 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb7	Lijn	S6 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb8	Lijn	S7 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb9	Lijn	S4 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb10	Lijn	S5 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb11	Lijn	S6 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb12	Lijn	S7 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb13	Lijn	S4 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb14	Lijn	S5 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb15	Lijn	S6 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb16	Lijn	S7 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb17	Lijn	S4 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb18	Lijn	S5 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb19	Lijn	S6 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb20	Lijn	S7 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb21	Lijn	S4 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb22	Lijn	S5 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb23	Lijn	S6 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb24	Lijn	S7 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij



Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
Slb25	Lijn	S4 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb26	Lijn	S5 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb27	Lijn	S6 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb28	Lijn	S7 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb29	Lijn	S4 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb30	Lijn	S5 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb31	Lijn	S7 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb32	Lijn	S6 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb33	Lijn	S4 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb34	Lijn	S5 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb35	Lijn	S7 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb36	Lijn	S6 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb37	Lijn	S4 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb38	Lijn	S5 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb39	Lijn	S7 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb40	Lijn	S6 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb41	Lijn	S4 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb42	Lijn	S5 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb43	Lijn	S7 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb44	Lijn	S6 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb45	Lijn	S4 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb46	Lijn	S5 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb47	Lijn	S7 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb48	Lijn	S6 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb49	Lijn	S4 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb50	Lijn	S5 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb51	Lijn	S7 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb52	Lijn	S6 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb53	Lijn	S4 GCS	13100.000 13400.000	Abso Vanaf einde	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
Slb54	Lijn	S5	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij



Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coörd	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
		GCS	13400.000	Vanaf einde								
Slb55	Lijn	S6	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb56	Lijn	S7	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb57	Lijn	S4	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb58	Lijn	S5	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb59	Lijn	S6	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb60	Lijn	S7	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb61	Lijn	S4	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb62	Lijn	S5	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb63	Lijn	S6	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb64	Lijn	S7	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb65	Lijn	S38	1500.000	Abso	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	1650.000	Vanaf einde								
Slb66	Lijn	S38	1650.000	Abso	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	2660.000	Vanaf einde								
Slb67	Lijn	S38	2660.000	Abso	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	4960.000	Vanaf einde								
Slb68	Lijn	S38	4960.000	Abso	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	6120.000	Vanaf einde								
Slb69	Lijn	S38	6120.000	Abso	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	10600.000	Vanaf einde								
Slb70	Lijn	S38	10600.000	Abso	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	10700.000	Vanaf einde								
Slb71	Lijn	S38	10700.000	Abso	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11300.000	Vanaf einde								
Slb72	Lijn	S38	11300.000	Abso	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11600.000	Vanaf einde								
Slb73	Lijn	S38	11600.000	Abso	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11800.000	Vanaf einde								
Slb74	Lijn	S38	11800.000	Abso	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	12100.000	Vanaf einde								
Slb75	Lijn	S38	12100.000	Abso	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
		GCS	12500.000	Vanaf einde								
Slb76	Lijn	S38	12500.000	Abso	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
		GCS	12700.000	Vanaf einde								
Slb77	Lijn	S38	12700.000	Abso	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13100.000	Vanaf einde								
Slb78	Lijn	S38	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb79	Lijn	S38	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb80	Lijn	S38	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb81	Lijn	S39	1500.000	Abso	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	1650.000	Vanaf einde								
Slb82	Lijn	S39	1650.000	Abso	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	2660.000	Vanaf einde								
Slb83	Lijn	S39	2660.000	Abso	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	4960.000	Vanaf einde								





Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
Slb84	Lijn	S39 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb85	Lijn	S39 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb86	Lijn	S39 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb87	Lijn	S39 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb88	Lijn	S39 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb89	Lijn	S39 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb90	Lijn	S39 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb91	Lijn	S39 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb92	Lijn	S39 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb93	Lijn	S39 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb94	Lijn	S39 GCS	13100.000 13400.000	Abso Vanaf einde	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
Slb95	Lijn	S39 GCS	13400.000 13500.000	Abso Vanaf einde	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb96	Lijn	S39 GCS	13500.000 13950.000	Abso Vanaf einde	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij



### 3. Belastingen

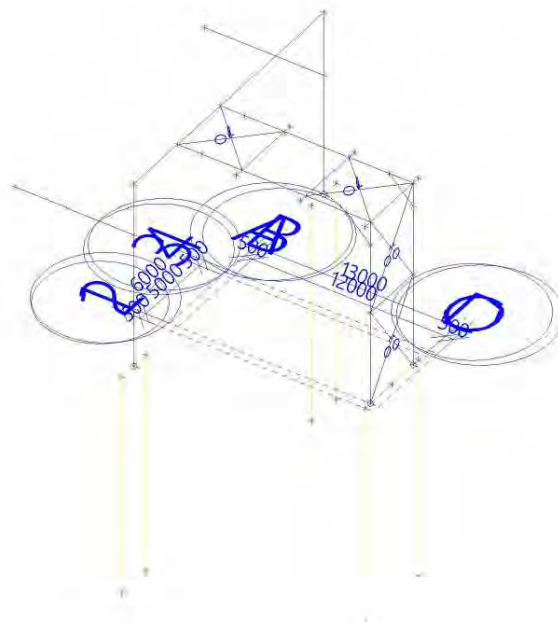
#### 3.1. Belastingsgevallen

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Richting	Duur	'Master' belastingsgeval
BG101	Eigen gewicht	Permanent	LG1	Eigen gewicht		-Z		
BG102	Permanent	Permanent	LG1	Standaard				
BG111	Wind x-as	Variabel	LG3	Statisch	Standaard		Kort	Geen
BG112	Wind y-as	Variabel	LG3	Statisch	Standaard		Kort	Geen
BG121	Veranderlijk + eq	Variabel	LG4	Statisch	Standaard		Kort	Geen

#### 3.2. Belastingsgevallen

##### 3.2.1. Belastingsgevallen - BG101

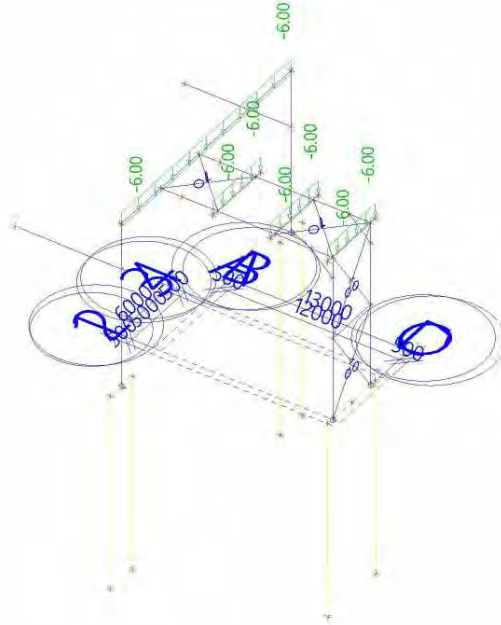
Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Richting
BG101	Eigen gewicht	Permanent	LG1	Eigen gewicht	-Z





### 3.2.2. Belastingsgevallen - BG102

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype
BG102	Permanent	Permanent	LG1	Standaard





Project  
Omschrijving  
Onderdeel

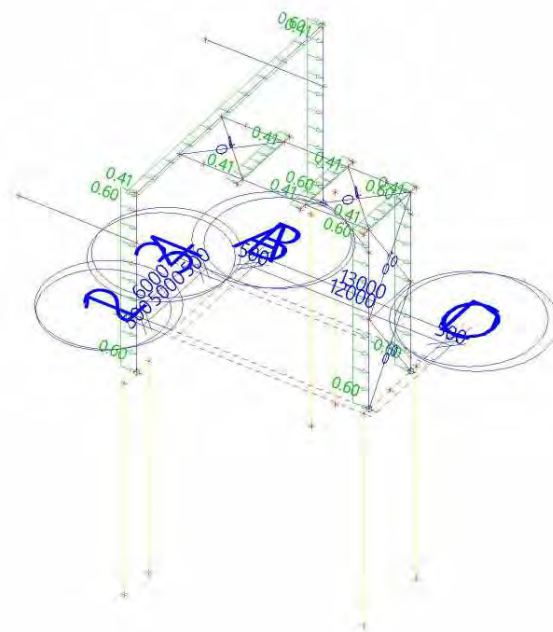
4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2a  
27/36

### 3.2.3. Belastingsgevallen - BG111

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Duur	'Master' belastingsgeval
BG111	Wind x-as	Variabel	LG3	Statisch	Standaard	Kort	Geen



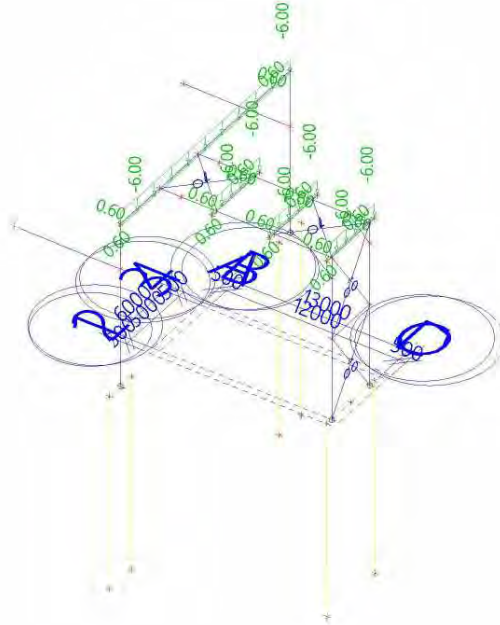




Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 29/36

### 3.2.5. Belastingsgevallen - BG121

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Duur	'Master' belastingsgeval
BG121	Veranderlijk + eq	Variabel	LG4	Statisch	Standaard	Kort	Geen





### 3.3. Belastinggroepen

Naam	Last	Relatie	Type
LG1	Permanent		
LG2	Variabel	Exclusief	Temperatuur
LG3	Variabel	Exclusief	Wind
LG4	Variabel	Standaard	Cat E : Opslagruimte

### 3.4. Combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
UGT-Set B	EN-UGT (STR/GEO) Set B	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00
BGT-kar	EN - BGT Karakteristiek	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00
BGT-quasi	EN-BGT Quasi-permanent	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00

### 3.5. Niet-lineaire combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
NC_UGT-Set B.1	Uiterste Grenstoestand	BG101 - Eigen gewicht	1.35
		BG102 - Permanent	1.35
NC_UGT-Set B.2	Uiterste Grenstoestand	BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.3	Uiterste Grenstoestand	BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.4	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.5	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.6	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.7	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.8	Uiterste Grenstoestand	BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.9	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.10	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.11	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	0.90



Naam	Type	Belastingsgevallen	Coëff. [-]
		BG102 - Permanent	0.90
NC_UGT-Set B.12	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.13	Uiterste Grenstoestand	BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.14	Uiterste Grenstoestand	BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.35
		BG102 - Permanent	1.35
NC_BGT-kar.1	Bruikbaarheidsgrenstoestand	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.2	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as	1.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.3	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as	1.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.4	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as	1.00
		BG121 - Veranderlijk + eq	1.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.5	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.6	Bruikbaarheidsgrenstoestand	BG121 - Veranderlijk + eq	1.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.7	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as	0.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.8	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as	0.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.9	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as	0.00
		BG121 - Veranderlijk + eq	1.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-kar.10	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as	0.00
		BG121 - Veranderlijk + eq	1.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-quasi.1	Bruikbaarheidsgrenstoestand	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-quasi.2	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as	0.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-quasi.3	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as	0.00
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-quasi.4	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as	0.00
		BG121 - Veranderlijk + eq	0.80
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-quasi.5	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as	0.00
		BG121 - Veranderlijk + eq	0.80
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
NC_BGT-quasi.6	Bruikbaarheidsgrenstoestand	BG121 - Veranderlijk + eq	0.80





Naam	Type	Belastingsgevallen	Coëff. [-]
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00

### 3.6. Resultaatklassen

Naam	Lijst
RK_NC_UGT-Set B	NC_UGT-Set B.1 NC_UGT-Set B.2 NC_UGT-Set B.3 NC_UGT-Set B.4 NC_UGT-Set B.5 NC_UGT-Set B.6 NC_UGT-Set B.7 NC_UGT-Set B.8 NC_UGT-Set B.9 NC_UGT-Set B.10 NC_UGT-Set B.11 NC_UGT-Set B.12 NC_UGT-Set B.13 NC_UGT-Set B.14
RK_NC_BGT-kar	NC_BGT-kar.1 NC_BGT-kar.2 NC_BGT-kar.3 NC_BGT-kar.4 NC_BGT-kar.5 NC_BGT-kar.6 NC_BGT-kar.7 NC_BGT-kar.8 NC_BGT-kar.9 NC_BGT-kar.10
RK_NC_BGT-quasi	NC_BGT-quasi.1 NC_BGT-quasi.2 NC_BGT-quasi.3 NC_BGT-quasi.4 NC_BGT-quasi.5 NC_BGT-quasi.6
GEO	UGT-Set B - EN-UGT (STR/GEO) Set B



## 4. Berekeningsverslag

### Lineaire berekening

Aantal 2D elementen		0
Aantal 1D-elementen		225
Aantal netknoten		211
Aantal vergelijkingen		1266
Buigtheorie	Mindlin	
Belastingsgevallen	BG101, BG102, BG111, BG112, BG121	
Start van de berekening	15.07.2022 16:22	
Einde berekening	15.07.2022 16:22	

### Som van lasten en reacties

Belastingsgeval	Waarde	X	Y	Z
		[kN]	[kN]	[kN]
BG101	Lasten	0.00	0.00	-612.85
	reactie in de knopen	2.22	0.00	612.85
	reactie op de lijnen	-2.22	0.00	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG102	Lasten	0.00	0.00	-196.74
	reactie in de knopen	8.39	0.03	196.74
	reactie op de lijnen	-8.39	-0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG111	Lasten	41.81	0.00	0.00
	reactie in de knopen	-26.72	-0.11	0.00
	reactie op de lijnen	-15.09	0.11	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG112	Lasten	0.00	77.09	0.00
	reactie in de knopen	0.51	-1.51	0.00
	reactie op de lijnen	-0.51	-75.58	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG121	Lasten	19.67	19.67	-196.74
	reactie in de knopen	-6.75	-0.65	196.74
	reactie op de lijnen	-12.92	-19.02	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00

## 5. Berekeningsverslag

### Niet-lineaire berekening

Aantal 2D elementen		0
Aantal 1D-elementen		225
Aantal netknoten		211
Aantal vergelijkingen		1266
Buigtheorie	Mindlin	
Geometrische niet-lineariteit	2de orde (Timoshenko)	
Berekeningsmethode	Picard	
Aantal incrementen		1
Maximum aantal iteraties		20

Niet-lineaire combinatie	Start van de berekening	Einde berekening	Aantal iteraties
NC_UGT-Set B.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.5	15.07.2022 16:22	15.07.2022 16:22	4
NC_UGT-Set B.6	15.07.2022 16:22	15.07.2022 16:22	7



Niet-lineaire combinatie	Start van de berekening	Einde berekening	Aantal iteraties
NC_UGT-Set B.7	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.8	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.9	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.10	15.07.2022 16:22	15.07.2022 16:22	4
NC_UGT-Set B.11	15.07.2022 16:22	15.07.2022 16:22	11
NC_UGT-Set B.12	15.07.2022 16:22	15.07.2022 16:22	11
NC_UGT-Set B.13	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.14	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.5	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.6	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.7	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.8	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.9	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.10	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-quasi.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.5	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.6	15.07.2022 16:22	15.07.2022 16:22	7

### Som van lasten en reacties

Niet-lineaire combinatie	Waarde	X [kN]	Y [kN]	Z [kN]
NC_UGT-Set B.1	Lasten	0.00	0.00	-1092.94
	reactie in de knopen	13.65	-0.05	1092.94
	reactie op de lijnen	-13.65	0.05	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.2	Lasten	0.00	0.00	-728.63
	reactie in de knopen	9.04	-0.02	728.63
	reactie op de lijnen	-9.04	0.02	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.3	Lasten	0.00	0.00	-973.12
	reactie in de knopen	12.13	-0.04	973.12
	reactie op de lijnen	-12.13	0.04	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.4	Lasten	62.72	0.00	-973.12
	reactie in de knopen	-28.49	-0.13	973.12
	reactie op de lijnen	-34.23	0.13	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.5	Lasten	0.00	115.63	-973.12
	reactie in de knopen	13.60	-1.15	973.12
	reactie op de lijnen	-13.60	-114.48	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.6	Lasten	92.23	29.51	-1268.23
	reactie in de knopen	-40.50	-1.04	1268.23
	reactie op de lijnen	-51.73	-28.47	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.7	Lasten	29.51	145.14	-1268.23
	reactie in de knopen	2.01	-2.02	1268.23
	reactie op de lijnen	-31.52	-143.13	0.00
	contact 1D	0.00	0.00	0.00



Niet-lineaire combinatie	Waarde	X [kN]	Y [kN]	Z [kN]
NC_UGT-Set B.8	contact 2D	0.00	0.00	0.00
	Lasten	29.51	29.51	-1268.23
	reactie in de knopen	0.69	-0.72	1268.23
	reactie op de lijnen	-30.20	-28.79	0.00
NC_UGT-Set B.9	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	62.72	0.00	-728.63
	reactie in de knopen	-31.48	-0.13	728.63
NC_UGT-Set B.10	reactie op de lijnen	-31.24	0.13	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	0.00	115.63	-728.63
NC_UGT-Set B.11	reactie in de knopen	10.51	-1.17	728.63
	reactie op de lijnen	-10.51	-114.46	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.12	Lasten	92.23	29.51	-1023.74
	reactie in de knopen	-43.44	-1.04	1023.74
	reactie op de lijnen	-48.79	-28.47	0.00
	contact 1D	0.00	0.00	0.00
NC_UGT-Set B.13	contact 2D	0.00	0.00	0.00
	Lasten	29.51	145.14	-1023.74
	reactie in de knopen	-1.06	-2.04	1023.74
	reactie op de lijnen	-28.45	-143.11	0.00
NC_UGT-Set B.14	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	29.51	29.51	-1023.74
	reactie in de knopen	-2.39	-0.71	1023.74
NC_BGT-kar.1	reactie op de lijnen	-27.12	-28.80	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	29.51	29.51	-1388.05
NC_BGT-kar.2	reactie in de knopen	2.20	-0.73	1388.05
	reactie op de lijnen	-31.71	-28.78	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.3	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
NC_BGT-kar.4	contact 2D	0.00	0.00	0.00
	Lasten	41.81	0.00	-809.59
	reactie in de knopen	-16.95	-0.08	809.59
	reactie op de lijnen	-24.87	0.08	0.00
NC_BGT-kar.5	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	0.00	77.09	-809.59
	reactie in de knopen	11.04	-0.79	809.59
NC_BGT-kar.6	reactie op de lijnen	-11.04	-76.30	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	61.49	19.67	-1006.33
NC_BGT-kar.7	reactie in de knopen	-24.77	-0.62	1006.33
	reactie op de lijnen	-36.72	-19.05	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.8	Lasten	19.67	96.76	-1006.33
	reactie in de knopen	3.40	-1.30	1006.33
	reactie op de lijnen	-23.08	-95.46	0.00
	contact 1D	0.00	0.00	0.00
NC_BGT-kar.9	contact 2D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00

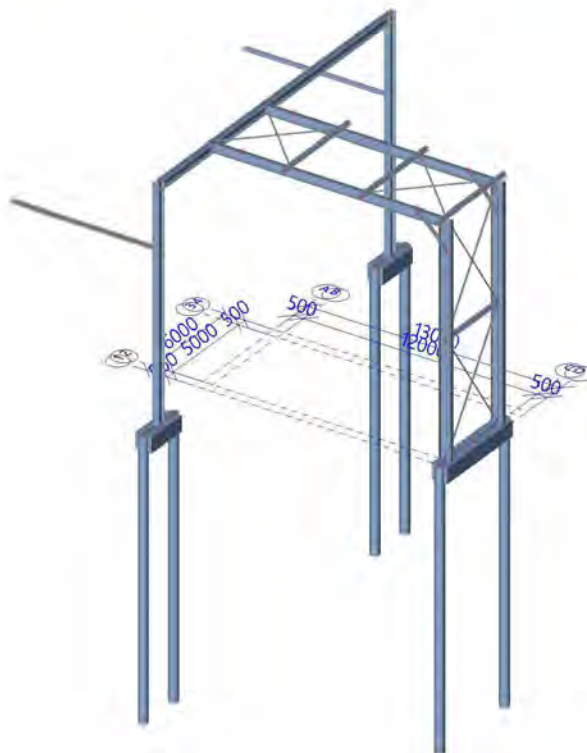


Niet-lineaire combinatie	Waarde	X [kN]	Y [kN]	Z [kN]
NC_BGT-kar.6	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.7	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.8	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.9	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.10	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.1	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.2	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.3	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.4	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.5	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.6	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00



# Bijlage 2.

## Uitvoer Resultaten Scia





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Resultaten	3
2.1. Vervormingen	3
2.1.1. Knoopverplaatsingen	3
2.1.1.1. Verplaatsing van knopen	3
2.1.1.2. Resultaten - $U_x$	3
2.1.1.3. Resultaten - $U_y$	4
2.1.1.4. Resultaten - $U_z$	4
2.1.1.5. Resultaten - $\Phi_x$	5
2.1.1.6. Resultaten - $\Phi_y$	5
2.1.1.7. Resultaten - $\Phi_z$	6
2.1.1.8. Resultaten - $U_{total}$	6
2.1.2. 3D verplaatsingen	7
2.1.2.1. 3D verplaatsing	7
2.1.2.2. Resultaten - $u_x$	7
2.1.2.3. Resultaten - $u_y$	8
2.1.2.4. Resultaten - $u_z$	8
2.1.2.5. Resultaten - $\phi_x$	9
2.1.2.6. Resultaten - $\phi_y$	9
2.1.2.7. Resultaten - $\phi_z$	10
2.1.2.8. Resultaten - $U_{total}$	10
2.1.3. 1D-ervormingen Algemeen	11
2.1.3.1. 1D-ervormingen	11
2.1.3.2. Resultaten - $u_x$	11
2.1.3.3. Resultaten - $u_y$	12
2.1.3.4. Resultaten - $u_z$	12
2.1.3.5. Resultaten - $\phi_x$	13
2.1.3.6. Resultaten - $\phi_y$	13
2.1.3.7. Resultaten - $\phi_z$	14
2.1.3.8. Resultaten - $U_{total}$	14
2.2. Krachten	15
2.2.1. Reactiekrachten	15
2.2.1.1. Reacties	15
2.2.1.2. Resultaten - $R_x$	16
2.2.1.3. Resultaten - $R_y$	16
2.2.1.4. Resultaten - $R_z$	17
2.2.1.5. Resultaten - $M_x$	17
2.2.1.6. Resultaten - $M_y$	18
2.2.1.7. Resultaten - $M_z$	18
2.2.2. Interne staafkrachten	19
2.2.2.1. Interne 1D-krachten	19
2.2.2.2. Resultaten - $N$	22
2.2.2.3. Resultaten - $V_y$	23
2.2.2.4. Resultaten - $V_z$	23
2.2.2.5. Resultaten - $M_x$	24
2.2.2.6. Resultaten - $M_y$	24
2.2.2.7. Resultaten - $M_z$	25
2.2.2.8. Resultaten - $V_r$	25
2.2.3. 3D stress	26
2.2.3.1. 3D spanning	26
2.2.3.2. Resultaten - $\sigma_1$	27
2.2.3.3. Resultaten - $\sigma_2$	27
2.2.3.4. Resultaten - $\sigma_E$	28
2.2.3.5. Resultaten - $\tau_{max,b}$ (2D)	28
2.2.3.6. Resultaten - $\tau_{tot}$ (1D)	29
2.2.4. 1D stress	30
2.2.4.1. 1D-spanningen	30
2.2.4.2. Resultaten - $\sigma_1$	31
2.2.4.3. Resultaten - $\sigma_2$	31
2.2.4.4. Resultaten - $\sigma_E$	32
2.2.4.5. Resultaten - $\tau_{tot}$	32



## 2. Resultaten

### 2.1. Vervormingen

#### 2.1.1. Knoopverplaatsingen

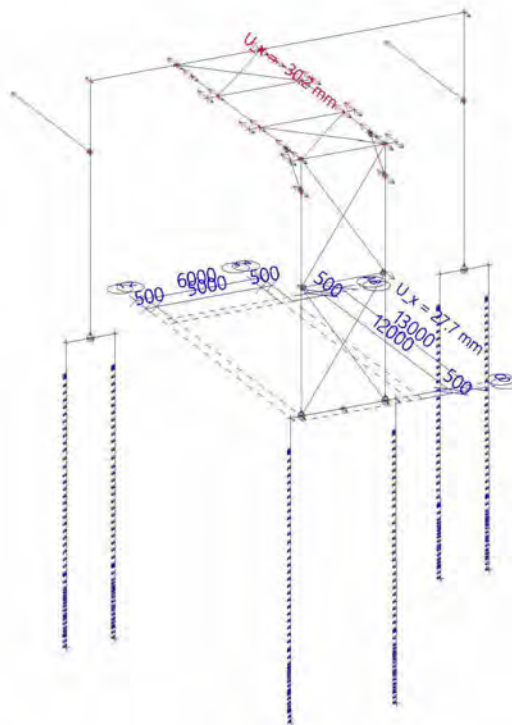
##### 2.1.1.1. Verplaatsing van knopen

Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-kar  
 Extreem: Globaal  
 Selectie: Alle

Naam	Belasting	$U_x$ [mm]	$U_y$ [mm]	$U_z$ [mm]	$\Phi_x$ [mrad]	$\Phi_y$ [mrad]	$\Phi_z$ [mrad]	$U_{total}$ [mm]
K41	NC_BGT-kar.1	<b>-30.2</b>	0.1	-19.6	2.0	-4.9	0.0	36.0
K36	NC_BGT-kar.4	<b>27.7</b>	2.1	-0.9	-0.8	1.5	-0.3	27.8
K53	NC_BGT-kar.1	0.0	<b>-8.0</b>	-0.5	-1.1	-2.5	3.6	8.0
K18	NC_BGT-kar.5	-13.9	42.0	<b>-73.0</b>	-0.5	-3.3	-2.9	<b>85.4</b>
K25	NC_BGT-kar.5	-22.5	19.9	<b>0.6</b>	-2.1	-5.1	-2.6	30.0
K44	NC_BGT-kar.5	-11.3	<b>44.4</b>	-0.9	<b>-10.9</b>	-3.9	3.2	45.8
K46	NC_BGT-kar.6	7.6	12.2	-0.9	<b>7.2</b>	2.2	-2.0	14.4
K24	NC_BGT-kar.6	-18.0	7.5	-27.3	4.2	<b>-8.1</b>	-1.1	33.6
K46	NC_BGT-kar.4	18.2	14.5	-0.9	6.9	<b>5.2</b>	2.7	23.3
K52	NC_BGT-kar.5	0.0	0.0	0.0	-3.4	0.1	<b>-5.9</b>	0.0
K44	NC_BGT-kar.1	-11.4	1.3	-0.6	-4.9	-3.9	<b>4.9</b>	11.5

##### 2.1.1.2. Resultaten - $U_x$

Waardes:  $U_x$   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-kar  
 Extreem: Globaal  
 Selectie: Alle

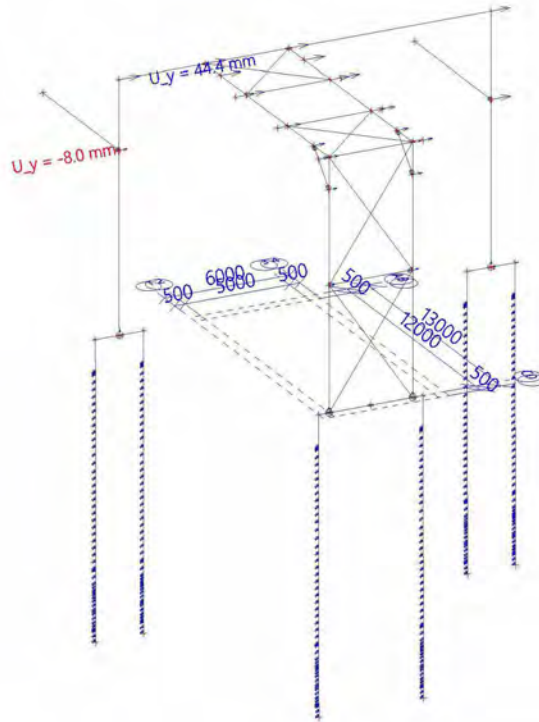






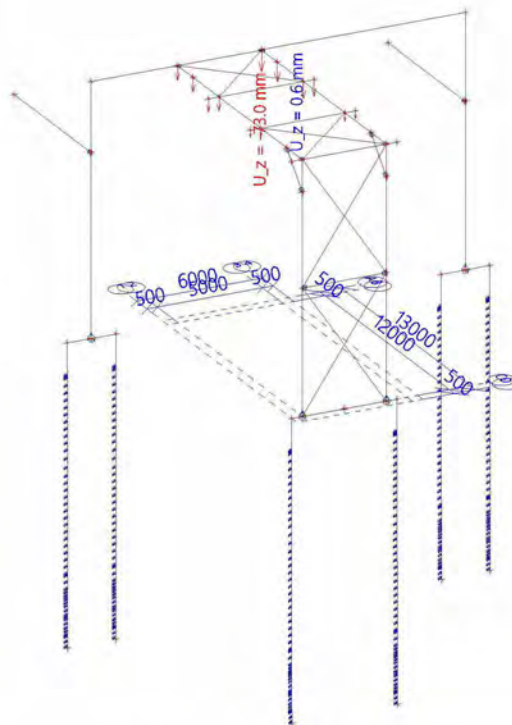
### 2.1.1.3. Resultaten - $U_y$

Waardes:  $U_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.4. Resultaten - $U_z$

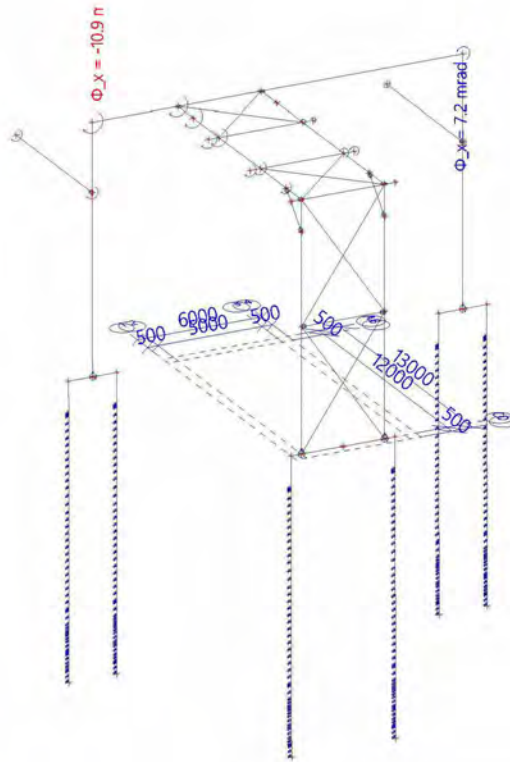
Waardes:  $U_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





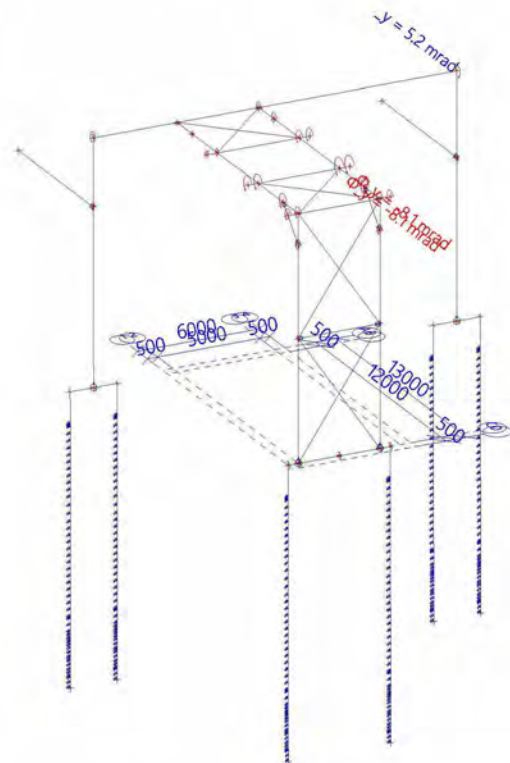
### 2.1.1.5. Resultaten - $\Phi_x$

Waardes:  $\Phi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.6. Resultaten - $\Phi_y$

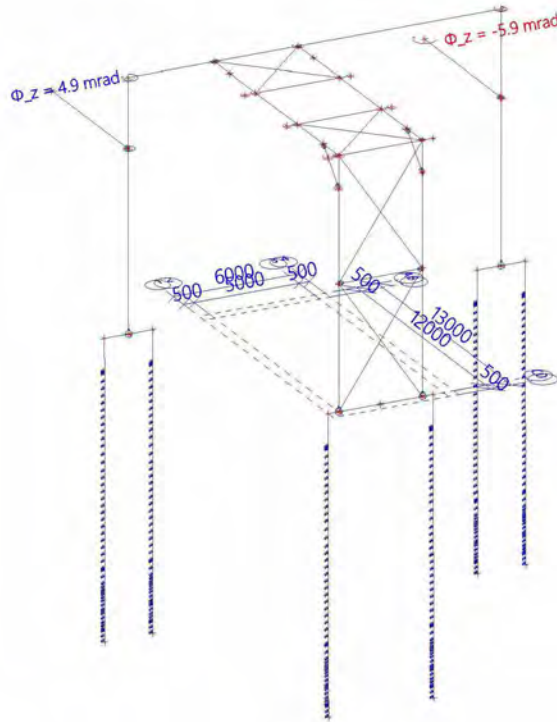
Waardes:  $\Phi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





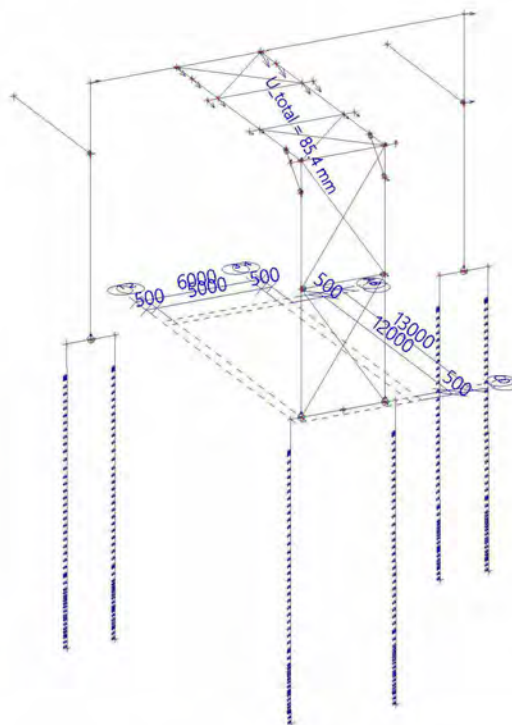
### 2.1.1.7. Resultaten - $\Phi_z$

Waardes:  $\Phi_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.6  
7/32

## 2.1.2. 3D verplaatsingen

### 2.1.2.1. 3D verplaatsing

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Selectie: Alle

Locatie: In knooppunten gem. bij macro. Systeem: LCS net element

**Resultaten op 1D-element:**

Extreme 1D: Globaal

Naam	dx [mm]	Vezel	Belasting	$u_x$ [mm]	$u_y$ [mm]	$u_z$ [mm]	$\phi_x$ [mrad]	$\phi_y$ [mrad]	$\phi_z$ [mrad]	$U_{total}$ [mm]
S39	500.000-	1	NC_BGT-kar.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S15	8117.000-	13	NC_BGT-kar.5	42.5	13.9	-73.5	-3.3	0.5	-2.9	86.0

### 2.1.2.2. Resultaten - $u_x$

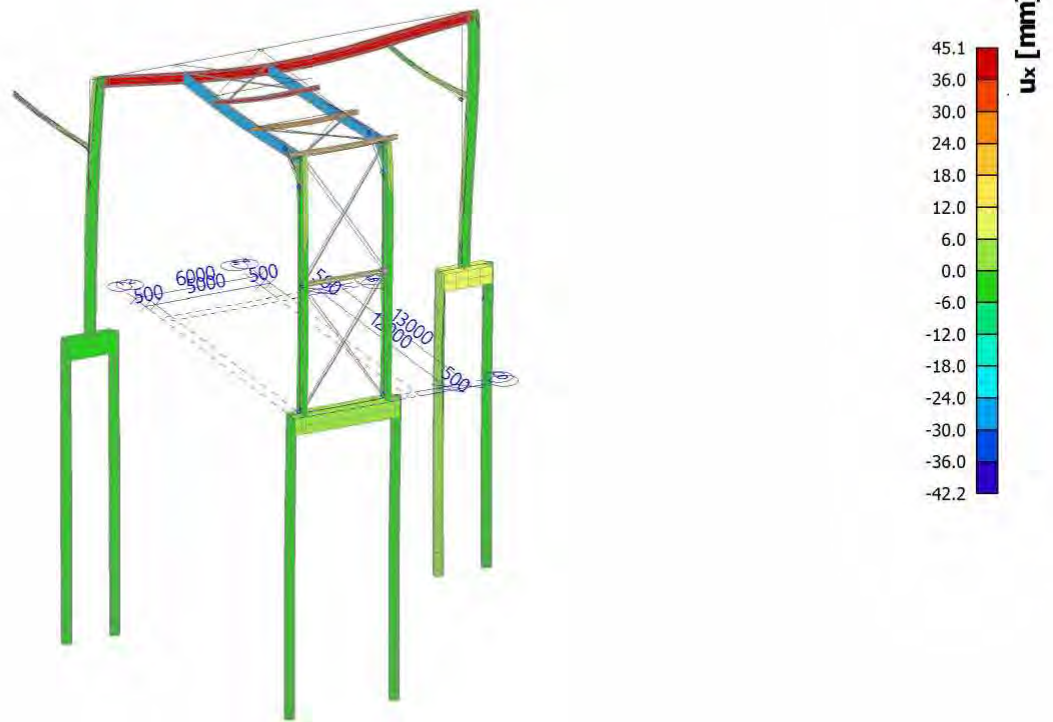
Waardes:  $u_x$

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Selectie: Alle

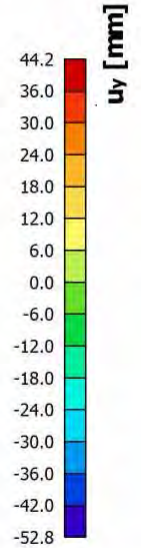
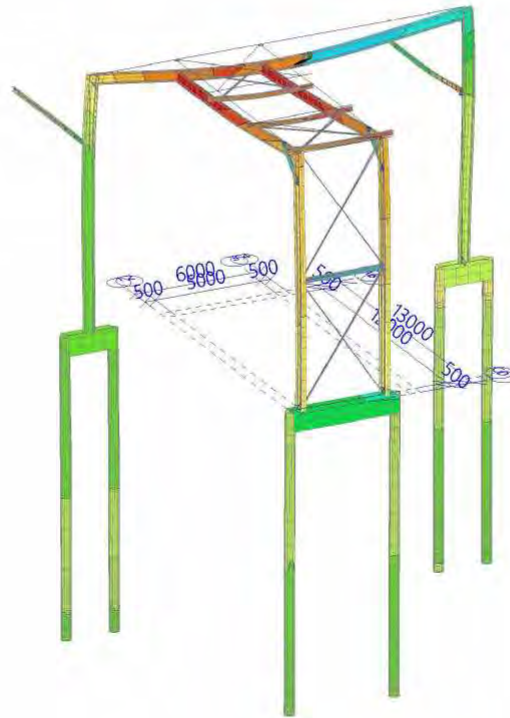
Locatie: In knooppunten gem. bij macro. Systeem: LCS net element





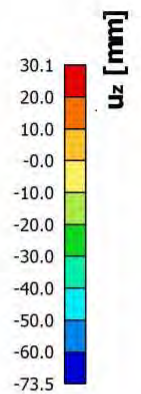
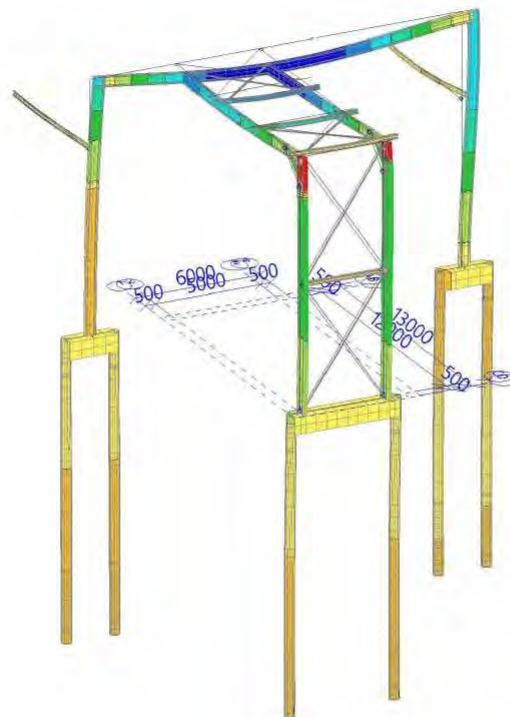
### 2.1.2.3. Resultaten - $u_y$

Waardes:  $u_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element



### 2.1.2.4. Resultaten - $u_z$

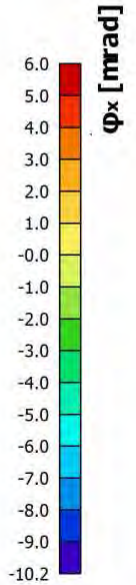
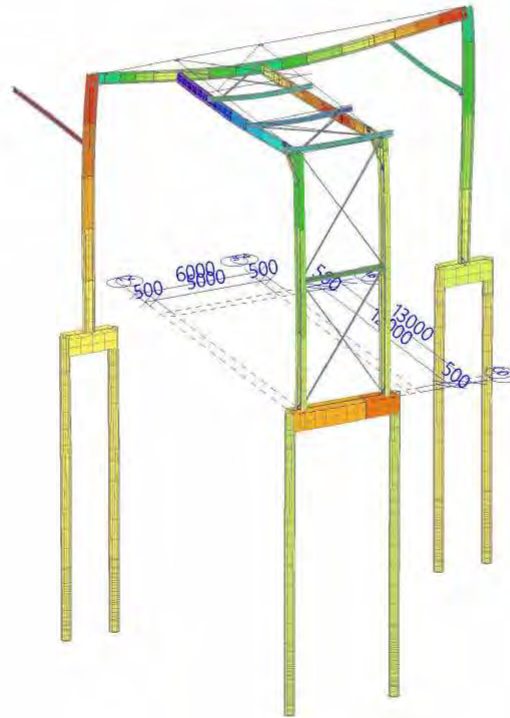
Waardes:  $u_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element





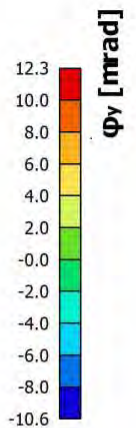
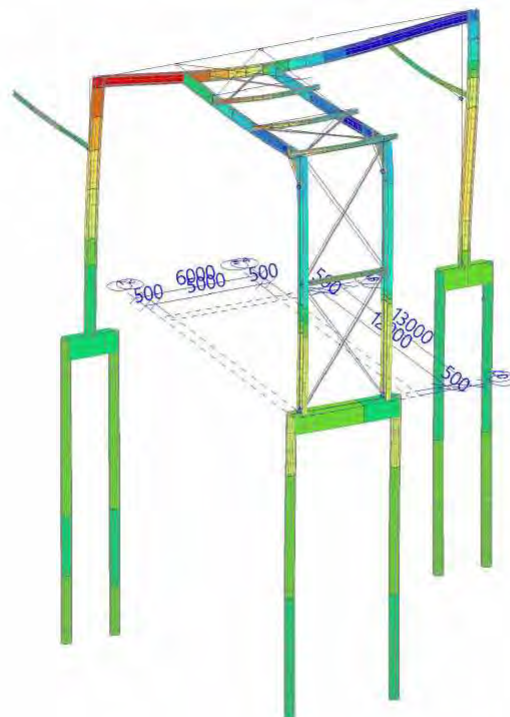
### 2.1.2.5. Resultaten - $\varphi_x$

Waardes:  $\varphi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element



### 2.1.2.6. Resultaten - $\varphi_y$

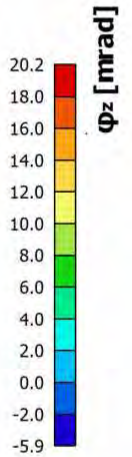
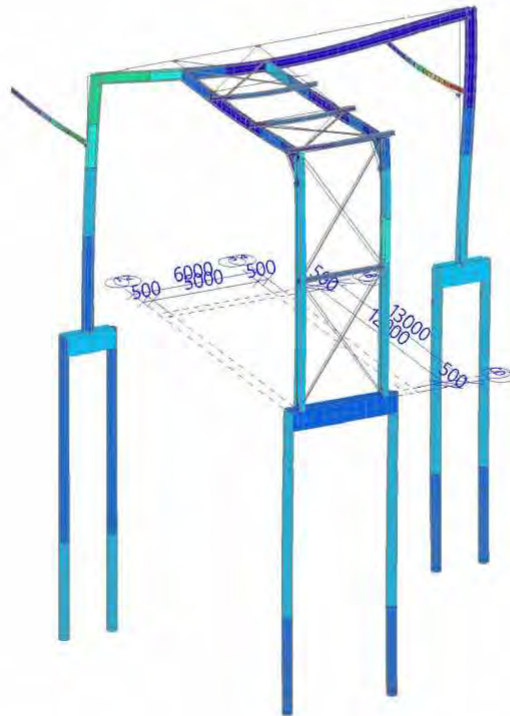
Waardes:  $\varphi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element





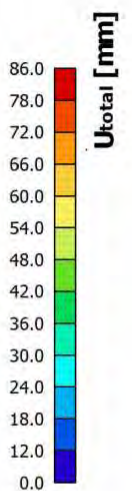
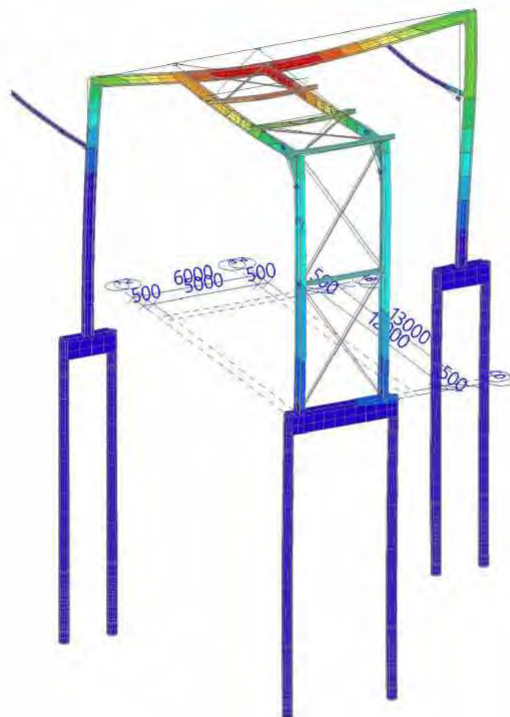
### 2.1.2.7. Resultaten - $\varphi_z$

Waardes:  $\varphi_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij macro. Systeem: LCS net element



### 2.1.2.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij macro. Systeem: LCS net element





## 2.1.3. 1D-ervormingen Algemeen

### 2.1.3.1. 1D-ervormingen

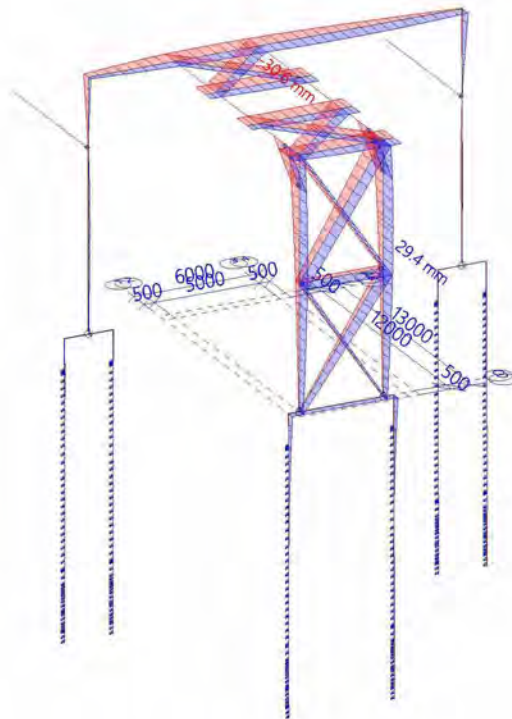
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle

#### Vervormingen

Naam	dx [mm]	Belasting	$u_x$ [mm]	$u_y$ [mm]	$u_z$ [mm]	$\phi_x$ [mrad]	$\phi_y$ [mrad]	$\phi_z$ [mrad]	$U_{total}$ [mm]
S17	4500.000-	NC_BGT-kar.1	<b>-30.6</b>	-0.1	-19.6	2.0	-4.9	0.0	36.3
S10	8115.000-	NC_BGT-kar.4	<b>29.4</b>	4.1	-0.9	-0.8	-0.1	-0.3	29.7
S41	3000.000	NC_BGT-kar.5	0.0	<b>-11.3</b>	-0.1	-3.4	-0.1	0.5	11.3
S11	9785.000-	NC_BGT-kar.5	4.3	<b>46.0</b>	-0.9	0.2	2.5	-1.1	46.2
S18	0.000	NC_BGT-kar.5	-22.9	20.1	<b>0.6</b>	-2.1	-5.1	-2.6	30.5
S15	1543.875	NC_BGT-kar.5	-15.2	42.0	-19.6	<b>-12.3</b>	-2.4	2.8	48.8
S15	14888.100	NC_BGT-kar.6	0.9	13.8	-29.4	<b>10.6</b>	0.6	-2.4	32.5
S13	8500.000	NC_BGT-kar.6	-16.7	8.0	-25.3	3.7	<b>-8.2</b>	-1.0	31.3
S11	11820.000	NC_BGT-kar.4	18.2	14.5	-0.9	6.9	<b>5.2</b>	2.7	23.3
S41	0.000	NC_BGT-kar.5	0.0	0.0	0.0	-3.4	0.1	<b>-5.9</b>	0.0
S41	7423.000	NC_BGT-kar.5	0.0	42.2	-0.8	-3.4	0.4	<b>20.2</b>	42.2
S34	0.000	NC_BGT-kar.5	-13.9	42.0	<b>-73.0</b>	0.0	0.0	0.0	85.4

### 2.1.3.2. Resultaten - $u_x$

Waardes:  $u_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle







Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
12/32

### 2.1.3.3. Resultaten - $u_y$

Waardes:  $u_y$

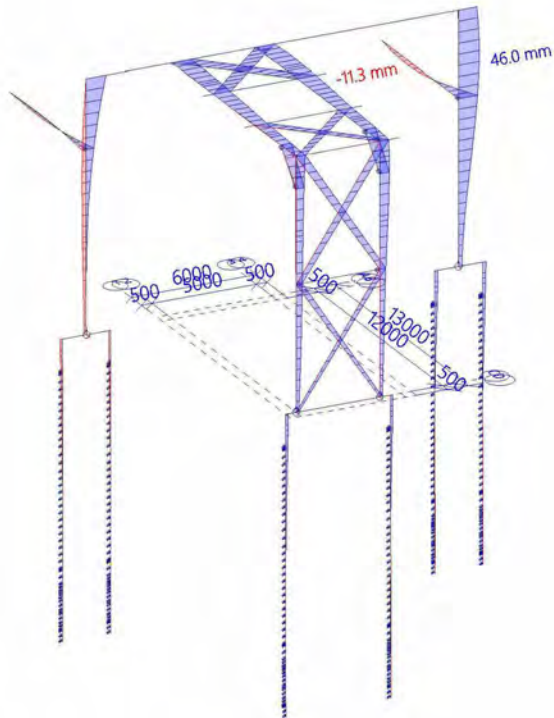
Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Globaal

Extreme 1D: Globaal

Selectie: Alle



### 2.1.3.4. Resultaten - $u_z$

Waardes:  $u_z$

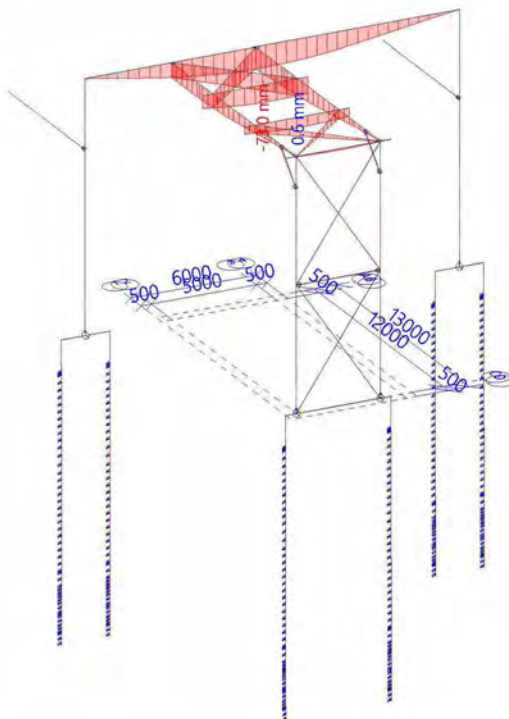
Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Globaal

Extreme 1D: Globaal

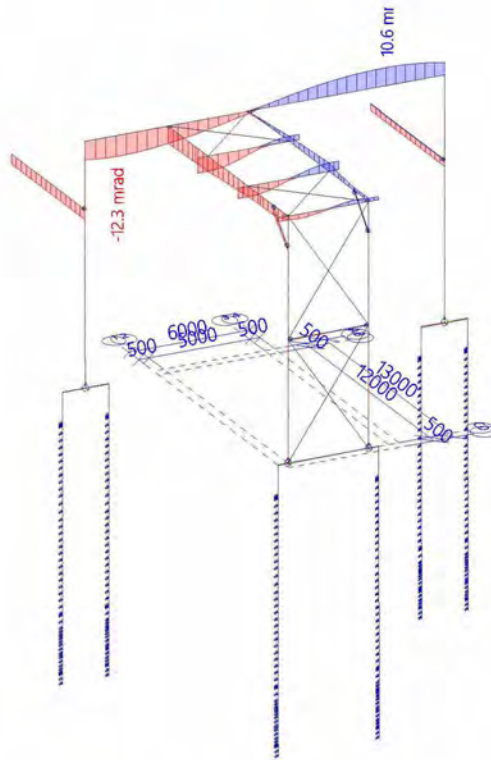
Selectie: Alle





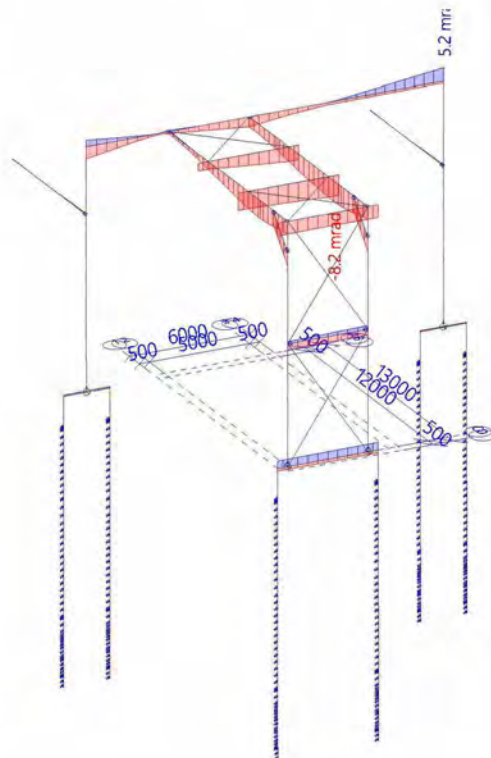
### 2.1.3.5. Resultaten - $\varphi_x$

Waardes:  $\varphi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle



### 2.1.3.6. Resultaten - $\varphi_y$

Waardes:  $\varphi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle





### 2.1.3.7. Resultaten - $\varphi_z$

Waardes:  $\varphi_z$

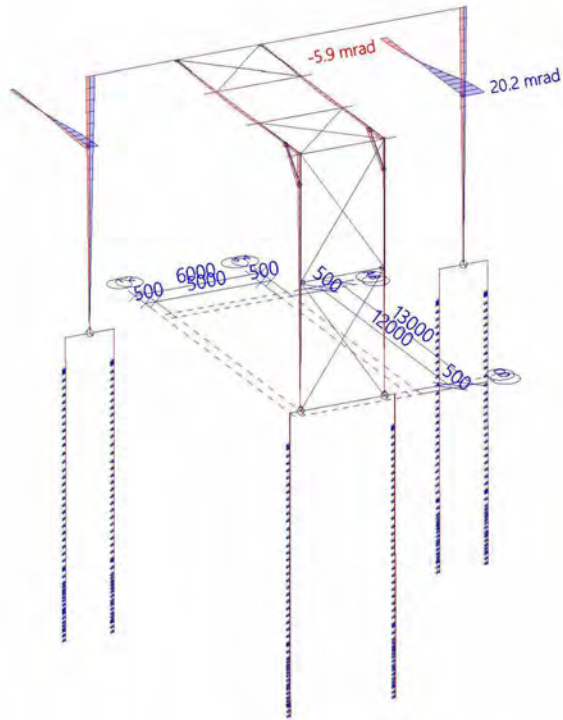
Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Globaal

Extreme 1D: Globaal

Selectie: Alle



### 2.1.3.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$

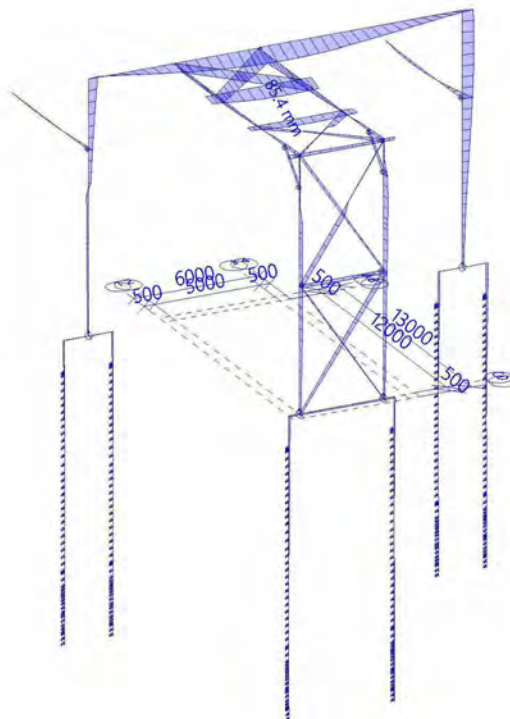
Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Globaal

Extreme 1D: Globaal

Selectie: Alle





## 2.2. Krachten

### 2.2.1. Reactiekrachten

#### 2.2.1.1. Reacties

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle  
**Knoopreacties**

Naam	Belasting	R <sub>x</sub> [kN]	R <sub>y</sub> [kN]	R <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [mm]	ε <sub>y</sub> [mm]
Sb2/S41	NC_UGT-Set B.11	<b>-21.91</b>	-1.30	1.51	0.00	0.00	0.00	0.0	0.0
Sb1/S40	NC_UGT-Set B.5	<b>13.49</b>	-0.57	1.82	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.0	0.0
Sb2/S41	NC_UGT-Set B.7	-8.08	<b>-2.16</b>	1.97	0.00	0.00	0.00	0.0	0.0
Sn8/K52	NC_UGT-Set B.7	0.00	<b>0.64</b>	0.49	0.00	0.00	0.00	0.0	0.0
Sn6/K50	NC_UGT-Set B.12	0.00	0.00	<b>-86.18</b>	0.00	0.00	0.00	0.0	0.0
Sn5/K49	NC_UGT-Set B.7	0.00	0.00	<b>461.60</b>	0.00	0.00	0.00	0.0	0.0

#### Lineaire intensiteit

Naam	dx [mm]	Belasting	R <sub>x</sub> [kN/m]	R <sub>y</sub> [kN/m]	R <sub>z</sub> [kN/m]	M <sub>x</sub> [kNm/m]	M <sub>y</sub> [kNm/m]	M <sub>z</sub> [kNm/m]
Slb3/S5	12500.000	NC_UGT-Set B.11	<b>-51.06</b>	-3.53	0.00	0.00	0.00	0.00
Slb65/S38	12500.000	NC_UGT-Set B.11	<b>4.00</b>	-23.37	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Slb65/S38	12500.000	NC_UGT-Set B.7	3.58	<b>-38.21</b>	0.00	0.00	0.00	0.00
Slb1/S7	12500.000	NC_UGT-Set B.14	-3.58	<b>19.26</b>	0.00	0.00	0.00	0.00

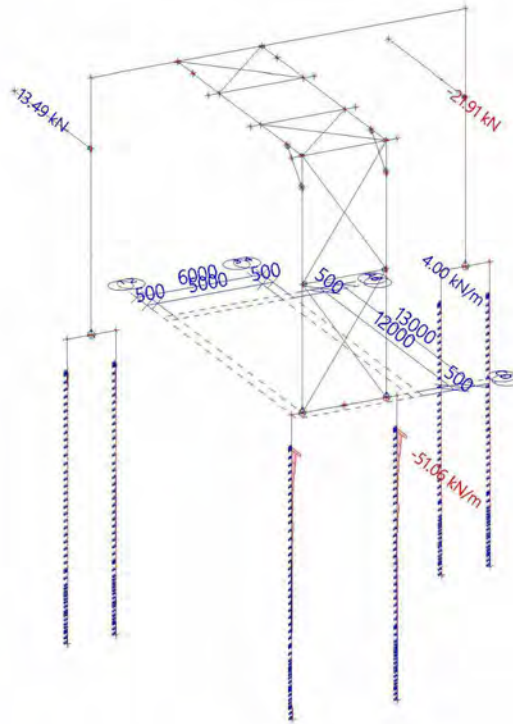
#### Reacties op lijnondersteuningen

Naam	dx [mm]	Belasting	R <sub>x</sub> [kN]	R <sub>y</sub> [kN]	R <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	e [mm]
Slb6/S5	11845.000	NC_UGT-Set B.6	<b>-9.84</b>	-0.92	0.00	0.00	0.00	0.00	0.0
Slb18/S5	6088.000	NC_UGT-Set B.11	<b>3.52</b>	-0.02	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.0
Slb66/S38	11845.000	NC_UGT-Set B.7	0.67	<b>-8.19</b>	0.00	0.00	0.00	0.00	0.0
Slb8/S7	11845.000	NC_UGT-Set B.14	-0.67	<b>4.17</b>	0.00	0.00	0.00	0.00	0.0



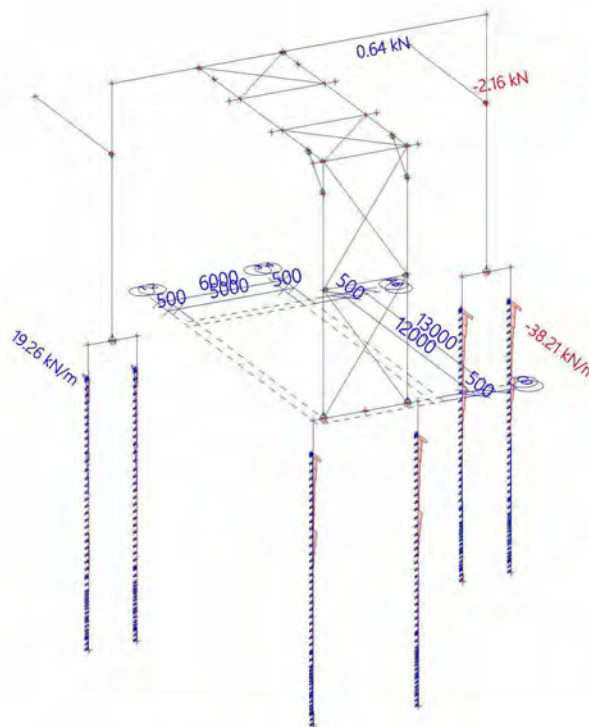
### 2.2.1.2. Resultaten - $R_x$

Waardes:  $R_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.3. Resultaten - $R_y$

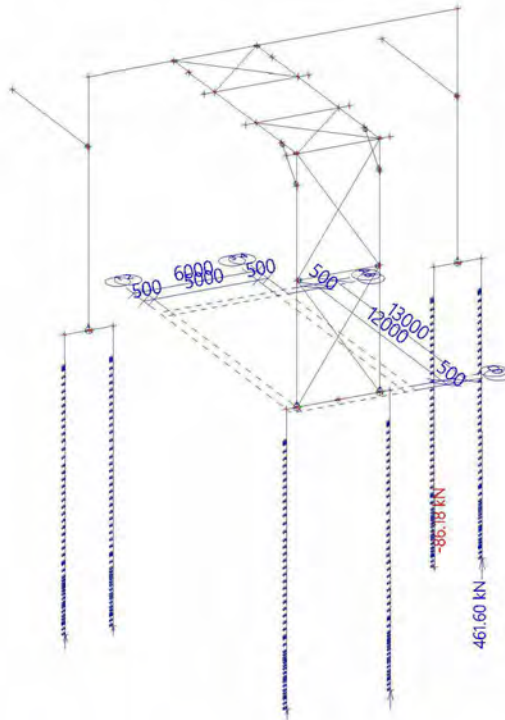
Waardes:  $R_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle





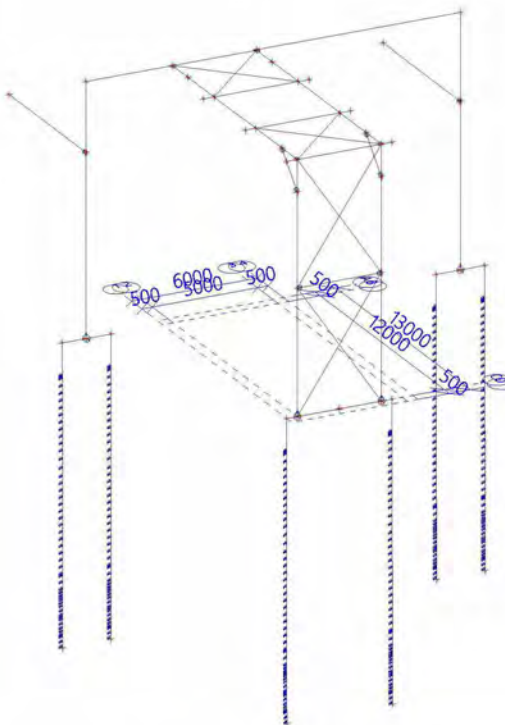
### 2.2.1.4. Resultaten - $R_z$

Waardes:  $R_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.5. Resultaten - $M_x$

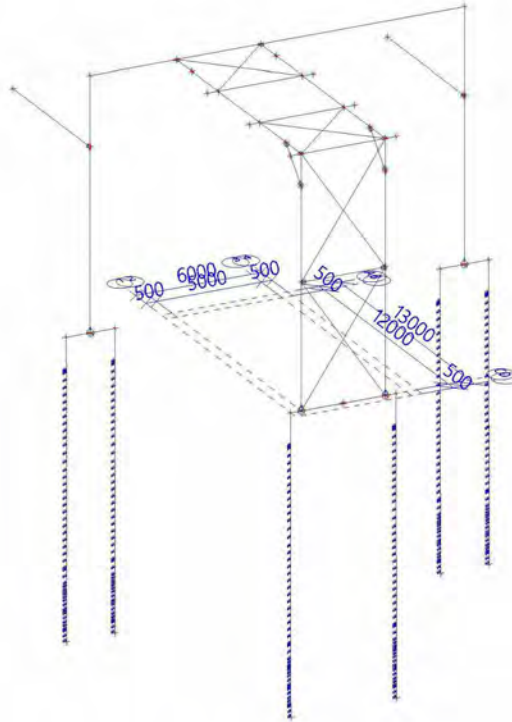
Waardes:  $M_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle





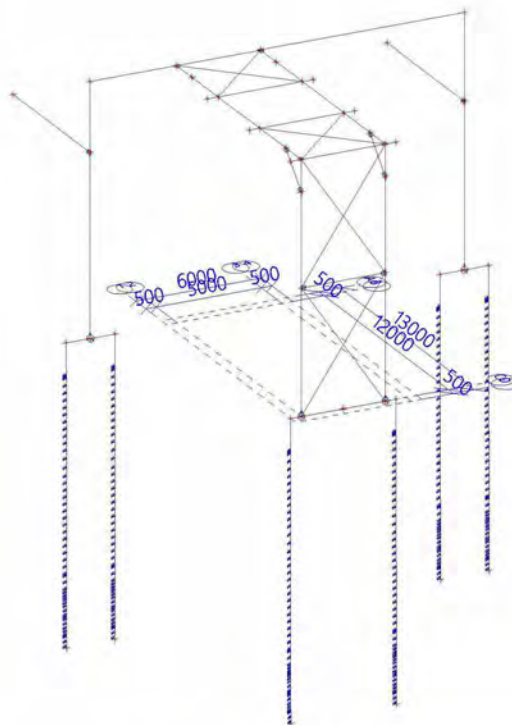
### 2.2.1.6. Resultaten - $M_y$

Waardes:  $M_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.7. Resultaten - $M_z$

Waardes:  $M_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle





## 2.2.2. Interne staafkrachten

### 2.2.2.1. Interne 1D-krachten

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle

Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S37	0.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>43.94</b>	-1.20	-135.82	3.68	77.08	-0.31
S2	5000.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.51	<b>-32.79</b>	-204.43	9.16	-15.79	-0.03
S2	0.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	1.93	<b>25.55</b>	153.11	-21.84	1.54	-0.03
S37	2300.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	-43.07	3.01	<b>-392.98</b>	-3.86	-82.89	0.33
S1	0.000	NC_UGT-Set B.14	BT-12 - Rechthoek (800; 800)	-24.20	1.01	<b>235.71</b>	-3.21	-46.08	0.14
S2	4500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	-3.02	-5.38	-132.87	<b>-35.61</b>	59.30	2.62
S2	0.000	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	0.06	3.95	121.50	<b>32.66</b>	-1.68	0.10
S37	1150.000-	NC_UGT-Set B.12	BT-12 - Rechthoek (800; 800)	40.66	-1.23	-153.81	3.72	<b>-96.86</b>	-1.70
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>-43.11</b>	3.00	-371.28	-3.85	<b>356.56</b>	<b>-3.13</b>
S2	4500.000+	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.52	-32.74	-195.00	9.13	84.06	<b>16.35</b>
S38	0.000	NC_UGT-Set B.7	BT-11 - Cirkel (460)	<b>-461.59</b>	-1.35	1.41	0.00	0.00	0.00
S39	14000.000	NC_UGT-Set B.12	BT-11 - Cirkel (460)	<b>137.68</b>	-40.26	-1.65	0.04	3.21	-86.99
S38	12500.000+	NC_UGT-Set B.7	BT-11 - Cirkel (460)	-400.14	<b>-44.81</b>	-1.78	0.02	5.43	-33.14
S7	12500.000+	NC_UGT-Set B.14	BT-11 - Cirkel (460)	-244.01	<b>23.65</b>	1.73	0.01	-5.43	20.36
S5	6984.000+	NC_UGT-Set B.11	BT-11 - Cirkel (460)	-196.51	0.59	<b>-15.77</b>	0.00	-29.11	2.87
S5	13500.000	NC_UGT-Set B.6	BT-11 - Cirkel (460)	-206.77	-6.16	<b>33.41</b>	-0.07	-13.16	-14.94
S5	14000.000	NC_UGT-Set B.12	BT-11 - Cirkel (460)	-323.20	-37.28	18.79	<b>-0.12</b>	26.12	-92.60
S5	14000.000	NC_UGT-Set B.5	BT-11 - Cirkel (460)	-270.72	-32.89	5.88	<b>0.09</b>	32.80	-81.70
S5	10573.333-	NC_UGT-Set B.11	BT-11 - Cirkel (460)	-186.36	-2.28	-5.36	-0.01	<b>-70.60</b>	-0.36
S5	14000.000	NC_UGT-Set B.14	BT-11 - Cirkel (460)	-228.15	-8.73	20.02	-0.02	<b>40.35</b>	-24.52
S38	14000.000	NC_UGT-Set B.7	BT-11 - Cirkel (460)	-392.85	-44.25	-1.83	0.05	2.72	<b>-100.02</b>
S7	14000.000	NC_UGT-Set	BT-11 -	-235.77	23.49	1.72	0.03	-2.85	<b>55.74</b>





Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
		B.14	Cirkel (460)						
S8	0.000	NC_UGT-Set B.14	ST-17 - HEA450	<b>-229.28</b>	3.12	-45.91	-0.12	116.74	-5.98
S15	0.000	NC_UGT-Set B.10	ST-17 - HEA450	<b>-2.97</b>	-7.80	66.34	-0.55	-70.48	0.61
S15	4117.000-	NC_UGT-Set B.7	ST-17 - HEA450	-27.56	<b>-10.90</b>	109.19	-0.78	321.25	-36.59
S8	8550.000+	NC_UGT-Set B.11	ST-17 - HEA450	-164.69	<b>13.29</b>	-30.71	0.75	-208.21	-35.50
S15	17790.000	NC_UGT-Set B.14	ST-17 - HEA450	-61.84	-3.54	<b>-195.06</b>	1.04	-483.80	-0.23
S15	0.000	NC_UGT-Set B.14	ST-17 - HEA450	-43.82	-7.29	<b>207.64</b>	-1.97	-409.38	3.00
S11	11820.000	NC_UGT-Set B.6	ST-17 - HEA450	-181.57	9.58	60.19	<b>-4.02</b>	469.45	4.29
S15	0.000	NC_UGT-Set B.11	ST-17 - HEA450	-30.20	10.34	160.70	<b>2.71</b>	-300.11	-1.14
S15	17790.000	NC_UGT-Set B.7	ST-17 - HEA450	-76.35	-4.80	-194.72	0.36	<b>-557.26</b>	-0.85
S11	11820.000	NC_UGT-Set B.7	ST-17 - HEA450	-194.48	5.38	76.93	-2.65	<b>574.36</b>	0.50
S11	7750.000-	NC_UGT-Set B.11	ST-17 - HEA450	-163.34	-9.30	54.66	-1.02	191.61	<b>-41.95</b>
S8	8550.000+	NC_UGT-Set B.5	ST-17 - HEA450	-98.13	-9.49	-6.86	-0.34	-102.87	<b>28.59</b>
S10	0.000	NC_UGT-Set B.7	ST-11 - IPE600	<b>-310.08</b>	-1.63	20.70	0.02	3.19	0.00
S10	11820.000	NC_UGT-Set B.11	ST-11 - IPE600	<b>34.74</b>	-2.25	-127.36	-0.10	56.64	-10.07
S10	5910.000+	NC_UGT-Set B.7	ST-11 - IPE600	-198.57	<b>-5.90</b>	20.14	0.34	124.29	6.45
S9	11820.000	NC_UGT-Set B.7	ST-11 - IPE600	1.29	<b>3.72</b>	-96.48	0.12	42.67	7.45
S10	0.000	NC_UGT-Set B.6	ST-11 - IPE600	-158.23	0.49	<b>33.91</b>	0.00	-29.83	0.01
S10	11820.000	NC_UGT-Set B.6	ST-11 - IPE600	33.01	-2.51	<b>-138.92</b>	<b>-0.12</b>	61.25	-11.40
S9	10320.000+	NC_UGT-Set B.7	ST-11 - IPE600	-0.99	2.31	-96.49	<b>0.37</b>	187.40	2.99
S10	0.000	NC_UGT-Set B.11	ST-11 - IPE600	-137.82	0.43	32.44	0.01	<b>-37.47</b>	0.01
S10	10320.000+	NC_UGT-Set B.6	ST-11 - IPE600	30.63	-2.45	-137.61	-0.11	<b>268.62</b>	-7.69
S10	11820.000	NC_UGT-Set B.14	ST-11 - IPE600	-0.73	-2.45	-116.38	-0.05	50.53	<b>-12.25</b>
S9	11820.000	NC_UGT-Set B.14	ST-11 - IPE600	-3.66	2.27	-95.57	0.08	40.40	<b>10.66</b>
S12	8000.000+	NC_UGT-Set B.7	ST-12 - IPE450	<b>-48.04</b>	-7.79	-62.10	-0.23	60.52	7.22
S13	12000.000	NC_UGT-Set B.6	ST-12 - IPE450	<b>118.53</b>	0.84	88.10	0.20	-88.32	-0.22
S13	8000.000+	NC_UGT-Set B.7	ST-12 - IPE450	-17.21	<b>-8.15</b>	-62.23	0.02	20.20	6.14
S13	10500.000-	NC_UGT-Set B.6	ST-12 - IPE450	-41.75	0.28	<b>-71.16</b>	0.63	-185.49	-1.08
S12	4000.000-	NC_UGT-Set B.7	ST-12 - IPE450	-45.74	6.34	28.26	<b>-0.49</b>	125.99	0.58
S13	10500.000-	NC_UGT-Set B.7	ST-12 - IPE450	-17.29	-0.11	-64.57	<b>0.69</b>	-138.36	-3.82
S13	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	118.24	0.71	<b>89.88</b>	0.56	<b>-221.72</b>	-1.11



Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S12	4000.000+	NC_UGT-Set B.14	ST-12 - IPE450	-18.03	1.40	-14.23	-0.26	<b>126.94</b>	-3.85
S12	2000.000	NC_UGT-Set B.7	ST-12 - IPE450	-45.69	0.11	30.19	-0.18	67.52	<b>-6.04</b>
S13	8000.000-	NC_UGT-Set B.7	ST-12 - IPE450	23.36	<b>8.71</b>	-22.17	-0.17	10.69	<b>9.10</b>
S23	3000.000	NC_UGT-Set B.7	ST-13 - HEA180	<b>-59.12</b>	0.00	-0.44	0.00	0.65	0.00
S16	500.000+	NC_UGT-Set B.14	ST-13 - HEA180	<b>1.62</b>	1.03	34.79	0.02	-1.72	0.44
S18	4500.000-	NC_UGT-Set B.11	ST-13 - HEA180	-30.89	<b>-3.09</b>	-29.90	0.01	-14.40	-0.30
S18	4500.000-	NC_UGT-Set B.14	ST-13 - HEA180	-30.50	-1.64	<b>-35.77</b>	0.00	-17.08	-0.11
S17	500.000+	NC_UGT-Set B.14	ST-13 - HEA180	-17.82	0.64	<b>35.41</b>	0.02	-4.13	0.40
S18	500.000+	NC_UGT-Set B.6	ST-13 - HEA180	-29.57	2.90	32.95	<b>0.06</b>	-14.52	-0.02
S18	4500.000-	NC_UGT-Set B.7	ST-13 - HEA180	-50.08	-1.70	-34.10	0.03	<b>-17.33</b>	-0.10
S16	2500.000-	NC_UGT-Set B.14	ST-13 - HEA180	-0.62	-0.56	-0.36	0.02	<b>32.74</b>	0.98
S16	500.000+	NC_UGT-Set B.11	ST-13 - HEA180	-2.08	<b>3.80</b>	29.50	<b>-0.02</b>	-2.47	<b>-3.40</b>
S18	2500.000-	NC_UGT-Set B.6	ST-13 - HEA180	-31.48	-0.07	-0.42	0.03	18.09	<b>2.96</b>
S22	0.000	NC_UGT-Set B.6	ST-14 - HEA120	<b>-227.36</b>	0.00	0.19	0.00	0.00	0.00
S21	2121.320	NC_UGT-Set B.2	ST-14 - HEA120	<b>-41.80</b>	0.00	-0.14	0.00	0.00	0.00
S21	2121.320	NC_UGT-Set B.14	ST-14 - HEA120	-152.18	<b>-0.01</b>	-0.21	-0.01	0.00	0.00
S22	2121.320	NC_UGT-Set B.8	ST-14 - HEA120	-183.02	<b>0.00</b>	-0.19	0.00	0.00	0.00
S22	2121.320	NC_UGT-Set B.14	ST-14 - HEA120	-191.47	0.00	<b>-0.21</b>	<b>0.01</b>	0.00	0.00
S22	0.000	NC_UGT-Set B.14	ST-14 - HEA120	-191.87	0.00	<b>0.21</b>	0.01	0.00	0.00
S21	2121.320	NC_UGT-Set B.6	ST-14 - HEA120	-185.46	0.00	-0.19	<b>-0.01</b>	0.00	0.00
S21	0.000	NC_UGT-Set B.7	ST-14 - HEA120	-154.09	0.00	0.19	-0.01	<b>0.00</b>	0.00
S22	1060.660	NC_UGT-Set B.14	ST-14 - HEA120	-191.67	0.00	0.00	0.01	<b>0.11</b>	0.00
S22	1590.990	NC_UGT-Set B.7	ST-14 - HEA120	-183.19	0.00	-0.10	0.00	0.08	<b>0.00</b>
S21	530.330	NC_UGT-Set B.7	ST-14 - HEA120	-154.00	0.00	0.09	-0.01	0.08	<b>0.00</b>
S25	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	<b>122.97</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
S25	0.000	NC_UGT-Set B.4	ST-15 - FLA80/10	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>
S35	0.000	NC_UGT-Set B.7	ST-16 - L60X6	<b>53.49</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
S33	0.000	NC_UGT-Set B.1	ST-16 - L60X6	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>
S40	2423.000-	NC_UGT-Set B.5	ST-18 - UNP200	<b>-13.49</b>	-0.43	-0.83	-0.01	-1.12	-1.13
S41	7423.000	NC_UGT-Set B.11	ST-18 - UNP200	<b>21.92</b>	-0.64	0.17	0.00	0.00	0.00
S41	5000.000+	NC_UGT-Set	ST-18 -	8.11	<b>-1.39</b>	0.93	-0.02	-1.35	3.20

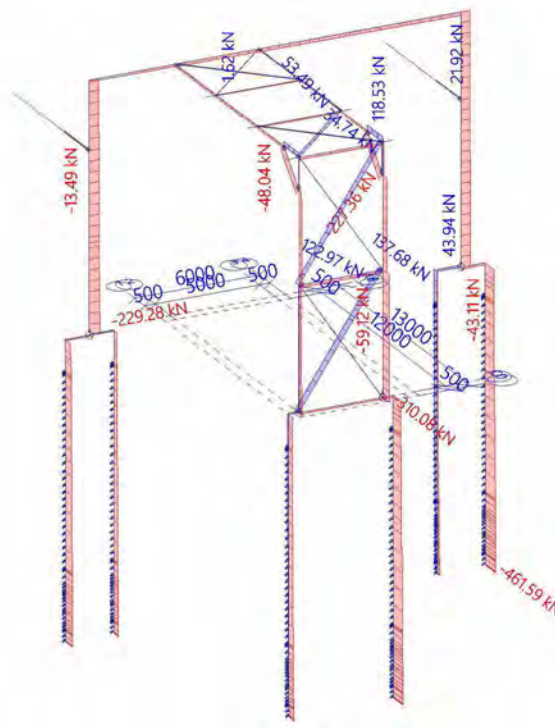


Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S41	5000.000-	B.7 NC_UGT-Set B.14	ST-18 - UNP200	0.00	0.35	-1.15	-0.01	-1.49	1.75
S40	2423.000+	B.14 NC_UGT-Set B.14	ST-18 - UNP200	0.00	-0.04	1.15	0.00	-1.48	0.23
S41	5000.000-	B.7 NC_UGT-Set B.7	ST-18 - UNP200	-0.01	0.64	-1.03	-0.02	-1.35	3.20
S40	2423.000+	B.1 NC_UGT-Set B.1	ST-18 - UNP200	0.00	-0.11	1.10	0.00	-1.23	0.56
S41	5000.000+	B.14 NC_UGT-Set B.14	ST-18 - UNP200	6.37	-0.75	1.03	-0.01	-1.49	1.75
S41	2000.000	B.1 NC_UGT-Set B.1	ST-18 - UNP200	0.00	0.11	-0.07	0.00	0.53	0.23
S40	2423.000+	B.12 NC_UGT-Set B.12	ST-18 - UNP200	0.00	0.33	0.79	-0.01	-1.08	-1.62

### 2.2.2.2. Resultaten - N

Waardes: **N**

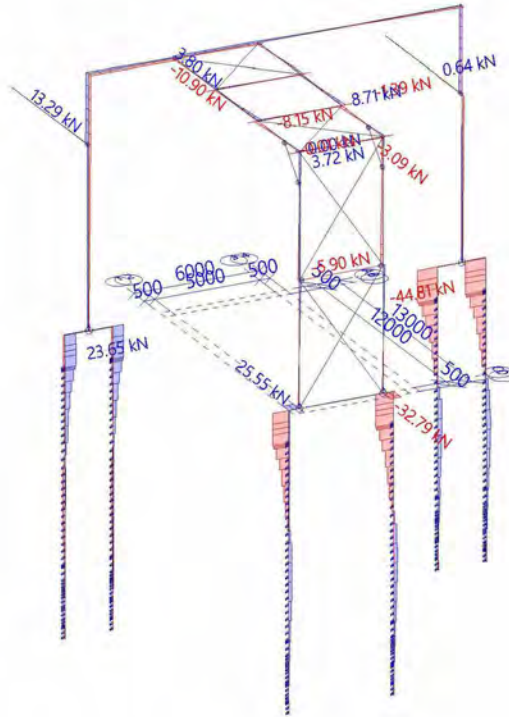
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





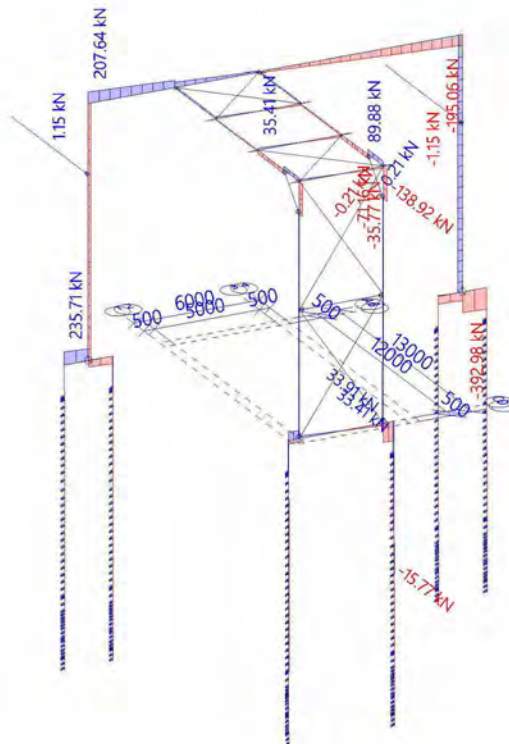
### 2.2.2.3. Resultaten - $V_y$

Waardes:  $V_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.2.4. Resultaten - $V_z$

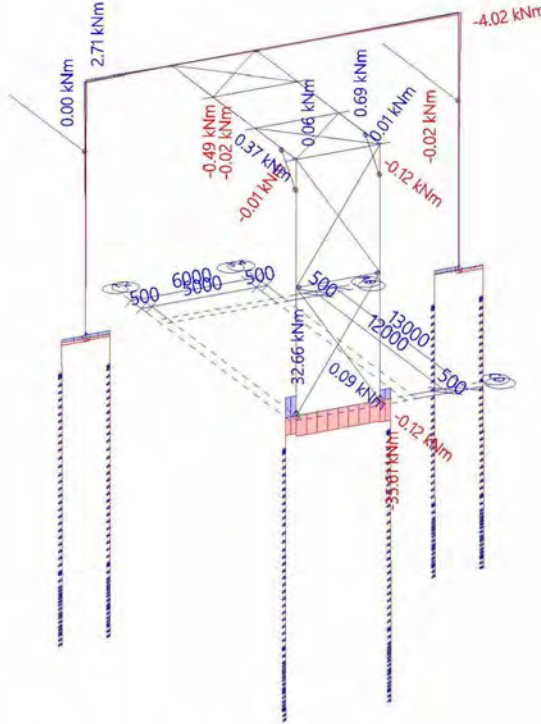
Waardes:  $V_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





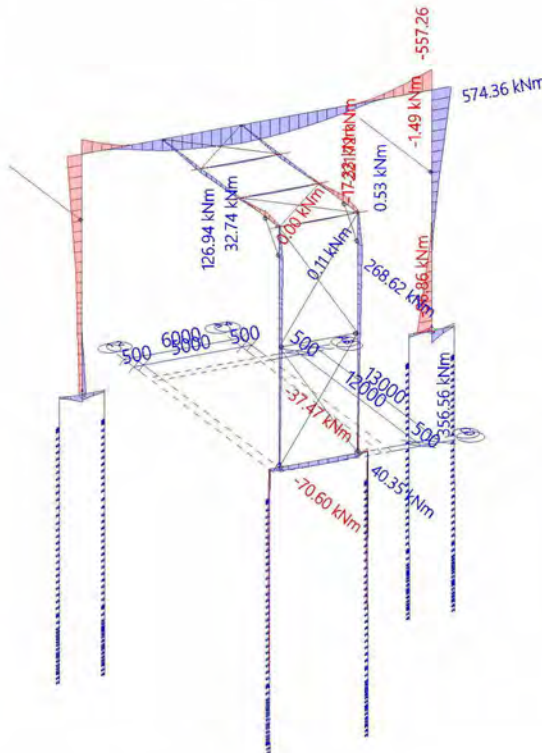
### 2.2.2.5. Resultaten - $M_x$

Waardes:  $M_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.2.6. Resultaten - $M_y$

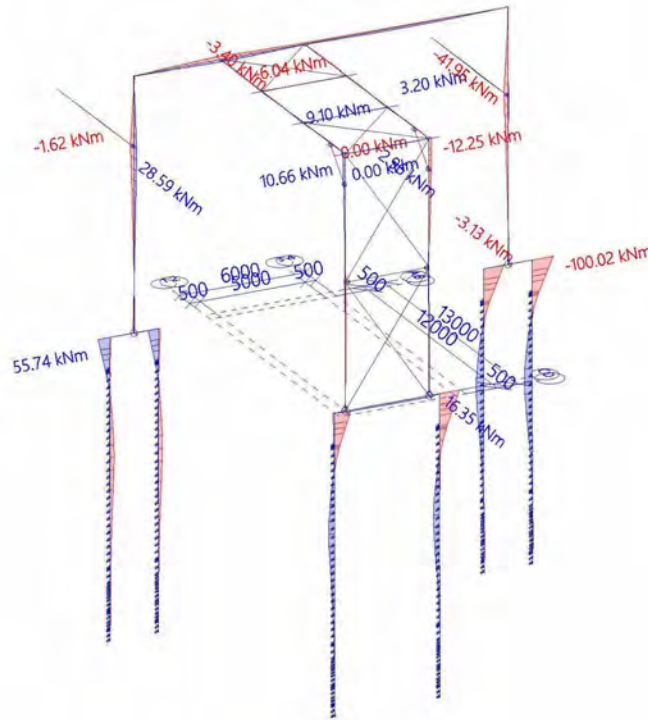
Waardes:  $M_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





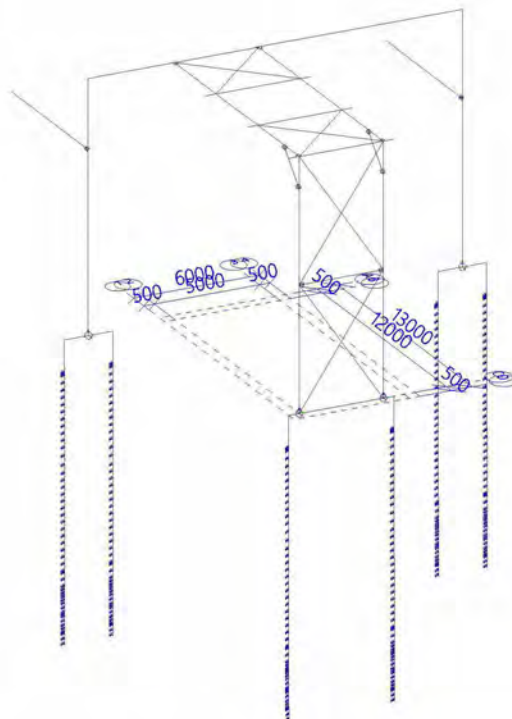
### 2.2.2.7. Resultaten - $M_z$

Waardes:  $M_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.2.8. Resultaten - $V_r$

Waardes:  $V_r$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





## 2.2.3. 3D stress

### 2.2.3.1. 3D spanning

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Selectie: Alle

Locatie: In knooppunten geen gem., Systeem: LCS net element

Hoofd grootheden

#### Resultaten op 1D-element

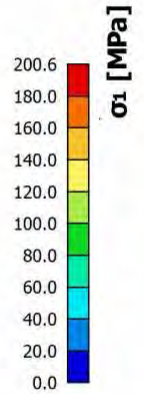
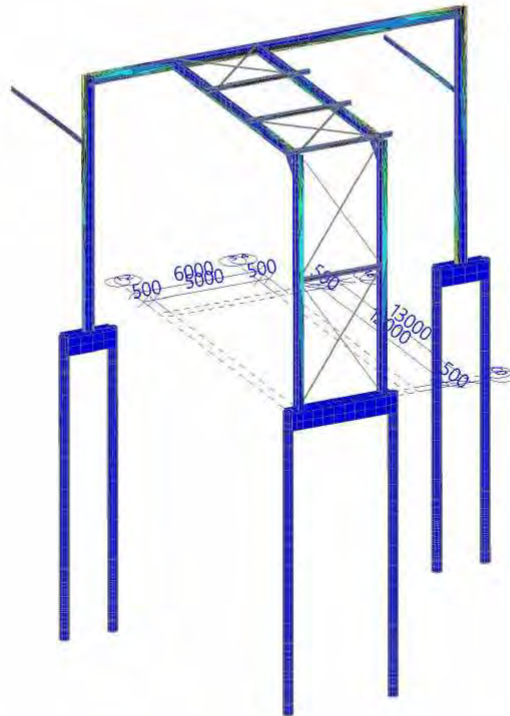
Extreme 1D: Doorsnede

Naam	dx [mm]	Vezel	Belasting	Doorsnede	$\sigma_1$ [MPa]	$\sigma_2$ [MPa]	$T_{tot}$ [MPa]	$\sigma_E$ [MPa]
S37	1150.000+	5	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	0.0	-4.3	0.0	<b>4.3</b>
S38	14000.000	16	NC_UGT-Set B.7	BT-11 - Cirkel (460)	0.0	-12.8	0.0	<b>12.8</b>
S11	11820.000	14	NC_UGT-Set B.7	ST-17 - HEA450	3.5	-212.6	27.4	<b>214.4</b>
S10	10320.000-	15	NC_UGT-Set B.6	ST-11 - IPE600	0.0	-120.8	1.3	<b>120.8</b>
S13	10500.000+	13	NC_UGT-Set B.6	ST-12 - IPE450	166.8	-0.9	12.2	<b>167.3</b>
S16	2500.000-	13	NC_UGT-Set B.14	ST-13 - HEA180	0.0	-121.1	1.3	<b>121.1</b>
S22	1060.660	15	NC_UGT-Set B.6	ST-14 - HEA120	0.0	-90.6	0.6	<b>90.6</b>
S25	7136.393	1	NC_UGT-Set B.7	ST-15 - FLA80/10	153.7	0.0	0.0	<b>153.7</b>
S35	0.000	1	NC_UGT-Set B.7	ST-16 - L60X6	77.4	0.0	0.0	<b>77.4</b>
S41	5000.000-	5	NC_UGT-Set B.7	ST-18 - UNP200	0.4	-126.3	6.7	<b>126.5</b>



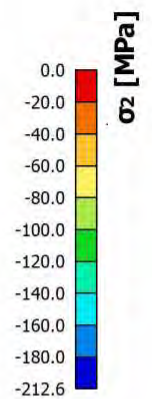
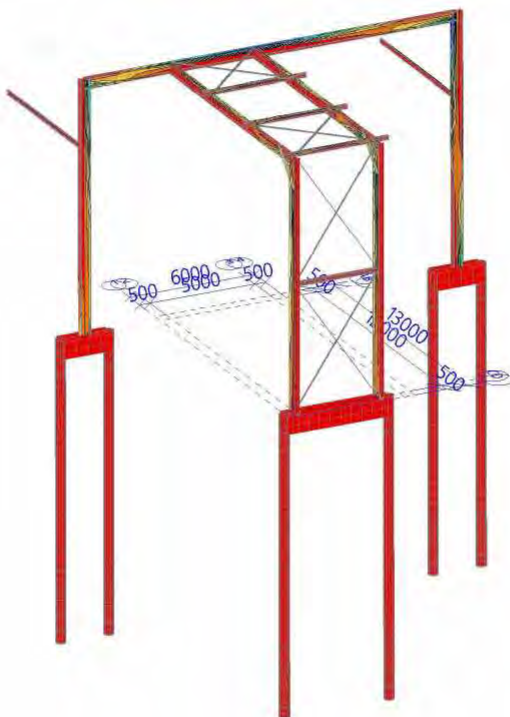
### 2.2.3.2. Resultaten - $\sigma_1$

Waardes:  $\sigma_1$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden



### 2.2.3.3. Resultaten - $\sigma_2$

Waardes:  $\sigma_2$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden

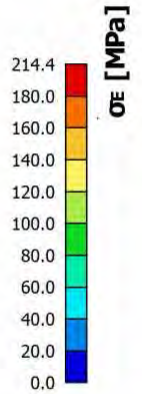
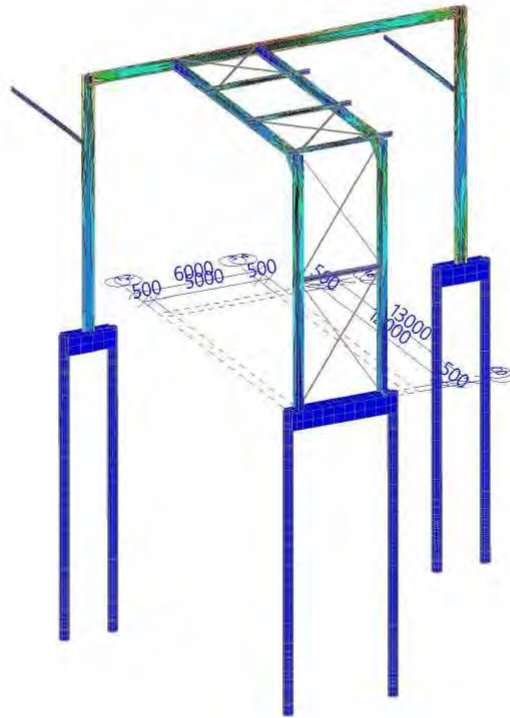






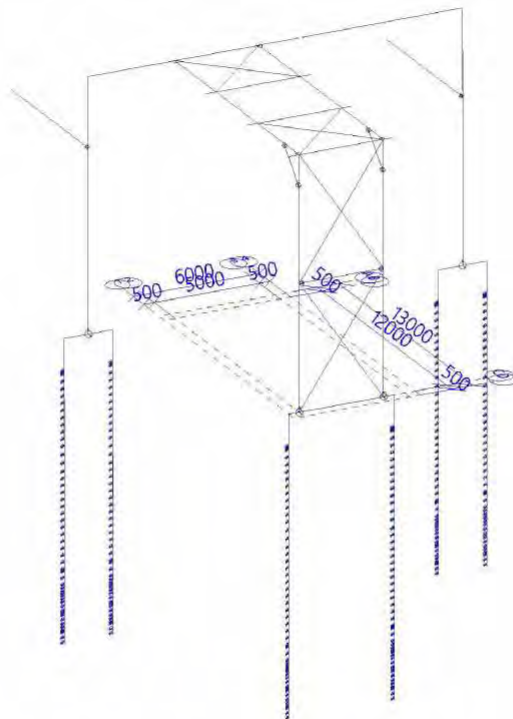
### 2.2.3.4. Resultaten - $\sigma_E$

Waardes:  $\sigma_E$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden



### 2.2.3.5. Resultaten - $\tau_{max,b}$ (2D)

Waardes:  $\tau_{max,b}$  (2D)  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

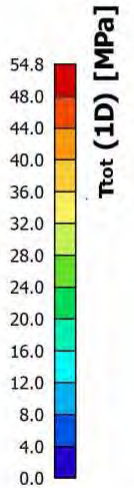
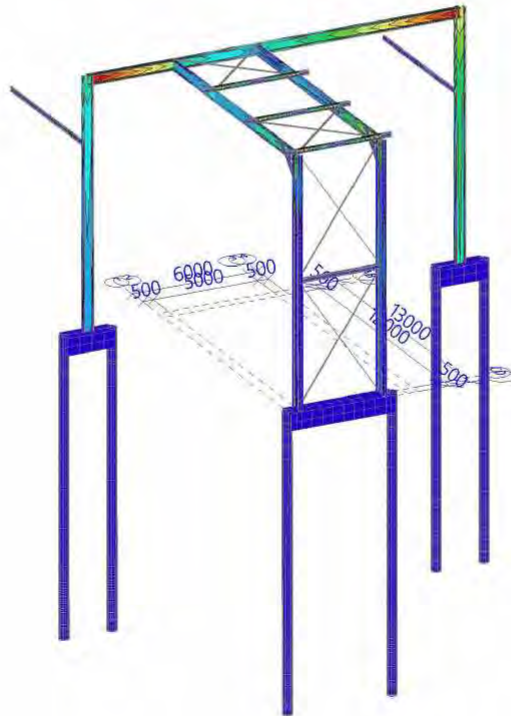
Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.6  
29/32

### 2.2.3.6. Resultaten - $\tau_{tot}$ (1D)

Waardes:  $\tau_{tot}$  (1D)

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden





## 2.2.4. 1D stress

### 2.2.4.1. 1D-spanningen

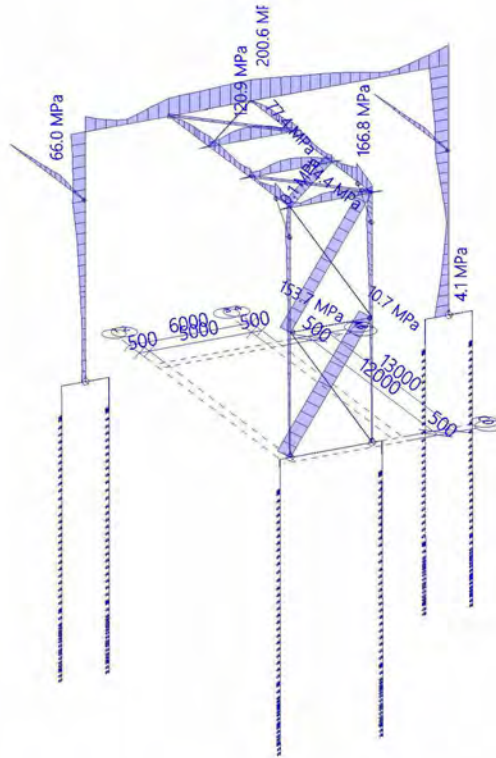
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle

Naam	dx [mm]	Vezel	Belasting	Doorsnede	$\sigma_1$ [MPa]	$\sigma_2$ [MPa]	T <sub>tot</sub> [MPa]	$\sigma_E$ [MPa]
S37	1150.000+	5	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	0.0	-4.3	0.0	<b>4.3</b>
S38	14000.000	16	NC_UGT-Set B.7	BT-11 - Cirkel (460)	0.0	-12.8	0.0	<b>12.8</b>
S11	11820.000	14	NC_UGT-Set B.7	ST-17 - HEA450	3.5	-212.6	27.4	<b>214.4</b>
S10	10320.000-	15	NC_UGT-Set B.6	ST-11 - IPE600	0.0	-120.8	1.3	<b>120.8</b>
S13	10500.000+	13	NC_UGT-Set B.6	ST-12 - IPE450	166.8	-0.9	12.2	<b>167.3</b>
S16	2500.000-	13	NC_UGT-Set B.14	ST-13 - HEA180	0.0	-121.1	1.3	<b>121.1</b>
S22	1060.660	15	NC_UGT-Set B.6	ST-14 - HEA120	0.0	-90.6	0.6	<b>90.6</b>
S25	7136.393	1	NC_UGT-Set B.7	ST-15 - FLA80/10	153.7	0.0	0.0	<b>153.7</b>
S35	0.000	1	NC_UGT-Set B.7	ST-16 - L60X6	77.4	0.0	0.0	<b>77.4</b>
S41	5000.000-	5	NC_UGT-Set B.7	ST-18 - UNP200	0.4	-126.3	6.7	<b>126.5</b>



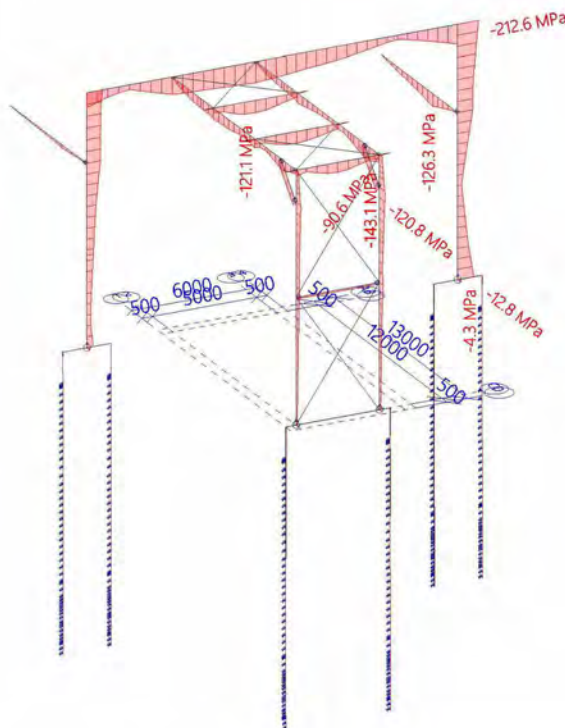
### 2.2.4.2. Resultaten - $\sigma_1$

Waardes:  $\sigma_1$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.4.3. Resultaten - $\sigma_2$

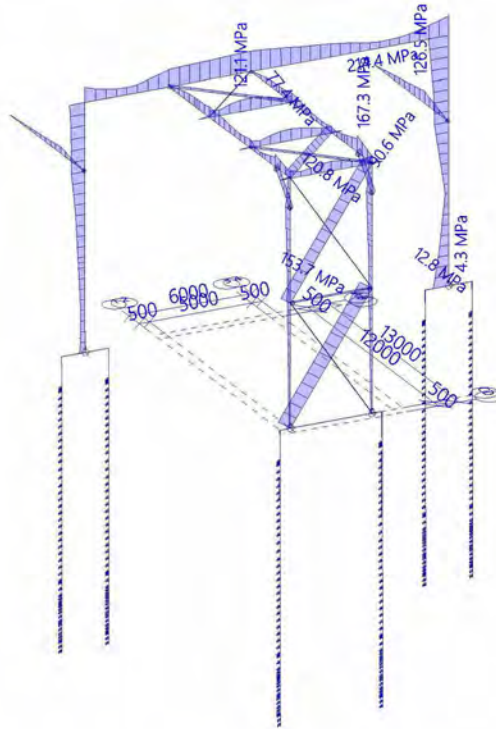
Waardes:  $\sigma_2$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





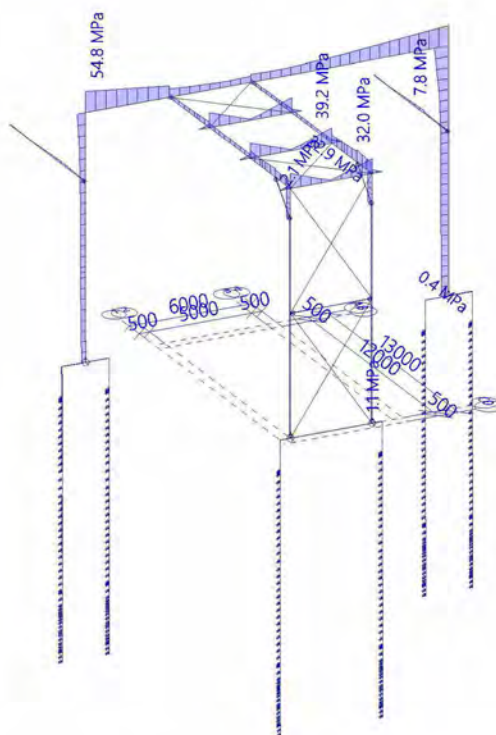
### 2.2.4.4. Resultaten - $\sigma_E$

Waardes:  $\sigma_E$   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle



### 2.2.4.5. Resultaten - $\tau_{tot}$

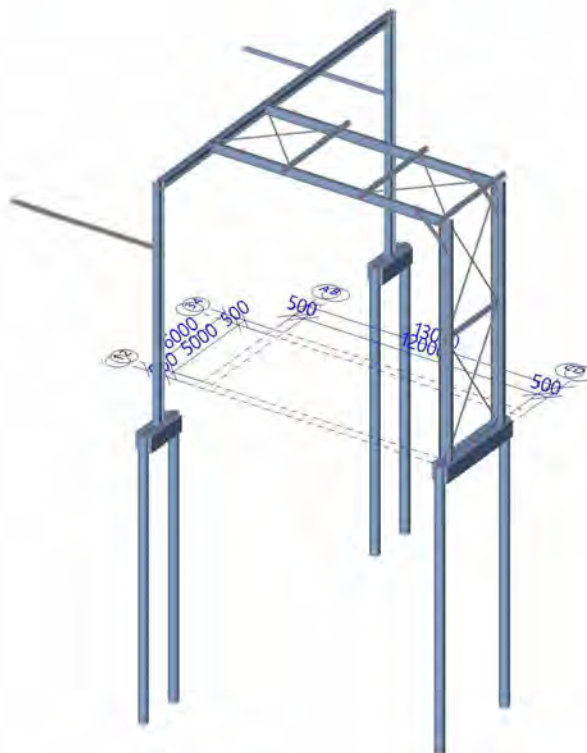
Waardes:  $\tau_{tot}$   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle





# Bijlage 3.

## Uitvoer Staalcontrole





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Staal	3
2.1. Slangheid staal	3
2.2. Iy	5
2.3. Iz	6
2.4. EC-EN 1993 UGT: staalcontrole	6
2.5. EC-EN 1993 UGT: staalcontrole	9
2.6. EC-EN 1993 BGT staalcontrole	33



## 2. Staal

### 2.1. Slankheid staal

Lineaire berekening

Staal	CS Naam	Onderdeel	Ongesch. y		L <sub>y</sub>	k <sub>y</sub>	l <sub>y</sub>	Lam y	l <sub>yz</sub>	I kip
			Ja	Nee	[mm]	[-]	[mm]	[-]	[mm]	
			Ongesch. z		L <sub>z</sub>	k <sub>z</sub>	l <sub>z</sub>	Lam z		
			Ja	Nee	[mm]	[-]	[mm]	[-]	[mm]	
S8	ST-17	1	Ja	Nee	11820.000	1.45	17163.403	90.73	8550.000	8550.000
			Nee	Ja	8550.000	0.58	4934.604	67.65		
S8	ST-17	2	Ja	Nee	11820.000	1.45	17163.403	90.73	3270.000	3270.000
			Nee	Ja	3270.000	0.86	2806.197	38.47		
S9	ST-11	1	Ja	Nee	10320.000	3.06	31619.955	130.15	5910.000	5910.000
			Nee	Ja	5910.000	0.85	5005.589	107.43		
S9	ST-11	2	Ja	Nee	10320.000	3.06	31619.955	130.15	5910.000	5910.000
			Nee	Ja	5910.000	0.72	4272.646	91.70		
S9	ST-11	3	Ja	Nee	1500.000	7.08	10625.702	43.74	5910.000	5910.000
			Nee	Ja	5910.000	0.72	4272.646	91.70		
S10	ST-11	1	Ja	Nee	10320.000	3.05	31427.763	129.36	5910.000	5910.000
			Nee	Ja	5910.000	0.85	5006.286	107.44		
S10	ST-11	2	Ja	Nee	10320.000	3.05	31427.763	129.36	5910.000	5910.000
			Nee	Ja	5910.000	0.72	4253.747	91.29		
S10	ST-11	3	Ja	Nee	1500.000	8.23	12338.969	50.79	5910.000	5910.000
			Nee	Ja	5910.000	0.72	4253.747	91.29		
S11	ST-17	1	Ja	Nee	11820.000	1.62	19147.516	101.22	7750.000	7750.000
			Nee	Ja	7750.000	0.61	4761.195	65.28		
S11	ST-17	2	Ja	Nee	11820.000	1.62	19147.516	101.22	4070.000	4070.000
			Nee	Ja	4070.000	0.78	3193.537	43.78		
S12	ST-12	1	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
			Nee	Ja	4000.000	0.78	3133.085	76.07		
S12	ST-12	2	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
			Nee	Ja	4000.000	0.78	3133.085	76.07		
S12	ST-12	3	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
			Nee	Ja	4000.000	0.54	2149.664	52.19		
S12	ST-12	4	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
			Nee	Ja	4000.000	0.77	3070.091	74.54		
S12	ST-12	5	Ja	Nee	1500.000	3.77	5648.894	30.57	4000.000	4000.000
			Nee	Ja	4000.000	0.77	3070.091	74.54		
S13	ST-12	1	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
			Nee	Ja	4000.000	0.79	3146.298	76.39		
S13	ST-12	2	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
			Nee	Ja	4000.000	0.79	3146.298	76.39		
S13	ST-12	3	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
			Nee	Ja	4000.000	0.54	2159.187	52.42		
S13	ST-12	4	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
			Nee	Ja	4000.000	0.77	3083.137	74.86		
S13	ST-12	5	Ja	Nee	1500.000	4.59	6884.252	37.25	4000.000	4000.000
			Nee	Ja	4000.000	0.77	3083.137	74.86		
S15	ST-17	1	Ja	Nee	17790.001	1.35	24031.170	127.03	4117.000	4117.000
			Nee	Ja	4117.000	0.87	3575.907	49.03		
S15	ST-17	2	Ja	Nee	17790.001	1.35	24031.170	127.03	4000.000	4000.000
			Nee	Ja	4000.000	0.75	2992.277	41.02		
S15	ST-17	3	Ja	Nee	17790.001	1.35	24031.170	127.03	9673.000	9673.000
			Nee	Ja	9673.000	0.81	7818.268	107.19		
S16	ST-13	1	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
			Nee	Ja	500.000	1.00	499.988	11.06		
S16	ST-13	2	Ja	Nee	5000.000	1.00	5000.000	67.17	4000.000	4000.000
			Nee	Ja	4000.000	0.55	2212.633	48.97		
S16	ST-13	3	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
			Nee	Ja	500.000	1.00	499.988	11.06		
S17	ST-13	1	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
			Nee	Ja	500.000	1.00	499.988	11.06		

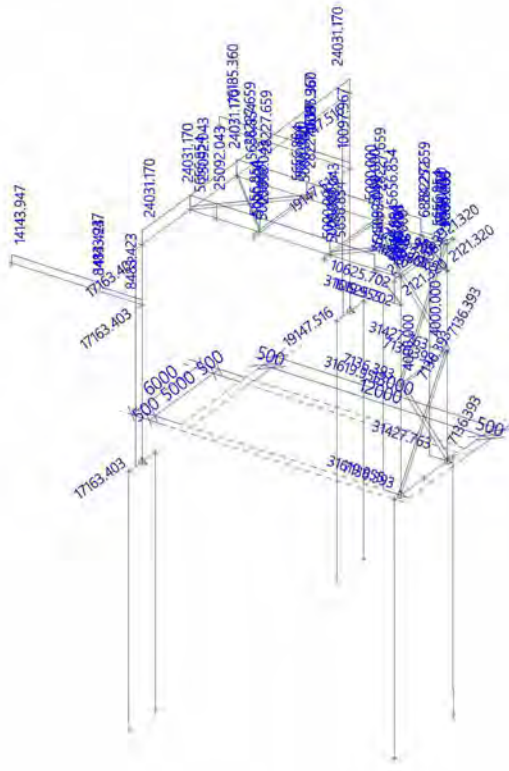




Staal	CS Naam	Onderdeel	Ongesch. y	ly	ky	ly	Lam y	lyz	I kip
				[mm]	[-]	[mm]	[-]	[mm]	
			Ongesch. z	Lz	kz	lz	Lam z		
				[mm]	[-]	[mm]	[-]		
S17	ST-13	2	Ja	5000.000	1.00	5000.000	67.17	4000.000	4000.000
			Nee	4000.000	0.52	2084.736	46.13		
S17	ST-13	3	Ja	5000.000	1.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S18	ST-13	1	Ja	5000.000	10.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S18	ST-13	2	Ja	4000.000	1.82	7284.203	97.86	4000.000	4000.000
			Nee	4000.000	0.99	3967.218	87.79		
S18	ST-13	3	Ja	500.000	10.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S21	ST-14	1	Ja	2121.320	1.00	2121.320	43.34	2121.320	2121.320
			Nee	2121.320	1.00	2121.267	70.20		
S22	ST-14	1	Ja	2121.320	1.00	2121.320	43.34	2121.320	2121.320
			Nee	2121.320	1.00	2121.267	70.20		
S23	ST-13	1	Ja	4000.000	1.00	4000.000	53.74	4000.000	4000.000
			Nee	4000.000	1.00	3999.900	88.52		
S25	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S26	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S27	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S28	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S33	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S34	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S35	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S36	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S40	ST-18	1	Ja	2423.000	3.50	8483.423	110.15	2423.000	2423.000
			Nee	2423.000	0.89	2158.816	100.70		
S40	ST-18	2	Ja	5000.000	2.83	14143.947	183.65	5000.000	5000.000
			Nee	5000.000	0.84	4210.659	196.40		
S41	ST-18	1	Ja	5000.000	3.24	16185.360	210.15	5000.000	5000.000
			Nee	5000.000	0.84	4210.456	196.39		
S41	ST-18	2	Ja	2423.000	4.17	10097.967	131.11	2423.000	2423.000
			Nee	2423.000	0.89	2158.719	100.69		

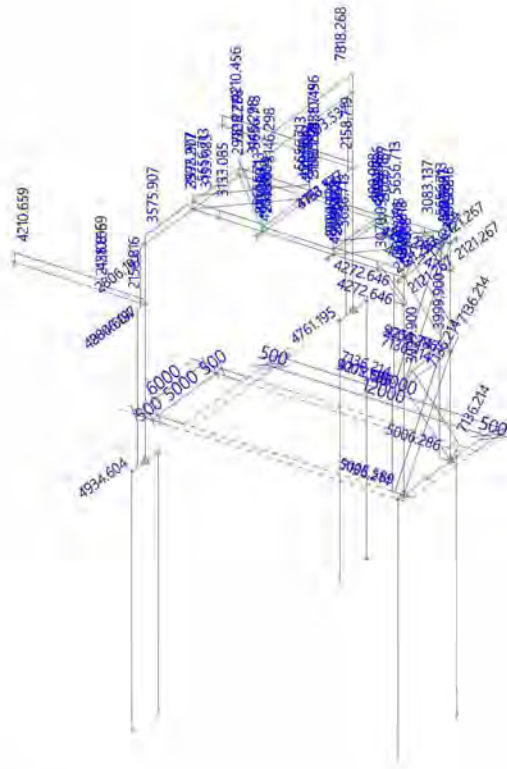


## 2.2. ly





## 2.3. IZ



## 2.4. EC-EN 1993 UGT: staalcontrole

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle

### Algehele eenheidscontrole

Naam	dx [mm]	Belasting	Doorsnede	Materiaal	Algehele eenh. controle [-]	Doorsnede controle [-]	Stab. controle [-]
S8	0.000	NC_UGT-Set B.14	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.67</b>	0.16	0.67
S9	5910.000+	NC_UGT-Set B.6	ST-11 - IPE600	S 235 JR (EN 10025-2)	<b>0.50</b>	0.19	0.50
S10	5910.000+	NC_UGT-Set B.6	ST-11 - IPE600	S 235 JR (EN 10025-2)	<b>0.70</b>	0.20	0.70
S11	0.000	NC_UGT-Set B.7	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.89</b>	0.57	0.89
S12	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	S 235 JR (EN 10025-2)	<b>0.49</b>	0.42	0.49
S13	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	S 235 JR (EN 10025-2)	<b>0.66</b>	0.55	0.66
S15	8117.000-	NC_UGT-Set B.7	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.78</b>	0.68	0.78
S16	3000.000	NC_UGT-Set B.14	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.50</b>	0.40	0.50
S17	3000.000	NC_UGT-Set B.14	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.50</b>	0.38	0.50
S18	4500.000-	NC_UGT-Set B.7	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.34</b>	0.23	0.34
S21	0.000	NC_UGT-Set B.6	ST-14 - HEA120	S 235 JR (EN 10025-2)	<b>0.45</b>	0.31	0.45
S22	0.000	NC_UGT-Set B.6	ST-14 - HEA120	S 235 JR (EN 10025-2)	<b>0.55</b>	0.38	0.55



Naam	dx [mm]	Belasting	Doorsnede	Materiaal	Algehele eenh. controle [-]	Doorsnede controle [-]	Stab. controle [-]
S23	3000.000	NC_UGT-Set B.7	ST-13 - HEA180	10025-2) S 235 JR (EN 10025-2)	0.10	0.06	0.10
S25	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.65	0.65	0.00
S26	7136.393	NC_UGT-Set B.9	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.02	0.02	0.00
S27	7136.393	NC_UGT-Set B.9	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.02	0.02	0.00
S28	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.52	0.52	0.00
S33	0.000	NC_UGT-Set B.12	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.22	0.22	0.00
S34	0.000	NC_UGT-Set B.1	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.03	0.03	0.00
S35	0.000	NC_UGT-Set B.7	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.33	0.33	0.00
S36	0.000	NC_UGT-Set B.6	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.21	0.21	0.00
S40	2423.000-	NC_UGT-Set B.12	ST-18 - UNP200	S 235 JR (EN 10025-2)	0.16	0.16	0.12
S41	5000.000+	NC_UGT-Set B.7	ST-18 - UNP200	S 235 JR (EN 10025-2)	0.30	0.30	0.00

## Resultaten - Gehele controle

Waardes: **Algehele eenh. controle**

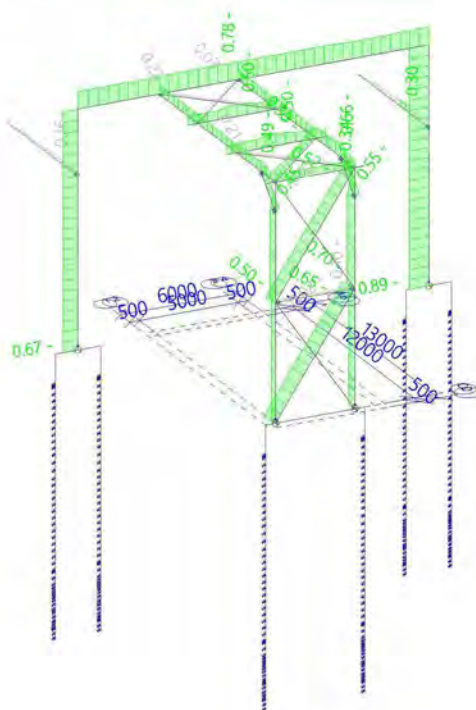
Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Hoofd

Extreme 1D: Element

Selectie: Alle





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

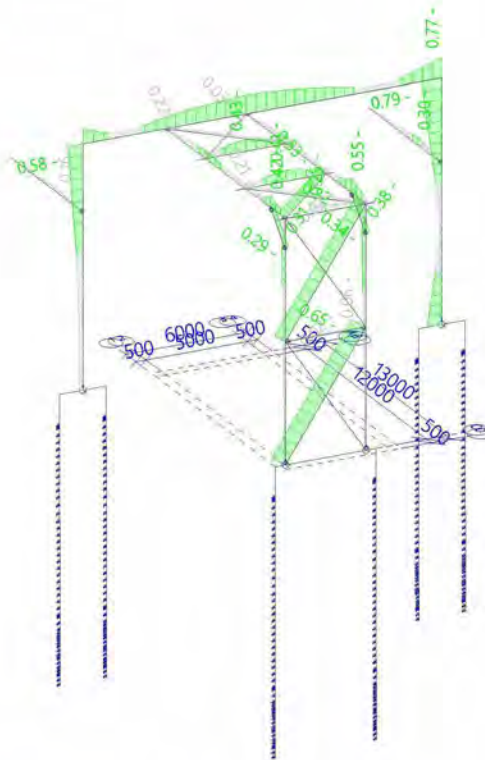
Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
8/39

## Resultaten - Doorsnedecontrole

Waardes: **Doorsnede controle**

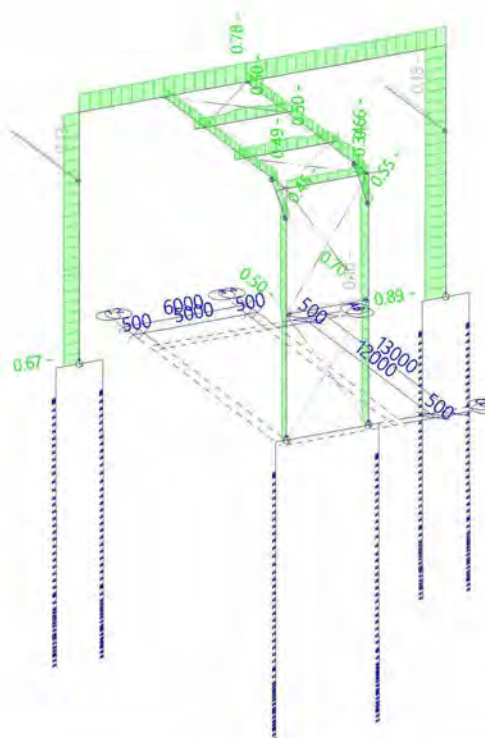
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - Stabiliteitscontrole

Waardes: **Stab. controle**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





## 2.5. EC-EN 1993 UGT: staalcontrole

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme ID: Doorsnede  
 Selectie: Alle

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S10	5.910 / 11.820 m	IPE600	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.70 -
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<b>Combinatiesleutel</b>
RK_NC_UGT-Set B / NC_UGT-Set B.6

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>			
Vloeisterkte $f_y$	225.0	MPa	
Treksterkte $f_u$	360.0	MPa	
Bouwwijze	Gewalst		

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 5.910 m

Interne krachten		Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-136.05	kN
Dwarskracht	$V_{y,Ed}$	-2.39	kN
Dwarskracht	$V_{z,Ed}$	28.23	kN
Torsie	$T_{Ed}$	0.18	kNm
Buigend moment	$M_{y,Ed}$	154.23	kNm
Buigend moment	$M_{z,Ed}$	2.63	kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	80	19	-4.226e+04	-4.848e+04								
3	SO	80	19	-3.759e+04	-3.137e+04								
4	I	514	12	-3.432e+04	5.176e+04	-0.66		0.55	42.83	63.76	74.32	91.82	1
5	SO	80	19	5.970e+04	6.592e+04	0.91	0.44	1.00	4.21	9.20	10.22	14.19	1
7	SO	80	19	5.503e+04	4.881e+04	0.89	0.47	1.00	4.21	9.20	10.22	14.73	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.  
 De doorsnede is geclassificeerd als klasse 1

### Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	1.5600e-02	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	3510.00	kN
Eenheidscontrole		0.04	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.5120e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	790.20	kNm
Eenheidscontrole		0.20	-



### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	4.8600e-04	$m^3$
Plastisch buigend moment	$M_{pl,z,Rd}$	109.35	kNm
Eenheidscontrole		0.02	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	8.7920e-03	$m^2$
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	1142.11	kN
Eenheidscontrole		0.00	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	8.3800e-03	$m^2$
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	1088.59	kN
Eenheidscontrole		0.03	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	15	
Totaal torsiemoment	$T_{Ed}$	2.0	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	129.9	MPa
Eenheidscontrole		0.02	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	790.20	kNm
Exponent van buigingsratio $y$	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	109.35	kNm
Exponent van buigingsratio $z$	$\beta$	1.00	

Eenheidscontrole (6.41) =  $0.04 + 0.02 = 0.06$  -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

.....**STABILITEITSCONTROLE**.....

### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 0.985 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2



Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	80	19	8.623e+03	7.449e+03	0.86	0.48	1.00	4.21	9.20	10.22	14.87	1
3	SO	80	19	9.504e+03	1.068e+04	0.89	0.44	1.00	4.21	9.20	10.22	14.21	1
4	I	514	12	9.177e+03	1.092e+04	0.84		1.00	42.83	28.62	34.74	41.11	4
5	SO	80	19	1.148e+04	1.265e+04	0.91	0.44	1.00	4.21	9.20	10.22	14.19	1
7	SO	80	19	1.060e+04	9.421e+03	0.89	0.47	1.00	4.21	9.20	10.22	14.72	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 4

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

### Effectieve doorsnede N-

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_w$ [mm]	$b_{w1}$ [mm]	$b_{w2}$ [mm]
1	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
3	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
4	I	514	2.250e+05	2.250e+05	1.00	4.00	0.74	0.95	489	244	244
5	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
7	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		

### Effectieve doorsnede My+

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_e$ [mm]	$b_{e1}$ [mm]	$b_{e2}$ [mm]
1	SO	80	-2.250e+05	-2.250e+05							
3	SO	80	-2.250e+05	-2.250e+05							
4	I	514	1.991e+05	-1.991e+05	-1.00	23.90	0.30	1.00	257	103	154
5	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
7	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		

### Effectieve doorsnede Mz+

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_e$ [mm]	$b_{e1}$ [mm]	$b_{e2}$ [mm]
1	SO	80	-6.136e+04	-2.250e+05							
3	SO	80	2.250e+05	6.136e+04	0.27	0.52	0.20	1.00	80		
4	I	514	0.000e+00	0.000e+00							
5	SO	80	2.250e+05	6.136e+04	0.27	0.52	0.20	1.00	80		
7	SO	80	-6.136e+04	-2.250e+05							

### Effectieve eigenschappen

Effectieve oppervlakte	$A_{eff}$	1.5300e-02	m <sup>2</sup>				
Effectieve traagheidsmoment	$I_{eff,y}$	9.2100e-04	m <sup>4</sup>	$I_{eff,z}$	3.3874e-05	m <sup>4</sup>	
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>	$W_{eff,z}$	3.0795e-04	m <sup>3</sup>	
Verschuiving van het zwaartepunt	$e_{N,y}$	0	mm	$e_{N,z}$	0	mm	

### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)





Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	10.320	5.910	m
Knikfactor	k	3.05	0.72	
Kniklengte	$l_{cr}$	31.428	4.254	m
Kritische Euler last	$N_{cr}$	1932.22	3879.64	kN
Slankeheid	$\lambda$	129.36	91.29	
Relatieve slankeheid	$\lambda_{rel}$	1.33	0.94	
Limietlankeheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		a	b	
Imperfectie	$\alpha$	0.21	0.34	
Reductie factor	$\chi$	0.45	0.63	
Knikweerstand	$N_{b,Rd}$	1553.52	2183.05	kN

Buigingsknikverificatie			
Effectieve oppervlakte van de doorsnede	$A_{eff}$	1.5300e-02	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	1553.52	kN
Eenheidscontrole		0.09	-

### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	938.34	kNm
Relatieve slankeheid	$\lambda_{rel,LT}$	0.86	
Limietlankeheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		c	
Imperfectie	$\alpha_{LT}$	0.49	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.73	
Correctiefactor	$k_c$	0.91	
Correctiefactor	f	0.96	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.76	
Rekenwaarde knikweerstand	$M_{b,Rd}$	525.52	kNm
Eenheidscontrole		0.29	-

M <sub>cr</sub> parameters			
LTB lengte	$l_{LT}$	5.910	m
Vorklengte	$L_g$	5.910	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	858.55	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	C	5.70	
Factor	S	2118	mm
Kip moment factor	$C_1$	1.20	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Effectieve oppervlakte van de doorsnede	$A_{eff}$	1.5300e-02	m <sup>2</sup>
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>
Effectieve doorsnedemodulus	$W_{eff,z}$	3.0795e-04	m <sup>3</sup>



Buig- en axiale drukcontrole parameters			
Ontwerpdrukkracht	$N_{Ed}$	136.05	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	268.62	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	-11.40	kNm
Additioneel moment	$\Delta M_{y,Ed}$	0.00	kNm
Additioneel moment	$\Delta M_{z,Ed}$	0.00	kNm
Karakteristieke drukweerstand	$N_{Rk}$	3442.39	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	690.75	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	69.29	kNm
Reductie factor	$\chi_y$	0.45	
Reductie factor	$\chi_z$	0.63	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.76	
Interactiefactor	$k_{yy}$	0.95	
Interactiefactor	$k_{yz}$	0.77	
Interactiefactor	$k_{zy}$	1.00	
Interactiefactor	$k_{zz}$	0.77	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S10 positie 10.320 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S10 positie 11.820 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.2	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalent moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		puntlast F	
Uiteinde moment	$M_{h,z}$	-11.40	kNm
Veldmoment	$M_{s,z}$	-7.69	kNm
Factor	$\alpha_{s,z}$	0.67	
Ratio van uiteinde momenten	$\psi_z$	-0.23	
Equivalent moment factor	$C_{mz}$	0.74	
Resultierend belastingtype LT		puntlast F	
Uiteinde moment	$M_{h,LT}$	154.23	kNm
Veldmoment	$M_{s,LT}$	268.62	kNm
Factor	$\alpha_{h,LT}$	0.57	
Ratio van uiteinde momenten	$\psi_{LT}$	0.40	
Equivalent moment factor	$C_{mLT}$	0.96	

Eenheidscontrole (6.61) =  $0.09 + 0.48 + 0.13 = 0.70 -$

Eenheidscontrole (6.62) =  $0.06 + 0.51 + 0.13 = 0.70 -$

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	11.820	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	562	mm
Lijfdikte	t	12	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

Plooverificatie		
Lijf slankheid	$h_w/t$	46.83
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S11	0.000 / 11.820 m	HEA450	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.89 -
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**Combinatiesleutel**  
RK\_NC\_UGT-Set B / NC\_UGT-Set B.7

Partiële veiligheidsfactoren	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

Materiaal			
Vloei sterkte	$f_y$	225.0	MPa
Trek sterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 0.000 m

Interne krachten		Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-213.51	kN
Dwarskracht	$V_{y,Ed}$	-3.56	kN
Dwarskracht	$V_{z,Ed}$	87.68	kN
Torsie	$T_{Ed}$	-0.17	kNm
Buigend moment	$M_{y,Ed}$	-413.41	kNm
Buigend moment	$M_{z,Ed}$	5.90	kNm

**Classificatie voor doorsnede-ontwerp**

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\sigma$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	117	21	1.458e+05	1.385e+05	0.95	0.45	1.00	5.58	9.20	10.22	14.37	1
3	SO	117	21	1.499e+05	1.572e+05	0.95	0.43	1.00	5.58	9.20	10.22	14.13	1
4	I	344	12	1.236e+05	-9.958e+04	-0.81		0.62	29.91	53.44	63.03	104.02	1
5	SO	117	21	-1.219e+05	-1.146e+05								
7	SO	117	21	-1.259e+05	-1.332e+05								

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Drukcontrole**

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	4005.00	kN
Eenheidscontrole		0.05	-

**Controle buigend moment voor  $M_y$**

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.2167e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	723.75	kNm
Eenheidscontrole		0.57	-

**Controle buigend moment voor  $M_z$**

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	9.6667e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	217.50	kNm
Eenheidscontrole		0.03	-

**Dwarskrachtcontrole voor  $V_y$**

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)



Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.3043e-02	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	1694.30	kN
Eenheidscontrole		0.00	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	6.5755e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	854.18	kN
Eenheidscontrole		0.10	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	1.4	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	129.9	MPa
Eenheidscontrole		0.01	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	723.75	kNm
Exponent van buigingsratio $y$	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	217.50	kNm
Exponent van buigingsratio $z$	$\beta$	1.00	

Eenheidscontrole (6.41) = 0.33 + 0.03 = 0.35 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

### .....STABILITEITSCONTROLE:.....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 4.359 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	117	21	2.658e+04	3.871e+04	0.69	0.46	1.00	5.58	9.20	10.22	14.54	1
3	SO	117	21	1.981e+04	7.677e+03	0.39	0.79	1.00	5.58	9.20	10.22	19.13	1
4	I	344	12	2.111e+04	1.984e+03	0.09		1.00	29.91	28.62	34.74	56.64	2
5	SO	117	21	-3.489e+03	-1.562e+04								
7	SO	117	21	3.287e+03	1.542e+04	0.21	0.53	1.00	5.58	9.20	10.22	15.60	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 2

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.



### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	11.820	7.750	m
Knikfactor	k	1.62	0.61	
Kniklengte	$l_{cr}$	19.148	4.761	m
Kritische Euler last	$N_{cr}$	3601.09	8658.39	kN
Slankheid	$\lambda$	101.22	65.28	
Relatieve slankheid	$\lambda_{rel}$	1.05	0.68	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		a	b	
Imperfectie	$\alpha$	0.21	0.34	
Reductie factor	$\chi$	0.63	0.79	
Knikweerstand	$N_{b,Rd}$	2512.80	3183.25	kN

Buigingsknikverificatie			
Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	2512.80	kN
Eenheidscontrole		0.08	-

### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Plastische doorsnedemodulus	$W_{pl,y}$	3.2167e-03	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	2425.10	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.55	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		b	
Imperfectie	$\alpha_{LT}$	0.34	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.94	
Correctiefactor	$k_c$	0.66	
Correctiefactor	f	0.85	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	1.00	
Rekenwaarde knikweerstand	$M_{b,Rd}$	723.75	kNm
Eenheidscontrole		0.57	-

Mcr parameters			
LTB lengte	$l_{LT}$	7.750	m
Vorklengte	$L_g$	7.750	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	575.00	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	C	9.49	
Factor	S	2102	mm
Kip moment factor	$C_1$	2.30	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)



Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Plastische doorsnedemodulus	W <sub>pl,y</sub>	3.2167e-03	m <sup>3</sup>
Plastische doorsnedemodulus	W <sub>pl,z</sub>	9.6667e-04	m <sup>3</sup>
Ontwerpdrukkracht	N <sub>Ed</sub>	213.51	kN
Ontwerp buigend moment (maximum)	M <sub>y,Ed</sub>	574.36	kNm
Ontwerp buigend moment (maximum)	M <sub>z,Ed</sub>	-20.91	kNm
Karakteristieke drukweerstand	N <sub>Rk</sub>	4005.00	kN
Karakteristieke momentweerstand	M <sub>y,Rk</sub>	723.75	kNm
Karakteristieke momentweerstand	M <sub>z,Rk</sub>	217.50	kNm
Reductie factor	χ <sub>y</sub>	0.63	
Reductie factor	χ <sub>z</sub>	0.79	
Gewijzigde reductiefactor	χ <sub>LT,mod</sub>	1.00	
Interactiefactor	k <sub>yy</sub>	0.96	
Interactiefactor	k <sub>yz</sub>	0.40	
Interactiefactor	k <sub>zy</sub>	0.58	
Interactiefactor	k <sub>zz</sub>	0.67	

Maximum moment M<sub>y,Ed</sub> is afgeleid van balk S11 positie 11.820 m.

Maximum moment M<sub>z,Ed</sub> is afgeleid van balk S11 positie 7.750 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.1	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalente moment factor	C <sub>my</sub>	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	M <sub>h,z</sub>	-20.91	kNm
Veldmoment	M <sub>s,z</sub>	-11.48	kNm
Factor	α <sub>s,z</sub>	0.55	
Ratio van uiteinde momenten	ψ <sub>z</sub>	-0.28	
Equivalente moment factor	C <sub>mz</sub>	0.64	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	M <sub>h,LT</sub>	-413.41	kNm
Veldmoment	M <sub>s,LT</sub>	-35.43	kNm
Factor	α <sub>s,LT</sub>	0.09	
Ratio van uiteinde momenten	ψ <sub>LT</sub>	-0.60	
Equivalente moment factor	C <sub>mLT</sub>	0.40	

Eenheidscontrole (6.61) = 0.08 + 0.76 + 0.04 = 0.89 -

Eenheidscontrole (6.62) = 0.07 + 0.46 + 0.06 = 0.59 -

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	11.820	m
Lijf		niet-verstijfd	
Lijfhoogte	h <sub>w</sub>	398	mm
Lijfdikte	t	12	mm
Materiaal coëfficiënt	ε	1.00	
Correctiefactor voor dwarskracht	η	1.20	

Plooi verificatie		
Lijf slankheid	h <sub>w</sub> /t	34.61
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S13	10.500 / 12.000 m	IPE450	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.66 -
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<b>Combinatiesleutel</b>	
RK_NC_UGT-Set B / NC_UGT-Set B.6	

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>			
Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 10.500 m

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	118.24 kN
Dwarskracht	$V_{y,Ed}$	0.71 kN
Dwarskracht	$V_{z,Ed}$	89.88 kN
Torsie	$T_{Ed}$	0.56 kNm
Buigend moment	$M_{y,Ed}$	-221.72 kNm
Buigend moment	$M_{z,Ed}$	-1.11 kNm

#### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	69	15	1.327e+05	1.373e+05	0.97	0.43	1.00	4.75	9.00	10.00	13.81	1
3	SO	69	15	1.294e+05	1.248e+05	0.96	0.44	1.00	4.75	9.00	10.00	13.98	1
4	I	379	9	1.125e+05	-1.364e+05	-1.21		0.43	40.30	83.85	96.66	151.08	1
5	SO	69	15	-1.567e+05	-1.612e+05								
7	SO	69	15	-1.533e+05	-1.487e+05								

**Opmerking:** De classificatielimiets zijn ingesteld volgens Semi-Comp+. De doorsnede is geclassificeerd als klasse 1

#### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	9.8800e-03	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	2321.80	kN
Uiterste trekweerstand	$N_{u,Rd}$	2560.90	kN
Trekweerstand	$N_{t,Rd}$	2321.80	kN
Eenhedscontrole		0.05	-

#### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	1.7020e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	399.97	kNm
Eenhedscontrole		0.55	-

#### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	2.7600e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	64.86	kNm
Eenhedscontrole		0.02	-

#### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)



Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	5.8338e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	791.51	kN
Eenheidscontrole		0.00	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	5.0824e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	689.57	kN
Eenheidscontrole		0.13	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	12.2	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	135.7	MPa
Eenheidscontrole		0.09	-

### Controle van gecombineerde afschuiving en torsie voor $V_y$ en $\tau_{t,Ed}$

Volgens EN 1993-1-1 artikel 6.2.6 & 6.2.7 en formule (6.25),(6.26)

Plastische dwarskrachtweerstand voor $V_y$ en $T_{Ed}$	$V_{pl,T,y,Rd}$	762.53	kN
Eenheidscontrole		0.00	-

### Controle van gecombineerde afschuiving en torsie voor $V_z$ en $\tau_{t,Ed}$

Volgens EN 1993-1-1 artikel 6.2.6 & 6.2.7 en formule (6.25),(6.26)

Plastische dwarskrachtweerstand voor $V_z$ en $T_{Ed}$	$V_{pl,T,z,Rd}$	664.32	kN
Eenheidscontrole		0.14	-

### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	399.97	kNm
Exponent van buigingsratio $y$	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	64.86	kNm
Exponent van buigingsratio $z$	$\beta$	1.00	

Eenheidscontrole (6.41) = 0.31 + 0.02 = 0.32 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

### .....STABILITEITSCONTROLE:.....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 0.000 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2





Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_{\sigma}$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	69	15	1.162e+03	1.167e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.78	1
3	SO	69	15	1.158e+03	1.153e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.81	1
4	I	379	9	1.207e+03	1.841e+03	0.66		1.00	40.30	28.00	34.00	43.16	3
5	SO	69	15	1.887e+03	1.882e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.81	1
7	SO	69	15	1.891e+03	1.896e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 3

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

Eigenschappen Semi-Comp+			
Materiaal coëfficiënt	$\epsilon$	1.00	
Slankheidslimiet flensklasse 2	$\beta_{2,y,f}$	10.00	
Slankheidslimiet flensklasse 3	$\beta_{3,y,f}$	14.00	
Slankheidslimiet lijfklasse 2	$\beta_{2,y,w}$	83.00	
Slankheidslimiet lijfklasse 3	$\beta_{3,y,w}$	124.00	
Slankheidslimiet flensklasse 2	$\beta_{2,z,f}$	10.00	
Slankheidslimiet flensklasse 3	$\beta_{3,z,f}$	16.00	
Verhouding lijfslankheid	c/t <sub>w</sub>	40.30	
Verhouding flensslankheid	c/t <sub>f</sub>	4.75	
Verhouding referentieslankheid	c/t <sub>ref,y</sub>	0.00	
Verhouding referentieslankheid	c/t <sub>ref,z</sub>	0.00	
Geïnterpoleerde doorsnedemodulus	W <sub>3,y</sub>	1.7020e-03	m <sup>3</sup>
Geïnterpoleerde doorsnedemodulus	W <sub>3,z</sub>	2.7600e-04	m <sup>3</sup>

**Opmerking:** De weerstand voor deze semi-compacte doorsnede is berekend volgens Semi-Comp+.

#### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Geïnterpoleerde doorsnedemodulus	W <sub>3,y</sub>	1.7020e-03	m <sup>3</sup>
Elastisch kritisch moment	M <sub>cr</sub>	725.92	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.74	
Limietslankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		c	
Imperfectie	$\alpha_{LT}$	0.49	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.80	
Correctiefactor	k <sub>c</sub>	0.90	
Correctiefactor	f	0.95	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.84	
Rekenwaarde knikweerstand	M <sub>b,Rd</sub>	337.25	kNm
Eenheidscontrole		0.66	-

Mcr parameters			
LTB lengte	l <sub>LT</sub>	4.000	m
Vorklengte	L <sub>g</sub>	4.000	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	2602.01	
Reductie factor	k <sub>red</sub>	1.00	
Coëfficiënt	C	6.66	
Factor	S	1753	mm
Kip moment factor	C <sub>1</sub>	1.25	
Kip moment factor	C <sub>2</sub>	0.00	

**Opmerking:** M<sub>cr</sub> is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor k<sub>c</sub> wordt bepaald op basis van C<sub>1</sub>.



## Buig- en axiale trekcontrole

Volgens EN 1993-1-3 artikel 6.3

Normaalkracht	$N_{Ed}$	118.24	kN
Buigend moment	$M_{y,Ed}$	-221.72	kNm
Buigend moment	$M_{z,Ed}$	-1.11	kNm
Trekweerstand	$N_{t,Rd}$	2321.80	kN
Buigweerstand	$M_{b,y,Rd}$	337.25	kNm
Vezel		1	
Elastische doorsnedemodulus	$W_{el,z,com}$	2.7600e-04	m <sup>3</sup>
Buigweerstand	$M_{c,z,Rd,com}$	64.86	kNm

Eenheidscontrole =  $0.66 + 0.02 - 0.05 = 0.62$  -

## Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	12.000	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	421	mm
Lijfdikte	t	9	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

Plooi verificatie		
Lijf slankheid	$h_w/t$	44.77
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

## EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S17	3.000 / 5.000 m	HEA180	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.50 -
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Combinatiesleutel	
RK_NC_UGT-Set B / NC_UGT-Set B.14	

Partiële veiligheidsfactoren	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

Materiaal			
Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 3.000 m

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-20.37 kN
Dwarskracht	$V_{y,Ed}$	-1.17 kN
Dwarskracht	$V_{z,Ed}$	-8.75 kN
Torsie	$T_{Ed}$	0.03 kNm
Buigend moment	$M_{y,Ed}$	29.29 kNm
Buigend moment	$M_{z,Ed}$	-0.02 kNm

## Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2



Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	72	10	-8.967e+04	-8.950e+04								
3	SO	72	10	-8.975e+04	-8.992e+04								
4	I	122	6	-6.667e+04	7.567e+04	-0.88		0.56	20.33	60.71	70.90	109.42	1
5	SO	72	10	9.866e+04	9.850e+04	1.00	0.43	1.00	7.58	9.00	10.00	13.80	1
7	SO	72	10	9.875e+04	9.892e+04	1.00	0.43	1.00	7.58	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+. De doorsnede is geïnclassificeerd als klasse 1

#### Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	4.5300e-03	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	1064.55	kN
Eenheidscontrole		0.02	-

#### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	76.38	kNm
Eenheidscontrole		0.38	-

#### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	1.5667e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	36.82	kNm
Eenheidscontrole		0.00	-

#### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	3.5460e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	481.11	kN
Eenheidscontrole		0.00	-

#### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.4520e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	197.00	kN
Eenheidscontrole		0.04	-

#### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	1.7	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	135.7	MPa
Eenheidscontrole		0.01	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

#### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	76.38	kNm
Exponent van buigingsratio y	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	36.82	kNm
Exponent van buigingsratio z	$\beta$	1.00	

Eenhedencontrole (6.41) = 0.15 + 0.00 = 0.15 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

....:STABILITEITSCONTROLE:....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 2.500 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\sigma$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	72	10	-9.774e+04	-1.018e+05								
3	SO	72	10	-9.573e+04	-9.171e+04								
4	I	122	6	-7.200e+04	8.081e+04	-0.89		0.56	20.33	60.91	71.12	110.52	1
5	SO	72	10	1.065e+05	1.106e+05	0.96	0.43	1.00	7.58	9.00	10.00	13.81	1
7	SO	72	10	1.045e+05	1.005e+05	0.96	0.44	1.00	7.58	9.00	10.00	13.99	1

**Opmerking:** De classificatielimiets zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

#### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	5.000	4.000	m
Knikfactor	k	1.00	0.52	
Kniklengte	$l_{cr}$	5.000	2.085	m
Kritische Euler last	$N_{cr}$	2080.91	4411.22	kN
Slankheid	$\lambda$	67.17	46.13	
Relatieve slankheid	$\lambda_{rel}$	0.72	0.49	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	

**Opmerking:** De slankheid of compressie kracht is zodanig dat Buigknik effecten kunnen worden genegeerd volgens EN 1993-1-1 artikel 6.3.1.2(4).

#### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

#### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	176.02	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.66	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		b	
Imperfectie	$\alpha_{LT}$	0.34	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.89	



Kip parameters			
Correctiefactor	$k_c$	0.93	
Correctiefactor	$f$	0.97	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.92	
Rekenwaarde knikweerstand	$M_{b,Rd}$	70.15	kNm
Eenhedscontrole		0.42	-

Mcr parameters			
LTB lengte	$l_{LT}$	4.000	m
Vorklengte	$L_g$	4.000	m
Inloed van lastpositie		geen invloed	
Factor	$\alpha$	2611.40	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	$C$	4.62	
Factor	$S$	1028	mm
Kip moment factor	$C_1$	1.14	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{Cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

#### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	$A$	4.5300e-03	m <sup>2</sup>
Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Plastische doorsnedemodulus	$W_{pl,z}$	1.5667e-04	m <sup>3</sup>
Ontwerpdrukkracht	$N_{Ed}$	20.37	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	31.45	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	-2.98	kNm
Karakteristieke drukweerstand	$N_{Rk}$	1064.55	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	76.38	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	36.82	kNm
Reductie factor	$\chi_y$	1.00	
Reductie factor	$\chi_z$	1.00	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.92	
Interactiefactor	$k_{yy}$	0.91	
Interactiefactor	$k_{yz}$	0.24	
Interactiefactor	$k_{zy}$	1.00	
Interactiefactor	$k_{zz}$	0.40	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S17 positie 2.500 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S17 positie 4.500 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.2	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalent moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	$M_{h,z}$	-2.98	kNm
Veldmoment	$M_{s,z}$	0.52	kNm
Factor	$\alpha_{s,z}$	-0.17	
Ratio van uiteinde momenten	$\psi_z$	-0.13	
Equivalent moment factor	$C_{mz}$	0.40	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	$M_{h,LT}$	-4.13	kNm
Veldmoment	$M_{s,LT}$	31.45	kNm
Factor	$\alpha_{h,LT}$	-0.13	
Ratio van uiteinde momenten	$\psi_{LT}$	0.90	
Equivalent moment factor	$C_{mLT}$	0.94	



Eenhedencontrole (6.61) = 0.02 + 0.41 + 0.02 = 0.45 -  
 Eenhedencontrole (6.62) = 0.02 + 0.45 + 0.03 = 0.50 -

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	5.000	m
Lijf		niet-verstijfd	
Lijfhoogte	h <sub>w</sub>	152	mm
Lijfdikte	t	6	mm
Materiaal coëfficiënt	ε	1.00	
Correctiefactor voor dwarskracht	η	1.20	

Plooi verificatie		
Lijf slankheid	h <sub>w</sub> /t	25.33
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S22	0.000 / 2.121 m	HEA120	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.55 -
-------------	-----------------	--------	-----------------------	-----------------	--------

Combinatiesleutel
RK_NC_UGT-Set B / NC_UGT-Set B.6

Partiële veiligheidsfactoren	
γ <sub>M0</sub> voor weerstand van doorsneden	1.00
γ <sub>M1</sub> voor weerstand tegen instabiliteit	1.00
γ <sub>M2</sub> voor weerstand van nettosecties	1.25

Materiaal			
Vloeisterkte	f <sub>y</sub>	235.0	MPa
Treksterkte	f <sub>u</sub>	360.0	MPa
Bouwwijze		Gewalst	

### .....DOORSNEDECONTROLE:.....

De kritische controle is op positie 0.000 m

Interne krachten	Berekende	Eenheid
Normaalkracht	N <sub>Ed</sub>	-227.36 kN
Dwarskracht	V <sub>y,Ed</sub>	0.00 kN
Dwarskracht	V <sub>z,Ed</sub>	0.19 kN
Torsie	T <sub>Ed</sub>	0.00 kNm
Buigend moment	M <sub>y,Ed</sub>	0.00 kNm
Buigend moment	M <sub>z,Ed</sub>	0.00 kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	σ <sub>1</sub> [kN/m <sup>2</sup> ]	σ <sub>2</sub> [kN/m <sup>2</sup> ]	ψ [-]	k <sub>σ</sub> [-]	α [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1
3	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
4	I	74	5	8.972e+04	8.972e+04	1.00		1.00	14.80	28.00	34.00	38.00	1
5	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
7	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1



Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.12.6  
26/39

## Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Drukweerstand	N <sub>c,Rd</sub>	594.55	kN
Eenheidscontrole		0.38	-

## Controle buigend moment voor M<sub>z</sub>

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	W <sub>pl,z</sub>	5.8750e-05	m <sup>3</sup>
Plastisch buigend moment	M <sub>pl,z,Rd</sub>	13.81	kNm
Eenheidscontrole		0.00	-

## Dwarskrachtcontrole voor V<sub>y</sub>

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	η	1.20	
Afschuifoppervlak	A <sub>v</sub>	2.0050e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor V <sub>y</sub>	V <sub>pl,y,Rd</sub>	272.03	kN
Eenheidscontrole		0.00	-

## Dwarskrachtcontrole voor V<sub>z</sub>

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	η	1.20	
Afschuifoppervlak	A <sub>v</sub>	8.4200e-04	m <sup>2</sup>
Plastische dwarskrachtweerstand voor V <sub>z</sub>	V <sub>pl,z,Rd</sub>	114.24	kN
Eenheidscontrole		0.00	-

## Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	T <sub>Ed</sub>	0.6	MPa
Elastische dwarskrachtweerstand	T <sub>Rd</sub>	135.7	MPa
Eenheidscontrole		0.00	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

De staaf voldoet aan de doorsnedecontrole.

## .....STABILITEITSCONTROLE:....

### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 1.061 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	σ <sub>1</sub> [kN/m <sup>2</sup> ]	σ <sub>2</sub> [kN/m <sup>2</sup> ]	ψ [-]	k <sub>σ</sub> [-]	α [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	46	8	8.874e+04	8.874e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1
3	SO	46	8	8.874e+04	8.874e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
4	I	74	5	8.901e+04	9.028e+04	0.99		1.00	14.80	28.00	34.00	38.19	1
5	SO	46	8	9.055e+04	9.055e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
7	SO	46	8	9.055e+04	9.055e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)



Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	2.121	2.121	m
Knikfactor	k	1.00	1.00	
Kniklengte	$l_{cr}$	2.121	2.121	m
Kritische Euler last	$N_{cr}$	2791.12	1064.00	kN
Slankheid	$\lambda$	43.34	70.20	
Relatieve slankheid	$\lambda_{rel}$	0.46	0.75	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		b	c	
Imperfectie	$\alpha$	0.34	0.49	
Reductie factor	$\chi$	0.90	0.70	
Knikweerstand	$N_{b,Rd}$	535.61	413.26	kN

Buigingsknikverificatie			
Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	413.26	kN
Eenhedencontrole		0.55	-

### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Plastische doorsnedemodulus	$W_{pl,y}$	1.1958e-04	m <sup>3</sup>
Plastische doorsnedemodulus	$W_{pl,z}$	5.8750e-05	m <sup>3</sup>
Ontwerpdrukkracht	$N_{Ed}$	227.36	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	0.10	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	0.00	kNm
Karakteristieke drukweerstand	$N_{Rk}$	594.55	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	28.10	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	13.81	kNm
Reductie factor	$\chi_y$	0.90	
Reductie factor	$\chi_z$	0.70	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	1.00	
Interactiefactor	$k_{yy}$	1.00	
Interactiefactor	$k_{yz}$	0.84	
Interactiefactor	$k_{zy}$	0.60	
Interactiefactor	$k_{zz}$	1.40	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S22 positie 1.061 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S22 positie 1.591 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.1	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalente moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	$M_{h,z}$	0.00	kNm
Veldmoment	$M_{s,z}$	0.00	kNm
Factor	$\alpha_{h,z}$	-0.23	
Ratio van uiteinde momenten	$\psi_z$	0.97	
Equivalente moment factor	$C_{mz}$	0.94	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	$M_{h,LT}$	0.00	kNm
Veldmoment	$M_{s,LT}$	0.10	kNm
Factor	$\alpha_{h,LT}$	0.00	
Ratio van uiteinde momenten	$\psi_{LT}$	1.00	





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.6  
28/39

Interactie methode 2 parameters		
Equivalente moment factor	$C_{mLT}$	0.95

Eenhedscontrole (6.61) =  $0.42 + 0.00 + 0.00 = 0.43$  -

Eenhedscontrole (6.62) =  $0.55 + 0.00 + 0.00 = 0.55$  -

### Plooi controle

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooi parameters			
Knik veldlengte	a	2.121	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	98	mm
Lijfdikte	t	5	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

### Plooi verificatie

Lijf slankheid	$h_w/t$	19.60
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S25	7.136 / 7.136 m	FLA80/10	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.65 -
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Combinatiesleutel	
RK_NC_UGT-Set B / NC_UGT-Set B.7	

Partiële veiligheidsfactoren	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

Materiaal			
Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

### ....:DOORSNEDECONTROLE:....

De kritische controle is op positie 7.136 m

Asdefinitie:

- y-hoofdas in deze normcontrole verwijst naar de z-hoofdas in SCIA Engineer

- z-hoofdas in deze normcontrole verwijst naar de y-hoofdas in SCIA Engineer

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	122.97 kN
Dwarskracht	$V_{y,Ed}$	0.00 kN
Dwarskracht	$V_{z,Ed}$	0.00 kN
Torsie	$T_{Ed}$	0.00 kNm
Bulgend moment	$M_{y,Ed}$	0.00 kNm
Buigend moment	$M_{z,Ed}$	0.00 kNm

### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	8.0000e-04	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	188.00	kN
Uiterste trekweerstand	$N_{u,Rd}$	207.36	kN
Trekweerstand	$N_{t,Rd}$	188.00	kN
Eenhedscontrole		0.65	-



De staaf voldoet aan de doorsnedecontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S35	0.000 / 5.657 m	L60X6	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.33 -
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<b>Combinatiesleutel</b>
RK_NC_UGT-Set B / NC_UGT-Set B.7

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>		
Vloeisterkte $f_y$	235.0	MPa
Treksterkte $f_u$	360.0	MPa
Bouwwijze	Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 0.000 m

Interne krachten	Berekende	Eenheid
Normaalkracht $N_{Ed}$	53.49	kN
Dwarskracht $V_{y,Ed}$	0.00	kN
Dwarskracht $V_{z,Ed}$	0.00	kN
Torsie $T_{Ed}$	0.00	kNm
Buigend moment $M_{y,Ed}$	0.00	kNm
Buigend moment $M_{z,Ed}$	0.00	kNm

### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede $A$	6.9100e-04	m <sup>2</sup>
Plastische trekweerstand $N_{pl,Rd}$	162.38	kN
Uiterste trekweerstand $N_{u,Rd}$	179.11	kN
Trekweerstand $N_{t,Rd}$	162.38	kN
Eenheidscontrole	0.33	-

De staaf voldoet aan de doorsnedecontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S41	5.000 / 7.423 m	UNP200	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.30 -
-------------	-----------------	--------	-----------------------	-----------------	--------

<b>Combinatiesleutel</b>
RK_NC_UGT-Set B / NC_UGT-Set B.7

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>		
Vloeisterkte $f_y$	235.0	MPa
Treksterkte $f_u$	360.0	MPa
Bouwwijze	Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 5.000 m



Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$ 8.11	kN
Dwarskracht	$V_{y,Ed}$ -1.39	kN
Dwarskracht	$V_{z,Ed}$ 0.93	kN
Torsie	$T_{Ed}$ -0.02	kNm
Buigend moment	$M_{y,Ed}$ -1.35	kNm
Buigend moment	$M_{z,Ed}$ 3.20	kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_o$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	UO	55	12	5.985e+02	1.033e+05	0.01	0.57	1.00	4.78	9.00	10.00	15.84	1
3	I	154	9	-3.000e+04	-4.057e+04								
5	UO	55	12	-1.233e+04	9.040e+04	-0.14	0.60	0.88	4.78	10.23	11.36	16.27	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geïnclassificeerd als klasse 1

### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	3.2200e-03	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	756.70	kN
Uiterste trekweerstand	$N_{u,Rd}$	834.62	kN
Trekweerstand	$N_{t,Rd}$	756.70	kN
Eenheidscontrole		0.01	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	2.2800e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	53.58	kNm
Eenheidscontrole		0.03	-

### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	5.1800e-05	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	12.17	kNm
Eenheidscontrole		0.26	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.7250e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	234.04	kN
Eenheidscontrole		0.01	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.7250e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	234.04	kN
Eenheidscontrole		0.00	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)



Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 31/39

Vezelindex	Vezel	3	
Totaal torsiemoment	T <sub>Ed</sub>	2.2	MPa
Elastische dwarskrachtweerstand	T <sub>Rd</sub>	135.7	MPa
Eenheidscontrole		0.02	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0,05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

#### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.1 en formule (6.2)

Plastische trekweerstand	N <sub>pl,Rd</sub>	756.70	kN
Plastisch buigend moment	M <sub>pl,y,Rd</sub>	53.58	kNm
Plastisch buigend moment	M <sub>pl,z,Rd</sub>	12.17	kNm

Eenheidscontrole (6.2) = 0.01 + 0.03 + 0.26 = 0.30 -

**Opmerking:** Er is geen specifieke interactieformule volgens EN 1993-1-1 artikel 6.2.9.1 van toepassing.

Daarom wordt de plastisch lineaire som volgens EN 1993-1-1 artikel 6.2.1(7) getoetst.

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

De staaf voldoet aan de doorsnedecontrole.

#### ....:STABILITEITSCONTROLE:....

#### Classificatie voor staafknikontwerp

Bestissende positie voor stabiliteitsclassificatie: 5.000 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	σ <sub>1</sub> [kN/m <sup>2</sup> ]	σ <sub>2</sub> [kN/m <sup>2</sup> ]	ψ [-]	k <sub>σ</sub> [-]	α [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse	klasse	klasse	
										1	2	3	
										[-]	[-]	[-]	
1	UO	55	12	3.068e+03	1.058e+05	0.03	0.56	1.00	4.78	9.00	10.00	15.77	1
3	I	154	9	-2.753e+04	-3.810e+04								
5	UO	55	12	-9.862e+03	9.287e+04	-0.11	0.59	0.90	4.78	9.96	11.06	16.17	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

#### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.2 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Algemeen geval	
Plastische doorsnedemodulus	W <sub>pl,y</sub>	2.2800e-04	m <sup>3</sup>
Elastisch kritisch moment	M <sub>cr</sub>	185.95	kNm
Relatieve slankheid	λ <sub>rel,LT</sub>	0.54	
Limiet slankheid	λ <sub>rel,LT,0</sub>	0.20	

**Opmerking:** De slankheid of het buigend moment is zo dat de kipeffecten genegeerd kunnen worden volgens EN 1993-1-1 artikel 6.3.2.2(4).

**Opmerking:** L/h is buiten de limieten, de gewijzigde ontwerpregel voor kip van U-profielen kan niet worden toegepast.

**Opmerking:** L/h is buiten de limieten, de gewijzigde ontwerpregel voor kip van U-profielen kan niet worden toegepast.

Mcr parameters			
LTB lengte	l <sub>LT</sub>	2.423	m
Invloed van lastpositie		geen invloed	
Correctiefactor	k	1.00	
Correctiefactor	k <sub>w</sub>	1.00	
Kip moment factor	C <sub>1</sub>	2.22	
Kip moment factor	C <sub>2</sub>	0.12	
Kip moment factor	C <sub>3</sub>	1.00	
Afschuifmiddenpuntafstand	d <sub>z</sub>	0	mm
Afstand tot lastoepassing	z <sub>g</sub>	0	mm
Mono-symmetrische constante	β <sub>y</sub>	0	mm



Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.12.e 32/39

#### Mcr parameters

Mono-symmetrische constante	$z_j$	0	mm
-----------------------------	-------	---	----

**Waarschuwing:** Er wordt niet voldaan aan alle voorwaarden van de Nederlandse NEN-EN NA (Art. NB.NB.1) en daarom wordt de standaard EC-EN-benadering gebruikt.

**Opmerking:** C parameters zijn bepaald volgens de ECCS 119 2006 / Galea 2002.

De staaf voldoet aan de stabiliteitscontrole.



## 2.6. EC-EN 1993 BGT staalcontrole

Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-quasi  
 Assenstelsel: Hoofd  
 Extreme 1D: Element  
 Selectie: Alle

### Algehele eenheidscontrole

Naam	dx [mm]	Belasting	U <sub>y,max</sub>	U <sub>y,ver</sub>	Limiet van	Limiet van	Controle van	Controle van	Zaag de u <sub>r</sub> (mm) Zaag [mm]	Check [-]
			[mm] U <sub>y,max</sub> [mm]	[mm] U <sub>y,ver</sub> [mm]	U <sub>y,max</sub> [mm] Limiet van U <sub>y,max</sub> [mm]	U <sub>y,ver</sub> [mm] Limiet van U <sub>y,ver</sub> [mm]	U <sub>y,max</sub> [-] Controle van U <sub>y,max</sub> [-]	U <sub>y,ver</sub> [-] Controle van U <sub>y,ver</sub> [-]		
S8	11820.000	NC_BGT-quasi.1	11.4 0.0	- -	21.8 39.4	21.8 39.4	0.52 0.00	- -	- -	<b>0.52</b>
S9	0.000	NC_BGT-quasi.1	0.0 -21.2	- -	19.7 68.8	19.7 68.8	0.00 0.31	- -	- -	<b>0.31</b>
S10	0.000	NC_BGT-quasi.1	0.0 -22.4	- -	19.7 68.8	19.7 68.8	0.00 0.33	- -	- -	<b>0.33</b>
S11	11820.000	NC_BGT-quasi.4	-5.3 0.0	-8.6 0.0	27.1 39.4	27.1 39.4	0.20 0.00	0.32 0.00	- -	<b>0.32</b>
S12	1000.000	NC_BGT-quasi.4	0.1 -35.4	0.0 -14.7	13.3 70.0	13.3 70.0	0.01 0.51	0.00 0.21	- -	<b>0.51</b>
S13	0.000	NC_BGT-quasi.4	0.0 -57.2	0.0 -23.1	13.3 70.0	13.3 70.0	0.00 0.82	0.00 0.33	- -	<b>0.82</b>
S15	8600.650	NC_BGT-quasi.4	-0.9 -65.6	-0.4 -22.3	64.5 59.3	64.5 59.3	0.01 1.11	0.01 0.38	- -	<b>1.11</b>
S16	2500.000+	NC_BGT-quasi.4	-0.4 -9.2	-0.3 -3.6	13.3 16.7	13.3 16.7	0.03 0.55	0.02 0.21	- -	<b>0.55</b>
S17	2500.000+	NC_BGT-quasi.4	-0.1 -8.7	-0.2 -3.7	13.3 16.7	13.3 16.7	0.01 0.52	0.01 0.22	- -	<b>0.52</b>
S18	0.000	NC_BGT-quasi.4	0.5 0.9	0.8 0.3	3.3 3.3	3.3 3.3	0.15 0.28	0.23 0.10	- -	<b>0.28</b>
S21	1060.660	NC_BGT-quasi.4	0.0 0.0	0.0 0.0	7.1 7.1	7.1 7.1	0.00 0.00	0.00 0.00	- -	<b>0.00</b>
S22	1060.660	NC_BGT-quasi.4	0.0 0.0	0.0 0.0	7.1 7.1	7.1 7.1	0.00 0.00	0.00 0.00	- -	<b>0.00</b>
S23	2000.000	NC_BGT-quasi.4	0.0 -0.2	0.0 0.0	13.3 13.3	13.3 13.3	0.00 0.02	0.00 0.00	- -	<b>0.02</b>
S25	3568.196+	NC_BGT-quasi.1	0.0 0.0	- -	23.8 23.8	23.8 23.8	0.00 0.00	- -	- -	<b>0.00</b>
S26	0.000	NC_BGT-quasi.4	20.9 0.0	4.0 0.0	47.6 23.8	47.6 23.8	0.44 0.00	0.08 0.00	- -	<b>0.44</b>
S27	3568.196-	NC_BGT-quasi.1	0.0 0.0	- -	23.8 23.8	23.8 23.8	0.00 0.00	- -	- -	<b>0.00</b>
S28	0.000	NC_BGT-quasi.1	-18.9 0.0	- -	47.6 23.8	47.6 23.8	0.40 0.00	- -	- -	<b>0.40</b>
S33	5656.854	NC_BGT-quasi.4	-8.3 -5.4	-4.2 3.4	37.7 37.7	37.7 37.7	0.22 0.14	0.11 0.09	- -	<b>0.22</b>
S34	5656.854	NC_BGT-quasi.4	16.4 19.4	3.3 11.0	37.7 37.7	37.7 37.7	0.44 0.52	0.09 0.29	- -	<b>0.52</b>
S35	0.000	NC_BGT-quasi.4	-17.5 -20.5	-1.5 -8.6	37.7 37.7	37.7 37.7	0.46 0.54	0.04 0.23	- -	<b>0.54</b>
S36	0.000	NC_BGT-quasi.4	-14.7 -17.6	-1.6 -9.0	37.7 37.7	37.7 37.7	0.39 0.47	0.04 0.24	- -	<b>0.47</b>
S40	0.000	NC_BGT-quasi.1	8.0 0.0	- -	16.2 8.1	16.2 8.1	0.50 0.00	- -	- -	<b>0.50</b>
S41	7423.000	NC_BGT-quasi.4	20.2 0.0	11.0 0.0	16.2 8.1	16.2 8.1	1.25 0.00	0.68 0.00	- -	<b>1.25</b>



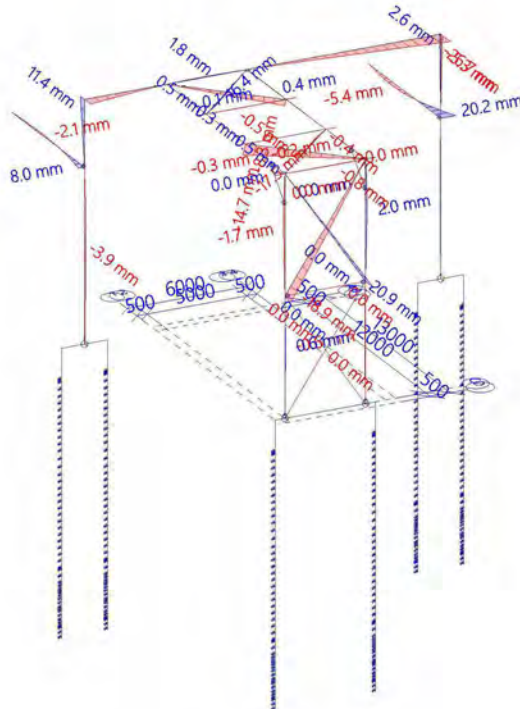
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.12.e  
34/39

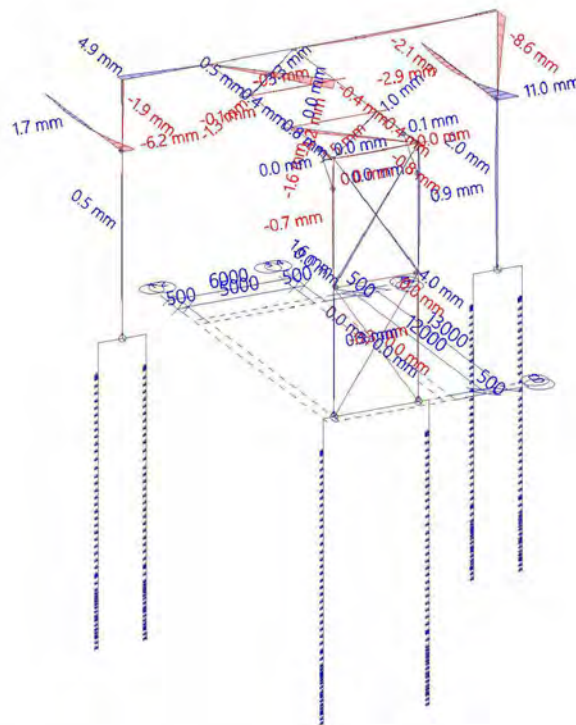
### Resultaten - $u_{y,max}$

Waardes:  $u_{y,max}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



### Resultaten - $u_{y,var}$

Waardes:  $u_{y,var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle









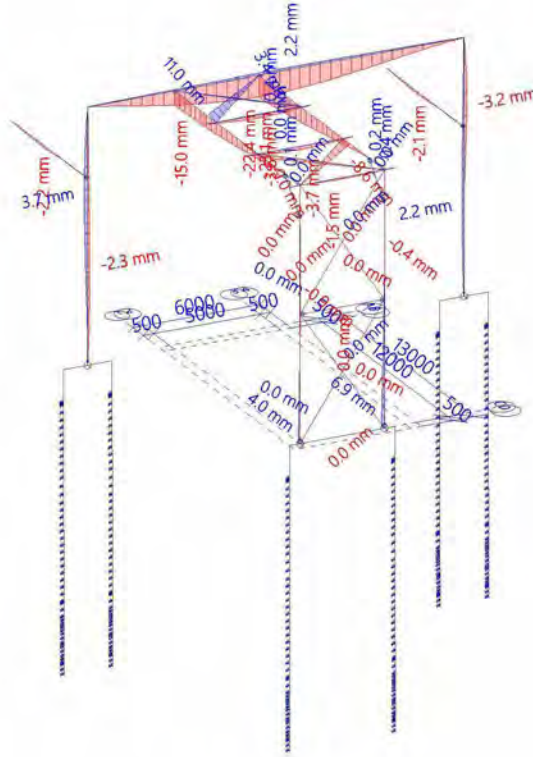
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.e  
36/39

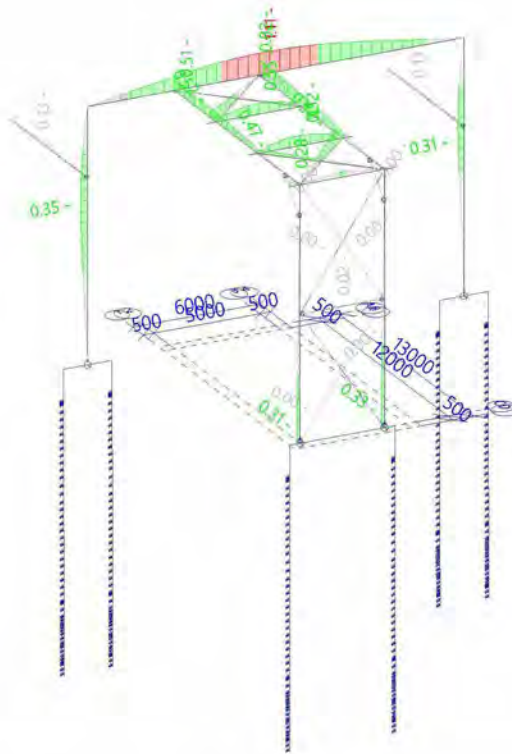
### Resultaten - $u_{z,var}$

Waardes:  $u_{z,var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



### Resultaten - Controle $u_z$

Waardes: **Controle  $u_z$**   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





Project  
Omschrijving  
Onderdeel

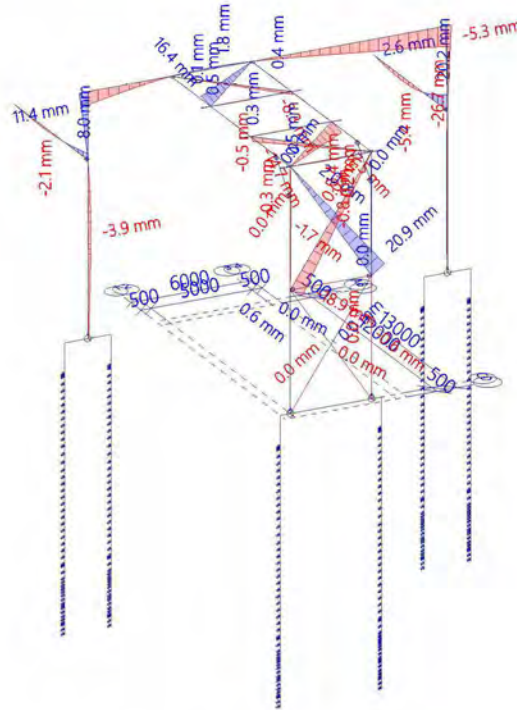
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Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
37/39

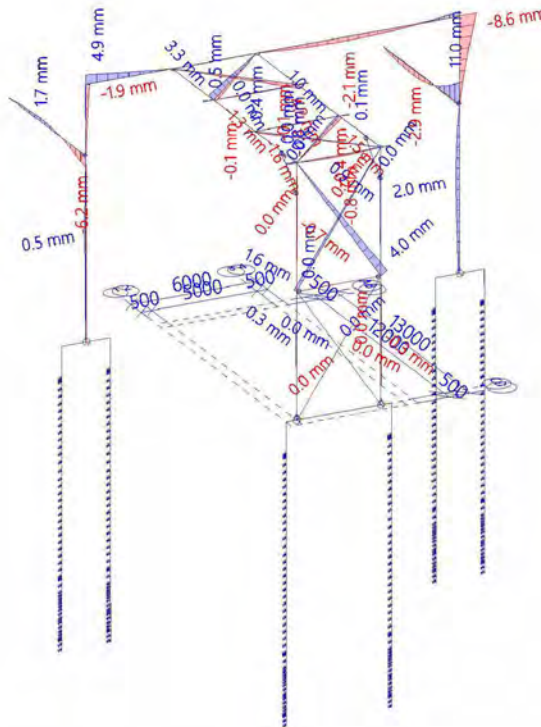
## Resultaten - $u_{y,max}$

Waardes:  $u_{y,max}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - $u_{y,var}$

Waardes:  $u_{y,var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





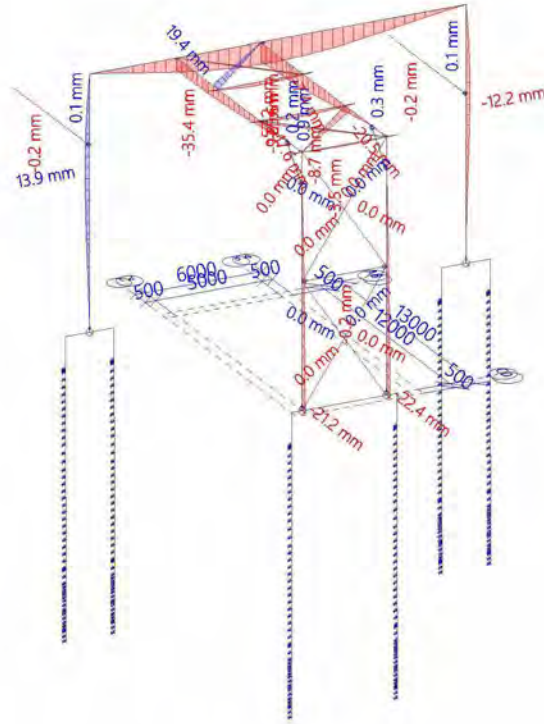
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.e  
38/39

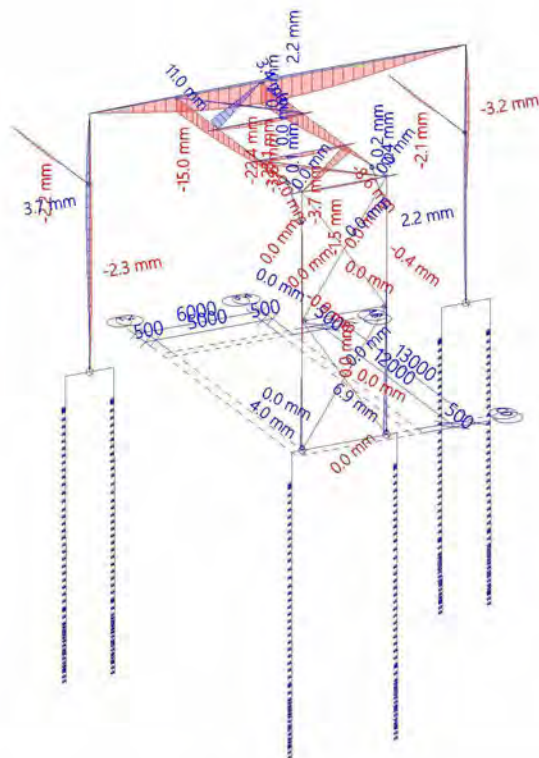
## Resultaten - $u_z^{\max}$

Waardes:  $u_{z,\max}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - $u_z^{\text{var}}$

Waardes:  $u_{z,\text{var}}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





Project  
Omschrijving  
Onderdeel

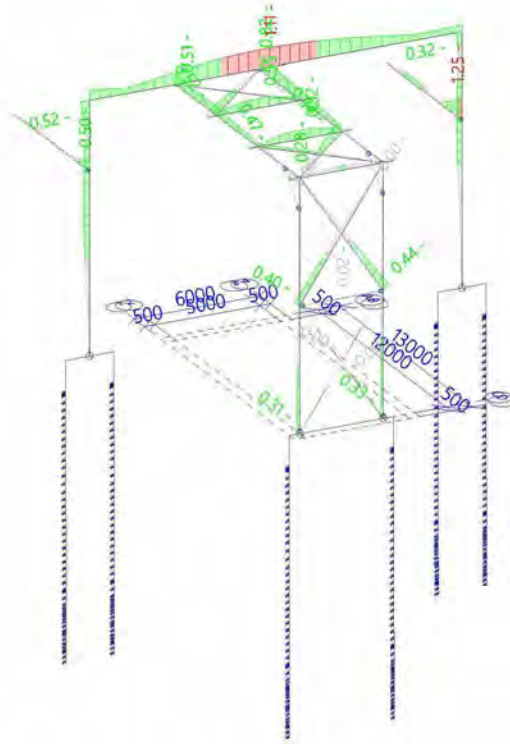
4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
39/39

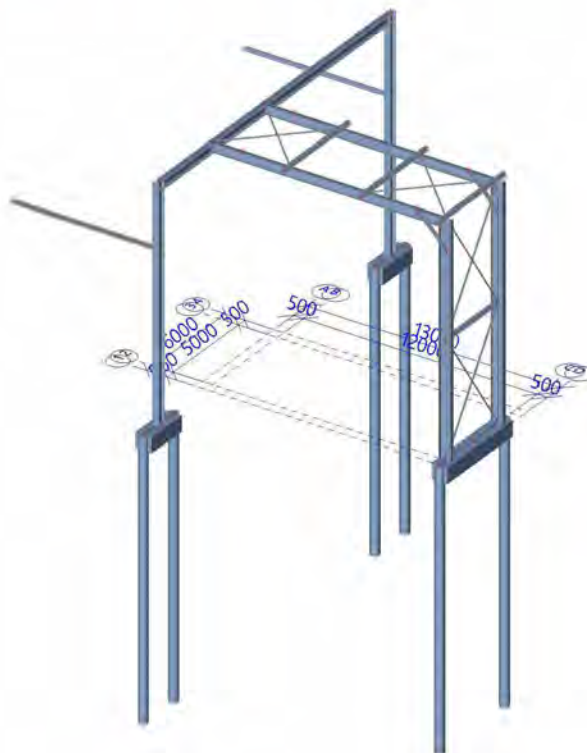
## Resultaten - Check Overall

Waardes: **Check Overall**  
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





# Bijlage 4. Betoncontrole





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Betoncontrole	3
2.1. Liggers	3
2.1.1. Ontwerpkrachten	3
2.1.1.1. Interne krachten (Ontwerp)	3
2.1.1.2. Rekenmodel - N	4
2.1.1.3. Rekenmodel - NEd	4
2.1.1.4. Rekenmodel - M	5
2.1.1.5. Rekenmodel - M-MEd	5
2.1.1.6. Rekenmodel - MEd	6
2.1.1.7. Rekenmodel - Mx	6
2.1.1.8. Rekenmodel - MEdx	7
2.1.1.9. Rekenmodel - V	7
2.1.1.10. Rekenmodel - V-VEd	8
2.1.1.11. Rekenmodel - VEd	8
2.1.2. Slankheid(Controle)	9
2.1.3. Voorstelling van stijfheid	9
2.1.4. Wapeningscontrole UGT	9
2.1.5. Controle capaciteits-response	10
2.1.6. Controle capaciteits-interactie diagram	15
2.1.7. Controleer afschuiving+torsie (UGT)	19
2.1.8. Controle limietspanning	29
2.1.9. Controle scheurwijdte (BGT)	33



## 2. Betoncontrole

### 2.1. Liggers

#### 2.1.1. Ontwerpkrachten

##### 2.1.1.1. Interne krachten (Ontwerp)

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Staaf

Extremes 1D: Globaal

Selectie: Alle

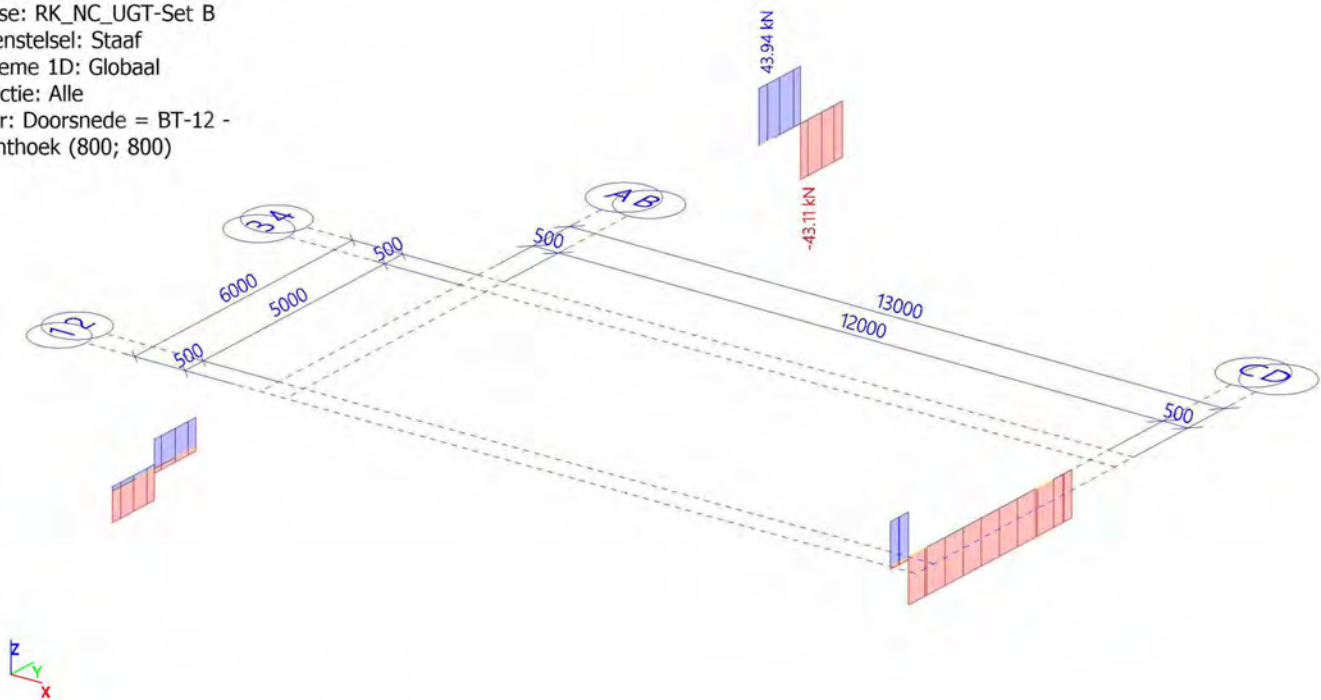
Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	N	V <sub>y</sub>	V <sub>z</sub>	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>
				[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
				N <sub>Ed</sub>	V <sub>Edy</sub>	V <sub>Edz</sub>	M <sub>Edx</sub>	M <sub>Edy</sub>	M <sub>Edz</sub>
				[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
S37	0.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>43.94</b> <b>43.94</b>	-1.20 0.00	-135.82 -135.82	3.68 3.68	77.08 77.08	-0.31 0.00
S2	5000.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.51 -5.51	<b>-32.79</b> <b>-32.79</b>	-204.43 -27.91	9.16 9.16	-15.79 -15.79	-0.03 -0.03
S2	0.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	1.93 1.93	<b>25.55</b> <b>25.55</b>	153.11 30.58	-21.84 -21.84	1.54 59.11	-0.03 -0.03
S37	2300.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	-43.07 -43.07	3.01 0.00	<b>-392.98</b> <b>-375.05</b>	-3.86 -3.86	-82.89 -82.89	0.33 0.00
S1	0.000	NC_UGT-Set B.14	BT-12 - Rechthoek (800; 800)	-24.20 -24.20	1.01 0.00	<b>235.71</b> <b>215.57</b>	-3.21 -3.21	-46.08 -46.08	0.14 0.00
S2	4500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	-3.02 -3.02	-5.38 0.00	-132.87 -32.43	<b>-35.61</b> <b>-35.61</b>	59.30 73.67	2.62 0.00
S2	0.000	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	0.06 0.06	3.95 0.00	121.50 33.26	<b>32.66</b> <b>32.66</b>	-1.68 -1.68	0.10 0.00
S37	1150.000-	NC_UGT-Set B.12	BT-12 - Rechthoek (800; 800)	40.66 40.66	-1.23 0.00	-153.81 -153.81	3.72 3.72	<b>-96.86</b> <b>-96.86</b>	-1.70 0.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>-43.11</b> <b>-43.11</b>	3.00 0.00	-371.28 -371.28	-3.85 -3.85	<b>356.56</b> <b>356.56</b>	<b>-3.13</b> 0.00
S2	4500.000+	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.52 -5.52	-32.74 -32.74	-195.00 -27.91	9.13 9.13	84.06 96.67	<b>16.35</b> <b>16.35</b>
S37	950.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	30.22 30.22	-1.32 -1.32	-67.63 -67.63	5.44 5.44	-1.82 -15.02	-1.47 <b>-1.74</b>



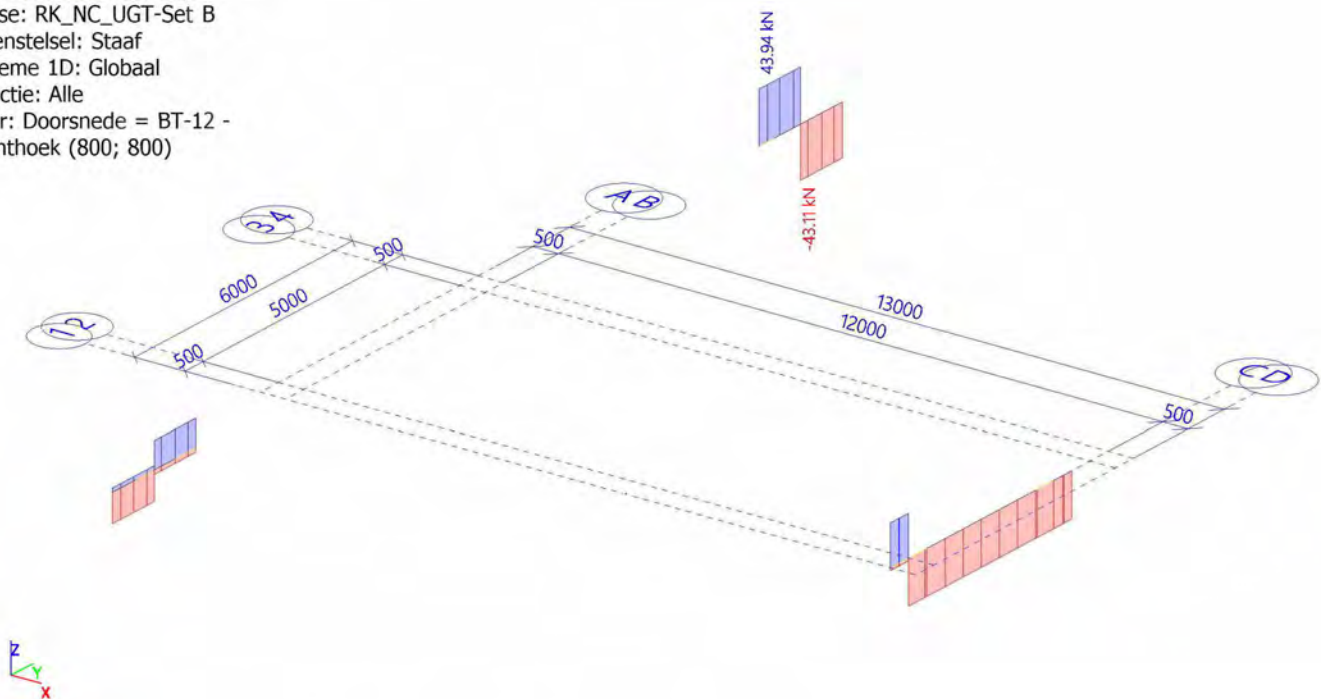
### 2.1.1.2. Rekenmodel - N

Waardes: **N**  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.3. Rekenmodel - NEd

Waardes: **NEd**  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



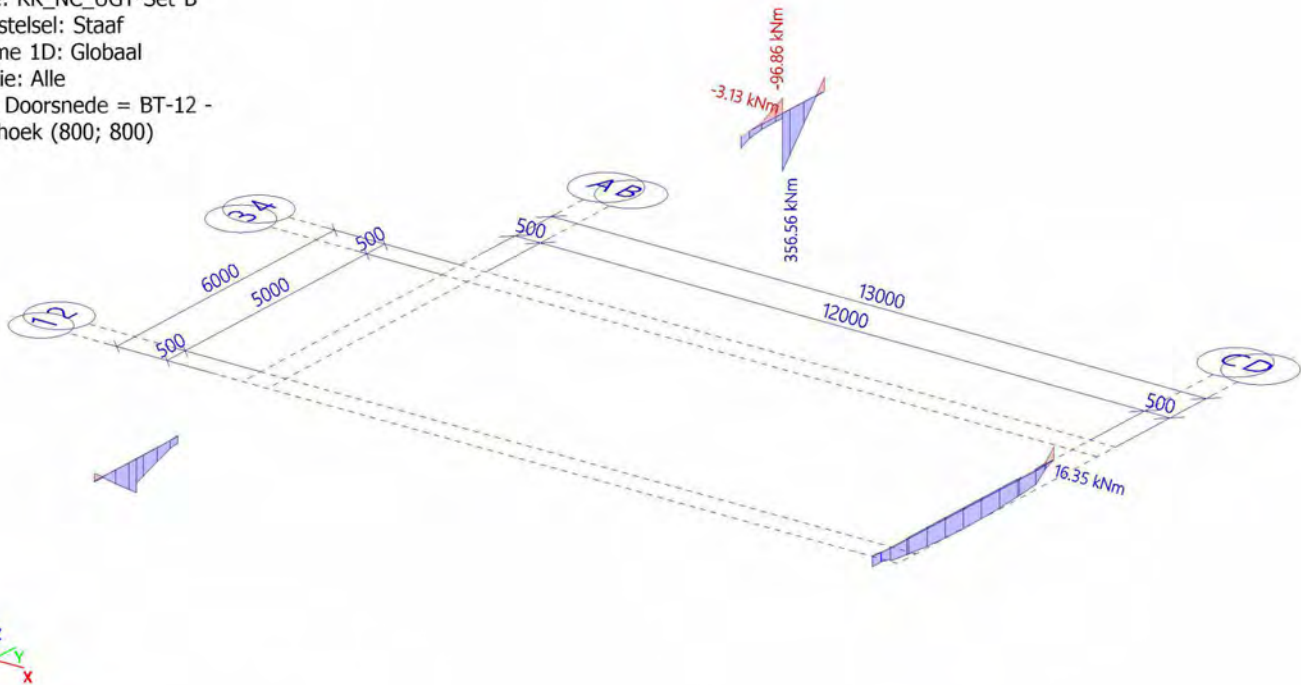




### 2.1.1.4. Rekenmodel - M

Waardes: **M**

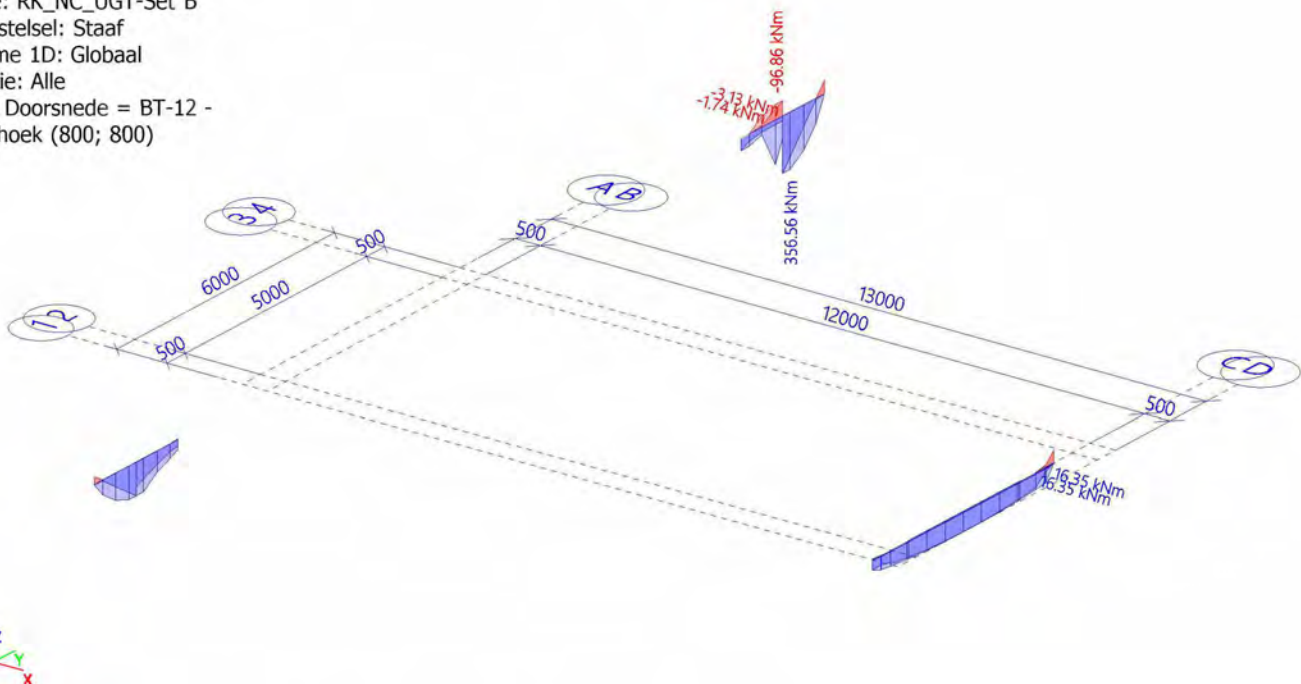
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.5. Rekenmodel - M-MEd

Waardes: **M-MEd**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

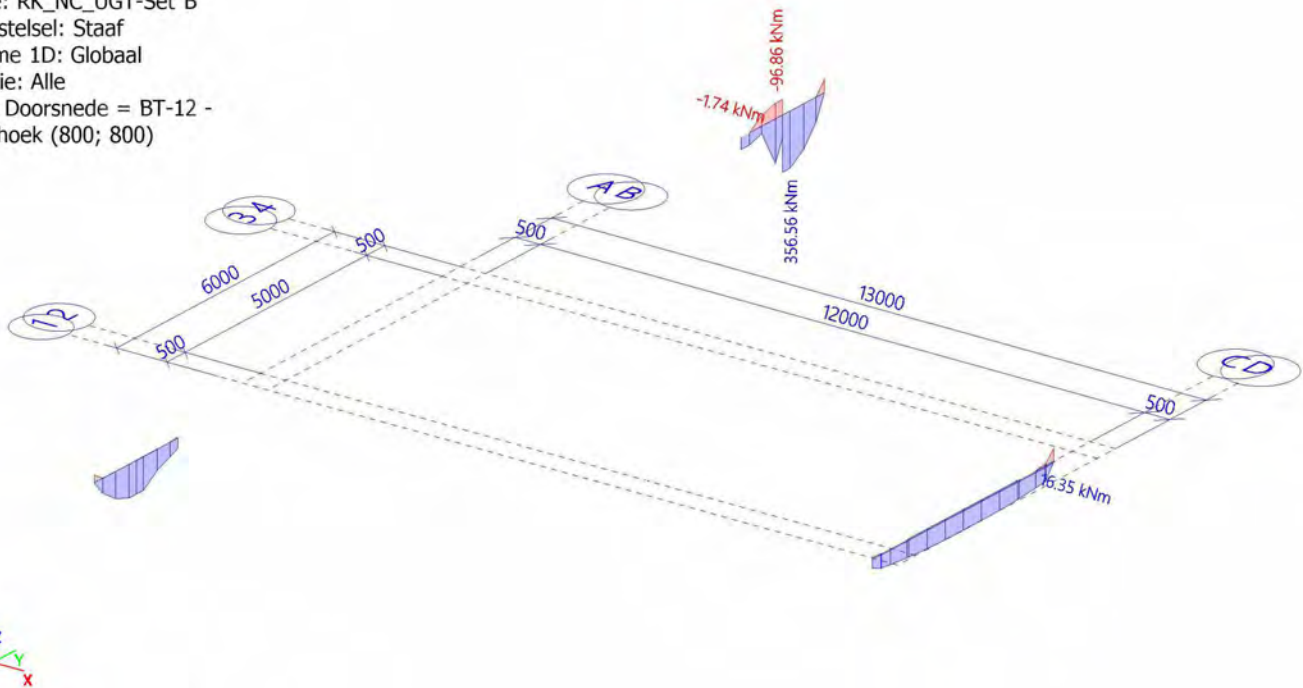




### 2.1.1.6. Rekenmodel - MEd

Waardes: **MEd**

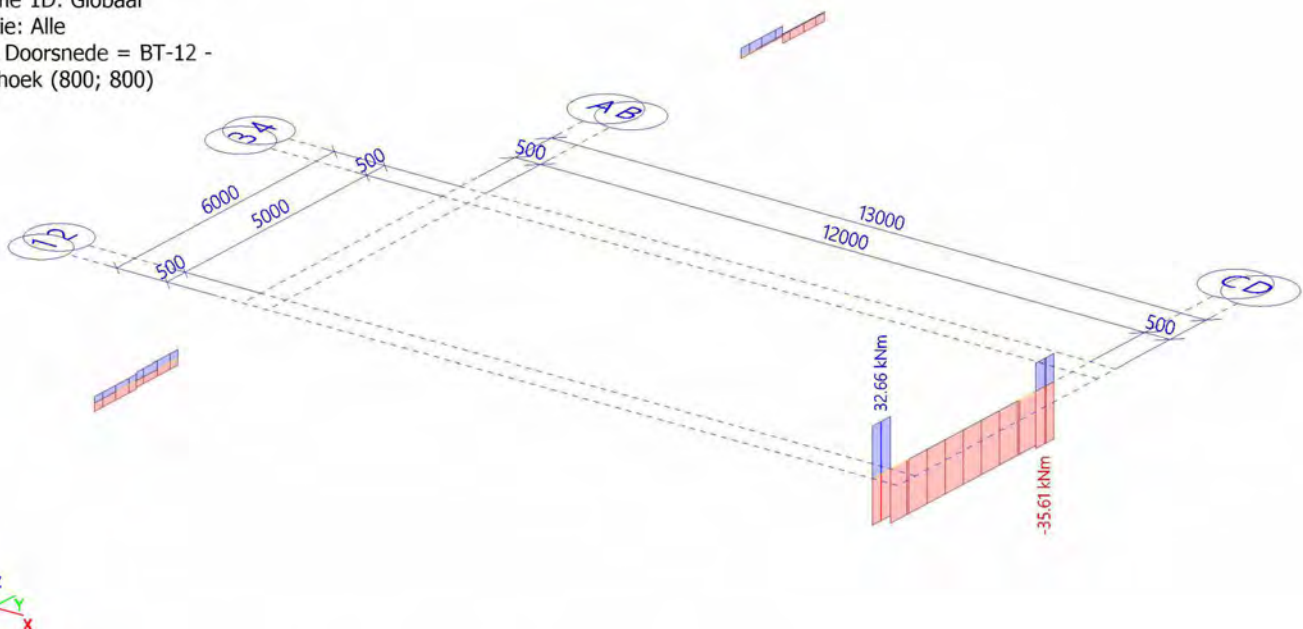
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.7. Rekenmodel - Mx

Waardes: **Mx**

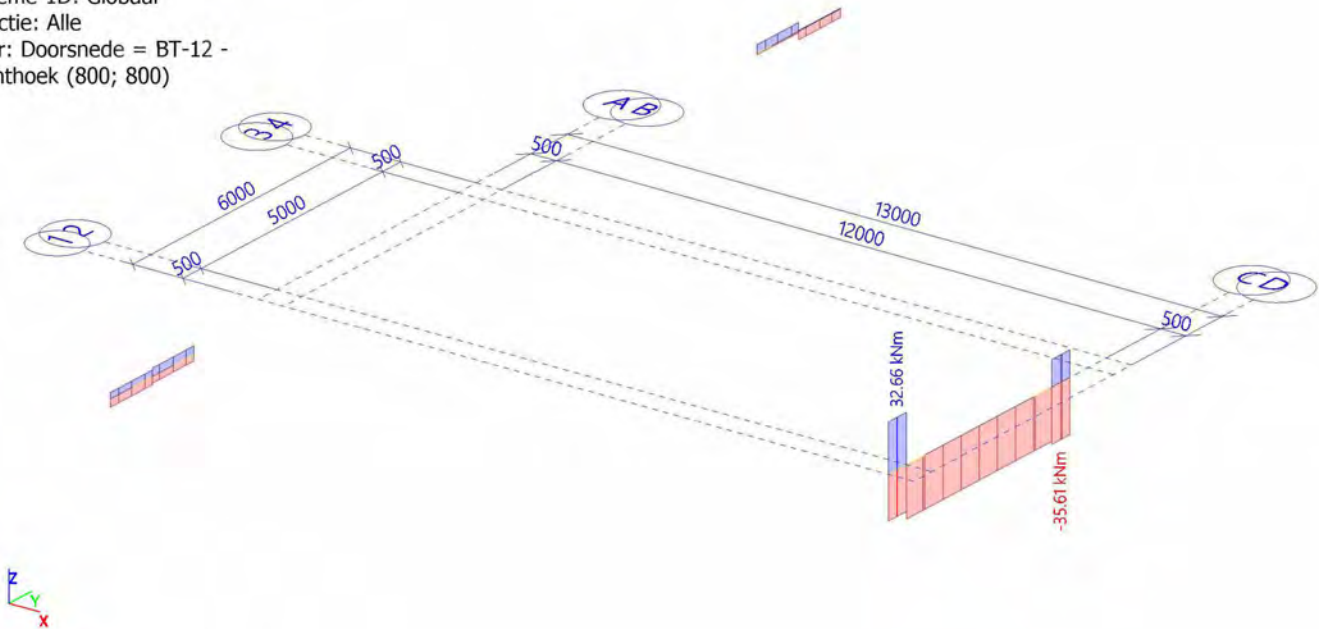
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)





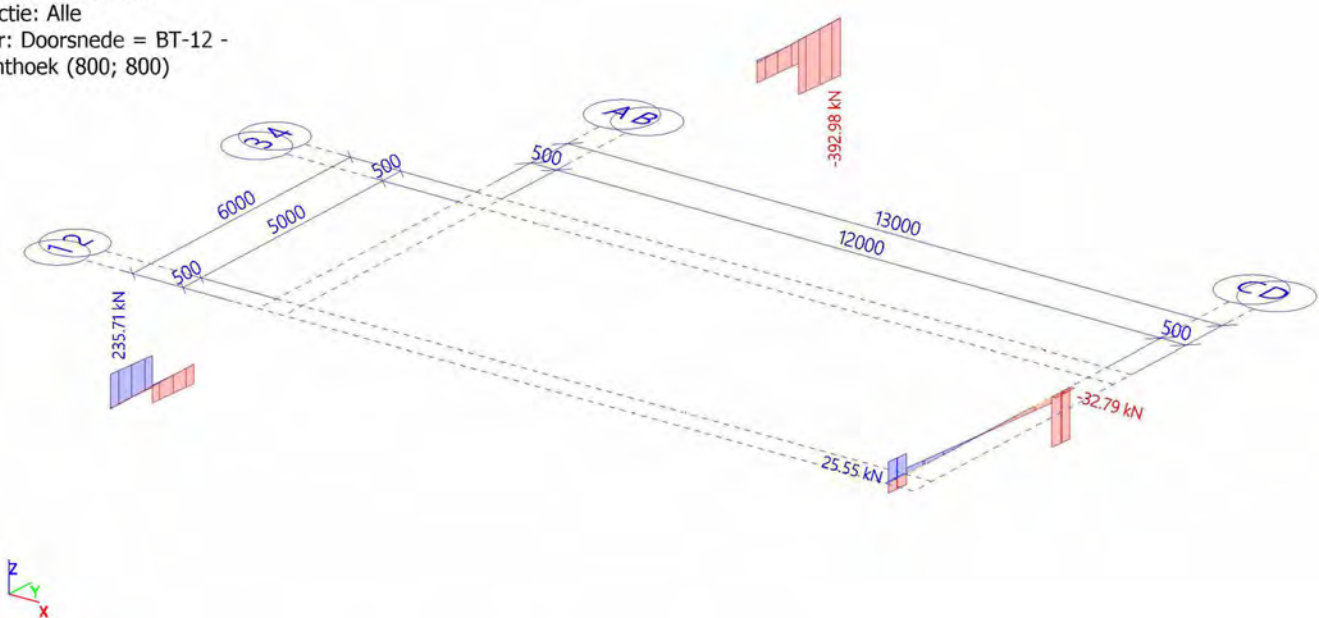
### 2.1.1.8. Rekenmodel - MEdx

Waardes: **M<sub>Edx</sub>**  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.9. Rekenmodel - V

Waardes: **V**  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

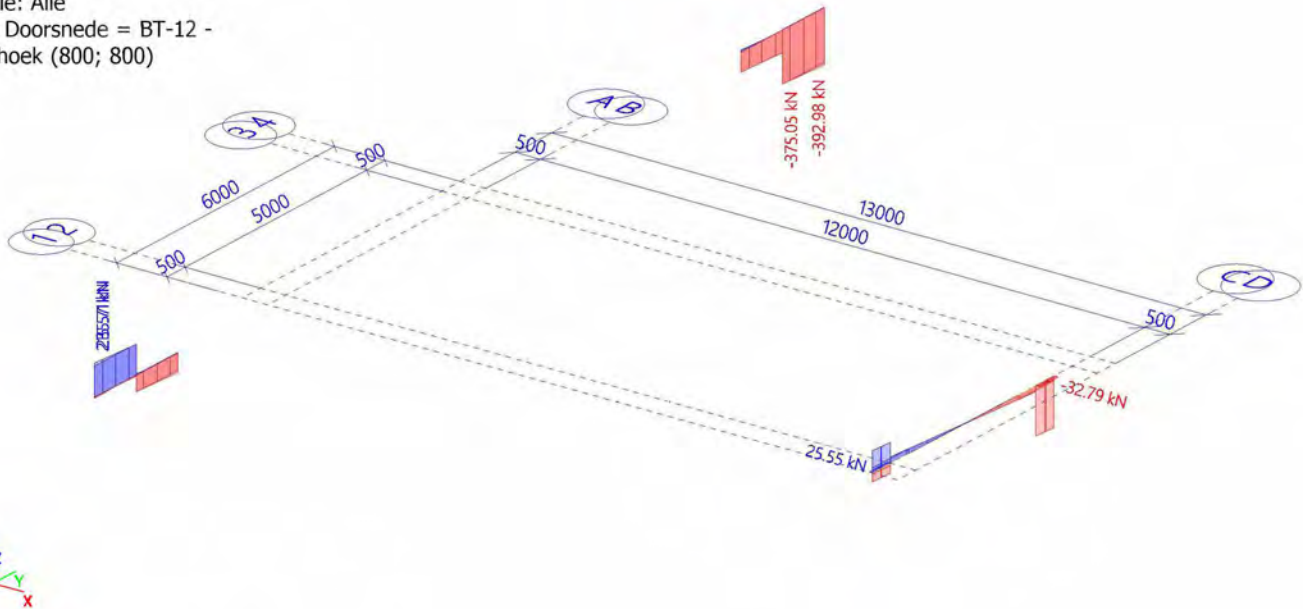




### 2.1.1.10. Rekenmodel - V-VEd

Waardes: **V-VEd**

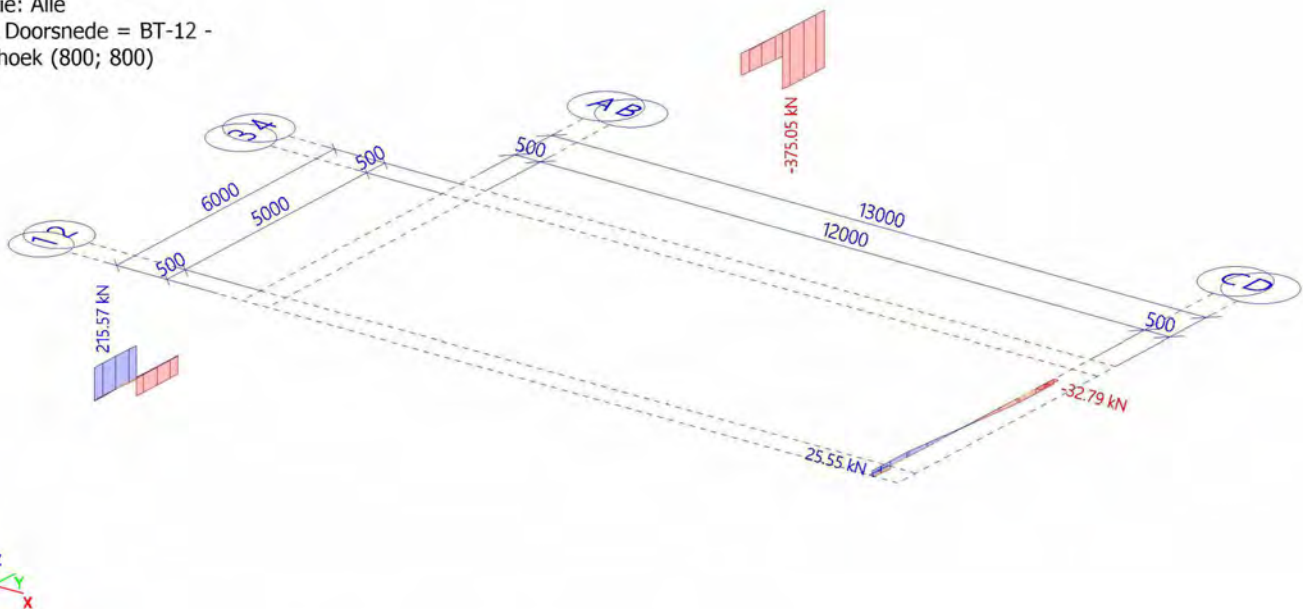
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.11. Rekenmodel - VEd

Waardes: **VEd**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)





## 2.1.2. Slankheid(Controle)

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Globaal  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$L_y$ [mm]	$\beta_{zz}$ [-]	$i_{oy}$ [mm]	$i_{oy}$ [m]	$\lambda_y$ [-]	$\lambda_{limy}$ [-]
				$L_z$ [mm]	$\beta_{yy}$ [-]	$i_{oz}$ [mm]	$i_{oz}$ [m]	$\lambda_z$ [-]	$\lambda_{limz}$ [-]
S2	500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	<b>4000.000</b> <b>5000.000</b>	<b>1.00</b> <b>10.00</b>	<b>40000.000</b> <b>5000.000</b>	2.3094e-01 2.3094e-01	<b>173.21</b> <b>21.65</b>	724.97 724.97
S1	1150.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	1150.000 2300.000	1.00 10.00	11500.000 2300.000	2.3094e-01 2.3094e-01	49.80 9.96	<b>0.00</b> <b>0.00</b>
S1	2300.000	NC_UGT-Set B.5	BT-12 - Rechthoek (800; 800)	1150.000 2300.000	1.00 10.00	11500.000 2300.000	2.3094e-01 2.3094e-01	49.80 9.96	<b>4277.63</b> <b>4277.63</b>

## 2.1.3. Voorstelling van stijfheid

Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-kar  
 Assenstelsel: Staaf  
 Extreme 1D: Globaal  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$N_{cr}$ [kN]	$M_{y,cr}$ [kNm]	State	$f_{\sigma,eff}$ [MPa]	$\sigma_s$ [MPa]	$x_{l,cr}$ [mm]	EA [MN]	$EI_y$ [MNm <sup>2</sup> ]
				$N_{char}$ [kN]	$M_{y,char}$ [kNm]		$\sigma_{cc}$ [MPa]	$\sigma_{sr}$ [MPa]	$\zeta$ [-]		$EI_z$ [MNm <sup>2</sup> ]
S1	0.000	NC_BGT-kar.1	BT-12 - Rechthoek (800; 800)	0.00 -12.15	0.00 -22.65	Korte termijn	3.20 0.00	0.0 0.0	0 0.00	<b>2.2236e+04</b>	<b>1.1968e+03</b> <b>1.1915e+03</b>

## 2.1.4. Wapeningscontrole UGT

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Doorsnede  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$UC_{trep}$ [-]	$UC_{lmt}$ [-]	$UC_{VT}$ [-]	$UC_{vpress}$ [-]	$UC_{crack}$ [-]	$UC_{diff}$ [-]	$UC_{det}$ [-]	UC [-]
S37	1350.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>1.00</b>	<b>0.98</b>	0.16	-	-	-	-	1.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	1.00	0.98	<b>0.89</b>	-	-	-	-	<b>1.00</b>

## Gehele controle

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Doorsnede  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



Naam	dx [mm]	Belasting	Doorsnede	UC <sub>resp</sub> [-]	UC <sub>int</sub> [-]	UC <sub>vr</sub> [-]	UC <sub>stress</sub> [-]	UC <sub>crack</sub> [-]	UC <sub>defl</sub> [-]	UC <sub>det</sub> [-]	UC [-]
S37	1350.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>1.00</b>	<b>0.98</b>	0.16	-	-	-	-	1.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	1.00	0.98	<b>0.89</b>	-	-	-	-	<b>1.00</b>

#### Rekenmodel - UC

Waardes: **UC**

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

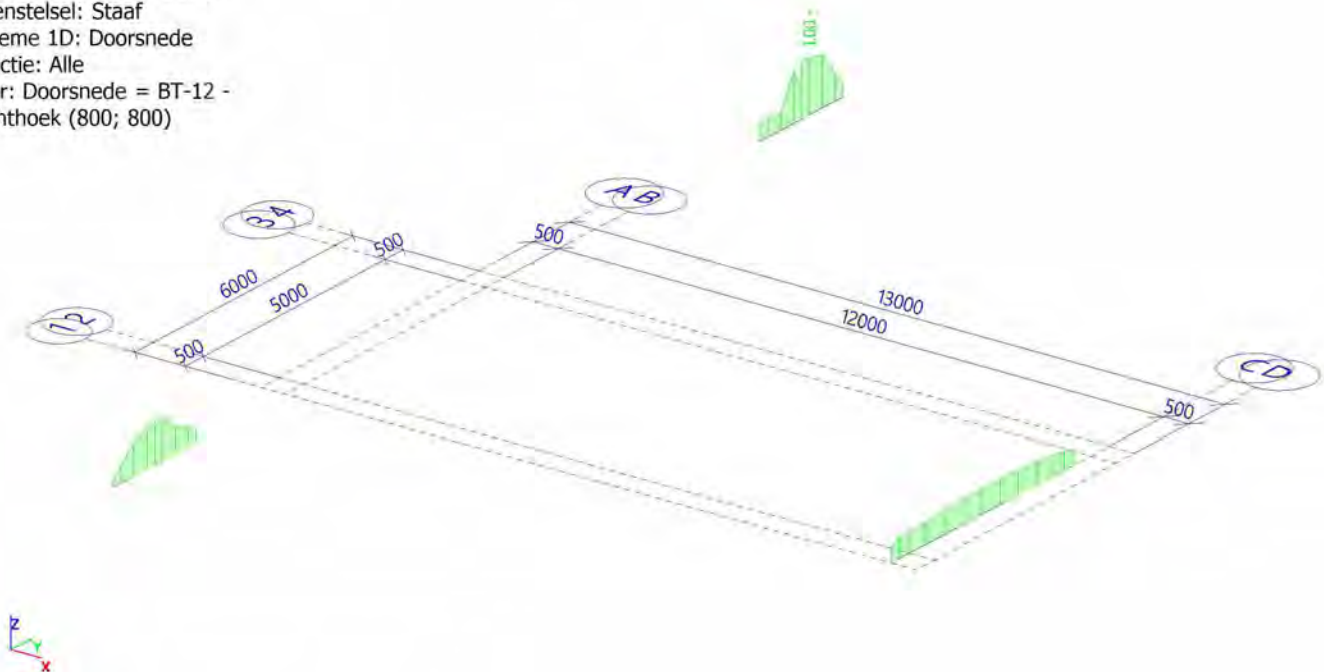
Assenstelsel: Staaf

Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 -

Rechthoek (800; 800)



#### 2.1.5. Controle capaciteits-responsie

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Staaf

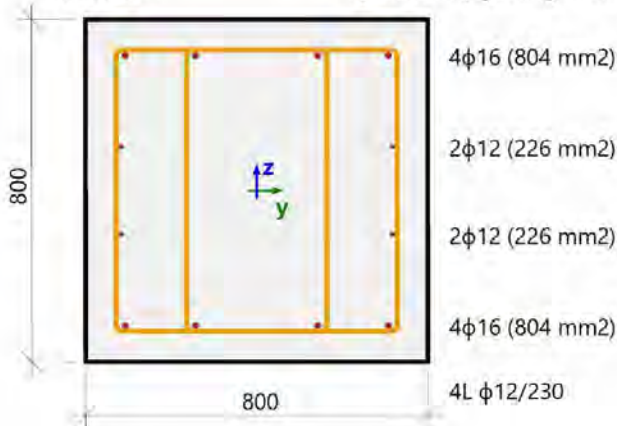
Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 7 [dx = 1.35 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y $\perp$	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z $\perp$	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4 $\phi$ 12+8 $\phi$ 16 (2061 mm <sup>2</sup> )
		$\rho_l = 0.322\%$ (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L $\phi$ 12/230 (452 mm <sup>2</sup> )
		$\rho_w = 0.246\%$ (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Materiaalkarakteristieken

Ontwerpbetondruksterkte

$$f_{cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$$

Ontwerpvloei spanning van langswapening

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa} \quad (3.15)$$

## Krachten

Inhoud van de combinatie: NC\_UGT-SetB.7

Van EEM analyse:

$$N = -43.1 \text{ kN} \quad M_y = 281 \text{ kNm} \quad M_z = -2.53 \text{ kNm}$$

## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0.1 \cdot (23.3 \cdot 10^6 \cdot 0.64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -43 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).

Herberekende buigmomenten:

Momentreductie boven steunpunt: Nee

Reductie van afschuifkrachten boven steunpunt: Nee

Verschuivingsregel gebruiken: Ja

$$N_{Ed} = -43.1 \text{ kN} \quad M_{Edy} = 357 \text{ kNm} \quad M_{Edz} = 0 \text{ kNm}$$



## Status van scheuren in buiging

$$\sigma_{ct,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow \text{doorsnede gescheurd bij buiging}$$

## Toetsing van beperkte hoogte van drukzone gebaseerd op 6.1(9) van NEN EN 1992-1-1

Grenswaarde van ontwerpnormaalkracht

$$N_{lim} = 0.1 \cdot A_c \cdot f_{cd} = 0.1 \cdot 0.64 \cdot 23.3 = 1493 \text{ kN}$$

Ontwerpwaarde van normaalkracht

$$N_{Ed} = -43.1 \text{ kN}$$

De waarde  $x_u$  berekend op basis van de weerstanden uit het interactiediagram

$$N_{Rd} = -43.9 \text{ kN}$$

$$M_{Rdy} = 363 \text{ kN}$$

$$M_{Rdz} = 0 \text{ kN}$$

Beperkte hoogte van drukzone

$$x_{u,lim} = \frac{500 \cdot 10^6 \cdot d}{500 \cdot 10^6 + f} = \frac{500 \cdot 10^6 \cdot 0.456}{500 \cdot 10^6 + 435 \cdot 10^6} = 0.244 \text{ m}$$

$$x_u < x_{u,lim} \Rightarrow 60.4 \text{ mm} < 244 \text{ mm}$$

Controlewaarde gerelateerd aan de beperking van de drukzone

$$UC_{x_u} = \frac{x_u}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248$$

## Overzicht van controle

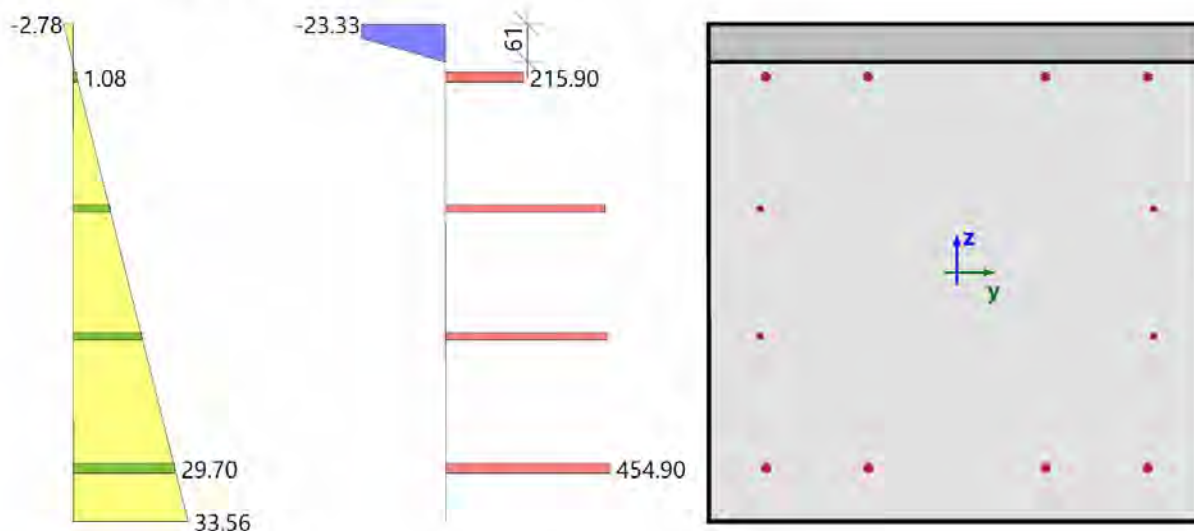
Type component	Vezel / Staaf	$\epsilon_{extr}$ [‰]	$\sigma_{extr}$ [MPa]	Controle rek [-]	Controle spanning [-]	$UC_{x_u}$ [-]	E.C. [-]	Grenswaarde [-]	Status
Beton	3	-2.78	-23.3	0.79	1.00	0.25	1.00	1	OK
Wapening	3	29.7	455	0.66	0.98				





Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

## Spanning en rek verdeling



## Extreme waarden van spanning/rek in component

Type component	Vezel / StAAF	$\epsilon$ [‰]	$\epsilon_{lim}$ [‰]	$\sigma$ [MPa]	$\sigma_{lim}$ [MPa]	E.C. [-]	Status
Beton - druk	3	-2.78	-3.5	-23.3	-23.3	1.00	OK
Beton - trek	1	33.6	0	0	0	0.00	OK
Wapening - druk	1	0	0	0	0	0.00	OK
Wapening - trek	3	29.7	45	455	466	0.98	OK

## Vlak van vervorming

Rek in het midden van het zwaartepunt

$$\epsilon_x = 15.4 \text{ ‰}$$

Kromming rond y-as

$$\epsilon_y = -45.4 \text{ ‰}$$

Kromming rond z-as

$$\epsilon_z = 0 \text{ ‰}$$

Hoogte van de drukzone

$$x = 61 \text{ mm}$$

Evenwichtshoogte van drukzone

$$x_{bal} = 289 \text{ mm}$$

Grenswaarde hoogte van drukzone

$$x_{lim} = 35 \text{ mm}$$

Helling van de neutrale as

$$\alpha_{NA} = 0^\circ$$

Hoogte van de doorsnede loodrecht op neutrale as

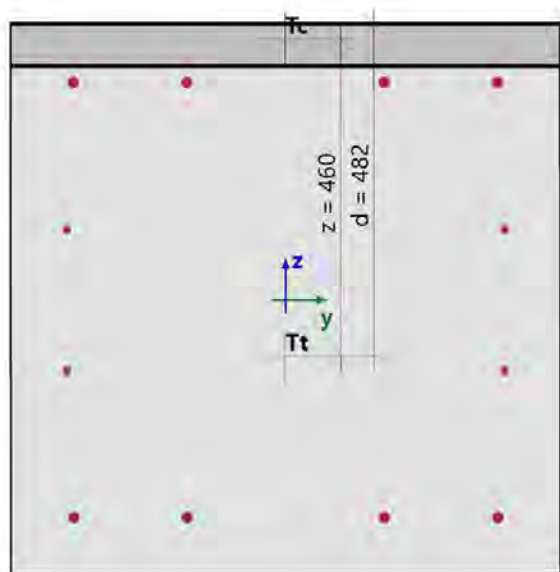
$$h = 800 \text{ mm}$$

Effectieve diepte van de doorsnede loodrecht op de neutrale as

$$d = 482 \text{ mm}$$

Hefboomsarm van de doorsnede loodrecht op neutrale as

$$z = 460 \text{ mm}$$



## Doorsnedekarakteristieken

Type component	$t_y$ [m]	$t_z$ [m]	A [m <sup>2</sup> ]	$I_y$ [m <sup>4</sup> ]	$I_z$ [m <sup>4</sup> ]
Beton - druk	0	0.369	0.049	$6.7 \cdot 10^{-3}$	$2.61 \cdot 10^{-3}$
Beton - trek	0	-0.031	0.591	0.0274	0.0315
Wapening - druk	0	0	0	0	0
Wapening - trek	0	0	$2.06 \cdot 10^{-3}$	$164 \cdot 10^{-6}$	$138 \cdot 10^{-6}$
Volledig beton	0	0	0.64	0.0341	0.0341
Alle wapeningsstaven	0	0	$2.06 \cdot 10^{-3}$	$164 \cdot 10^{-6}$	$138 \cdot 10^{-6}$

## Krachten in alle doorsnedecomponenten

Type component	$N_{res}$ [kN]	$M_{res,y}$ [kNm]	$M_{res,z}$ [kNm]	$e_y$ [m]	$e_z$ [m]
Beton - druk	-784	296	0	0	0.378
Beton - trek	0	0	0	0	0
Wapening - druk	0	0	0	0	0
Wapening - trek	741	60.7	0	0	-0.082
Alles onder druk	-784	296	0	0	0.378
Alles onder trek	741	60.7	0	0	-0.082
Overzicht	-43.1	357	0		

### Gedetailleerde resultaten van spanningen en rekken in betonvezels

Vezel	Materiaal	$y_i$ [m]	$z_i$ [m]	$\epsilon$ [‰]	$\epsilon_{lim}$ [‰]	$\sigma$ [MPa]	$\sigma_{lim}$ [MPa]	$\epsilon / \epsilon_{lim}$ [-]	$\sigma / \sigma_{lim}$ [-]	Controle
1	C35/45	0.4	-0.4	33.6	0	0	0	0	0	OK
2	C35/45	0.4	0	15.4	0	0	0	0	0	OK
3	C35/45	0.4	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
4	C35/45	0	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
5	C35/45	-0.4	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
6	C35/45	-0.4	0	15.4	0	0	0	0	0	OK
7	C35/45	-0.4	-0.4	33.6	0	0	0	0	0	OK
8	C35/45	0	-0.4	33.6	0	0	0	0	0	OK

### Gedetailleerde resultaten van spanningen en rekken in wapeningsstaven

Staf	Materiaal	$d_s$ [mm]	$y_i$ [m]	$z_i$ [m]	$\epsilon$ [‰]	$\epsilon_{lim}$ [‰]	$\sigma$ [MPa]	$\sigma_{lim}$ [MPa]	$\epsilon / \epsilon_{lim}$ [-]	$\sigma / \sigma_{lim}$ [-]	Controle
1	B 500B	16	0.143	0.315	1.08	45	216	466	0.02	0.46	OK
2	B 500B	16	-0.307	0.315	1.08	45	216	466	0.02	0.46	OK
3	B 500B	16	-0.307	-0.315	29.7	45	455	466	0.66	0.98	OK
4	B 500B	16	0.143	-0.315	29.7	45	455	466	0.66	0.98	OK
5	B 500B	16	-0.143	-0.315	29.7	45	455	466	0.66	0.98	OK
6	B 500B	16	0.307	-0.315	29.7	45	455	466	0.66	0.98	OK
7	B 500B	12	-0.317	0.102	10.7	45	441	466	0.24	0.95	OK
8	B 500B	12	-0.317	-0.102	20.1	45	448	466	0.45	0.96	OK
9	B 500B	12	0.317	-0.102	20.1	45	448	466	0.45	0.96	OK
10	B 500B	12	0.317	0.102	10.7	45	441	466	0.24	0.95	OK
11	B 500B	16	0.307	0.315	1.08	45	216	466	0.02	0.46	OK
12	B 500B	16	-0.143	0.315	1.08	45	216	466	0.02	0.46	OK

### Verklaring van fouten, waarschuwingen en opmerkingen

Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

#### 2.1.6. Controle capaciteits-interactie diagram

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Staaf

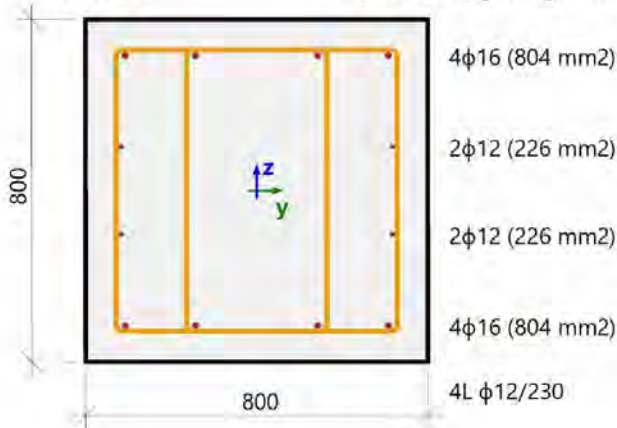
Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 7 [dx = 1.35 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y $\perp$	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z $\perp$	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4 $\phi$ 12+8 $\phi$ 16 (2061 mm <sup>2</sup> )
		$\rho_l = 0.322\%$ (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L $\phi$ 12/230 (452 mm <sup>2</sup> )
		$\rho_w = 0.246\%$ (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Materiaalkarakteristieken

Ontwerpbetondruksterkte

$$f_{cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$$

Ontwerpvloei spanning van langswapening

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa} \quad (3.15)$$

## Krachten

Van EEM analyse

$$N = -43.1 \text{ kN} \quad M_y = 281 \text{ kNm} \quad M_z = -2.53 \text{ kNm}$$

Inhoud van de combinatie:

NC\_UGT-SetB.7

## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0.1 \cdot (23.3 \cdot 10^6 \cdot 0.64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -43 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).



Herberekende buigmomenten:

Momentreductie boven steunpunt: Nee                      Reductie van afschuifkrachten boven steunpunt: Nee

Verschuivingsregel gebruiken: Ja

$N_{Ed} = -43.1 \text{ kN}$     $M_{Edy} = 357 \text{ kNm}$     $M_{Edz} = 0 \text{ kNm}$

### Invoergegevens voor het genereren van interactiediagrammen

Methode van interactieve diagramma controle	$N_u M_u$
Verdeling van verticale rekken	250
Aantal verticale snedes	18
Resultante waarde van buigmoment	$M_{res} = 357 \text{ kNm}$
Hoek van resulterend buigmoment is gerelateerd aan $M_y$ richting in horizontaal vlak $M_y$ - $M_z$	$\alpha_{M_y M_z} = 180^\circ$
Hoek van resulterend buigmoment is gerelateerd aan $N$ richting in verticaal vlak $N$ - $M_{res}$	$\alpha_{NM} = -6.89^\circ$

### Status van scheuren in buiging

$\sigma_{ct,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow$  doorsnede gescheurd bij buiging

### Toetsing van beperkte hoogte van drukzone gebaseerd op 6.1(9) van NEN EN 1992-1-1

Grenswaarde van ontwerpnormaalkracht

$$N_{lim} = 0.1 \cdot A_c \cdot f_{cd} = 0.1 \cdot 0.64 \cdot 23.3 = 1493 \text{ kN}$$

Ontwerpwaarde van normaalkracht

$$N_{Ed} = -43.1 \text{ kN}$$

De waarde  $x_u$  berekend op basis van de weerstanden uit het interactiediagram

$$N_{Rd} = -43.9 \text{ kN}$$

$$M_{Rdy} = 363 \text{ kNm}$$

$$M_{Rdz} = 0 \text{ kNm}$$

Beperkte hoogte van drukzone

$$x_{u,lim} = \frac{500 \cdot 10^6 \cdot d}{500 \cdot 10^6 + f} = \frac{500 \cdot 10^6 \cdot 0.456}{500 \cdot 10^6 + 435 \cdot 10^6} = 0.244 \text{ m}$$

$$x_u < x_{u,lim} \Rightarrow 60.4 \text{ mm} < 244 \text{ mm}$$

Controlewaarde gerelateerd aan de beperking van de drukzone

$$UC_{x_u} = \frac{x_u}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248$$

### Berekening van weerstanden

Weerstanden in positieve richting    $N_{Rd+} = 41 \text{ kN}$     $M_{Rdy+} = 363 \text{ kNm}$     $M_{Rdz+} = 0 \text{ kNm}$

Weerstanden in negatieve richting    $N_{Rd-} = -44 \text{ kN}$     $M_{Rdy-} = -336 \text{ kNm}$     $M_{Rdz-} = 0 \text{ kNm}$



## Overzicht van controle

Krachten:  $N_{Ed} = -43.1 \text{ kN}$   $M_{Edy} = 357 \text{ kNm}$   $M_{Edz} = 0 \text{ kNm}$

Weerstand:  $N_{Rd} = -44 \text{ kN}$   $M_{Rdy} = 363 \text{ kNm}$   $M_{Rdz} = 0 \text{ kNm}$

Berekenen van de eenheidscontrole:

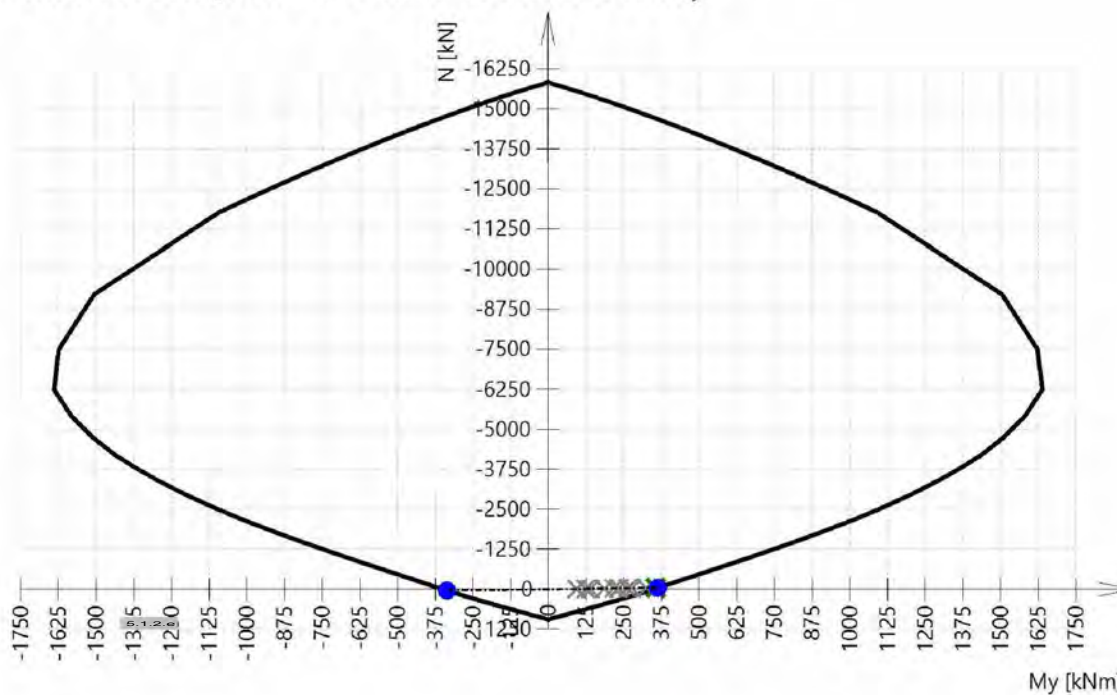
$$UC = \frac{\sqrt{N_{Ed}^2 + M_{Edy}^2 + M_{Edz}^2}}{\sqrt{N_{Rd}^2 + M_{Rdy}^2 + M_{Rdz}^2}} = \frac{\sqrt{-43.1^2 + 357^2 + 0^2}}{\sqrt{-43.9^2 + 363^2 + 0^2}} = 0.981$$

Eenheidscontrole gebaseerd op  $x_{u,lim}$  volgens 6.1(9) van NEN EN 1992-1-1

$$UC_{xu} = \frac{x}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248 \leq 1 \quad \text{OK}$$

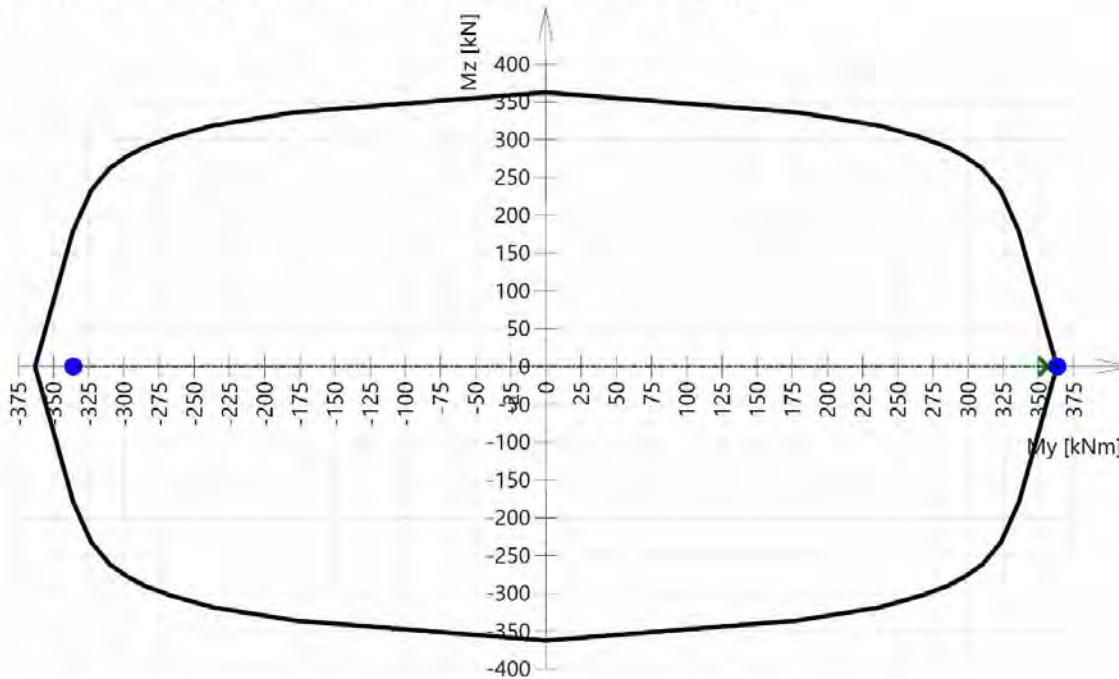
Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

## 3D-interactiediagram - Verticale doorsnede N- $M_y$





### 3D-interactiediagram - Horizontale doorsnede $M_y$ - $M_z$



### Verklaring van fouten, waarschuwingen en opmerkingen

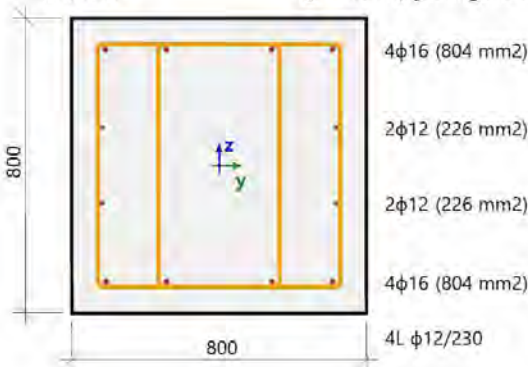
Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

### 2.1.7. Controleer afschuiving+torsie (UGT)

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Doorsnede  
Selectie: Alle  
Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 6 [dx = 1.15 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4φ12+8φ16 (2061 mm <sup>2</sup> )
		ρ <sub>l</sub> = 0.322 % (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L φ12/230 (452 mm <sup>2</sup> )
		ρ <sub>w</sub> = 0.246 % (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Instellingen

Methode voor berekening afschuifweerstand: Standaard

Grenswaarde van de hoek tussen buigende momenten en resultante afschuifkrachten voor het gebruik van de standaardmethode:  $\alpha_{VM,lim} = 15^\circ$

Equivalentente dunwandige doorsnede: Automatisch

De hoek tussen de betondrukschoor en de staaf: Gebruikersinvoer:  $\theta_{inp} = 40^\circ \Rightarrow \cot(\theta_{inp}) = 1.19$

## Krachten

Inhoud van de combinatie: NC\_UGT-SetB.7

$N_{Ed} = -43.1 \text{ kN}$   $M_{Edy} = 357 \text{ kNm}$   $M_{Edz} = 0 \text{ kNm}$   $V_{Edy} = 0 \text{ kN}$   $V_{Edz} = -371 \text{ kN}$   $T_{Ed} = -3.85 \text{ kNm}$

Hoek van gradiënt van rekvlak

$$\alpha_M = 90^\circ$$

Hoek van resultante van afschuiving

$$\alpha_V = -90^\circ$$

Resultante van dwarskracht

$$V_{Ed} = \sqrt{V_{Edy}^2 + V_{Edz}^2} = \sqrt{0^2 + (-371)^2} = 371 \text{ kN}$$

$$\alpha_V = \alpha_V + 180 = -90 + 180 = 90^\circ$$

Verskil tussen hoeken  $\alpha_M$  en  $\alpha_V$

$$\alpha_{MV} = \text{abs}(\alpha_M - \alpha_V) = \text{abs}(90 - 90) = 0^\circ$$

## Materiaalkarakteristieken

Ontwerpbetondruksterkte

$$f_{ctd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$$

Ontwerp betontreksterkte

$$f_{ctd} = \frac{\alpha_{ct} \cdot f_{ctk005}}{\gamma_c} = \frac{1 \cdot 2.2}{1.5} = 1.47 \text{ MPa} \quad (3.15, 3.16)$$





### Berekening van hoek tussen betondrukschoor en staafas

- minimale waarde:

$$\theta_{\min} = 21.8^\circ \Rightarrow \cot(\theta_{\min}) = 2.5 \quad (\S 6.2.3(2))$$

- maximale waarde:

$$\theta_{\max} = 45^\circ \Rightarrow \cot(\theta_{\max}) = 1 \quad (\S 6.2.3(2))$$

- invoer/berekende waarde:

$$\theta = \theta_{\text{inp}} = 40^\circ, \cot(\theta) = 1.19$$

Opm.: Automatische berekening van hoek is uitgeschakeld, gebruikerswaarde wordt in rekening genomen



## Controleer afschuiving en bereken afschuifweerstand

### Doorsnedeparameters

Minimale breedte van doorsnede in trekzone

$$y_{bw} = 0 \text{ mm} \quad z_{bw} = 339 \text{ mm} \quad b_w = 800 \text{ mm}$$

Opm.: Waarde  $b_w$  is berekend als de kleinste breedte van de doorsnede in het trekoppervlak loodrecht op de resultante van de afschuifkracht.

Minimale breedte van de doorsnede tussen trek- en drukschoor

$$y_{bw1} = 0 \text{ mm} \quad z_{bw1} = 378 \text{ mm} \quad b_{w1} = 800 \text{ mm}$$

Opm.: Waarde  $b_{w1}$  is berekend als de kleinste breedte van de doorsnede tussen het trek- en drukkoord loodrecht op de resultante van de afschuifkracht.

Hoogte van doorsnede is herberekend in de richting van de resultante van de dwarskracht

$$h = 800 \text{ mm}$$

Opm.: De waarde  $h$  wordt berekend als de breedte van de doorsnede op het zwaartepunt in de richting van de resultante van de dwarskracht.

Oppervlakte betondoorsnede

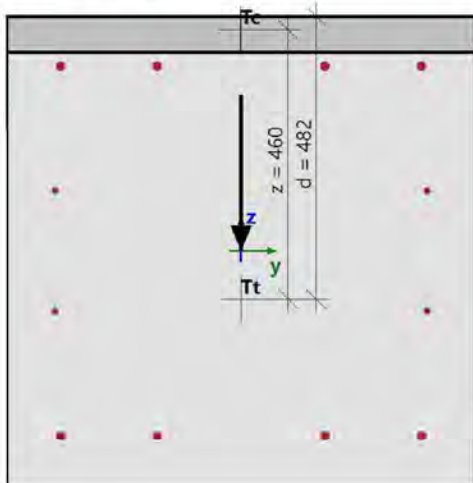
$$A_c = 0.64 \text{ m}^2$$

Effectieve diepte omgerekend naar richting van resultante van dwarskracht

$$d = 482 \text{ mm}$$

Hefboomsarm van interne krachten omgerekend naar richting van resultante van dwarskracht

$$z = 460 \text{ mm}$$





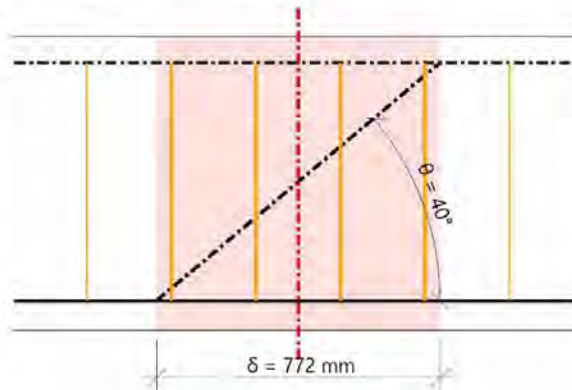
## Parameters van dwarswapening

### Invoerparameters

Beugels over de lengte van scheurafschuifprojectie  $\delta = z \cdot \cot(\theta) = 772 \text{ mm}$ , interval (-386; 386)

$$z = \text{Coeff}_d \cdot \text{Coeff}_z \cdot h = 0.9 \cdot 0.9 \cdot 0.8 = 648 \text{ mm} \quad \delta = z \cdot \cotg(\theta) = 0.648 \cdot \cotg(40) = 772 \text{ mm}$$

ID	Zone	$x_s$ [mm]	$\phi_s$ [mm]	$s_s$ [mm]	$n_s$ []	$\alpha_s$ [°]	$f_{ywk}$ [MPa]
1	1	-345	12	230	4	90	500
2	1	-115	12	230	4	90	500
3	1	115	12	230	4	90	500
4	1	345	12	230	4	90	500
Avg.	-	-	12	230	4	90	500



Aantal snedes per beugel

Diameter van de wapening

Hart - op - hartafstand van beugel in langsrichting

Hoek van beugels van staafas

Karakteristieke vloeigrens

Doorsnedeoppervlakte van dwarswapening

$$A_{sw} = n_s \cdot \pi \cdot \left(\frac{\phi_s}{2}\right)^2 = 4 \cdot 3.14 \cdot \left(\frac{12}{2}\right)^2 = 452 \text{ mm}^2$$

Maximale longitudinale tussenafstand van beugelwapening

$$s_l = s_{inp} = 230 \text{ mm}$$

Doorsnedeoppervlak per meter

$$A_{swm} = \frac{A_{sw}}{s_l} = \frac{452 \cdot 10^{-6}}{0.23} = 1967 \text{ mm}^2/\text{m}$$

$$n_s = 4$$

$$\phi_s = 12 \text{ mm}$$

$$s_{inp} = 0.23 \text{ m}$$

$$\alpha_s = 90^\circ$$

$$f_{ywk} = 500 \text{ MPa}$$

## Parameters van langswapening

Het oppervlak van de trekwapening

$$A_{sl} = 2061 \text{ mm}^2$$



## Berekening van afschuifweerstand

Ontwerpschuifweerstand van de staaf zonder dwarswapening

$$\sigma_{cl,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow \text{doorsnede gescheurd bij buiging}$$

Berekening ontwerp dwarskrachtweerstand van de staaf zonder dwarskrachtwapening volgens artikel 6.2.2(1).

Coëfficiënt voor hoogte van de doorsnede

$$k = \min\left(1 + \left(\frac{200}{d}\right)^{\frac{1}{2}}; 2\right) = \min\left(1 + \left(\frac{200}{482}\right)^{\frac{1}{2}}; 2\right) = 1.64 \quad (\$6.2.2(1))$$

Geometrische wapeningsverhouding

$$\rho_1 = \min\left(\frac{A_{sl}}{b_w \cdot d}; 0.02\right) = \min\left(\frac{2.06 \cdot 10^{-3}}{0.8 \cdot 0.482}; 0.02\right) = 5.34 \cdot 10^{-3} \quad (\$6.2.2(1))$$

Axiale spanning in de doorsnede

$$\sigma_{cp} = \min\left(\frac{-N_{Ed}}{A_c}; 0.2 \cdot f_{cd}\right) = \min\left(\frac{-43.1}{0.64}; 0.2 \cdot 23.3\right) = 0.0674 \text{ MPa} \quad (\$6.2.2(1))$$

Andere coëfficiënten

$$C_{Rdc} = 0.12 \quad v_{min} = 0.437 \text{ MPa} \quad k_1 = 0.15$$

Berekening van de rekenwaarde

$$\begin{aligned} V_{Rdc} &= 10^6 \cdot \left( C_{Rdc} \cdot k \cdot \left( 100 \cdot \rho_1 \cdot f_{ck} \right)^{\frac{1}{3}} + k_1 \cdot \sigma_{cp} \right) \cdot b_w \cdot d \quad (6.2.a) \\ &= 10^6 \cdot \left( 0.12 \cdot 1.64 \cdot \left( 100 \cdot 5.34 \cdot 10^{-3} \cdot 35 \right)^{\frac{1}{3}} + 0.15 \cdot 0.0674 \right) \cdot 0.8 \cdot 0.482 = 206 \text{ kN} \end{aligned}$$

$$\begin{aligned} V_{Rdcmin} &= 10^6 \cdot \left( v_{min} + k_1 \cdot \sigma_{cp} \right) \cdot b_w \cdot d \quad (6.2.b) \\ &= 10^6 \cdot \left( 0.437 + 0.15 \cdot 0.0674 \right) \cdot 0.8 \cdot 0.482 = 172 \text{ kN} \end{aligned}$$

$$V_{Rdc} = \max(V_{Rdc}; V_{Rdcmin}; 0) = \max(205851; 172222; 0) = 206 \text{ kN}$$

Opm.: Ontwerp afschuifweerstand van de staaf zonder de afschuifwapening is berekend volgens Artikel 6.2.2(1), omdat de doorsnede is gescheurd in flexure in UGT of de doorsnede is niet belast door normaalkracht en buigmomenten.



## Ontwerpafschuifweerstand van de staaf met dwarswapening

Ontwerpspanning van dwarswapening

$$A_{sw} = n_s \cdot \pi \cdot \left(\frac{\phi_s}{2}\right)^2 = 4 \cdot 3.14 \cdot \left(\frac{12}{2}\right)^2 = 452 \text{ mm}^2$$

$$\sigma_{swd} = \frac{\frac{V_{Ed}}{z} \cdot s_i}{A_{sw} \cdot (\cotg(\theta) + \cotg(\alpha_s) \cdot \sin(\alpha_s))} = \frac{\frac{371276}{0.46} \cdot 0.23}{452 \cdot 10^{-6} \cdot (\cotg(40) + \cotg(90) \cdot \sin(90))} = 345 \text{ MPa}$$

Ontwerpvloei spanning van dwarswapening

$$f_{ywd} = 0.8 \cdot f_{ywk} = 0.8 \cdot 500 = 400 \text{ MPa} \quad , \text{ omdat } \sigma_{swd} < 0.8 \cdot f_{ywk}$$

Opm.: Ontwerp vloei sterkte van de dwarswapening is gereduceerd tot 0.8 x  $f_{ywk}$  (EN 1992-1-1, Artikel 6.2.3(3)), omdat de ontwerpspanning van de dwarswapening onder de 80% van de karakteristieke vloei spanning  $f_{yk}$  is.

Ontwerpafschuifweerstand van de staaf met dwarswapening

$$V_{Rds} = \frac{A_{sw}}{s_i} \cdot z \cdot f_{ywd} \cdot \cotg(\theta) = \frac{452 \cdot 10^{-6}}{0.23} \cdot 0.46 \cdot 400 \cdot 10^6 \cdot \cotg(40) = 431 \text{ kN} \quad (6.8)$$

## Rekenwaarde van de max. afschuifkracht welke kan worden verdragen door de staaf

Sterktereductiefactor voor beton gescheurd in afschuiving - waarde  $v$

$$v = 0.6 \cdot \left(1 - \frac{f_{ck}}{250}\right) = 0.6 \cdot \left(1 - \frac{35}{250}\right) = 0.516 \quad (6.6N)$$

Sterktereductiefactor voor beton gescheurd in afschuiving - waarde  $v_1$

$$\sigma_{cp} = \min\left(\frac{-N_{Ed}}{A_c}; 0.2 \cdot f_{cd}\right) = \min\left(\frac{-43.1}{0.64}; 0.2 \cdot 23.3\right) = 0.0674 \text{ MPa}$$

$$v_1 = 0.6 \quad (6.10.aN)$$

Coëfficiënt voor de bepaling van de spanning in de drukdiagonaal

$$\alpha_{cw} = 1 \quad (\text{voor niet-voorgespannen element}) \quad (6.2.3(3)N3)$$

Rekenwaarde van de max. afschuifkracht welke kan worden verdragen door de staaf

$$V_{Rdmax} = \frac{\alpha_{cw} \cdot b_{w1} \cdot z \cdot v_1 \cdot f_{cd}}{(\cotg(\theta) + \tg(\theta))} = \frac{1 \cdot 0.8 \cdot 0.46 \cdot 0.6 \cdot 23.3 \cdot 10^6}{(\cotg(40) + \tg(40))} = 2534 \text{ kN} \quad (6.9)$$

Maximale dwarskracht bij het steunpunt (zonder gebruik van factor  $\beta$ )

$$V_{Edmax} = 0.5 \cdot b_{w1} \cdot d \cdot v \cdot f_{cd} = 0.5 \cdot 0.8 \cdot 0.482 \cdot 0.516 \cdot 23.3 \cdot 10^6 = 2321 \text{ kN} \quad (6.5)$$

Afschuifweerstand van de staaf

$$V_{Rd} = \min(V_{Rds} + V_{cdd} + V_{td}; V_{Rdmax} + V_{cdd} + V_{td}; V_{Edmax} + V_{cdd} + V_{td}) = \min(431 + 0 + 0; 2534 + 0 + 0; 2321 + 0 + 0) = 431 \text{ kN}$$



## Afschuifcontrole

Controle  $V_{Rdmax}$

$$V_{Ed} = 371 \text{ kN} \leq V_{Rdmax} + V_{ccd} + V_{td} = 2534 \text{ kN}$$

Opm.: De controle voldoet voor het verbrijzelen van de drukschoor ( $V_{Ed} \leq V_{Rd,max} + V_{td} + V_{ccd}$ ).

Controle  $V_{Edmax}$

$$V_{Ed} = 371 \text{ kN} \leq V_{Edmax} + V_{ccd} + V_{td} = 2321 \text{ kN}$$

Opm.: De controle voldoet voor dwarskracht nabij de ondersteuning ( $V_{Ed} \leq V_{Ed,max} + V_{td} + V_{ccd}$ ).

Controle  $V_{Rdc}$  en  $V_{Rds}$

$$V_{Ed} = 371 \text{ kN} < V_{Rds} + V_{ccd} + V_{td} = 431 \text{ kN}$$

Opm.: De controle voldoet voor dwarswapening ( $V_{Ed} < V_{Rds} + V_{ccd} + V_{td}$ ).

## Eenh. Controle

$$UC = \frac{V_{Ed}}{V_{Rd}} = \frac{371 \text{ kN}}{431 \text{ kN}} = 0.862$$

## Controleer torsie en bereken torsieweerstand

Totale oppervlakte van doorsnede

$$A_c = 640000 \text{ mm}^2$$

Totale oppervlakte van doorsnede

$$u_c = 3200 \text{ mm}$$

De oppervlakte van langswapening voor torsie

$$A_{sl} = 1433 \text{ mm}^2$$

De minimum afstand tussen wapeningsstaven binnen beugel voor torsie en rand van doorsnede

$$a_{sl} = 83 \text{ mm}$$

Effectieve wanddikte

$$t_{ef} = \max\left(\frac{A_c}{u_c}; 2 \cdot a_{sl}\right) = \max\left(\frac{640000}{3200}; 2 \cdot 83\right) = 200 \text{ mm} \quad (\S 6.3.2(1))$$

Omtrek en oppervlakte van de zone binnen de centrale lijn van de effectieve doorsnede

$$u_k = 2071 \text{ mm}$$

$$A_k = 261300 \text{ mm}^2$$

Opm.: Torsieparameters [waardes van  $A_k$  en  $u_k$ ] zijn berekend volgens de automatisch ingestelde methode [Methode = Van torsiebeugel].



## Parameters voor afschuif/torsie wapening

Beugels over de lengte van scheurafschuifprojectie  $\delta = z \cdot \cot(\theta) = 772 \text{ mm}$ , interval (-386; 386)

$$z = \text{Coeff}_d \cdot \text{Coeff}_z \cdot h = 0.9 \cdot 0.9 \cdot 0.8 = 648 \text{ mm} \quad \delta = z \cdot \cotg(\theta) = 0.648 \cdot \cotg(40) = 772 \text{ mm}$$

ID	Zone	$x_s$ [mm]	$\phi_s$ [mm]	$s_s$ [mm]	$n_s$ []	$\alpha_s$ [°]	$f_{ywk}$ [MPa]
1	1	-345	12	230	2	90	500
2	1	-115	12	230	2	90	500
3	1	115	12	230	2	90	500
4	1	345	12	230	2	90	500
Avg.	-	-	12	230	2	90	500

## Invoerparameters

Diameter  $\phi_{st} = 12 \text{ mm}$

Hoek van beugels van staafas  $\alpha_{st} = 90^\circ$

Karakteristieke vloeigrens  $f_{ywk} = 500 \text{ MPa}$

Doorsnedeoppervlakte van dwarswapening

$$A_{swt} = \pi \cdot \left(\frac{\phi_{st}}{2}\right)^2 = 3.14 \cdot \left(\frac{12}{2}\right)^2 = 113 \text{ mm}^2$$

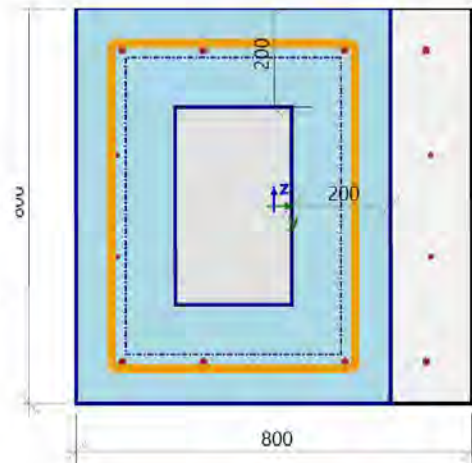
Maximale longitudinale tussenafstand van beugelwapening  $s_{lt} = 230 \text{ mm}$

Doorsnedeoppervlakte van dwarskrachtwapening per meter

$$A_{swtm} = \frac{A_{swt}}{s_{lt}} = \frac{113}{230} = 492 \text{ mm}^2/\text{m}$$

Ontwerpvloeiingspanning van dwarswapening

$$f_{ywd} = \frac{f_{ywk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa}$$



## Berekening van torsie weerstanden

### Ontwerp torsie scheurmoment

$$T_{Rdt} = 2 \cdot f_{ctd} \cdot t_{ef} \cdot A_k = 2 \cdot 1.47 \cdot 200 \cdot 261300 = 153 \text{ kNm}$$

### Ontwerp weerstandbiedend torsiemoment van torsiewapening

$$T_{Rds} = 2 \cdot A_k \cdot \frac{A_{swt}}{s_{lt}} \cdot f_{ywd} \cdot \cotg(\theta) = 2 \cdot 261300 \cdot \frac{113}{230} \cdot 435 \cdot \cotg(40) = 133 \text{ kNm}$$

## Maximaal ontwerptorsieweerstandsmoment

Sterkereductiefactor voor beton gescheurd in afschuiving – waarde v

$$v = 0.6 \cdot \left(1 - \frac{f_{ck}}{250}\right) = 0.6 \cdot \left(1 - \frac{35}{250}\right) = 0.516 \quad (6.6N)$$

$$v_1 = 0.6 \quad (6.10.aN)$$

Coëfficiënt voor de bepaling van de spanning in de drukdiagonaal

$$\alpha_{cw} = 1 \quad (\text{voor niet-voorgespannen element}) \quad (6.2.3(3)N3)$$

Maximaal ontwerptorsieweerstandsmoment

$$T_{Rdmax} = 2 \cdot v \cdot \alpha_{cw} \cdot f_{ctd} \cdot A_k \cdot t_{ef} \cdot \cos(\theta) \cdot \sin(\theta) \\ = 2 \cdot 0.516 \cdot 1 \cdot 23.3 \cdot 261300 \cdot 200 \cdot \cos(40) \cdot \sin(40) = 620 \text{ kNm}$$



Torsie weerstandsmoment van de staaf

$$T_{Rd} = \min(T_{Rdc}; T_{Rdmax}) = 153 \text{ kNm}$$

Additionele torsiekracht

Ontwerp additionele spanning

$$\sigma_{sdl} = \frac{\text{abs}(T_{Ed}) \cdot u_k \cdot \cotg(\theta)}{2 \cdot A_k \cdot A_{sl}} = \frac{\text{abs}(-3.85) \cdot 2071 \cdot \cotg(40)}{2 \cdot 261300 \cdot 1433} = 12.7 \text{ MPa} \quad (6.28)$$

Ontwerp vloeigrens

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa}$$

Ontwerp additionele trekkrachten

$$F_{sdl} = \sigma_{sdl} \cdot A_{sl} = 12.7 \cdot 1433 = 18.2 \text{ kN}$$

Maximale ontwerpkracht

$$F_{sdmax} = f_{yd} \cdot A_{sl} = 435 \cdot 1433 = 623 \text{ kN}$$

## Torsie controle

Controle  $T_{Rdmax}$

$$T_{Ed} = 3.85 \text{ kNm} \leq T_{Rdmax} = 620 \text{ kNm}$$

Opm.: De controle voldoet voor het bezwijken van de drukschoor ( $T_{Ed} < T_{Rd,max}$ ).

Controle  $T_{Rdc}$  en  $T_{Rds}$

$$T_{Ed} = -3.85 \text{ kNm} < T_{Rdc} = 153 \text{ kNm} \text{ and } T_{Ed} = 3.85 \text{ kNm} < T_{Rds} = 133 \text{ kNm}$$

Opm.: De controle voldoet, torsiemoment kan opgenomen worden door het beton ( $T_{Ed} \leq T_{Rdc}$ ), dwarswapening is niet nodig. Het is niet nodig om de torsieweerstand van de ingevoerde afschuifwapening ( $T_{Rds}$ ) te controleren. Daarom wordt de torsieweerstand berekend maar niet gecontroleerd.

Controleer  $F_{sdmax}$

$$F_{sd} = 18.2 \text{ kN} \leq F_{sdmax} = 623 \text{ kN}$$

Opm.: De controle van additionele trekkracht in langswapening is geslaagd.

## Eenh. Controle

$$UC = \max\left(\frac{\text{abs}(T_{Ed})}{T_{Rd}}, \frac{F_{sd}}{F_{sdmax}}\right) = \max\left(\frac{\text{abs}(-3.85 \text{ kNm})}{153 \text{ kNm}}, \frac{18.2 \text{ kN}}{623 \text{ kN}}\right) = 0.0292$$

## Interactie controle $V_y + V_z + T$

Interactiecontrole  $V_y + V_z + T$  (beton)

Controleer vergelijking  $(T_{Ed}/T_{Rdmax}) + (V_{Ed}/V_{Rdmax})$

$$\left(\frac{\text{abs}(T_{Ed})}{T_{Rdmax}}\right) + \left(\frac{\text{abs}(V_{Ed})}{V_{Rdmax}}\right) = \left(\frac{\text{abs}(-3.85)}{620}\right) + \left(\frac{\text{abs}(371)}{2534}\right) = 0.153 \leq 1 \quad (6.29)$$

Opm.: Interactie controle  $V_y + V_z + T$  for het bezwijken van de drukschoor voldoet.





Controleer vergelijking  $(T_{Ed}/T_{Rdc}) + (V_{Ed}/V_{Rdc})$

$$\left( \frac{\text{abs}(T_{Ed})}{T_{Rdc}} \right) + \left( \frac{\text{abs}(V_{Ed})}{V_{Rdc}} \right) = \left( \frac{\text{abs}(-3.85)}{153} \right) + \left( \frac{\text{abs}(371)}{206} \right) = 1.83 > 1 \text{ and } A_{sw} > 0 \quad (6.31)$$

Opm.: Afschuifkrachten en het torsiemoment kunnen niet worden gedragen door het beton, dwarswapening is benodigd.

Eenh. Controle

$$UC_{int,con} = 0.153$$

### Interactiecontrole $V_y + V_z + T$ (dwarswapening)

Ontwerpspanning

$$\sigma_{swd} = \left( \frac{\text{abs}(T_{Ed})}{2 \cdot A_k} + \frac{V_{Ed}}{n_s \cdot z} \right) \cdot \left( \frac{s_{lt}}{A_{swt} \cdot \cotg(\theta)} \right) = \left( \frac{\text{abs}(-3.85)}{2 \cdot 261300} + \frac{371}{4 \cdot 460} \right) \cdot \left( \frac{230}{113 \cdot \cotg(40)} \right) = 357 \text{ MPa}$$

Ontwerp vloeigrens

$$f_{ywd} = 0.8 \cdot f_{ywk} = 0.8 \cdot 500 = 400 \text{ MPa}, \text{ (omdat } \sigma_{swd} < 0.8 \cdot f_{ywk})$$

Opm.: Ontwerp vloeigrens van de dwarswapening is gereduceerd naar  $0.8 \times f_{ywk}$  (EN 1992-1-1, Artikel 6.2.3(3)) omdat de ontwerpspanning van de dwarswapening is onder 80% van de karakteristieke vloeispanning  $f_{yk}$ .

$$\sigma_{swd} = 357 \text{ MPa} < f_{ywd} = 400 \text{ MPa}$$

Opm.: Interactie controle  $V_y + V_z + T$  voor afschuifwapening voldoet.

Eenh. Controle

$$UC_{int,shear} = \frac{\sigma_{swd}}{f_{ywd}} = \frac{357}{400} = 0.893$$

### Totale eenheidscontrole van de interactie

$$UC_{int} = \max(UC_{int,con}; UC_{int,shear}) = \max(0.153; 0.893) = 0.893$$

### Totale waarde van eenheidscontrole

$$UC = \max(UC_{shear}; UC_{tor}; UC_{int,con}; UC_{int,shear}) = \max(0.862; 0.0292; 0.153; 0.893) = 0.893$$

### 2.1.8. Controle limietspanning

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Staaf

Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

## Balk S37

NEN EN 1992-1-1+C2/NB+A1:2020

## Rechthoek (800; 800)

Doorsnede 6 [dx = 1.15 m]



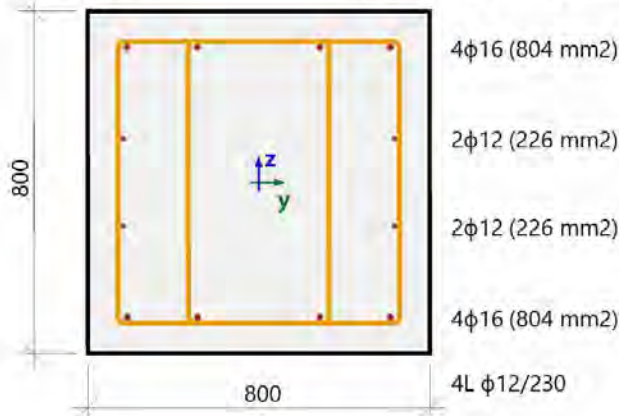
### Staaflengte:

"Knik  $y$ - $y$ ⊥  
Knik  $z$ - $z$ ⊥

$L = 2.3$  m

$L_y = 11.5$  m (zijdelings flexibel)

$L_z = 2.3$  m (zijdelings flexibel)



### Beton: C35/45

Bilineair spanning-rekdiagram

Milieuklasse:

Boven: XC4, XD3, XF2, XA2

Onder: XC2, XD3, XF2, XA2

### Langswapening: B 500B

Bilineair met oplopende bovenvertakking

$4\phi 12 + 8\phi 16$  (2061 mm<sup>2</sup>)

$\rho_l = 0.322$  % (16.2 kg/m)

### Dwarskrachtwapening: B 500B

Bilineair met oplopende bovenvertakking

$4L \phi 12/230$  (452 mm<sup>2</sup>)

$\rho_w = 0.246$  % (15.4 kg/m)

### Dekking (beugel)

Bovenzijde: 65 mm

Onderzijde: 65 mm

Links: 65 mm

Rechts: 65 mm

## Materiaalkarakteristieken

Karakteristieke betondruksterkte Karakteristieke vloeisterkte van de langswapening

$$f_{ck} = 35 \text{ MPa}$$

$$f_{yk} = 500 \text{ MPa}$$

Gemiddelde betontreksterkte

$$f_{ctm} = 3.2 \text{ MPa}$$

Elasticiteitsmodulus van beton:

$$E_c = 34 \text{ GPa}$$

## Krachten

Van EEM analyse

Karakteristieke waarden:

NC\_BGT-kar.5

$$N = -30.9 \text{ kN} \quad M_y = 258 \text{ kNm} \quad M_z = -1.96 \text{ kNm}$$

Quasi-permanente waarden:

NC\_BGT-kar.5

$$N_{qp} = -30.9 \text{ kN} \quad M_{y,qp} = 258 \text{ kNm} \quad M_{z,qp} = -1.96 \text{ kNm}$$

Hoek van resultante van buigmoment:  $\alpha_M = 90.4^\circ$



## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0,1 \cdot (23,3 \cdot 10^6 \cdot 0,64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -31 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).

Karakteristieke waarden:  $N_{char,r} = -30,9 \text{ kN}$   $M_{y,char,r} = 258 \text{ kNm}$   $M_{z,char,r} = 0 \text{ kNm}$

Quasi-permanente waarden:  $N_{qp,r} = -30,9 \text{ kN}$   $M_{y,qp,r} = 258 \text{ kNm}$   $M_{z,qp,r} = 0 \text{ kNm}$

Hoek van resultante van buigmoment:  $\alpha_{M,r} = 90^\circ$

## Overzicht van controle

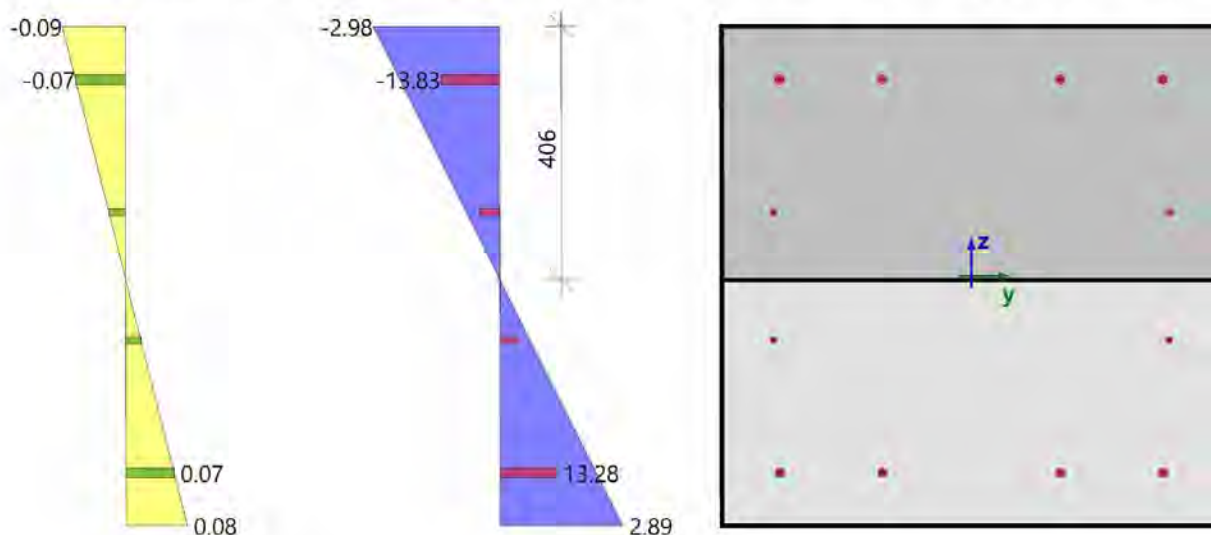
Belasting	E	$E_c$	UC	Status	UC	Status	UC	Status	UC	Grenswaarde	Status
type	[MPa]		$\$7.2(2)$	$\$7.2(2)$	$\$7.2(3)$	$\$7.2(3)$	$\$7.2(5)$	$\$7.2(5)$	[-]	[-]	
			[-]	Kar.	[-]	Q.-P.	[-]	Kar.			
Kort	$E_c$	34100	0.14	OK	0.19	OK	0.03	OK	0.19	1	OK

Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

## Controle van scheuren in doorsnede

Belasting	Type	$E_c$	Combi.	$N_{Ed}$	$M_{Edy}$	$M_{Edz}$	$\sigma_{ct}$	h	$f_{ct,eff}$	Scheur-
	module	[MPa]		[kN]	[kNm]	[kNm]	[MPa]	[mm]	[MPa]	vorming.
Kort	$E_c$	34100	Kar.	-30.9	258	0	2.89	800	3.2	NEE

## Spanning-rekverdeling voor scheurvorming (ongescheurde toestand) - kortetermijnbelasting

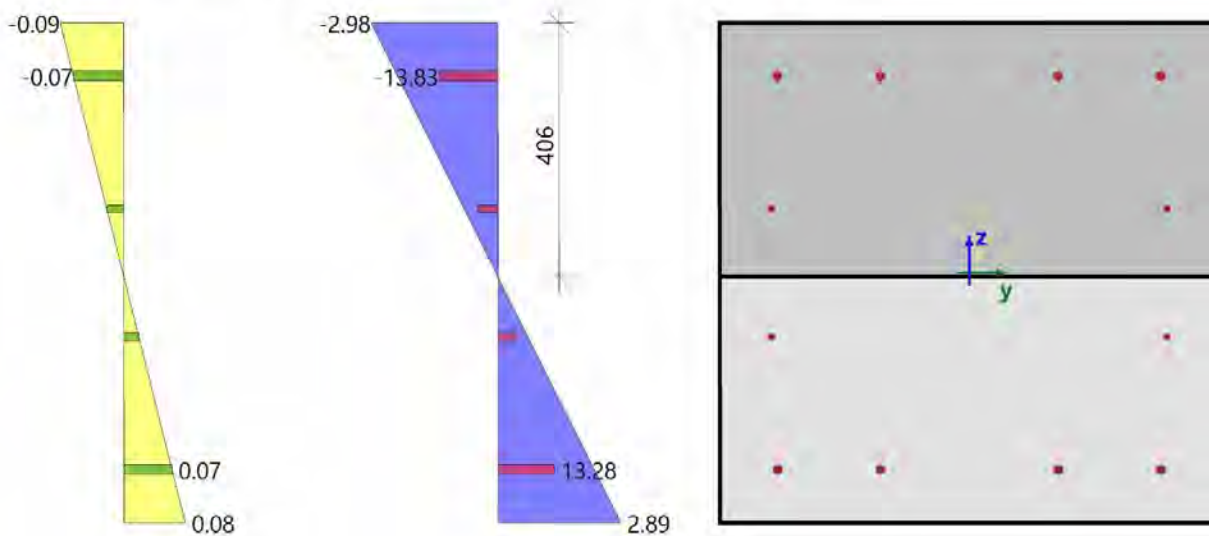




## Doorsnedekarakteristieken

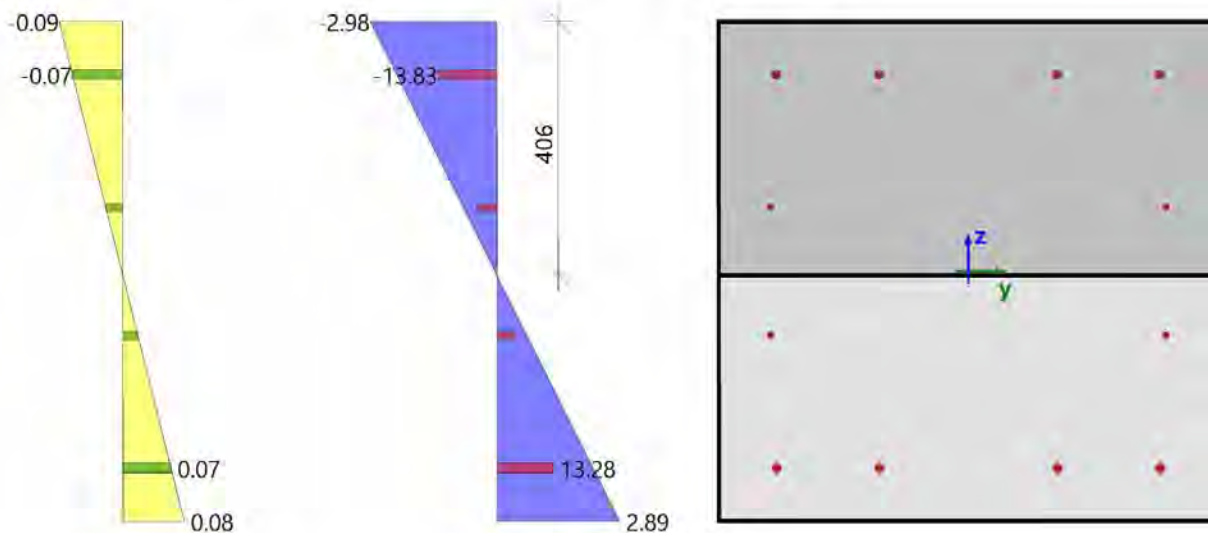
Belasting	Combi.	$t_{iy}$ [m]	$t_{iz}$ [m]	$A_i$ [m <sup>2</sup> ]	$I_{iy}$ [m <sup>4</sup> ]	$I_{iz}$ [m <sup>4</sup> ]	$x_i$ [m]	$\epsilon_{c,max}$ [‰]	$\epsilon_{c,min}$ [‰]	$\sigma_{c,max}$ [MPa]	$\sigma_{c,min}$ [MPa]
Kort	Kar.	0	0	0.652	0.0351	0.0349	0.406	0.085	-0.087	2.89	-2.98
Kort	Q.-P.	0	0	0.652	0.0351	0.0349	0.406	0.085	-0.087	2.89	-2.98

## Spanning-rekverdeling met betontreksterkte onder karakteristieke combinatie - kortetermijnbelasting





## Spanning-rekverdeling met betontreksterkte onder quasi-permanente combinatie - kortetermijnbelasting



### Spanningscontrole in beton

Controletype	Belasting	$N_{Ed}$ [kN]	$M_{Edy}$ [kNm]	$M_{Edz}$ [kNm]	$y_i$ [mm]	$z_i$ [mm]	$\sigma_c$ [MPa]	$\sigma_{c,lim}$ [MPa]	$\sigma_c/\sigma_{c,lim}$ [-]	Status
§7.2(2) Kar.	Kort	-30.9	258	0	0.4	0.4	-2.98	-21	0.142	OK
§7.2(3) Q.-P.	Kort	-30.9	258	0	0.4	0.4	-2.98	-15.8	0.189	OK

### Spanningscontrole in niet-voorgespannen wapening

Controletype	Belasting	$N_{Ed}$ [kN]	$M_{Edy}$ [kNm]	$M_{Edz}$ [kNm]	$y_i$ [mm]	$z_i$ [mm]	$\sigma_s$ [MPa]	$\sigma_{s,lim}$ [MPa]	$\sigma_s/\sigma_{s,lim}$ [-]	Status
§7.2(5) Kar.	Kort	-30.9	258	0	-0.31	-0.32	13.3	500	0.027	OK

### Verklaring van fouten, waarschuwingen en opmerkingen

Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

#### 2.1.9. Controle scheurwijdte (BGT)

Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Staaf  
Extreme 1D: Doorsnede  
Selectie: Alle  
Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 0 [dx = 0 m]
<b>Staaflengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y <sup>⊥</sup>	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z <sup>⊥</sup>	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
	4φ16 (804 mm <sup>2</sup> )	Boven: XC4, XD3, XF2, XA2
	2φ12 (226 mm <sup>2</sup> )	Onder: XC2, XD3, XF2, XA2
	2φ12 (226 mm <sup>2</sup> )	<b>Langswapening: B 500B</b>
	4φ16 (804 mm <sup>2</sup> )	Bilineair met oplopende bovenvertakking
	4L φ12/230	4φ12+8φ16 (2061 mm <sup>2</sup> )
		ρ <sub>l</sub> = 0.322 % (16.2 kg/m)
	<b>Dwarskrachtwapening: B 500B</b>	Bilineair met oplopende bovenvertakking
	4L φ12/230 (452 mm <sup>2</sup> )	ρ <sub>w</sub> = 0.246 % (15.4 kg/m)
	<b>Dekking (beugel)</b>	
	Bovenzijde: 65 mm	
	Onderzijde: 65 mm	
	Links: 65 mm	
	Rechts: 65 mm	

## Materiaalkarakteristieken

Effectieve sterkte van beton:

$$f_{ct,eff} = f_{ctm} = 3.2 \text{ MPa}$$

Betonsterkte bij scheurvorming:

$$\sigma_{cr} = 3.2 \text{ MPa}$$

Elasticiteitsmodulus van beton:

$$E_c = E_{cm} = 34.1 \text{ GPa}$$

## Krachten

Karakteristieke waarden

NC\_BGT-kar.1

$$N_{char} = 10.4 \text{ kN} \quad M_{y,char} = 19.1 \text{ kNm} \quad M_{z,char} = 0 \text{ kNm}$$

Frequente waarden

NC\_BGT-kar.1

$$N_{freq} = 10.4 \text{ kN} \quad M_{y,freq} = 19.1 \text{ kNm} \quad M_{z,freq} = 0 \text{ kNm}$$

Hoek van de buigendmoment resultante

$$\alpha_M = 90^\circ$$

## Doorsnedekarakteristieken

Type	Doorsnede niet-gescheurd	CSS gescheurd
t <sub>iy</sub> [m]	0	0
t <sub>iz</sub> [m]	0	0.303
A <sub>i</sub> [m <sup>2</sup> ]	0.652	0.0785
I <sub>iy</sub> [m <sup>4</sup> ]	0.0351	9.53·10 <sup>-3</sup>
I <sub>iz</sub> [m <sup>4</sup> ]	0.0349	4.35·10 <sup>-3</sup>

## Berekening van scheurkrachten (ongescheurde sectie)

Maximale spanning in beton

$$\sigma_{ct} = 0.233 \text{ MPa}$$

Scheurkrachten

$$N_{cr} = 142 \text{ kN} \quad M_{cy} = 262 \text{ kNm} \quad M_{cz} = 0 \text{ kNm}$$

$$\sigma_{ct} = 0.233 \text{ MPa} < \sigma_{cr} = 3.2 \text{ MPa} \Rightarrow \text{Geen scheurvorming}$$

Opm.: De scheur is niet verschenen, omdat de maximale trekspanning is minder dan de scheursterkte.

Berekening scheurwijdte

$$w = 0 \text{ mm}$$



Project	4922005	Datum	08. 03. 2019
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.8 35/35

## Eenh. Controle

Berekening eenheidscontrole

$$UC = \frac{w}{w_{\max}} = \frac{0 \text{ mm}}{0.2 \text{ mm}} = \mathbf{0}$$

Controle scheurwijdte

$$w = \mathbf{0 \text{ mm}} = < w_{\max} = \mathbf{0.2 \text{ mm}}$$

Opm.: Controle scheurwijdte voldoet, omdat de scheur kleiner is dan de limietwaarde.



15-12-2022

## Leidingbrug CCS Zone 17

### Aan

5.1.2.e  
5.1.2.e @yara.com

### Van

5.1.2.e  
5.1.2.e @konstruktis.com

### CC

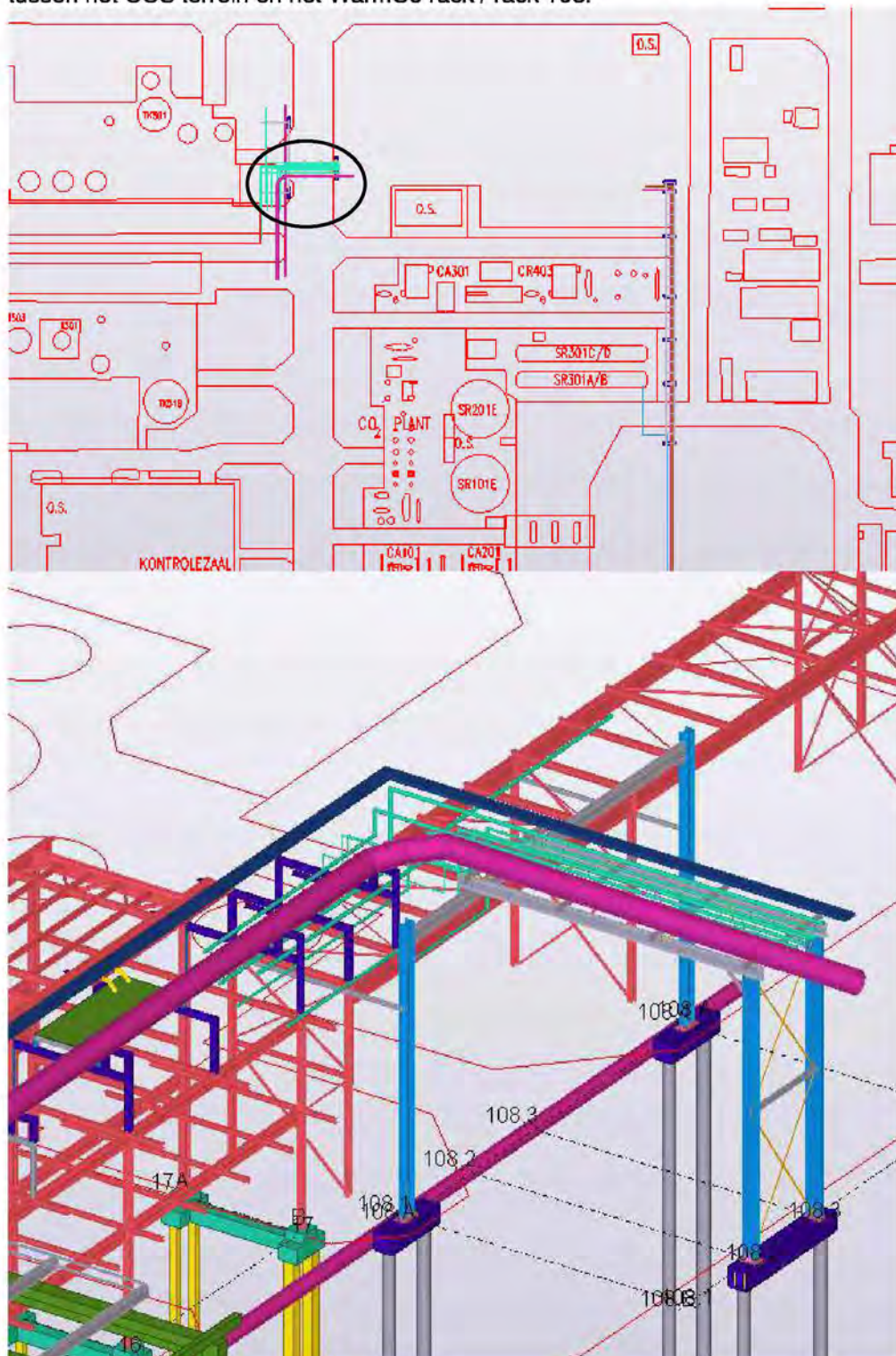
5.1.2.e  
5.1.2.e @konstruktis.com

### Betreft

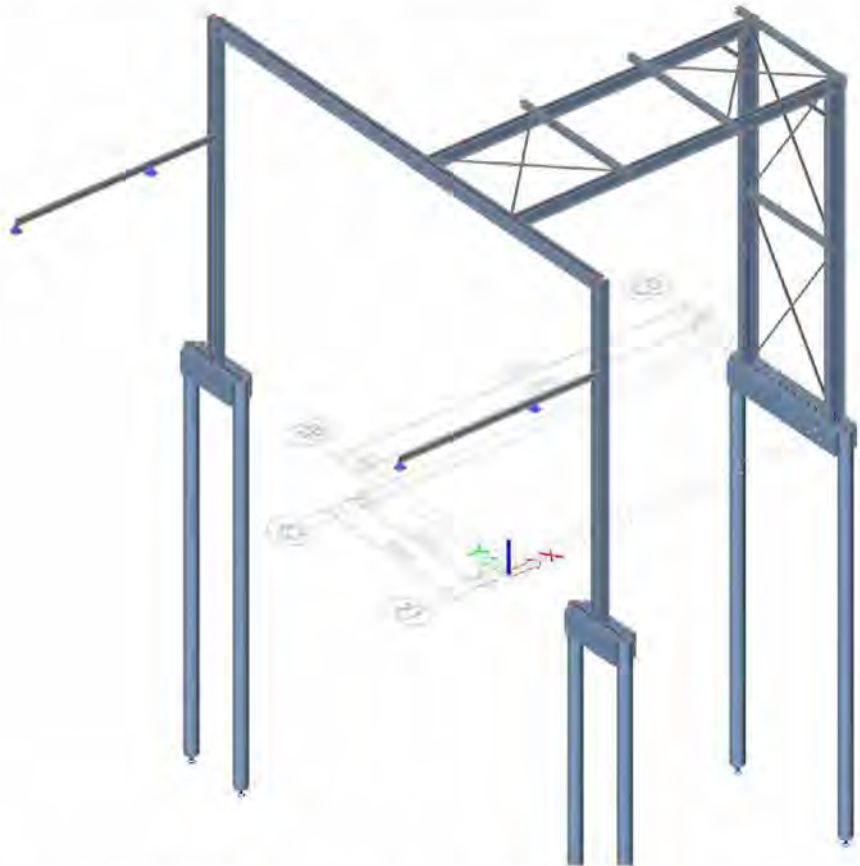
Leidingbrug CCS Zone 17

Beste 5.1.2.e

In deze memo word de basis toetsing gedaan van de brug die als koppeling dient tussen het CCS terrein en het WarmCo rack / rack 108.





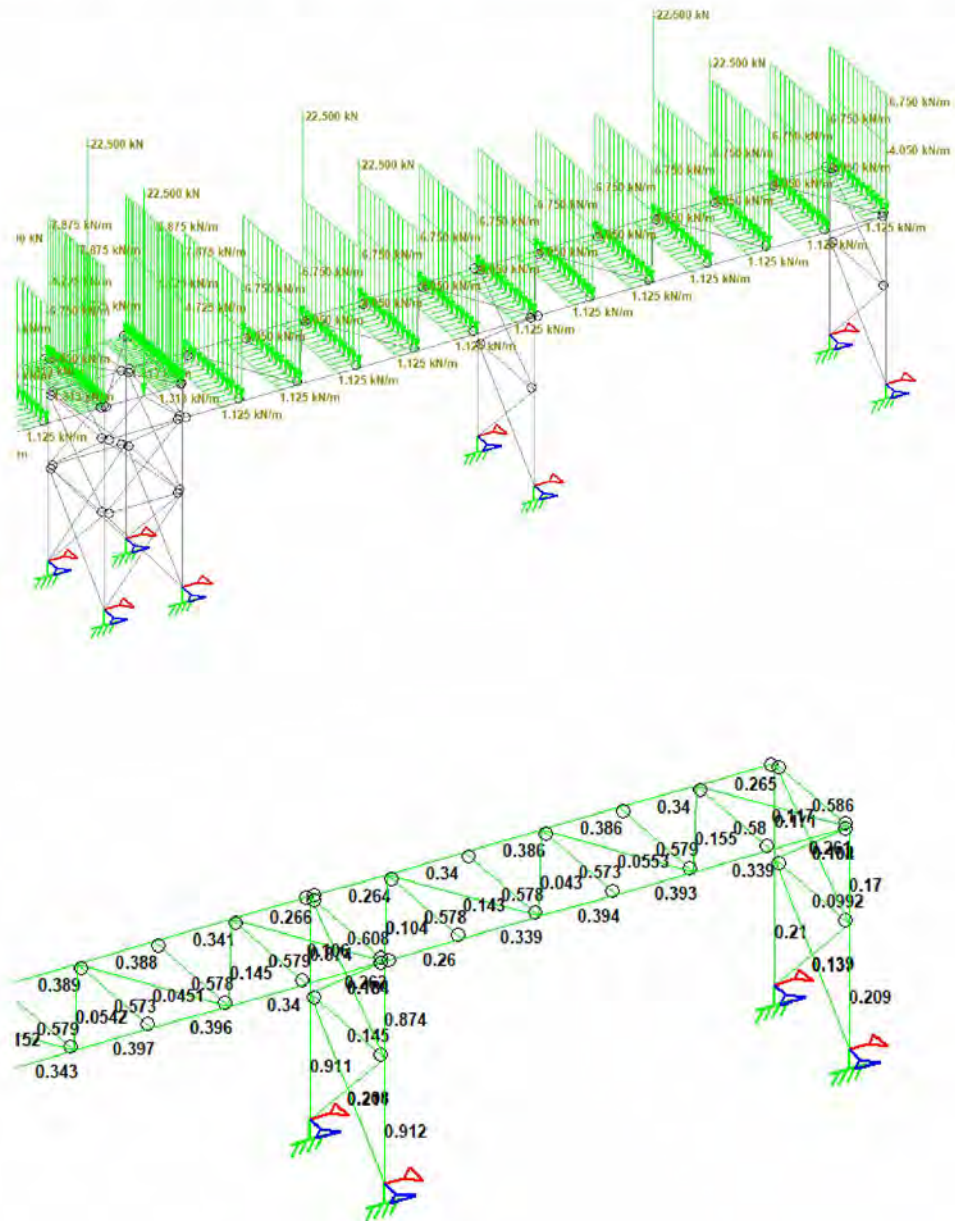


Op basis van de funderingsgegevens voor het Compressorhuis gedeelte zijn de palen hier ingeschat op een Fundex paal  $\varnothing 460$  met een lengte van 14 m.

In de bijgevoegde uitvoer van Scia is aangetoond dat deze brug voldoet aan de gevraagde eisen.

Voor de stabiliteit wordt gebruik gemaakt van het WarmCo rack, hiervan is daarom een aparte toetsing gemaakt.

De berekening is origineel opgesteld door Jacobs middels STAAD.pro.

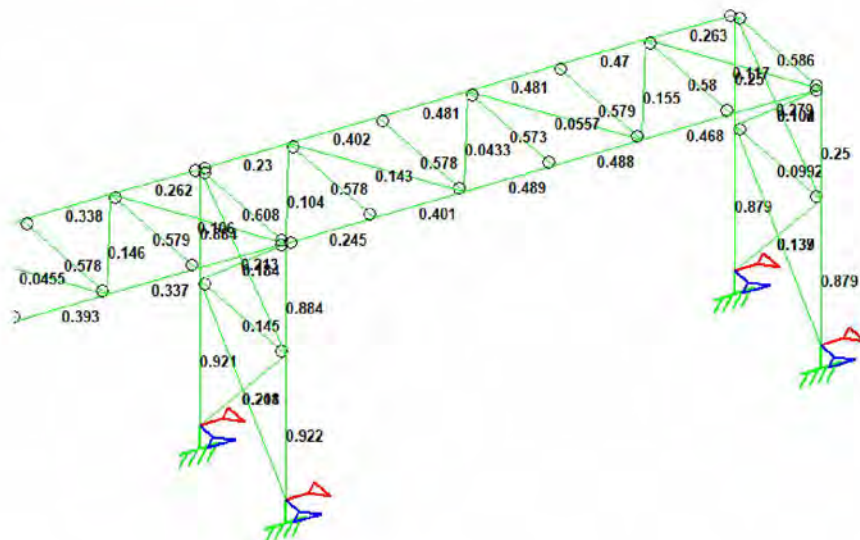
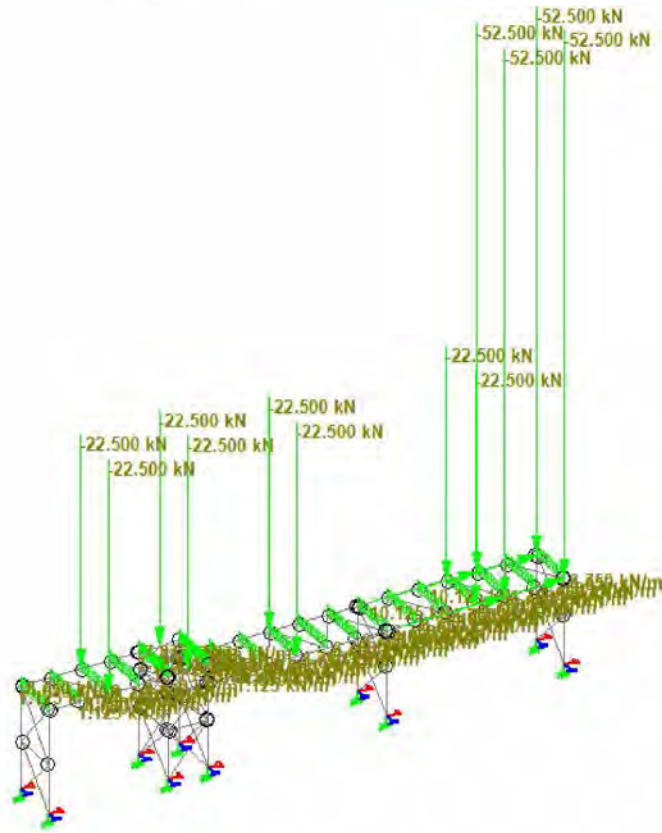


De bestaande constructie is daarbij als uitgangspunt genomen waarop de nieuwe lasten zijn toegevoegd. Voor de nieuwe lasten is gerekend met  $3 \text{ kN/m}^2$  aan veranderlijk +  $1.5 \text{ kN/m}^2$  als permanent, wat samengesteld  $4.5 \text{ kN/m}^2$  wordt wat als veranderlijk (conservatief) is gerekend over een oppervlak van  $6 \times 5 = 30 \text{ m}^2$  wat in 4 puntlasten van  $35 \text{ kN}$  (afgerond + staalgewicht) resulteerd. Voor de horizontaalkrachten wordt met  $3 \times 30 \times 0.3 / 4 = 6.75 \text{ kN}$  resulteerd.



Projectno. : 4922005  
Doc. no. : M1101  
Project : Piperacks CCS

revision : -  
Date : 15-dec-22  
Page no. : MEM - 4

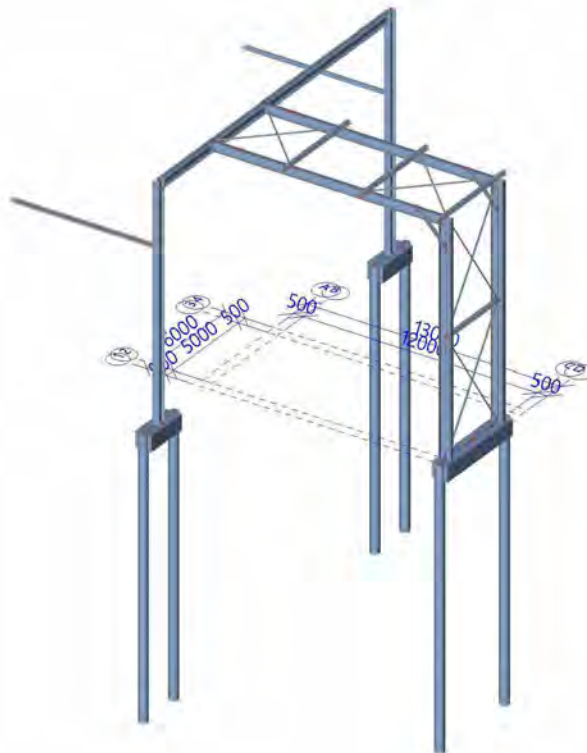


Het eindspant zal hierbij in de belasting toenemen van 21% naar 88% gebaseerd op de kniklengte. Voor de liggers is dit van 39.3% naar 48.9%. Gebaseerd op deze resultaten voldoet het bestaande rack aan alle eisen.



# Bijlage 1.

## Invoer Scia Rekenmodel





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Rekenmodel	3
2.1. Instellingen manager	3
2.2. Algemene model omschrijving	4
2.2.1. Isometric view	4
2.2.2. Isometric view	5
2.2.3. X view	6
2.2.4. Y view	7
2.2.5. Z view	8
2.2.6. Materialen	8
2.2.7. Doorsneden	9
2.2.8. Analysis model	13
2.2.9. Lagen	13
2.2.10. UCS	13
2.3. Model gegevens	14
2.3.1. Instellingen net	14
2.3.2. Instellingen solver	14
2.3.3. 1D	15
2.3.3.1. Knopen	15
2.3.3.2. Knopen	16
2.3.3.3. Staven	16
2.3.3.4. Staven	17
2.3.3.5. Scharnieren	18
2.3.3.6. Staaf niet-lineariteit	18
2.3.3.7. Kruisende staven	18
2.3.4. 2D	18
2.3.4.1. Platen	19
2.3.5. Supports	20
2.3.5.1. Steunpunten	20
2.3.5.2. Knoopondersteuning	20
2.3.5.3. Puntondersteuning op staaf	21
2.3.5.4. Lijnondersteuning op staven	21
3. Belastingen	25
3.1. Belastinggevallen	25
3.2. Belastinggevallen	25
3.2.1. Belastinggevallen - BG101	25
3.2.2. Belastinggevallen - BG102	26
3.2.3. Belastinggevallen - BG111	27
3.2.4. Belastinggevallen - BG112	28
3.2.5. Belastinggevallen - BG121	29
3.3. Belastinggroepen	30
3.4. Combinaties	30
3.5. Niet-lineaire combinaties	30
3.6. Resultaatklassen	32
4. Berekeningsverslag	33
5. Berekeningsverslag	33



## 2. Rekenmodel

### 2.1. Instellingen manager

#### Combinatie Instellingen

Categorie H lasten moeten niet gecombineerd worden met sneeuw of wind

#### Psi factoren

Belasting	Psi0	Psi1	Psi2
CategoryA	0.4	0.5	0.3
CategoryB	0.5	0.5	0.3
CategoryC	0.6	0.7	0.6
CategoryD	0.4	0.7	0.6
CategoryE	1	0.9	0.8
CategoryF	0.7	0.7	0.6
CategoryG	0.7	0.5	0.3
CategoryH	0	0	0
Sneeuw	0	0.2	0
Wind	0	0.2	0
Temperatuur	0	0.5	0
Regenwater	0	0	0
Constructiebelasting	1	0	0.2

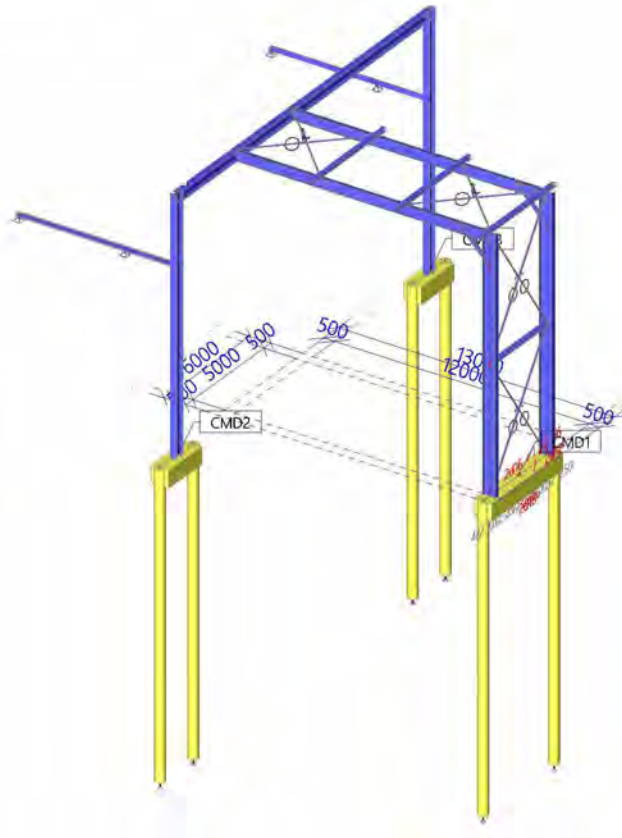
#### Belastingfactoren

Permanente actie - ongunstig	1.35
Permanente actie - gunstig [-]	0.90
Variabele last	1.50
Begeleidende variabele actie	1.50
Reductie factor ksi [-]	0.89
Permanente actie - ongunstig	1.00
Permanente actie - gunstig	1.00
Variabele last	1.30
Begeleidende variabele actie	1.30



## 2.2. Algemene model omschrijving

### 2.2.1. Isometric view



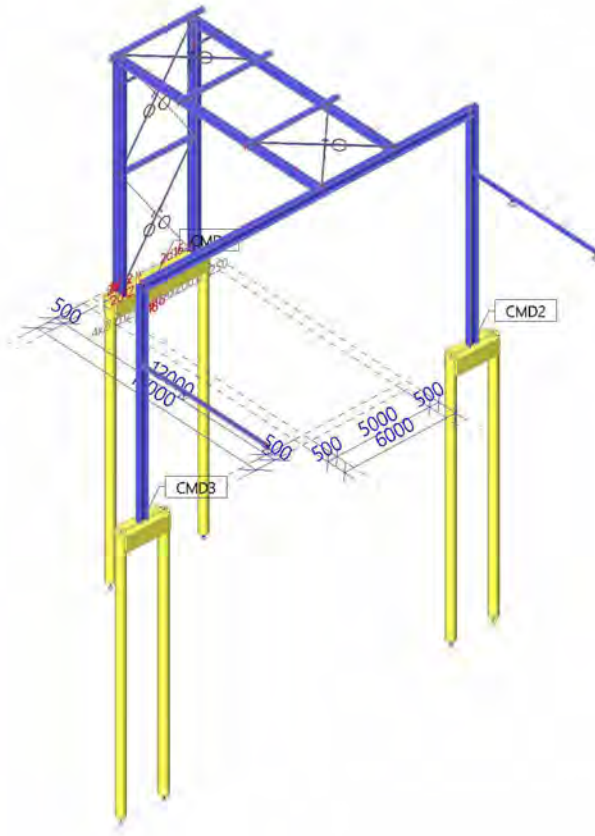


Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur S.1.2.e  
5/36

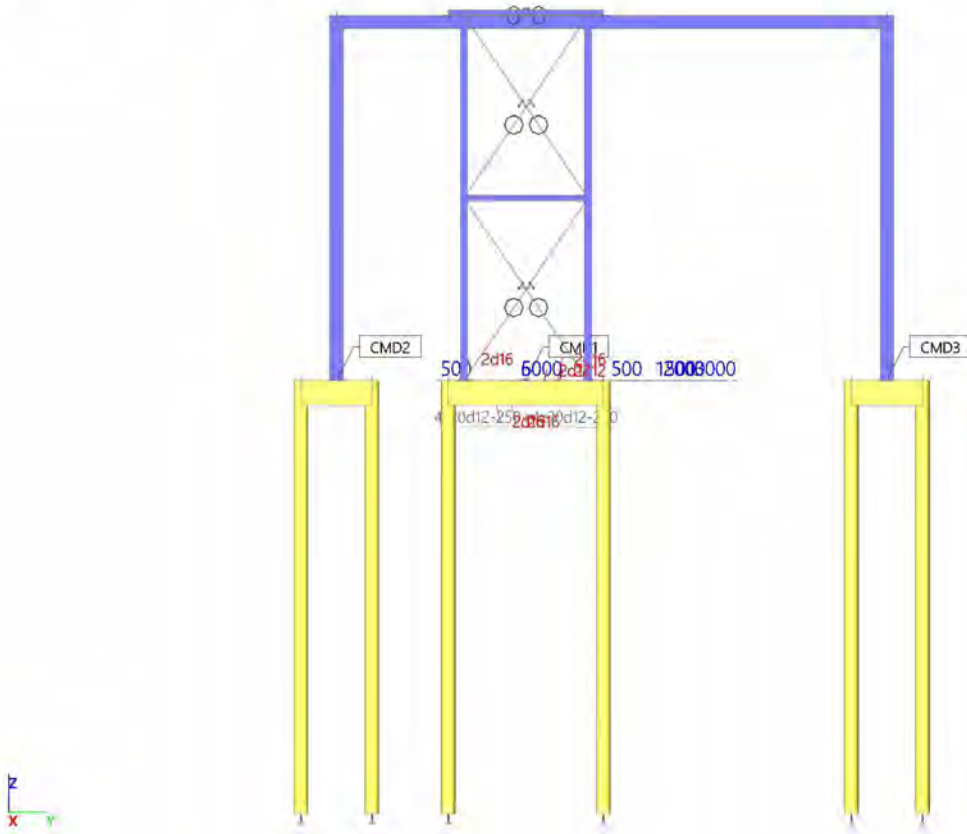
## 2.2.2. Isometric view







## 2.2.3. X view



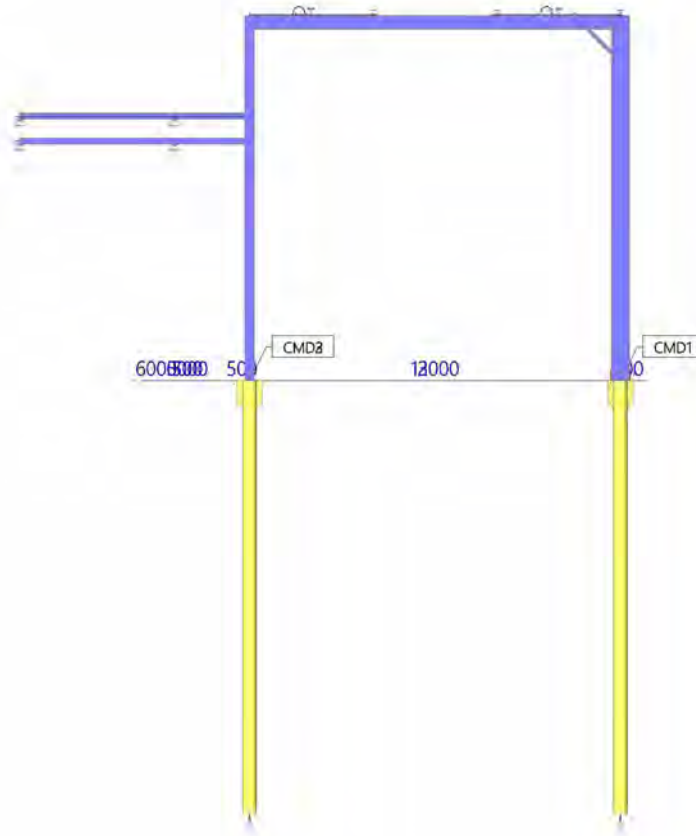


Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

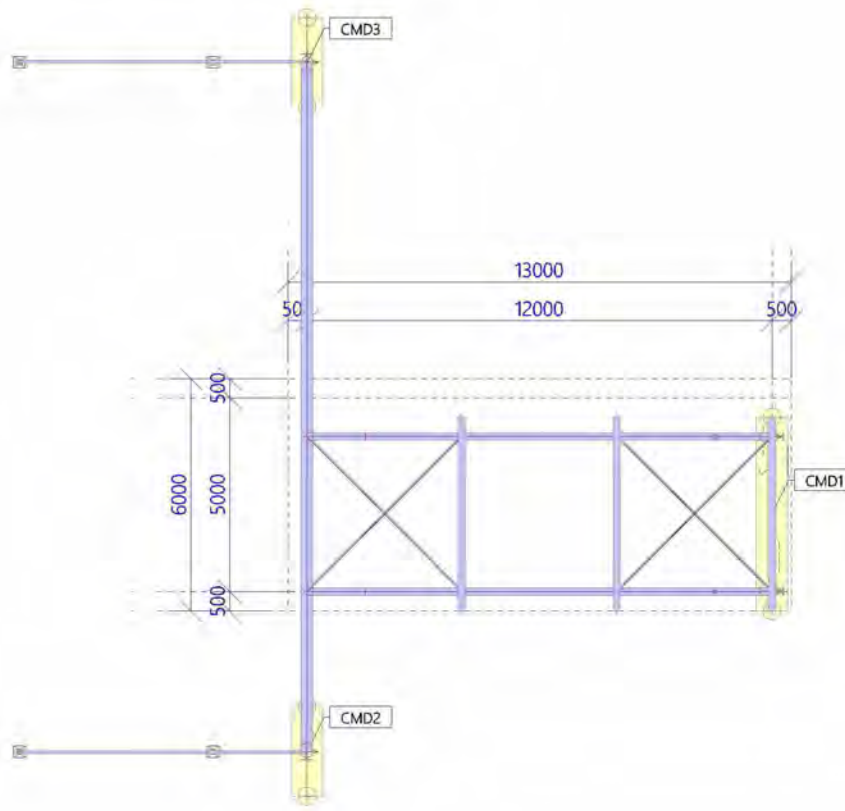
Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur S.12.8  
7/36

## 2.2.4. Y view





## 2.2.5. Z view



## 2.2.6. Materialen

### Staal EC3

Naam	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa]	Poisson - nu	Onderlimiet [mm]	Bovenlimiet [mm]	Fy (bereik) [MPa]	Fu (bereik) [MPa]
		G-mod [MPa]	Thermisch uitz. [m/mK]				
S 235 JR (EN 10025-2)	8000.0	2.1000e+05 8.0769e+04	0.3 0.00	0	3	235.0	360.0
				3	16	235.0	360.0
				16	40	225.0	360.0
				40	63	215.0	360.0
				63	80	215.0	360.0
				80	100	215.0	360.0
				100	150	195.0	350.0
				150	200	185.0	340.0
				200	250	175.0	340.0

### Beton EC2

Naam	Type	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa]	Poisson - nu	Thermisch uitz. [m/mK]	Karakteristieke cilinderdruksterkte f <sub>ck</sub> (28) [MPa]
C35/45	Beton	2500.0	3.4100e+04	0.2	0.00	35.00



## Wapening EC2

Naam	Type	Massa eenheid [kg/m <sup>3</sup> ]	E-mod [MPa]	G-mod [MPa]	Thermisch uitz. [m/mK]	Karakteristieke vloeisterkte fyk [MPa]
B 500B	Betonstaal	7850.0	2.0000e+05	8.3333e+04	0.00	500.0

Naam	E-mod [MPa]	Poisson - nu	Massa eenheid [kg/m <sup>3</sup> ]	Log. decrement (niet-uniforme demping enkel)	Specifieke hitte [J/gK]
Type	G-mod [MPa]				
Rigid	1.0000e+12	0.3	0.0	0.15	6.0000e-01
Algemeen materiaal	3.8462e+11				

### Verklaring van symbolen

Log. decrement (niet-uniforme demping enkel)	Deze materiaal dempingseigenschap is enkel toegepast in het geval van het niet-uniform is demping is geactiveerd voor dynamische analyse (zie project functionaliteit). Gelieve op te merken, dat niet-uniforme demping een specifieke licentie benodigd, welke geen deel uit maakt van het standaard dynamische pakket.
--	---

## 2.2.7. Doorsneden

BT-11		
Type	Cirkel	
Gedetailleerd	460	
Vorm type	Dikke wanden	
Onderdeelmateriaal	C35/45	
Bouwwijze	beton	
A [m <sup>2</sup> ]	1.6619e-01	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.4936e-01	1.4936e-01
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	2.1979e-03	2.1979e-03
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	9.5559e-03	9.5559e-03
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	1.6223e-02	1.6223e-02
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	6.1807e-15	4.4047e-03
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	230	230
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	0.00e+00	0.00e+00
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	0.00e+00	0.00e+00
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.4451e+00	1.4451e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

BT-12		
Type	Rechthoek	
Gedetailleerd	800; 800	
Vorm type	Dikke wanden	
Onderdeelmateriaal	C35/45	

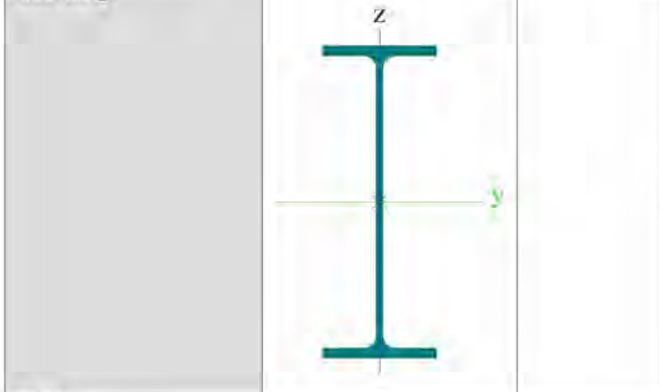
Bouwwijze beton		
A [m <sup>2</sup> ]	6.4000e-01	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	5.3391e-01	5.3391e-01
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	3.4133e-02	3.4133e-02
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	8.5333e-02	8.5333e-02
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	0.0000e+00	0.0000e+00
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	3.3063e-05	5.7500e-02
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	400	400
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	0.00e+00	0.00e+00
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	0.00e+00	0.00e+00
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	3.2000e+00	3.2000e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

ST-11		
Type	IPE600	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	a	b
A [m <sup>2</sup> ]	1.5600e-02	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	8.6202e-03	7.2722e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	9.2080e-04	3.3870e-05
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	3.0700e-03	3.0800e-04



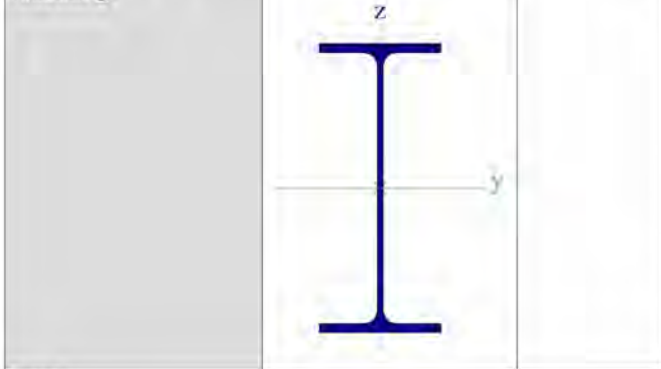
Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.12a 10/36

$W_{ply}$ [m <sup>3</sup> ], $W_{plz}$ [m <sup>3</sup> ]	3.5120e-03	4.8600e-04
$I_w$ [m <sup>6</sup> ], $I_t$ [m <sup>4</sup> ]	2.8460e-06	1.6500e-06
$d_y$ [mm], $d_z$ [mm]	0	0
$c_{yucs}$ [mm], $c_{zucs}$ [mm]	110	300
$\alpha$ [deg]	0.00	
$M_{ply+}$ [Nm], $M_{ply-}$ [Nm]	8.26e+05	8.26e+05
$M_{plz+}$ [Nm], $M_{plz-}$ [Nm]	1.14e+05	1.14e+05
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.0146e+00	2.0146e+00
$\beta_y$ [mm], $\beta_z$ [mm]	0	0
Afbeelding		



### ST-12

Type	IPE450	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	a	b
A [m <sup>2</sup> ]	9.8800e-03	
$A_y$ [m <sup>2</sup> ], $A_z$ [m <sup>2</sup> ]	5.5856e-03	4.3051e-03
$I_y$ [m <sup>4</sup> ], $I_z$ [m <sup>4</sup> ]	3.3740e-04	1.6760e-05
$W_{ely}$ [m <sup>3</sup> ], $W_{elz}$ [m <sup>3</sup> ]	1.5000e-03	1.7600e-04
$W_{ply}$ [m <sup>3</sup> ], $W_{plz}$ [m <sup>3</sup> ]	1.7020e-03	2.7600e-04
$I_w$ [m <sup>6</sup> ], $I_t$ [m <sup>4</sup> ]	7.9100e-07	6.6900e-07
$d_y$ [mm], $d_z$ [mm]	0	0
$c_{yucs}$ [mm], $c_{zucs}$ [mm]	95	225
$\alpha$ [deg]	0.00	
$M_{ply+}$ [Nm], $M_{ply-}$ [Nm]	4.00e+05	4.00e+05
$M_{plz+}$ [Nm], $M_{plz-}$ [Nm]	6.50e+04	6.50e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.6050e+00	1.6050e+00
$\beta_y$ [mm], $\beta_z$ [mm]	0	0
Afbeelding		



### ST-13

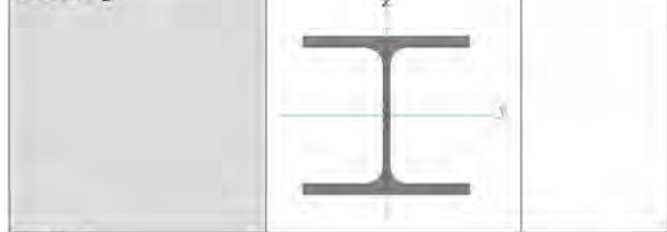
Type	HEA180	
Vormnorm	1 - I-doorsnede	

Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	b	c
A [m <sup>2</sup> ]	4.5300e-03	
$A_y$ [m <sup>2</sup> ], $A_z$ [m <sup>2</sup> ]	3.2772e-03	1.0992e-03
$I_y$ [m <sup>4</sup> ], $I_z$ [m <sup>4</sup> ]	2.5100e-05	9.2500e-06
$W_{ely}$ [m <sup>3</sup> ], $W_{elz}$ [m <sup>3</sup> ]	2.9400e-04	1.0300e-04
$W_{ply}$ [m <sup>3</sup> ], $W_{plz}$ [m <sup>3</sup> ]	3.2500e-04	1.5667e-04
$I_w$ [m <sup>6</sup> ], $I_t$ [m <sup>4</sup> ]	6.0211e-08	1.4800e-07
$d_y$ [mm], $d_z$ [mm]	0	0
$c_{yucs}$ [mm], $c_{zucs}$ [mm]	90	86
$\alpha$ [deg]	0.00	
$M_{ply+}$ [Nm], $M_{ply-}$ [Nm]	7.64e+04	7.64e+04
$M_{plz+}$ [Nm], $M_{plz-}$ [Nm]	3.68e+04	3.68e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.0200e+00	1.0241e+00
$\beta_y$ [mm], $\beta_z$ [mm]	0	0
Afbeelding		



### ST-14

Type	HEA120	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	b	c
A [m <sup>2</sup> ]	2.5300e-03	
$A_y$ [m <sup>2</sup> ], $A_z$ [m <sup>2</sup> ]	1.8775e-03	6.1698e-04
$I_y$ [m <sup>4</sup> ], $I_z$ [m <sup>4</sup> ]	6.0600e-06	2.3100e-06
$W_{ely}$ [m <sup>3</sup> ], $W_{elz}$ [m <sup>3</sup> ]	1.0600e-04	3.8500e-05
$W_{ply}$ [m <sup>3</sup> ], $W_{plz}$ [m <sup>3</sup> ]	1.1958e-04	5.8750e-05
$I_w$ [m <sup>6</sup> ], $I_t$ [m <sup>4</sup> ]	6.4719e-09	5.9900e-08
$d_y$ [mm], $d_z$ [mm]	0	0
$c_{yucs}$ [mm], $c_{zucs}$ [mm]	60	57
$\alpha$ [deg]	0.00	
$M_{ply+}$ [Nm], $M_{ply-}$ [Nm]	2.81e+04	2.81e+04
$M_{plz+}$ [Nm], $M_{plz-}$ [Nm]	1.38e+04	1.38e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	6.7700e-01	6.7730e-01
$\beta_y$ [mm], $\beta_z$ [mm]	0	0
Afbeelding		



### ST-15

Type	FLA80/10	
Vormnorm	7 - Volledig rechthoekige doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	



Knik y-y, Knik z-z	c	c
A [m <sup>2</sup> ]	8.0000e-04	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	6.6667e-04	6.6667e-04
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	6.6667e-09	4.2667e-07
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	1.3333e-06	1.0667e-05
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	2.0000e-06	1.6000e-05
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	0.0000e+00	2.6667e-08
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	40	5
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	4.70e+02	4.70e+02
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	3.76e+03	3.76e+03
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	1.8000e-01	1.8000e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

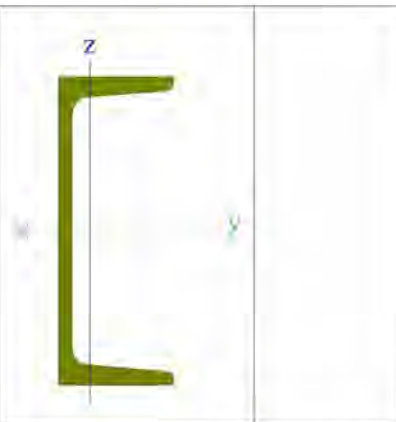
<b>ST-16</b>		
Type	L60X6	
Vormnorm	4 - L-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	b	b
A [m <sup>2</sup> ]	6.9100e-04	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	5.7999e-04	5.8516e-04
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	3.6100e-07	9.4300e-08
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	8.5150e-06	3.9562e-06
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	1.3551e-05	6.9893e-06
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	2.1441e-41	8.6400e-09
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	-20	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	17	17
α [deg]	45.00	
I <sub>yzcs</sub> [m <sup>4</sup> ]	-1.3344e-07	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	3.18e+03	3.18e+03
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	1.64e+03	1.64e+03
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.3300e-01	2.3310e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	79
Afbeelding		

<b>ST-17</b>		
Type	HEA450	
Vormnorm	1 - I-doorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	a	b
A [m <sup>2</sup> ]	1.7800e-02	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.2141e-02	5.2398e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	6.3700e-04	9.4700e-05
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	2.9000e-03	6.3100e-04
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	3.2167e-03	9.6667e-04
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	4.1476e-06	2.4400e-06
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	0	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	150	220
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	7.56e+05	7.56e+05
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	2.27e+05	2.27e+05
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	2.0100e+00	2.0104e+00
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	0
Afbeelding		

<b>ST-18</b>		
Type	UNP200	
Vormnorm	5 - Kanaaldoorsnede	
Vorm type	Dunwandig	
Onderdeelmateriaal	S 235 JR (EN 10025-2)	
Bouwwijze	gewalst	
Knik y-y, Knik z-z	c	c
A [m <sup>2</sup> ]	3.2200e-03	
A <sub>y</sub> [m <sup>2</sup> ], A <sub>z</sub> [m <sup>2</sup> ]	1.6758e-03	1.6900e-03
I <sub>y</sub> [m <sup>4</sup> ], I <sub>z</sub> [m <sup>4</sup> ]	1.9100e-05	1.4800e-06
W <sub>ely</sub> [m <sup>3</sup> ], W <sub>elz</sub> [m <sup>3</sup> ]	1.9100e-04	2.7000e-05
W <sub>ply</sub> [m <sup>3</sup> ], W <sub>plz</sub> [m <sup>3</sup> ]	2.2800e-04	5.1800e-05
I <sub>w</sub> [m <sup>6</sup> ], I <sub>t</sub> [m <sup>4</sup> ]	1.0499e-08	1.2000e-07
d <sub>y</sub> [mm], d <sub>z</sub> [mm]	-44	0
c <sub>yucs</sub> [mm], c <sub>zucs</sub> [mm]	20	100
α [deg]	0.00	
M <sub>ply+</sub> [Nm], M <sub>ply-</sub> [Nm]	5.35e+04	5.35e+04
M <sub>plz+</sub> [Nm], M <sub>plz-</sub> [Nm]	1.22e+04	1.22e+04
AL [m <sup>2</sup> /m], AD [m <sup>2</sup> /m]	6.6100e-01	6.6027e-01
β <sub>y</sub> [mm], β <sub>z</sub> [mm]	0	217



Afbeelding



#### Verklaring van symbolen

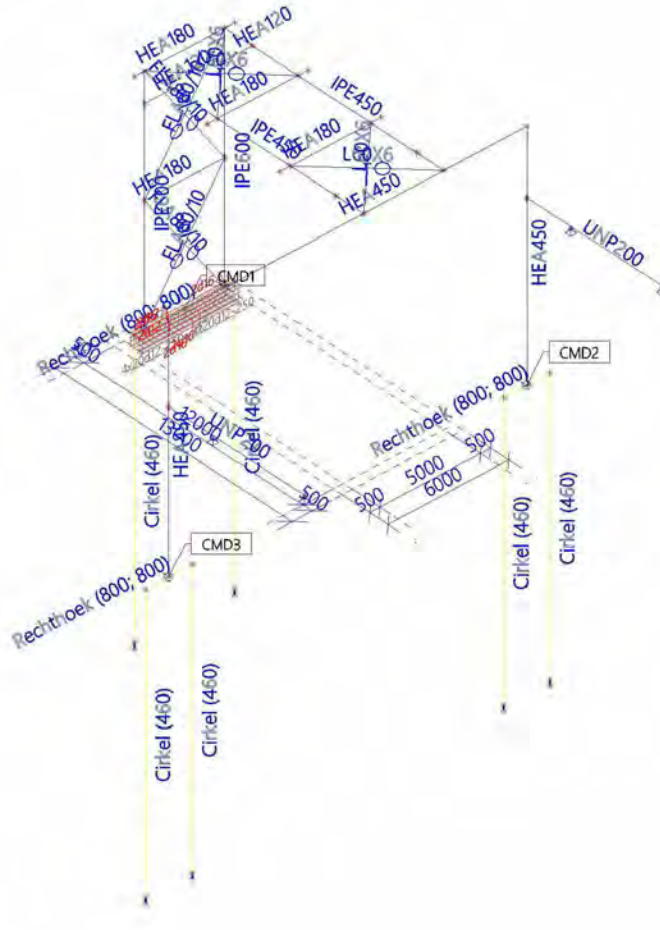
A	Gebied
$A_y$	Afschuifoppervlak in hoofd y-richting - Berekend door 2D EEM analyse
$A_z$	Afschuifoppervlak in hoofd z-richting - Berekend door 2D EEM analyse
$I_y$	Tweede moment van het gebied rond de hoofd y-as
$I_z$	Tweede moment van het gebied rond de hoofd z-as
$W_{ely}$	Elastische doorsnede modulus rond de hoofd y-as
$W_{elz}$	Elastische doorsnede modulus rond de hoofd z-as
$W_{ply}$	Plastische doorsnede modulus rond de hoofd y-as
$W_{plz}$	Plastische doorsnede modulus rond de hoofd z-as
$I_w$	Welvings constante - Berekend door 2D EEM analyse
$I_t$	Torsie constante - Berekend door 2D EEM analyse
$d_y$	Afschuif middencoördinaat in hoofd y-richting gemeten vanaf het zwaartepunt - Berekend door 2D EEM analyse
$d_z$	Afschuif middencoördinaat in hoofd z-richting gemeten vanaf het zwaartepunt - Berekend door 2D EEM analyse

#### Verklaring van symbolen

$c_{yucs}$	Zwaartepunt coördinaten in Y-richting van het invoer assen systeem
$c_{zucs}$	Zwaartepunt coördinaten in Z-richting van het invoer assen systeem
$\alpha$	Rotatiehoek van het hoofd assen systeem
$I_{yzlcs}$	Product moment van het gebied in het LCS systeem
$M_{ply+}$	Plastisch moment rond de hoofd y-as voor een positief $M_y$ moment
$M_{ply-}$	Plastisch moment rond de hoofd y-as voor een negatief $M_y$ moment
$M_{plz+}$	Plastisch moment rond de hoofd z-as voor een positief $M_z$ moment
$M_{plz-}$	Plastisch moment rond de hoofd z-as voor een negatief $M_z$ moment
AL	Omtrek per eenheidslengte
AD	Uithardingsoppervlakte per eenheidslengte
$\beta_y$	Mono-symmetrische constante rond de hoofd y-as
$\beta_z$	Mono-symmetrische constante rond de hoofd z-as



### 2.2.8. Analysis model



### 2.2.9. Lagen

Naam	enkel	Constructiemodel
Laag1	*	

### 2.2.10. UCS

Huidig UCS			
Type	vector		
X [mm], Y [mm], Z [mm]	0.000	0.000	0.000
X-X, X-Y, X-Z	1	0	0
Y-X, Y-Y, Y-Z	0	1	0
Z-X, Z-Y, Z-Z	0	0	1





## 2.3. Model gegevens

### 2.3.1. Instellingen net

Naam	NetInstelling1
Minimumafstand tussen definitiepunt en -lijn [m]	0.001
Gemiddeld aantal 1D-netelementen op rechte 1D-elementen	1
Gemiddelde grootte van 2D-netelement [mm]	1000.000
Definitie van netelementen afmetingen voor panelen	Handmatig
Gemiddelde afmeting van paneelelement [mm]	1000.000
Elastisch net	✓
Pas automatische netverfijning toe	* 100.000
Minimum lengte van staafelement [mm]	100.000
Maximum lengte van staafelement [mm]	1000000.000
Gemiddelde grootte van voorspankabels, elementen op elastische bedding, niet-lineaire grondveer [mm]	1000.000
Generatie van knopen op staven	* 1000000.000
Generatie van variabele excentriciteiten op elementen in plaats van constante excentriciteiten	* 1000.000
Verdeling op consoles en variabele staven	5
Verdeling voor integratiestrook en 2D-1D upgrade	50
Netverfijning volgens het liggertype	Geen
Maximale hoek uit het vlak van vierhoekig element [mrad]	30.0
Verh. voorgedefinieerd net	1.5

### 2.3.2. Instellingen solver

Naam	SolverSetup1
Negeer dwarskrachtvervormingen ( Ay, Az >> A )	* 1
Initiële spanning	* 1
Pas IRS (Improved Reduced System) methode toe	* 1
Pas massa- en stijfheidsfactoren toe	✓ 1
Aantal diktes van plaatrib	20
Maximumaantal bodeminteractie-iteraties	10
Maximum aantal iteraties	20
Aantal incrementen	1
Aantal knikvormen	2
Aantal sneden op gemiddelde staaf	10
Aantal eigenmodes	10
Stap voor grond/waterdruk [mm]	500.000
C1x [MN/m <sup>3</sup> ]	1.0000e-01
C1y [MN/m <sup>3</sup> ]	1.0000e-01
C1z [MN/m <sup>3</sup> ]	1.0000e+01
C2x [MN/m]	5.0000e+00
C2y [MN/m]	5.0000e+00
Wapeningscoëfficiënt	1
Waarschuwing als de maximale translatie groter is dan [mm]	1000.0
Waarschuwing als de maximale rotatie groter is dan [mrad]	100.0
Tolerantie van parallelisme [deg]	10.00
Overspanningslengteverhouding Le/beff,max (1 kant) [-]	8.00
Enkelvoudig opgelegde ligger [-]	1.00
Inwendige overspanning [-]	0.70
Eind overspanning [-]	0.85
Uitkraging [-]	2.00
Solver nauwkeurigheid ratio	1
Grond combinatie	Geen
Plastische scharnieren norm	Geen norm
Buigtheorie van plaat/schaal berekening	Mindlin
Type solver	Direct
Type van eigenwaarde solver	Lanczos
Type van eigenwaarde solver	Lanczos
Berekeningsmethode	Picard



## 2.3.3. 1D

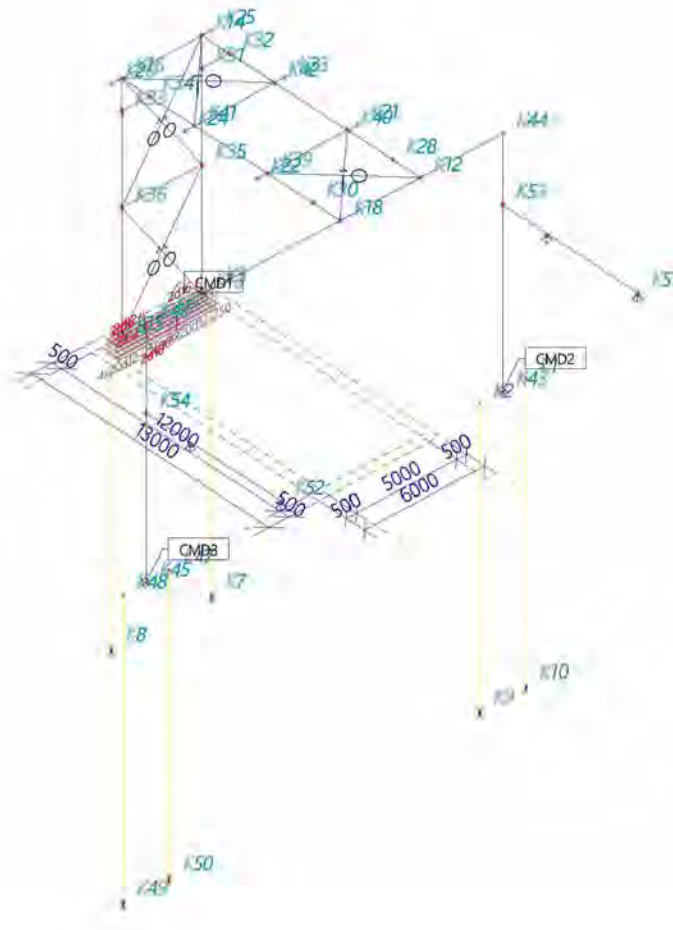
### 2.3.3.1. Knopen

Naam	Coördinaat X [mm]	Coördinaat Y [mm]	Coördinaat Z [mm]
K1	500.000	-4767.000	0.000
K2	500.000	-2467.000	0.000
K3	12500.000	0.000	0.000
K4	12500.000	5000.000	0.000
K6	12500.000	2500.000	0.000
K7	12500.000	0.000	-14000.000
K8	12500.000	5000.000	-14000.000
K9	500.000	-2467.000	-14000.000
K10	500.000	-4767.000	-14000.000
K12	500.000	500.000	11820.000
K13	12500.000	500.000	0.000
K14	12500.000	500.000	11820.000
K15	12500.000	4500.000	0.000
K16	12500.000	4500.000	11820.000
K18	500.000	4500.000	11820.000
K21	4500.000	0.000	11820.000
K22	4500.000	5000.000	11820.000
K23	8500.000	0.000	11820.000
K24	8500.000	5000.000	11820.000
K25	12500.000	0.000	11820.000
K26	12500.000	5000.000	11820.000
K28	2000.000	500.000	11820.000
K30	2000.000	4500.000	11820.000

Naam	Coördinaat X [mm]	Coördinaat Y [mm]	Coördinaat Z [mm]
K31	12500.000	500.000	10320.000
K32	11000.000	500.000	11820.000
K33	12500.000	4500.000	10320.000
K34	11000.000	4500.000	11820.000
K35	12500.000	500.000	5910.000
K36	12500.000	4500.000	5910.000
K39	4500.000	4500.000	11820.000
K40	4500.000	500.000	11820.000
K41	8500.000	4500.000	11820.000
K42	8500.000	500.000	11820.000
K43	500.000	-3617.000	0.000
K44	500.000	-3617.000	11820.000
K45	500.000	14173.000	0.000
K46	500.000	14173.000	11820.000
K47	500.000	13023.000	0.000
K48	500.000	15323.000	0.000
K49	500.000	15323.000	-14000.000
K50	500.000	13023.000	-14000.000
K51	-6923.000	-3617.000	8550.000
K52	-6923.000	14173.000	7750.000
K53	500.000	-3617.000	8550.000
K54	500.000	14173.000	7750.000



### 2.3.3.2. Knopen



### 2.3.3.3. Staven

Naam	Doorsnede	Materiaal	Lengte [mm]	Beginknoop	Eindknoop	Type
S1	BT-12 - Rechthoek (800; 800)	C35/45	2300.000	K1	K2	Balk (80)
S2	BT-12 - Rechthoek (800; 800)	C35/45	5000.000	K3	K4	Balk (80)
S4	BT-11 - Cirkel (460)	C35/45	14000.000	K7	K3	Kolom (100)
S5	BT-11 - Cirkel (460)	C35/45	14000.000	K8	K4	Kolom (100)
S6	BT-11 - Cirkel (460)	C35/45	14000.000	K9	K2	Kolom (100)
S7	BT-11 - Cirkel (460)	C35/45	14000.000	K10	K1	Kolom (100)
S8	ST-17 - HEA450	S 235 JR (EN 10025-2)	11820.000	K43	K44	Kolom (100)
S9	ST-11 - IPE600	S 235 JR (EN 10025-2)	11820.000	K13	K14	Kolom (100)
S10	ST-11 - IPE600	S 235 JR (EN 10025-2)	11820.000	K15	K16	Kolom (100)
S11	ST-17 - HEA450	S 235 JR (EN 10025-2)	11820.000	K45	K46	Kolom (100)
S12	ST-12 - IPE450	S 235 JR (EN 10025-2)	12000.000	K12	K14	Balk (80)
S13	ST-12 - IPE450	S 235 JR (EN 10025-2)	12000.000	K18	K16	Balk (80)
S15	ST-17 - HEA450	S 235 JR (EN 10025-2)	17790.000	K44	K46	Balk (80)
S16	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K21	K22	Balk (80)
S17	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K23	K24	Balk (80)
S18	ST-13 - HEA180	S 235 JR (EN 10025-2)	5000.000	K25	K26	Balk (80)
S21	ST-14 - HEA120	S 235 JR (EN 10025-2)	2121.320	K31	K32	Balk (80)
S22	ST-14 - HEA120	S 235 JR (EN 10025-2)	2121.320	K33	K34	Balk (80)
S23	ST-13 - HEA180	S 235 JR (EN 10025-2)	4000.000	K35	K36	Balk (80)
S25	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K13	K36	Balk (80)

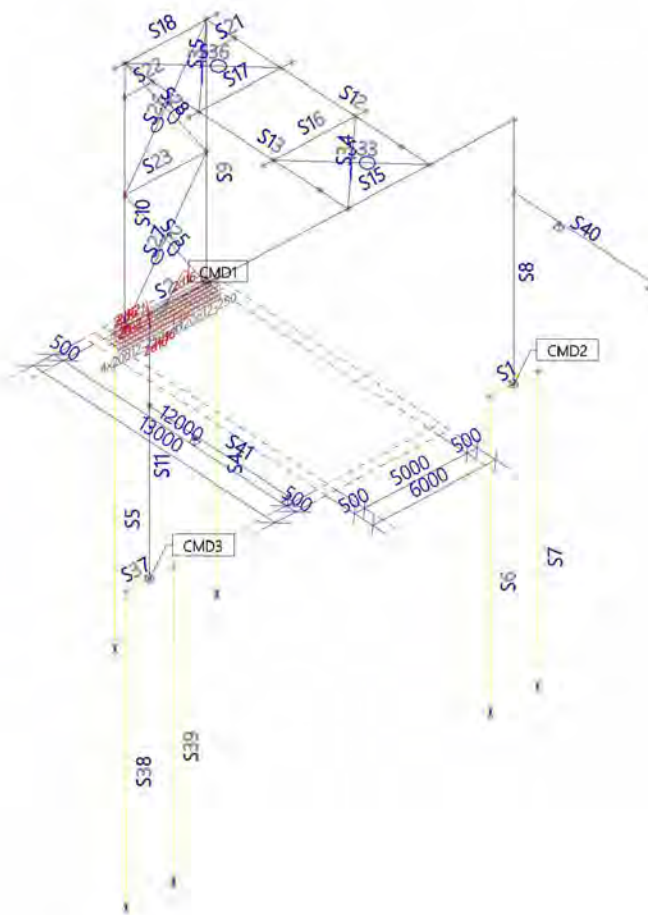


Project 4922005  
Omschrijving Statische berekening  
Onderdeel Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur 5.12.e  
17/36

Naam	Doorsnede	Materiaal	Lengte [mm]	Beginknoop	Eindknoop	Type
S26	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K36	K14	Balk (80)
S27	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K15	K35	Balk (80)
S28	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	7136.393	K35	K16	Balk (80)
S33	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K12	K39	Balk (80)
S34	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K18	K40	Balk (80)
S35	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K41	K14	Balk (80)
S36	ST-16 - L60X6	S 235 JR (EN 10025-2)	5656.854	K42	K16	Balk (80)
S37	BT-12 - Rechthoek (800; 800)	C35/45	2300.000	K47	K48	Balk (80)
S38	BT-11 - Cirkel (460)	C35/45	14000.000	K49	K48	Kolom (100)
S39	BT-11 - Cirkel (460)	C35/45	14000.000	K50	K47	Kolom (100)
S40	ST-18 - UNP200	S 235 JR (EN 10025-2)	7423.000	K53	K51	Balk (80)
S41	ST-18 - UNP200	S 235 JR (EN 10025-2)	7423.000	K52	K54	Balk (80)

### 2.3.3.4. Staven





### 2.3.3.5. Scharnieren

Naam	Staal Positie	ux	uy	uz	phix	phiy	phiz
		Fun - ux	Fun - uy	Fun - uz	Fun - phix	Fun - phiy	Fun - phiz
		Stijf - ux [MN/m]	Stijf - uy [MN/m]	Stijf - uz [MN/m]	Stijf - phix [MNm/rad]	Stijf - phiy [MNm/rad]	Stijf - phiz [MNm/rad]
H5	S12 Beide	Vast	Vast	Vast	Vast	Vast	Vrij
H6	S13 Beide	Vast	Vast	Vast	Vast	Vast	Vrij
H7	S21 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H8	S22 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H12	S9 Begin	Vast	Vast	Vast	Vast	Vast	Vrij
H13	S10 Begin	Vast	Vast	Vast	Vast	Vast	Vrij
H16	S23 Beide	Vast	Vast	Vast	Vast	Vrij	Vrij
H17	S41 Eind	Vast	Vast	Vast	Vast	Vrij	Vrij
H18	S40 Begin	Vast	Vast	Vast	Vast	Vrij	Vrij

### 2.3.3.6. Staal niet-lineariteit

Naam	Staal	Type
BN1	S25	Alleen trek
BN2	S26	Alleen trek

Naam	Staal	Type
BN3	S27	Alleen trek
BN4	S28	Alleen trek

Naam	Staal	Type
BN9	S33	Alleen trek
BN10	S34	Alleen trek

Naam	Staal	Type
BN11	S35	Alleen trek
BN12	S36	Alleen trek

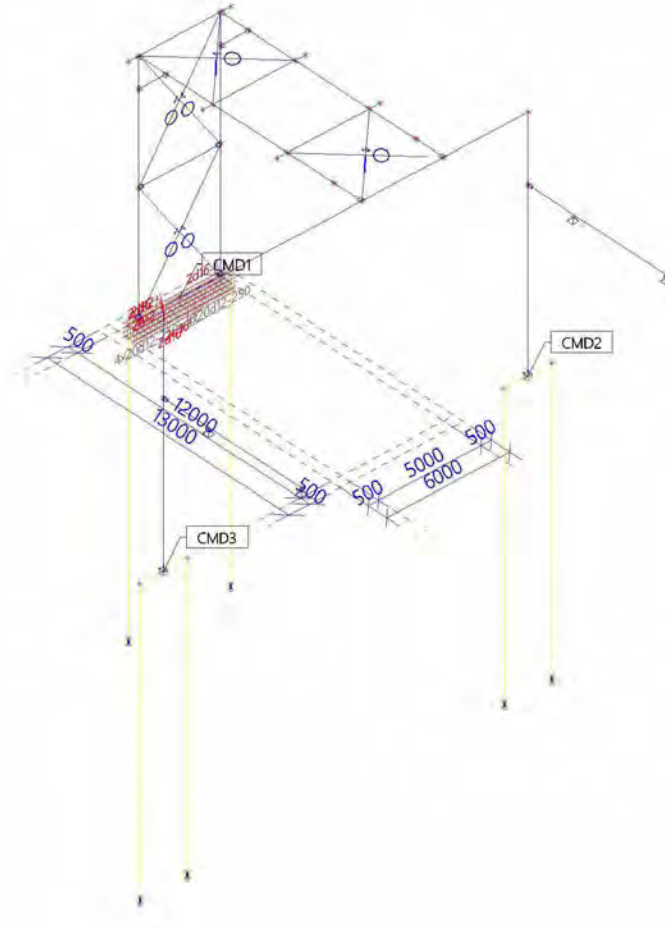
### 2.3.3.7. Kruisende staven

Naam	1e staaf	2e staaf	Type
Kruis1	S12	S16	Vast
Kruis2	S12	S17	Vast
Kruis3	S13	S16	Vast
Kruis4	S13	S17	Vast

### 2.3.4. 2D



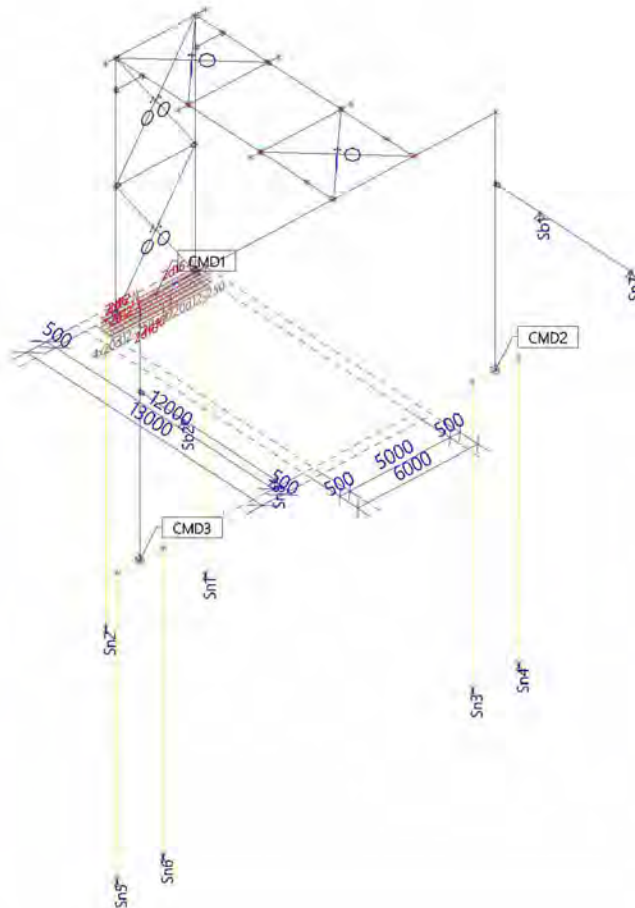
## 2.3.4.1. Platen





## 2.3.5. Supports

### 2.3.5.1. Steunpunten



### 2.3.5.2. Knoopondersteuningen

Naam Knoop	Systeem UCS	Type Hoek [deg]	X Stijfheid X [MN/m]	Y Stijfheid Y [MN/m]	Z Stijfheid Z [MN/m]	Rx Stijfheid Rx [MNm/rad]	Ry Stijfheid Ry [MNm/rad]	Rz Stijfheid Rz [MNm/rad]
Sn1 K7	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn2 K8	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn3 K9	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn4 K10	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn5 K49	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn6 K50	GCS	Standaard	Vrij	Vrij	Niet-lineair 1.5000e+01	Vrij	Vrij	Vrij
Sn7 K51	GCS	Standaard	Vast	Vast	Vast	Vrij	Vrij	Vrij
Sn8 K52	GCS	Standaard	Vast	Vast	Vast	Vrij	Vrij	Vrij



### 2.3.5.3. Puntondersteuning op staaf

Naam	Type	Coör	Pos x [mm]	dx [mm]	X	Y	Z	Rx	Ry	Rz
		Systeem	Oors	Herh (n)						
Sb1	Standaard	Abso GCS	5000.000 Vanaf einde	1	Vast	Vast	Vast	Vrij	Vrij	Vrij
Sb2	Standaard	Abso GCS	5000.000 Vanaf begin	1	Vast	Vast	Vast	Vrij	Vrij	Vrij

### 2.3.5.4. Lijnondersteuning op staven

Naam	Type	Staat	Pos x1 [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x2 [mm]	Oors								
Slb1	Lijn	S7 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb2	Lijn	S4 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb3	Lijn	S5 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb4	Lijn	S6 GCS	1500.000 1650.000	Abso Vanaf einde	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb5	Lijn	S4 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb6	Lijn	S5 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb7	Lijn	S6 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb8	Lijn	S7 GCS	1650.000 2660.000	Abso Vanaf einde	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
Slb9	Lijn	S4 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb10	Lijn	S5 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb11	Lijn	S6 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb12	Lijn	S7 GCS	2660.000 4960.000	Abso Vanaf einde	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb13	Lijn	S4 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb14	Lijn	S5 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb15	Lijn	S6 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb16	Lijn	S7 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb17	Lijn	S4 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb18	Lijn	S5 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb19	Lijn	S6 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb20	Lijn	S7 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb21	Lijn	S4 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb22	Lijn	S5 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb23	Lijn	S6 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb24	Lijn	S7 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij





Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
Slb25	Lijn	S4 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb26	Lijn	S5 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb27	Lijn	S6 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb28	Lijn	S7 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb29	Lijn	S4 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb30	Lijn	S5 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb31	Lijn	S7 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb32	Lijn	S6 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb33	Lijn	S4 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb34	Lijn	S5 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb35	Lijn	S7 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb36	Lijn	S6 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb37	Lijn	S4 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb38	Lijn	S5 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb39	Lijn	S7 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb40	Lijn	S6 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb41	Lijn	S4 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb42	Lijn	S5 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb43	Lijn	S7 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb44	Lijn	S6 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb45	Lijn	S4 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb46	Lijn	S5 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb47	Lijn	S7 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb48	Lijn	S6 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb49	Lijn	S4 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb50	Lijn	S5 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb51	Lijn	S7 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb52	Lijn	S6 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb53	Lijn	S4 GCS	13100.000 13400.000	Abso Vanaf einde	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
Slb54	Lijn	S5	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij



Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
		GCS	13400.000	Vanaf einde								
Slb55	Lijn	S6	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb56	Lijn	S7	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb57	Lijn	S4	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb58	Lijn	S5	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb59	Lijn	S6	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb60	Lijn	S7	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb61	Lijn	S4	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb62	Lijn	S5	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb63	Lijn	S6	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb64	Lijn	S7	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb65	Lijn	S38	1500.000	Abso	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	1650.000	Vanaf einde								
Slb66	Lijn	S38	1650.000	Abso	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	2660.000	Vanaf einde								
Slb67	Lijn	S38	2660.000	Abso	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	4960.000	Vanaf einde								
Slb68	Lijn	S38	4960.000	Abso	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	6120.000	Vanaf einde								
Slb69	Lijn	S38	6120.000	Abso	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	10600.000	Vanaf einde								
Slb70	Lijn	S38	10600.000	Abso	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	10700.000	Vanaf einde								
Slb71	Lijn	S38	10700.000	Abso	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11300.000	Vanaf einde								
Slb72	Lijn	S38	11300.000	Abso	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11600.000	Vanaf einde								
Slb73	Lijn	S38	11600.000	Abso	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	11800.000	Vanaf einde								
Slb74	Lijn	S38	11800.000	Abso	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	12100.000	Vanaf einde								
Slb75	Lijn	S38	12100.000	Abso	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
		GCS	12500.000	Vanaf einde								
Slb76	Lijn	S38	12500.000	Abso	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
		GCS	12700.000	Vanaf einde								
Slb77	Lijn	S38	12700.000	Abso	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13100.000	Vanaf einde								
Slb78	Lijn	S38	13100.000	Abso	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13400.000	Vanaf einde								
Slb79	Lijn	S38	13400.000	Abso	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	13500.000	Vanaf einde								
Slb80	Lijn	S38	13500.000	Abso	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij
		GCS	13950.000	Vanaf einde								
Slb81	Lijn	S39	1500.000	Abso	Verend	4.2000e+00	Verend	4.2000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	1650.000	Vanaf einde								
Slb82	Lijn	S39	1650.000	Abso	Verend	2.1000e+00	Verend	2.1000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	2660.000	Vanaf einde								
Slb83	Lijn	S39	2660.000	Abso	Verend	1.5000e+00	Verend	1.5000e+00	Vrij	Vrij	Vrij	Vrij
		GCS	4960.000	Vanaf einde								



Naam	Type	Staal	Pos x <sub>1</sub> [mm]	Coör	X	Stijfheid X [MN/m <sup>2</sup> ]	Y	Stijfheid Y [MN/m <sup>2</sup> ]	Z	Rx	Ry	Rz
		Systeem	Pos x <sub>2</sub> [mm]	Oors								
Slb84	Lijn	S39 GCS	4960.000 6120.000	Abso Vanaf einde	Verend	8.2000e+00	Verend	8.2000e+00	Vrij	Vrij	Vrij	Vrij
Slb85	Lijn	S39 GCS	6120.000 10600.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb86	Lijn	S39 GCS	10600.000 10700.000	Abso Vanaf einde	Verend	5.7000e+00	Verend	5.7000e+00	Vrij	Vrij	Vrij	Vrij
Slb87	Lijn	S39 GCS	10700.000 11300.000	Abso Vanaf einde	Verend	6.0000e+00	Verend	6.0000e+00	Vrij	Vrij	Vrij	Vrij
Slb88	Lijn	S39 GCS	11300.000 11600.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb89	Lijn	S39 GCS	11600.000 11800.000	Abso Vanaf einde	Verend	4.8000e+00	Verend	4.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb90	Lijn	S39 GCS	11800.000 12100.000	Abso Vanaf einde	Verend	7.5000e+00	Verend	7.5000e+00	Vrij	Vrij	Vrij	Vrij
Slb91	Lijn	S39 GCS	12100.000 12500.000	Abso Vanaf einde	Verend	1.0800e+01	Verend	1.0800e+01	Vrij	Vrij	Vrij	Vrij
Slb92	Lijn	S39 GCS	12500.000 12700.000	Abso Vanaf einde	Verend	1.2300e+01	Verend	1.2300e+01	Vrij	Vrij	Vrij	Vrij
Slb93	Lijn	S39 GCS	12700.000 13100.000	Abso Vanaf einde	Verend	6.4000e+00	Verend	6.4000e+00	Vrij	Vrij	Vrij	Vrij
Slb94	Lijn	S39 GCS	13100.000 13400.000	Abso Vanaf einde	Verend	6.6000e+00	Verend	6.6000e+00	Vrij	Vrij	Vrij	Vrij
Slb95	Lijn	S39 GCS	13400.000 13500.000	Abso Vanaf einde	Verend	7.8000e+00	Verend	7.8000e+00	Vrij	Vrij	Vrij	Vrij
Slb96	Lijn	S39 GCS	13500.000 13950.000	Abso Vanaf einde	Verend	1.3100e+01	Verend	1.3100e+01	Vrij	Vrij	Vrij	Vrij



## 3. Belastingen

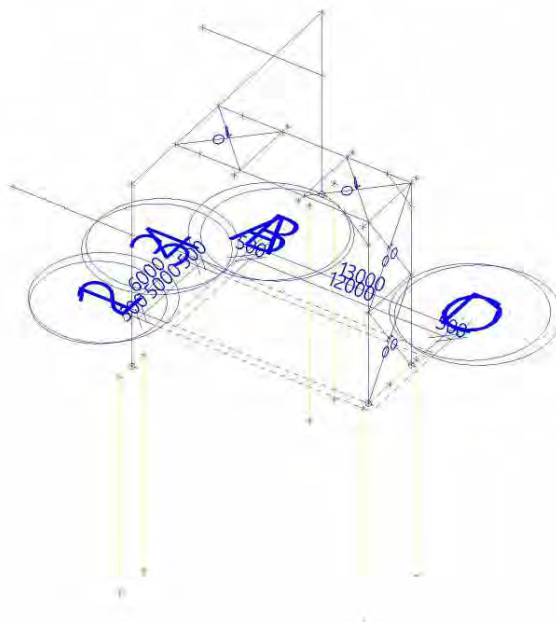
### 3.1. Belastingsgevallen

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Richting	Duur	'Master' belastingsgeval
BG101	Eigen gewicht	Permanent	LG1	Eigen gewicht		-Z		
BG102	Permanent	Permanent	LG1	Standaard				
BG111	Wind x-as	Variabel	LG3	Statisch	Standaard		Kort	Geen
BG112	Wind y-as	Variabel	LG3	Statisch	Standaard		Kort	Geen
BG121	Veranderlijk + eq	Variabel	LG4	Statisch	Standaard		Kort	Geen

### 3.2. Belastingsgevallen

#### 3.2.1. Belastingsgevallen - BG101

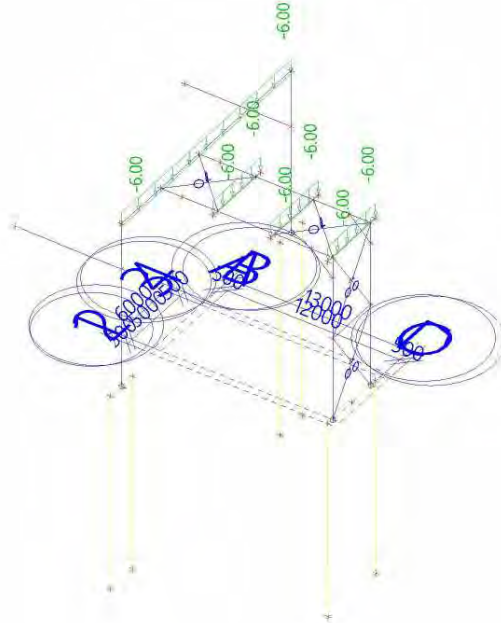
Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Richting
BG101	Eigen gewicht	Permanent	LG1	Eigen gewicht	-Z





### 3.2.2. Belastingsgevallen - BG102

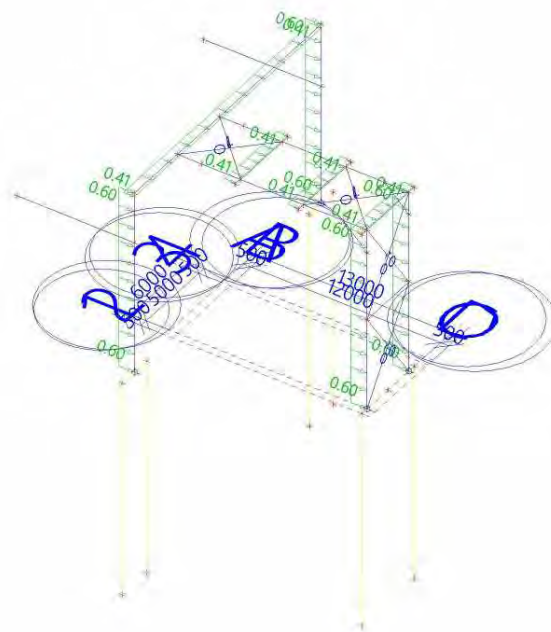
Naam	Omschrijving	Actie type	Lastgroep	Belastingtype
BG102	Permanent	Permanent	LG1	Standaard





### 3.2.3. Belastingsgevallen - BG111

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Duur	'Master' belastingsgeval
BG111	Wind x-as	Variabel	LG3	Statisch	Standaard	Kort	Geen



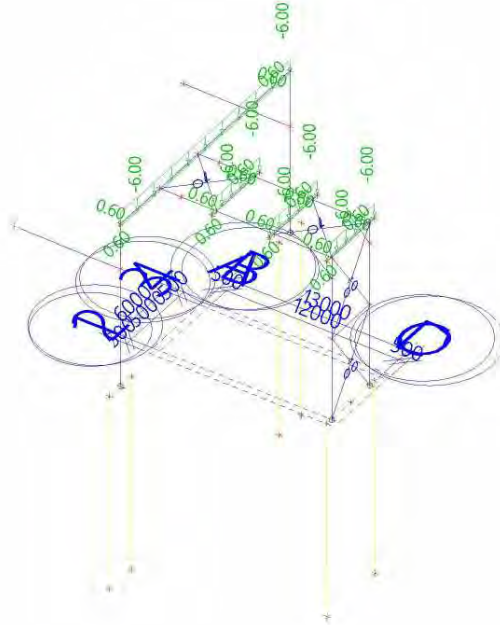




Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 29/36

### 3.2.5. Belastingsgevallen - BG121

Naam	Omschrijving	Actie type	Lastgroep	Belastingtype	Spec	Duur	'Master' belastingsgeval
BG121	Veranderlijk + eq	Variabel	LG4	Statisch	Standaard	Kort	Geen







### 3.3. Belastinggroepen

Naam	Last	Relatie	Type
LG1	Permanent		
LG2	Variabel	Exclusief	Temperatuur
LG3	Variabel	Exclusief	Wind
LG4	Variabel	Standaard	Cat E : Opslagruimte

### 3.4. Combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
UGT-Set B	EN-UGT (STR/GEO) Set B	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00
BGT-kar	EN - BGT Karakteristiek	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00
BGT-quasi	EN-BGT Quasi-permanent	BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00
		BG111 - Wind x-as	1.00
		BG112 - Wind y-as	1.00
		BG121 - Veranderlijk + eq	1.00

### 3.5. Niet-lineaire combinaties

Naam	Type	Belastingsgevallen	Coëff. [-]
NC_UGT-Set B.1	Uiterste Grenstoestand	BG101 - Eigen gewicht	1.35
		BG102 - Permanent	1.35
NC_UGT-Set B.2	Uiterste Grenstoestand	BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.3	Uiterste Grenstoestand	BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.4	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.5	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.6	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.7	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.8	Uiterste Grenstoestand	BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	1.20
		BG102 - Permanent	1.20
NC_UGT-Set B.9	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.10	Uiterste Grenstoestand	BG112 - Wind y-as	1.50
		BG101 - Eigen gewicht	0.90
		BG102 - Permanent	0.90
NC_UGT-Set B.11	Uiterste Grenstoestand	BG111 - Wind x-as	1.50
		BG121 - Veranderlijk + eq	1.50
		BG101 - Eigen gewicht	0.90



Naam	Type	Belastingsgevallen	Coëff. [-]
		BG102 - Permanent	0.90
NC_UGT-Set B.12	Uiterste Grenstoestand	BG112 - Wind y-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.50 1.50 0.90 0.90
NC_UGT-Set B.13	Uiterste Grenstoestand	BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.50 0.90 0.90
NC_UGT-Set B.14	Uiterste Grenstoestand	BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.50 1.35 1.35
NC_BGT-kar.1	Bruikbaarheidsgrenstoestand	BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00
NC_BGT-kar.2	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00
NC_BGT-kar.3	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00
NC_BGT-kar.4	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00 1.00
NC_BGT-kar.5	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00 1.00
NC_BGT-kar.6	Bruikbaarheidsgrenstoestand	BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00 1.00
NC_BGT-kar.7	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00
NC_BGT-kar.8	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00
NC_BGT-kar.9	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00 1.00
NC_BGT-kar.10	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00 1.00
NC_BGT-quasi.1	Bruikbaarheidsgrenstoestand	BG101 - Eigen gewicht BG102 - Permanent	1.00 1.00
NC_BGT-quasi.2	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00
NC_BGT-quasi.3	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG101 - Eigen gewicht BG102 - Permanent	0.00 1.00 1.00
NC_BGT-quasi.4	Bruikbaarheidsgrenstoestand	BG111 - Wind x-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	0.00 0.80 1.00 1.00
NC_BGT-quasi.5	Bruikbaarheidsgrenstoestand	BG112 - Wind y-as BG121 - Veranderlijk + eq BG101 - Eigen gewicht BG102 - Permanent	0.00 0.80 1.00 1.00
NC_BGT-quasi.6	Bruikbaarheidsgrenstoestand	BG121 - Veranderlijk + eq	0.80



Naam	Type	Belastingsgevallen	Coëff. [-]
		BG101 - Eigen gewicht	1.00
		BG102 - Permanent	1.00

### 3.6. Resultaatklassen

Naam	Lijst
RK_NC_UGT-Set B	NC_UGT-Set B.1 NC_UGT-Set B.2 NC_UGT-Set B.3 NC_UGT-Set B.4 NC_UGT-Set B.5 NC_UGT-Set B.6 NC_UGT-Set B.7 NC_UGT-Set B.8 NC_UGT-Set B.9 NC_UGT-Set B.10 NC_UGT-Set B.11 NC_UGT-Set B.12 NC_UGT-Set B.13 NC_UGT-Set B.14
RK_NC_BGT-kar	NC_BGT-kar.1 NC_BGT-kar.2 NC_BGT-kar.3 NC_BGT-kar.4 NC_BGT-kar.5 NC_BGT-kar.6 NC_BGT-kar.7 NC_BGT-kar.8 NC_BGT-kar.9 NC_BGT-kar.10
RK_NC_BGT-quasi	NC_BGT-quasi.1 NC_BGT-quasi.2 NC_BGT-quasi.3 NC_BGT-quasi.4 NC_BGT-quasi.5 NC_BGT-quasi.6
GEO	UGT-Set B - EN-UGT (STR/GEO) Set B



## 4. Berekeningsverslag

### Lineaire berekening

Aantal 2D elementen		0
Aantal 1D-elementen		225
Aantal netknoten		211
Aantal vergelijkingen		1266
Buigtheorie	Mindlin	
Belastingsgevallen	BG101, BG102, BG111, BG112, BG121	
Start van de berekening	15.07.2022 16:22	
Einde berekening	15.07.2022 16:22	

### Som van lasten en reacties

Belastingsgeval	Waarde	X	Y	Z
		[kN]	[kN]	[kN]
BG101	Lasten	0.00	0.00	-612.85
	reactie in de knopen	2.22	0.00	612.85
	reactie op de lijnen	-2.22	0.00	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG102	Lasten	0.00	0.00	-196.74
	reactie in de knopen	8.39	0.03	196.74
	reactie op de lijnen	-8.39	-0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG111	Lasten	41.81	0.00	0.00
	reactie in de knopen	-26.72	-0.11	0.00
	reactie op de lijnen	-15.09	0.11	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG112	Lasten	0.00	77.09	0.00
	reactie in de knopen	0.51	-1.51	0.00
	reactie op de lijnen	-0.51	-75.58	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
BG121	Lasten	19.67	19.67	-196.74
	reactie in de knopen	-6.75	-0.65	196.74
	reactie op de lijnen	-12.92	-19.02	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00

## 5. Berekeningsverslag

### Niet-lineaire berekening

Aantal 2D elementen		0
Aantal 1D-elementen		225
Aantal netknoten		211
Aantal vergelijkingen		1266
Buigtheorie	Mindlin	
Geometrische niet-lineariteit	2de orde (Timoshenko)	
Berekeningsmethode	Picard	
Aantal Incrementen		1
Maximum aantal iteraties		20

Niet-lineaire combinatie	Start van de berekening	Einde berekening	Aantal iteraties
NC_UGT-Set B.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.5	15.07.2022 16:22	15.07.2022 16:22	4
NC_UGT-Set B.6	15.07.2022 16:22	15.07.2022 16:22	7



Niet-lineaire combinatie	Start van de berekening	Einde berekening	Aantal iteraties
NC_UGT-Set B.7	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.8	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.9	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.10	15.07.2022 16:22	15.07.2022 16:22	4
NC_UGT-Set B.11	15.07.2022 16:22	15.07.2022 16:22	11
NC_UGT-Set B.12	15.07.2022 16:22	15.07.2022 16:22	11
NC_UGT-Set B.13	15.07.2022 16:22	15.07.2022 16:22	7
NC_UGT-Set B.14	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.5	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.6	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.7	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.8	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-kar.9	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-kar.10	15.07.2022 16:22	15.07.2022 16:22	3
NC_BGT-quasi.1	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.2	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.3	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.4	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.5	15.07.2022 16:22	15.07.2022 16:22	7
NC_BGT-quasi.6	15.07.2022 16:22	15.07.2022 16:22	7

#### Som van lasten en reacties

Niet-lineaire combinatie	Waarde	X	Y	Z
		[kN]	[kN]	[kN]
NC_UGT-Set B.1	Lasten	0.00	0.00	-1092.94
	reactie in de knopen	13.65	-0.05	1092.94
	reactie op de lijnen	-13.65	0.05	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.2	Lasten	0.00	0.00	-728.63
	reactie in de knopen	9.04	-0.02	728.63
	reactie op de lijnen	-9.04	0.02	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.3	Lasten	0.00	0.00	-973.12
	reactie in de knopen	12.13	-0.04	973.12
	reactie op de lijnen	-12.13	0.04	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.4	Lasten	62.72	0.00	-973.12
	reactie in de knopen	-28.49	-0.13	973.12
	reactie op de lijnen	-34.23	0.13	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.5	Lasten	0.00	115.63	-973.12
	reactie in de knopen	13.60	-1.15	973.12
	reactie op de lijnen	-13.60	-114.48	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.6	Lasten	92.23	29.51	-1268.23
	reactie in de knopen	-40.50	-1.04	1268.23
	reactie op de lijnen	-51.73	-28.47	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.7	Lasten	29.51	145.14	-1268.23
	reactie in de knopen	2.01	-2.02	1268.23
	reactie op de lijnen	-31.52	-143.13	0.00
	contact 1D	0.00	0.00	0.00



Niet-lineaire combinatie	Waarde	X [kN]	Y [kN]	Z [kN]
NC_UGT-Set B.8	contact 2D	0.00	0.00	0.00
	Lasten	29.51	29.51	-1268.23
	reactie in de knopen	0.69	-0.72	1268.23
	reactie op de lijnen	-30.20	-28.79	0.00
NC_UGT-Set B.9	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	62.72	0.00	-728.63
	reactie in de knopen	-31.48	-0.13	728.63
NC_UGT-Set B.10	reactie op de lijnen	-31.24	0.13	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	0.00	115.63	-728.63
NC_UGT-Set B.11	reactie in de knopen	10.51	-1.17	728.63
	reactie op de lijnen	-10.51	-114.46	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_UGT-Set B.12	Lasten	92.23	29.51	-1023.74
	reactie in de knopen	-43.44	-1.04	1023.74
	reactie op de lijnen	-48.79	-28.47	0.00
	contact 1D	0.00	0.00	0.00
NC_UGT-Set B.13	contact 2D	0.00	0.00	0.00
	Lasten	29.51	145.14	-1023.74
	reactie in de knopen	-1.06	-2.04	1023.74
	reactie op de lijnen	-28.45	-143.11	0.00
NC_UGT-Set B.14	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	29.51	29.51	-1388.05
	reactie in de knopen	2.20	-0.73	1388.05
NC_BGT-kar.1	reactie op de lijnen	-31.71	-28.78	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	0.00	0.00	-809.59
NC_BGT-kar.2	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.3	Lasten	41.81	0.00	-809.59
	reactie in de knopen	-16.95	-0.08	809.59
	reactie op de lijnen	-24.87	0.08	0.00
	contact 1D	0.00	0.00	0.00
NC_BGT-kar.4	contact 2D	0.00	0.00	0.00
	Lasten	0.00	77.09	-809.59
	reactie in de knopen	11.04	-0.79	809.59
	reactie op de lijnen	-11.04	-76.30	0.00
NC_BGT-kar.5	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	61.49	19.67	-1006.33
	reactie in de knopen	-24.77	-0.62	1006.33
NC_BGT-kar.5	reactie op de lijnen	-36.72	-19.05	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
	Lasten	19.67	96.76	-1006.33
NC_BGT-kar.5	reactie in de knopen	3.40	-1.30	1006.33
	reactie op de lijnen	-23.08	-95.46	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00

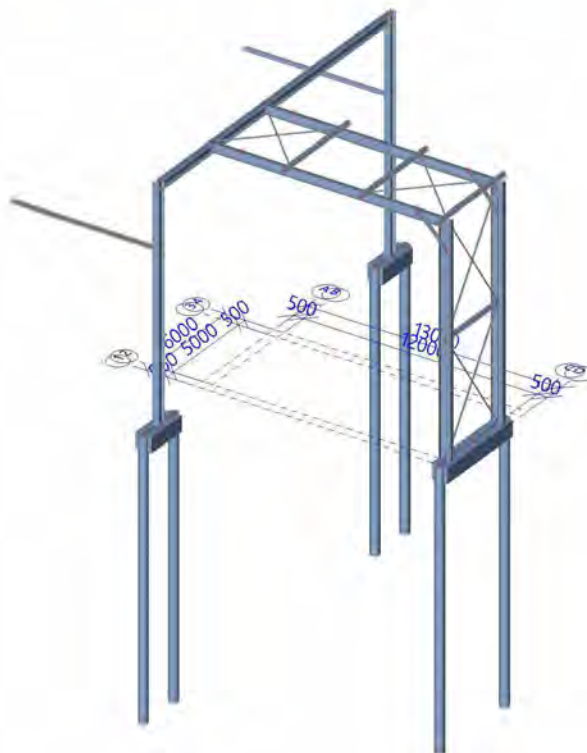


Niet-lineaire combinatie	Waarde	X [kN]	Y [kN]	Z [kN]
NC_BGT-kar.6	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.7	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.8	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.9	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-kar.10	Lasten	19.67	19.67	-1006.33
	reactie in de knopen	2.46	-0.46	1006.33
	reactie op de lijnen	-22.13	-19.21	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.1	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.2	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.3	Lasten	0.00	0.00	-809.59
	reactie in de knopen	10.06	-0.03	809.59
	reactie op de lijnen	-10.06	0.03	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.4	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.5	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00
NC_BGT-quasi.6	Lasten	15.74	15.74	-966.98
	reactie in de knopen	3.95	-0.37	966.98
	reactie op de lijnen	-19.69	-15.37	0.00
	contact 1D	0.00	0.00	0.00
	contact 2D	0.00	0.00	0.00



# Bijlage 2.

## Uitvoer Resultaten Scia







## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Resultaten	3
2.1. Vervormingen	3
2.1.1. Knoopverplaatsingen	3
2.1.1.1. Verplaatsing van knopen	3
2.1.1.2. Resultaten - $U_x$	3
2.1.1.3. Resultaten - $U_y$	4
2.1.1.4. Resultaten - $U_z$	4
2.1.1.5. Resultaten - $\Phi_x$	5
2.1.1.6. Resultaten - $\Phi_y$	5
2.1.1.7. Resultaten - $\Phi_z$	6
2.1.1.8. Resultaten - $U_{total}$	6
2.1.2. 3D verplaatsingen	7
2.1.2.1. 3D verplaatsing	7
2.1.2.2. Resultaten - $u_x$	7
2.1.2.3. Resultaten - $u_y$	8
2.1.2.4. Resultaten - $u_z$	8
2.1.2.5. Resultaten - $\phi_x$	9
2.1.2.6. Resultaten - $\phi_y$	9
2.1.2.7. Resultaten - $\phi_z$	10
2.1.2.8. Resultaten - $U_{total}$	10
2.1.3. 1D-ervormingen Algemeen	11
2.1.3.1. 1D-ervormingen	11
2.1.3.2. Resultaten - $u_x$	11
2.1.3.3. Resultaten - $u_y$	12
2.1.3.4. Resultaten - $u_z$	12
2.1.3.5. Resultaten - $\phi_x$	13
2.1.3.6. Resultaten - $\phi_y$	13
2.1.3.7. Resultaten - $\phi_z$	14
2.1.3.8. Resultaten - $U_{total}$	14
2.2. Krachten	15
2.2.1. Reactiekrachten	15
2.2.1.1. Reacties	15
2.2.1.2. Resultaten - $R_x$	16
2.2.1.3. Resultaten - $R_y$	16
2.2.1.4. Resultaten - $R_z$	17
2.2.1.5. Resultaten - $M_x$	17
2.2.1.6. Resultaten - $M_y$	18
2.2.1.7. Resultaten - $M_z$	18
2.2.2. Interne staafkrachten	19
2.2.2.1. Interne 1D-krachten	19
2.2.2.2. Resultaten - $N$	22
2.2.2.3. Resultaten - $V_y$	23
2.2.2.4. Resultaten - $V_z$	23
2.2.2.5. Resultaten - $M_x$	24
2.2.2.6. Resultaten - $M_y$	24
2.2.2.7. Resultaten - $M_z$	25
2.2.2.8. Resultaten - $V_r$	25
2.2.3. 3D stress	26
2.2.3.1. 3D spanning	26
2.2.3.2. Resultaten - $\sigma_1$	27
2.2.3.3. Resultaten - $\sigma_2$	27
2.2.3.4. Resultaten - $\sigma_E$	28
2.2.3.5. Resultaten - $\tau_{max,b}$ (2D)	28
2.2.3.6. Resultaten - $\tau_{tot}$ (1D)	29
2.2.4. 1D stress	30
2.2.4.1. 1D-spanningen	30
2.2.4.2. Resultaten - $\sigma_1$	31
2.2.4.3. Resultaten - $\sigma_2$	31
2.2.4.4. Resultaten - $\sigma_E$	32
2.2.4.5. Resultaten - $\tau_{tot}$	32



## 2. Resultaten

### 2.1. Vervormingen

#### 2.1.1. Knoopverplaatsingen

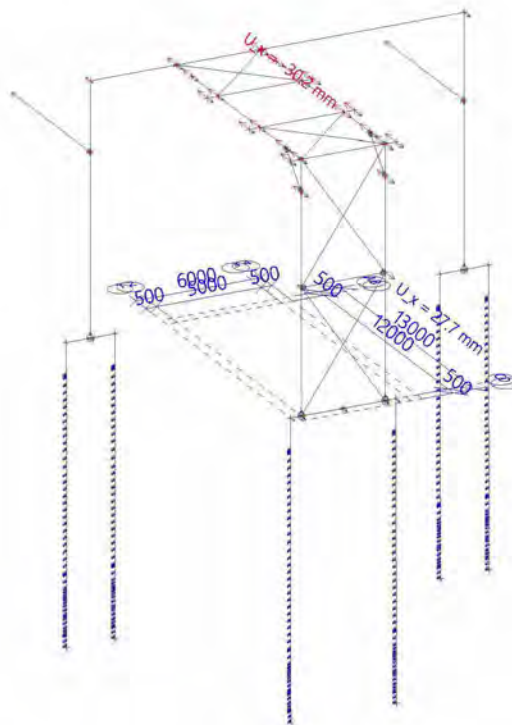
##### 2.1.1.1. Verplaatsing van knopen

Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-kar  
 Extreem: Globaal  
 Selectie: Alle

Naam	Belasting	U <sub>x</sub> [mm]	U <sub>y</sub> [mm]	U <sub>z</sub> [mm]	Φ <sub>x</sub> [mrad]	Φ <sub>y</sub> [mrad]	Φ <sub>z</sub> [mrad]	U <sub>total</sub> [mm]
K41	NC_BGT-kar.1	<b>-30.2</b>	0.1	-19.6	2.0	-4.9	0.0	36.0
K36	NC_BGT-kar.4	<b>27.7</b>	2.1	-0.9	-0.8	1.5	-0.3	27.8
K53	NC_BGT-kar.1	0.0	<b>-8.0</b>	-0.5	-1.1	-2.5	3.6	8.0
K18	NC_BGT-kar.5	-13.9	42.0	<b>-73.0</b>	-0.5	-3.3	-2.9	<b>85.4</b>
K25	NC_BGT-kar.5	-22.5	19.9	<b>0.6</b>	-2.1	-5.1	-2.6	30.0
K44	NC_BGT-kar.5	-11.3	<b>44.4</b>	-0.9	<b>-10.9</b>	-3.9	3.2	45.8
K46	NC_BGT-kar.6	7.6	12.2	-0.9	<b>7.2</b>	2.2	-2.0	14.4
K24	NC_BGT-kar.6	-18.0	7.5	-27.3	4.2	<b>-8.1</b>	-1.1	33.6
K46	NC_BGT-kar.4	18.2	14.5	-0.9	6.9	<b>5.2</b>	2.7	23.3
K52	NC_BGT-kar.5	0.0	0.0	0.0	-3.4	0.1	<b>-5.9</b>	0.0
K44	NC_BGT-kar.1	-11.4	1.3	-0.6	-4.9	-3.9	<b>4.9</b>	11.5

##### 2.1.1.2. Resultaten - U<sub>x</sub>

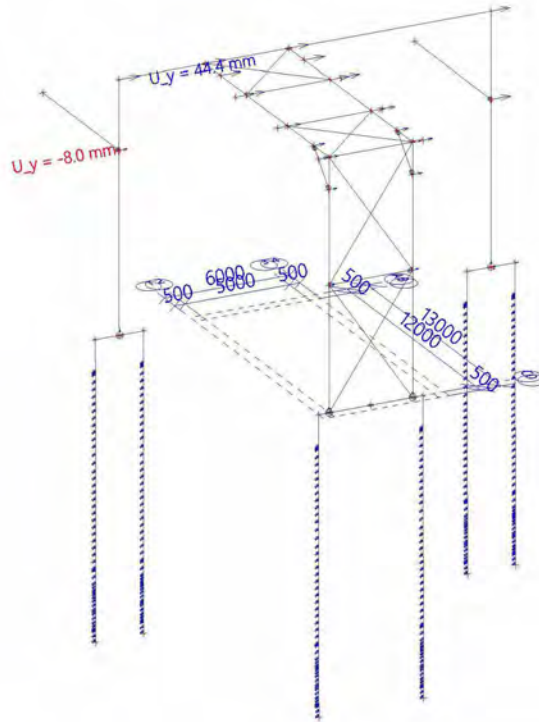
Waardes: U<sub>x</sub>  
 Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-kar  
 Extreem: Globaal  
 Selectie: Alle





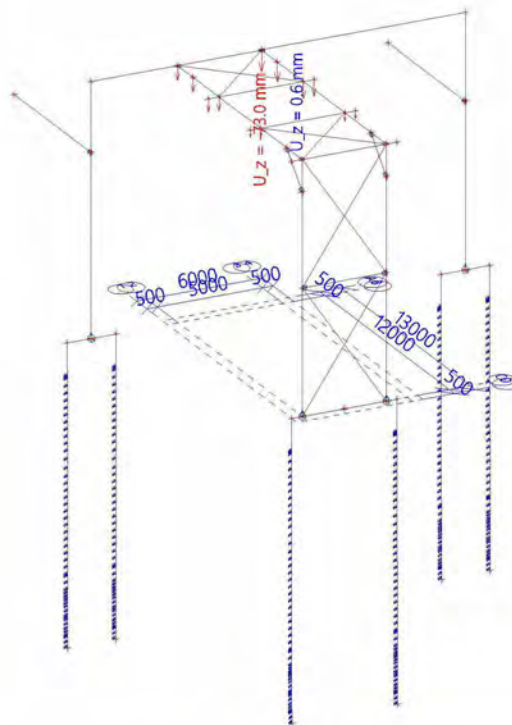
### 2.1.1.3. Resultaten - $U_y$

Waardes:  $U_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.4. Resultaten - $U_z$

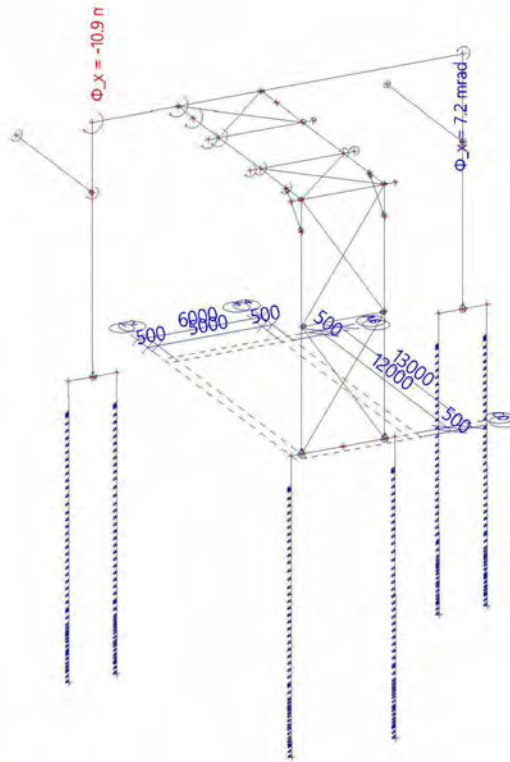
Waardes:  $U_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





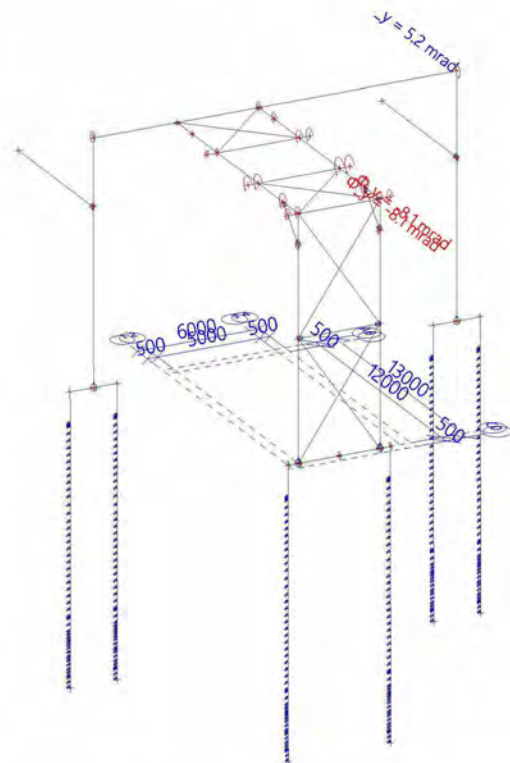
### 2.1.1.5. Resultaten - $\Phi_x$

Waardes:  $\Phi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.6. Resultaten - $\Phi_y$

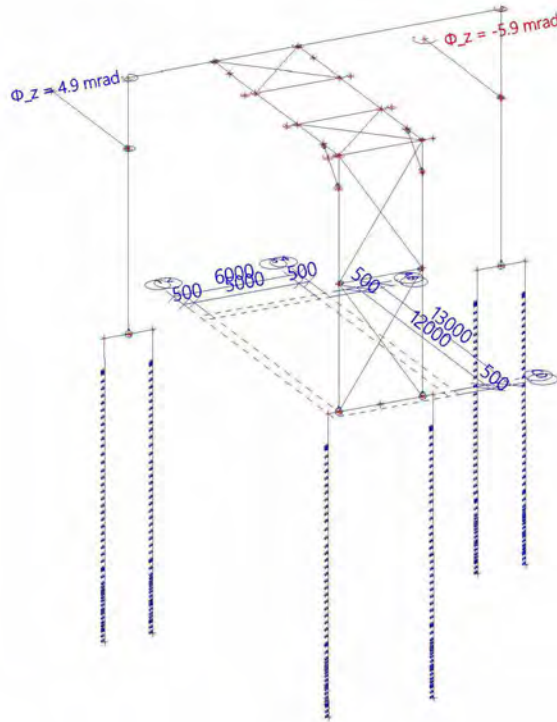
Waardes:  $\Phi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





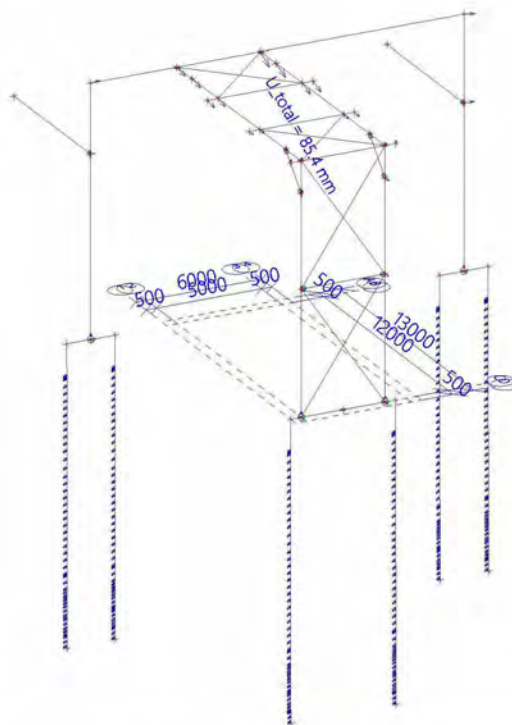
### 2.1.1.7. Resultaten - $\Phi_z$

Waardes:  $\Phi_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle



### 2.1.1.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Extreem: Globaal  
Selectie: Alle





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.6  
7/32

## 2.1.2. 3D verplaatsingen

### 2.1.2.1. 3D verplaatsing

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Selectie: Alle

Locatie: In knooppunten gem. bij macro. Systeem: LCS net element

**Resultaten op 1D-element:**

Extreme 1D: Globaal

Naam	dx [mm]	Vezel	Belasting	$u_x$ [mm]	$u_y$ [mm]	$u_z$ [mm]	$\phi_x$ [mrad]	$\phi_y$ [mrad]	$\phi_z$ [mrad]	$U_{total}$ [mm]
S39	500.000-	1	NC_BGT-kar.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S15	8117.000-	13	NC_BGT-kar.5	42.5	13.9	-73.5	-3.3	0.5	-2.9	86.0

### 2.1.2.2. Resultaten - $u_x$

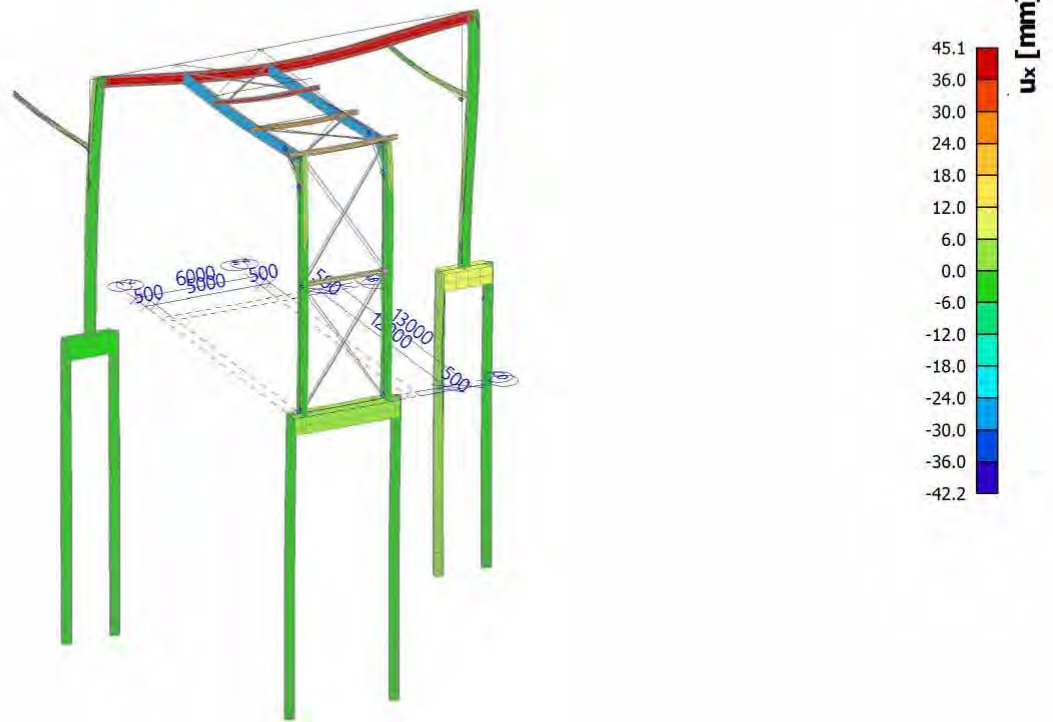
Waardes:  $u_x$

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Selectie: Alle

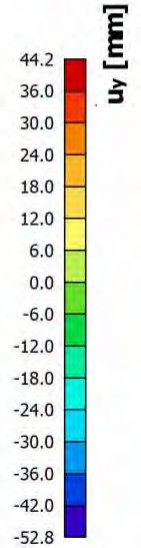
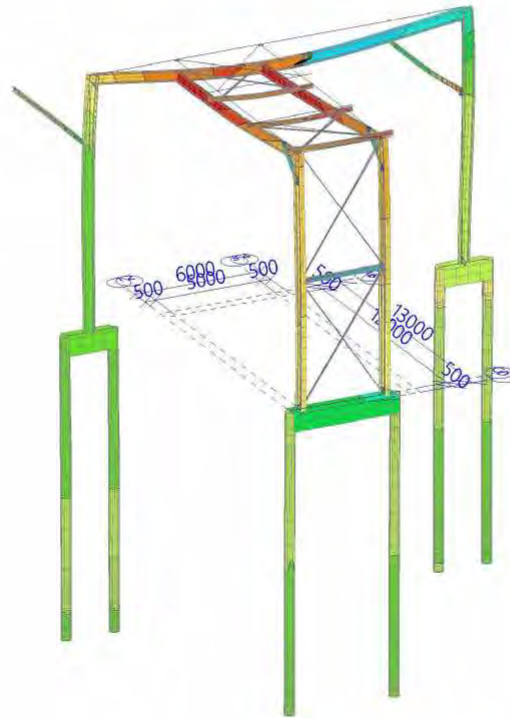
Locatie: In knooppunten gem. bij macro. Systeem: LCS net element





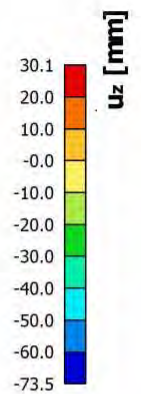
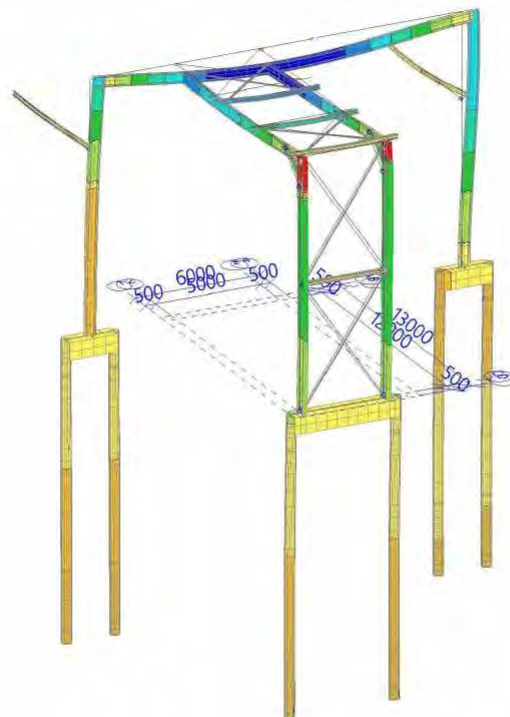
### 2.1.2.3. Resultaten - $u_y$

Waardes:  $u_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij macro. Systeem: LCS net element



### 2.1.2.4. Resultaten - $u_z$

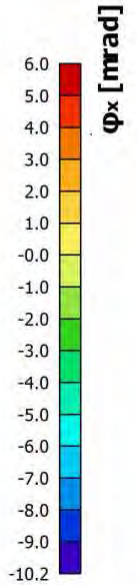
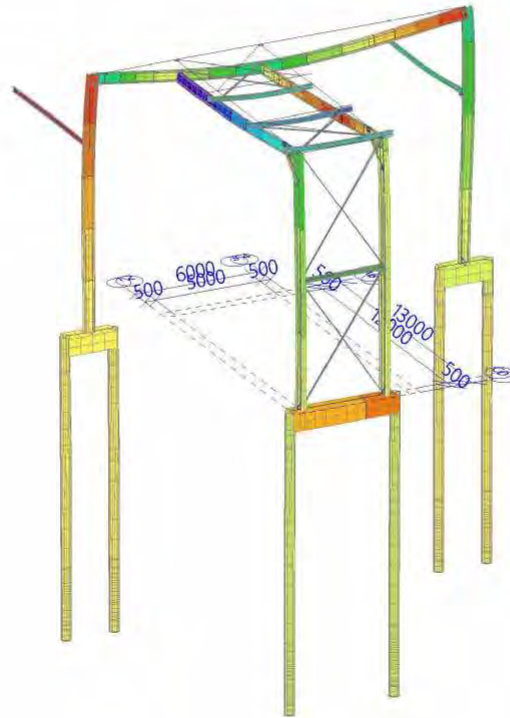
Waardes:  $u_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij macro. Systeem: LCS net element





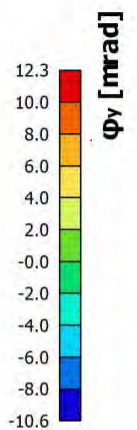
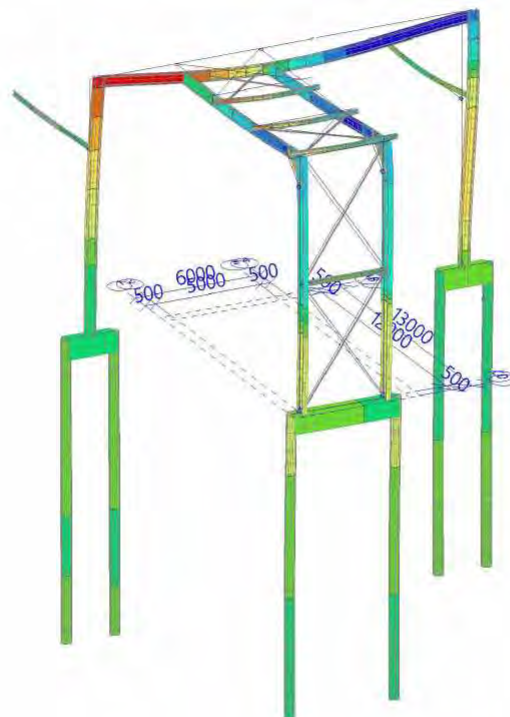
### 2.1.2.5. Resultaten - $\varphi_x$

Waardes:  $\varphi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element



### 2.1.2.6. Resultaten - $\varphi_y$

Waardes:  $\varphi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element







Project  
Omschrijving  
Onderdeel

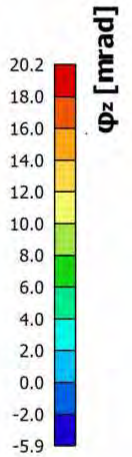
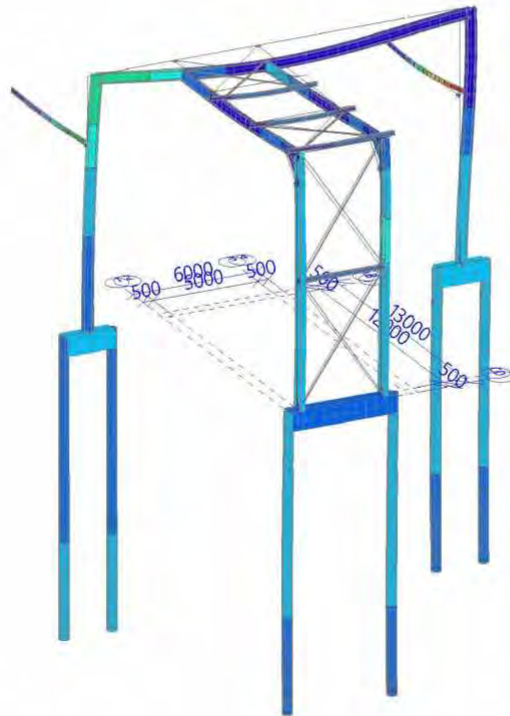
4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2a  
10/32

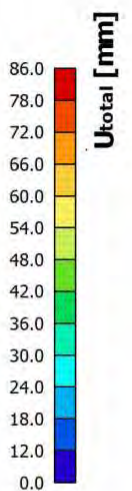
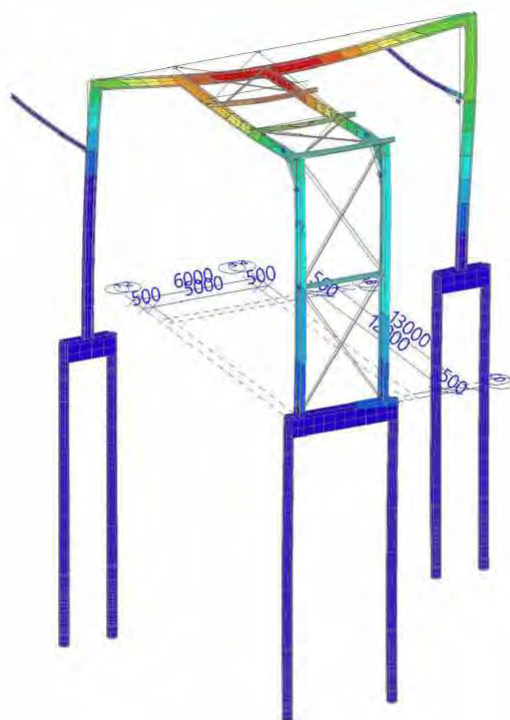
### 2.1.2.7. Resultaten - $\varphi_z$

Waardes:  $\varphi_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element



### 2.1.2.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Selectie: Alle  
Locatie: In knooppunten gem. bij  
macro. Systeem: LCS net element





## 2.1.3. 1D-ervormingen Algemeen

### 2.1.3.1. 1D-ervormingen

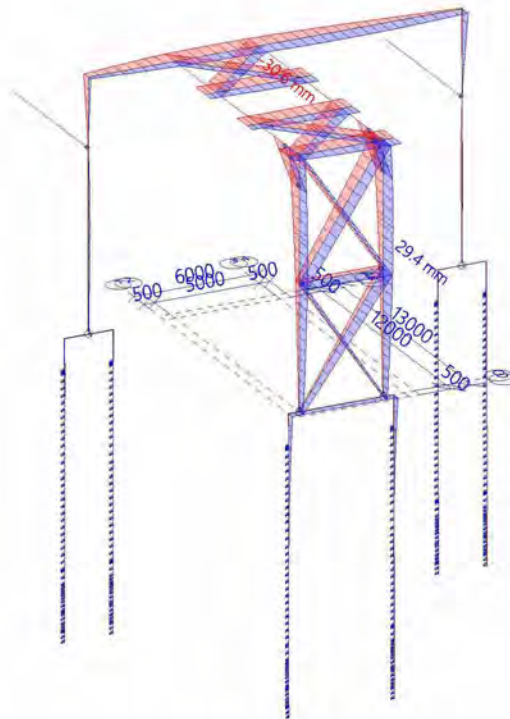
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle

#### Vervormingen

Naam	dx [mm]	Belasting	$u_x$ [mm]	$u_y$ [mm]	$u_z$ [mm]	$\phi_x$ [mrad]	$\phi_y$ [mrad]	$\phi_z$ [mrad]	$U_{total}$ [mm]
S17	4500.000-	NC_BGT-kar.1	<b>-30.6</b>	-0.1	-19.6	2.0	-4.9	0.0	36.3
S10	8115.000-	NC_BGT-kar.4	<b>29.4</b>	4.1	-0.9	-0.8	-0.1	-0.3	29.7
S41	3000.000	NC_BGT-kar.5	0.0	<b>-11.3</b>	-0.1	-3.4	-0.1	0.5	11.3
S11	9785.000-	NC_BGT-kar.5	4.3	<b>46.0</b>	-0.9	0.2	2.5	-1.1	46.2
S18	0.000	NC_BGT-kar.5	-22.9	20.1	<b>0.6</b>	-2.1	-5.1	-2.6	30.5
S15	1543.875	NC_BGT-kar.5	-15.2	42.0	-19.6	<b>-12.3</b>	-2.4	2.8	48.8
S15	14888.100	NC_BGT-kar.6	0.9	13.8	-29.4	<b>10.6</b>	0.6	-2.4	32.5
S13	8500.000	NC_BGT-kar.6	-16.7	8.0	-25.3	3.7	<b>-8.2</b>	-1.0	31.3
S11	11820.000	NC_BGT-kar.4	18.2	14.5	-0.9	6.9	<b>5.2</b>	2.7	23.3
S41	0.000	NC_BGT-kar.5	0.0	0.0	0.0	-3.4	0.1	<b>-5.9</b>	0.0
S41	7423.000	NC_BGT-kar.5	0.0	42.2	-0.8	-3.4	0.4	<b>20.2</b>	42.2
S34	0.000	NC_BGT-kar.5	-13.9	42.0	<b>-73.0</b>	0.0	0.0	0.0	85.4

### 2.1.3.2. Resultaten - $u_x$

Waardes:  $u_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
12/32

### 2.1.3.3. Resultaten - $u_y$

Waardes:  $u_y$

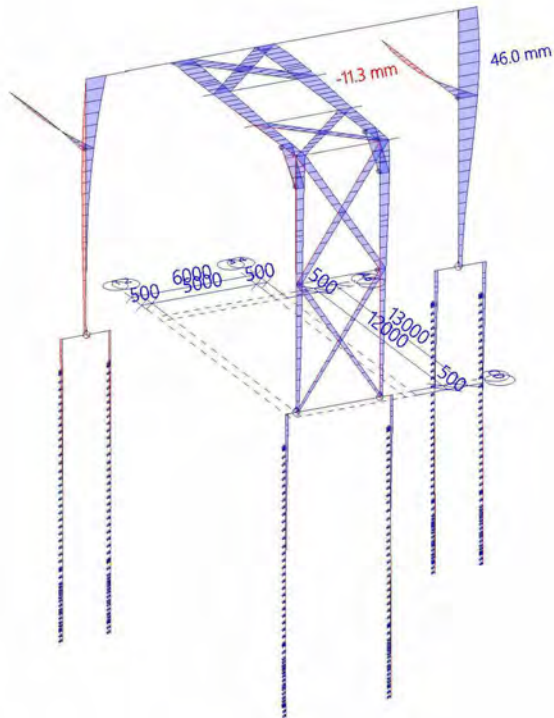
Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Globaal

Extreme 1D: Globaal

Selectie: Alle



### 2.1.3.4. Resultaten - $u_z$

Waardes:  $u_z$

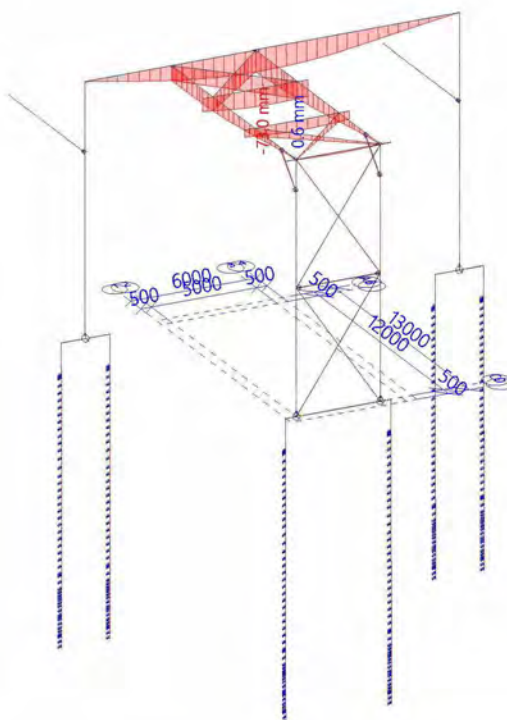
Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Globaal

Extreme 1D: Globaal

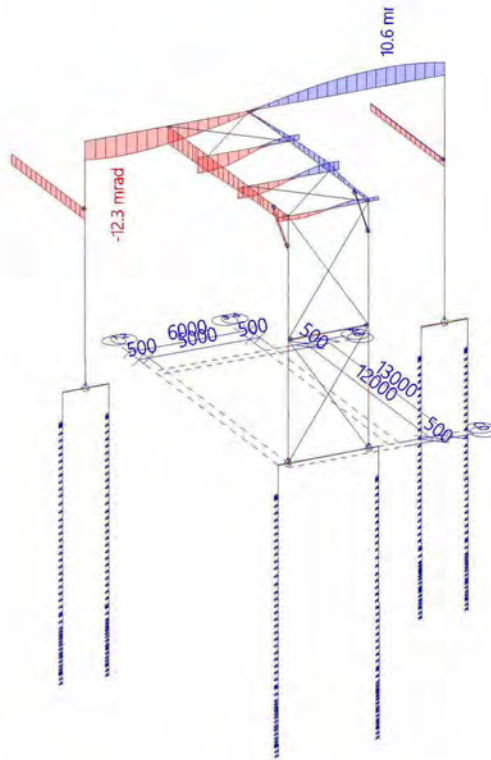
Selectie: Alle





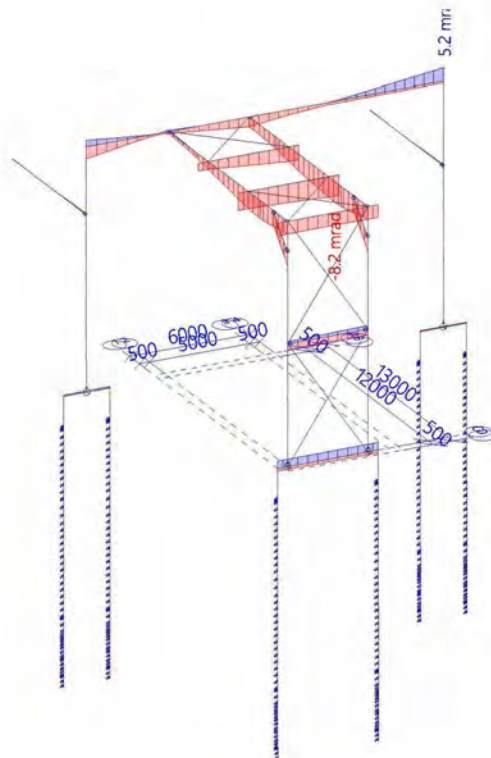
### 2.1.3.5. Resultaten - $\varphi_x$

Waardes:  $\varphi_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle



### 2.1.3.6. Resultaten - $\varphi_y$

Waardes:  $\varphi_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle

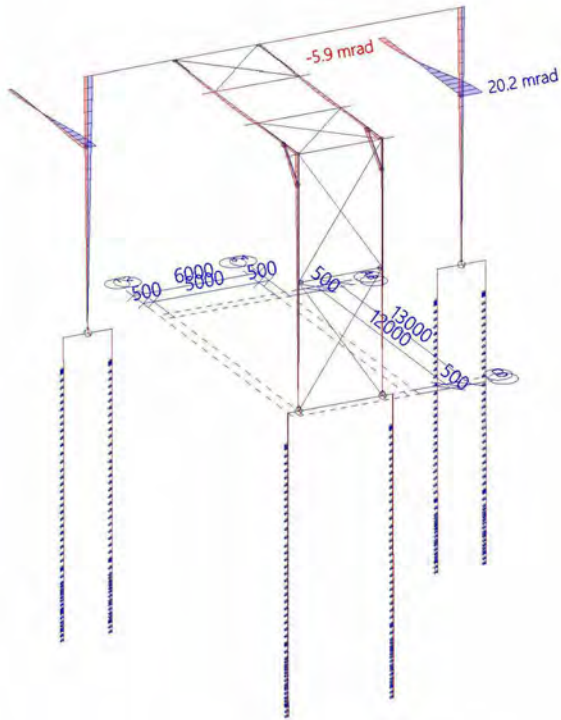




### 2.1.3.7. Resultaten - $\varphi_z$

Waardes:  $\varphi_z$

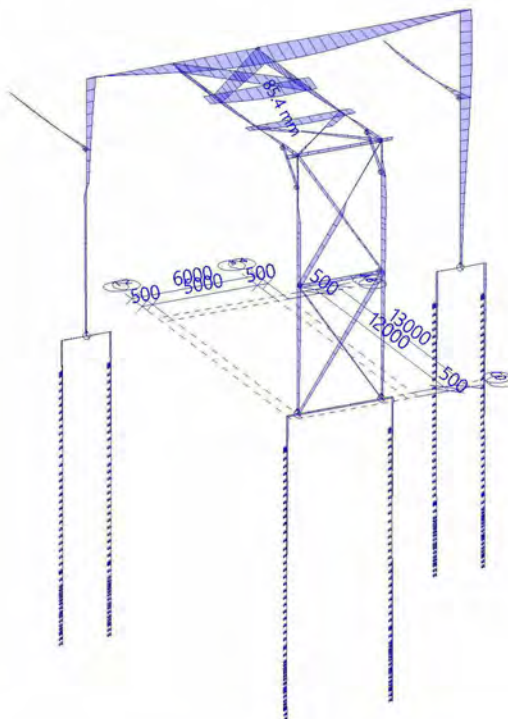
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle



### 2.1.3.8. Resultaten - $U_{total}$

Waardes:  $U_{total}$

Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Globaal  
Extreme 1D: Globaal  
Selectie: Alle





## 2.2. Krachten

### 2.2.1. Reactiekrachten

#### 2.2.1.1. Reacties

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle  
**Knoopreacties**

Naam	Belasting	R <sub>x</sub> [kN]	R <sub>y</sub> [kN]	R <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	ε <sub>x</sub> [mm]	ε <sub>y</sub> [mm]
Sb2/S41	NC_UGT-Set B.11	<b>-21.91</b>	-1.30	1.51	0.00	0.00	0.00	0.0	0.0
Sb1/S40	NC_UGT-Set B.5	<b>13.49</b>	-0.57	1.82	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.0	0.0
Sb2/S41	NC_UGT-Set B.7	-8.08	<b>-2.16</b>	1.97	0.00	0.00	0.00	0.0	0.0
Sn8/K52	NC_UGT-Set B.7	0.00	<b>0.64</b>	0.49	0.00	0.00	0.00	0.0	0.0
Sn6/K50	NC_UGT-Set B.12	0.00	0.00	<b>-86.18</b>	0.00	0.00	0.00	0.0	0.0
Sn5/K49	NC_UGT-Set B.7	0.00	0.00	<b>461.60</b>	0.00	0.00	0.00	0.0	0.0

#### Lineaire intensiteit

Naam	dx [mm]	Belasting	R <sub>x</sub> [kN/m]	R <sub>y</sub> [kN/m]	R <sub>z</sub> [kN/m]	M <sub>x</sub> [kNm/m]	M <sub>y</sub> [kNm/m]	M <sub>z</sub> [kNm/m]
Slb3/S5	12500.000	NC_UGT-Set B.11	<b>-51.06</b>	-3.53	0.00	0.00	0.00	0.00
Slb65/S38	12500.000	NC_UGT-Set B.11	<b>4.00</b>	-23.37	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
Slb65/S38	12500.000	NC_UGT-Set B.7	3.58	<b>-38.21</b>	0.00	0.00	0.00	0.00
Slb1/S7	12500.000	NC_UGT-Set B.14	-3.58	<b>19.26</b>	0.00	0.00	0.00	0.00

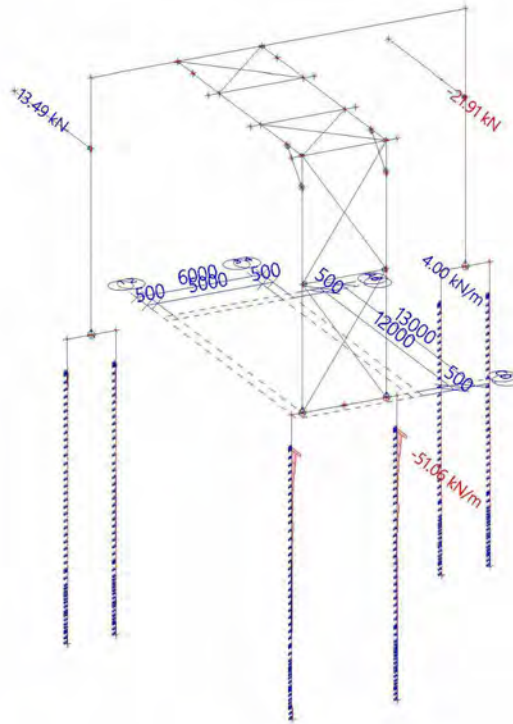
#### Reacties op lijnondersteuningen

Naam	dx [mm]	Belasting	R <sub>x</sub> [kN]	R <sub>y</sub> [kN]	R <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]	e [mm]
Slb6/S5	11845.000	NC_UGT-Set B.6	<b>-9.84</b>	-0.92	0.00	0.00	0.00	0.00	0.0
Slb18/S5	6088.000	NC_UGT-Set B.11	<b>3.52</b>	-0.02	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	0.0
Slb66/S38	11845.000	NC_UGT-Set B.7	0.67	<b>-8.19</b>	0.00	0.00	0.00	0.00	0.0
Slb8/S7	11845.000	NC_UGT-Set B.14	-0.67	<b>4.17</b>	0.00	0.00	0.00	0.00	0.0



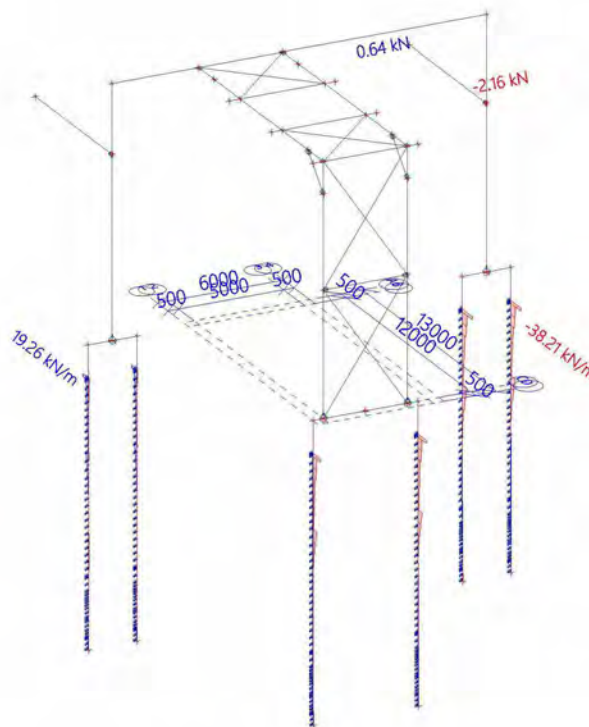
### 2.2.1.2. Resultaten - $R_x$

Waardes:  $R_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.3. Resultaten - $R_y$

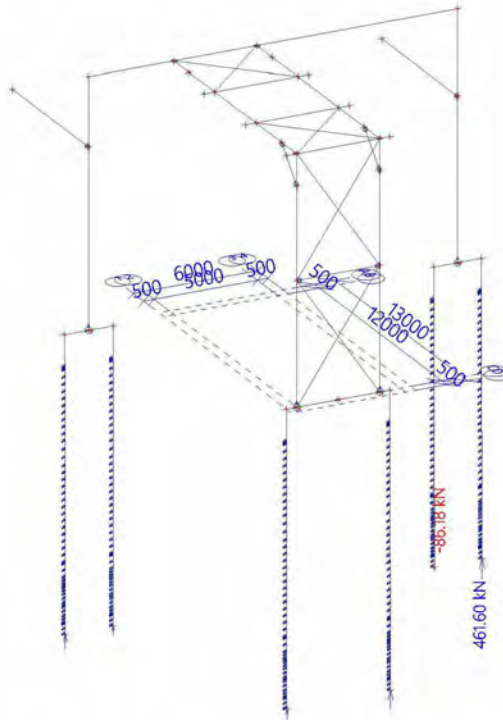
Waardes:  $R_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle





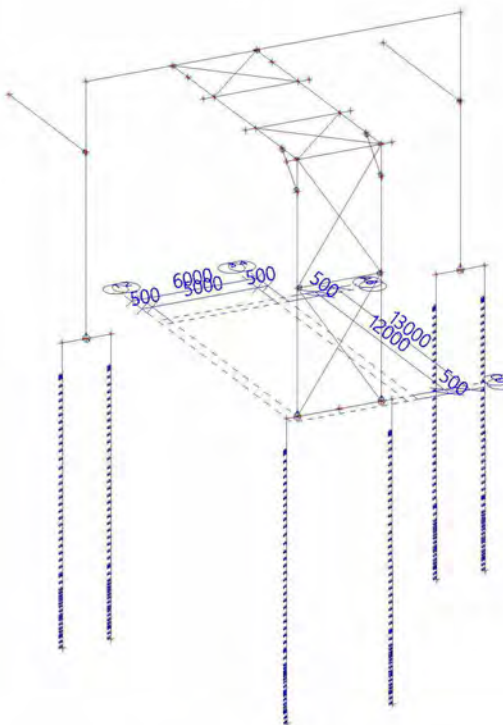
### 2.2.1.4. Resultaten - $R_z$

Waardes:  $R_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.5. Resultaten - $M_x$

Waardes:  $M_x$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle

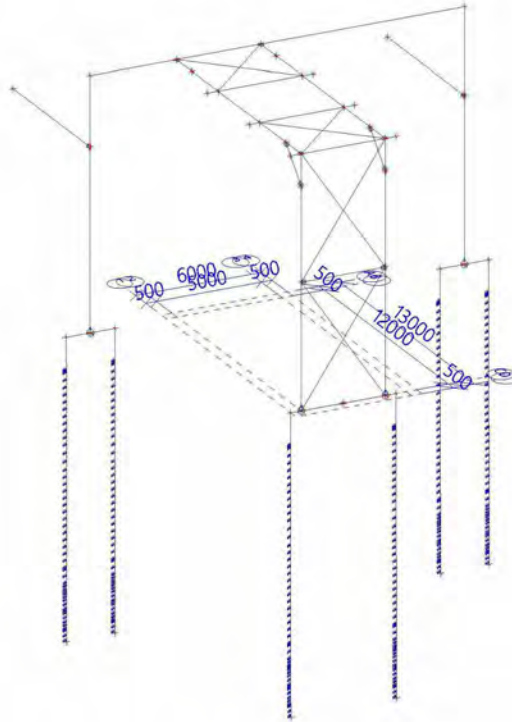






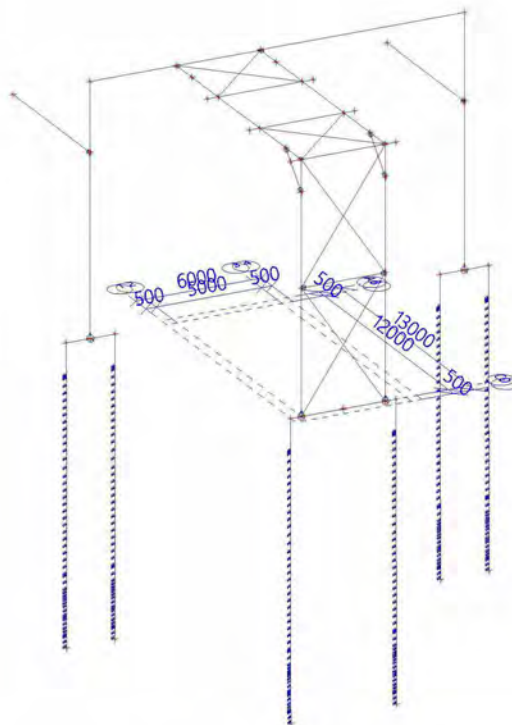
### 2.2.1.6. Resultaten - $M_y$

Waardes:  $M_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle



### 2.2.1.7. Resultaten - $M_z$

Waardes:  $M_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Systeem: Globaal  
Extreem: Globaal  
Selectie: Alle





## 2.2.2. Interne staafkrachten

### 2.2.2.1. Interne 1D-krachten

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle

Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S37	0.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>43.94</b>	-1.20	-135.82	3.68	77.08	-0.31
S2	5000.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.51	<b>-32.79</b>	-204.43	9.16	-15.79	-0.03
S2	0.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	1.93	<b>25.55</b>	153.11	-21.84	1.54	-0.03
S37	2300.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	-43.07	3.01	<b>-392.98</b>	-3.86	-82.89	0.33
S1	0.000	NC_UGT-Set B.14	BT-12 - Rechthoek (800; 800)	-24.20	1.01	<b>235.71</b>	-3.21	-46.08	0.14
S2	4500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	-3.02	-5.38	-132.87	<b>-35.61</b>	59.30	2.62
S2	0.000	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	0.06	3.95	121.50	<b>32.66</b>	-1.68	0.10
S37	1150.000-	NC_UGT-Set B.12	BT-12 - Rechthoek (800; 800)	40.66	-1.23	-153.81	3.72	<b>-96.86</b>	-1.70
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>-43.11</b>	3.00	-371.28	-3.85	<b>356.56</b>	<b>-3.13</b>
S2	4500.000+	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.52	-32.74	-195.00	9.13	84.06	<b>16.35</b>
S38	0.000	NC_UGT-Set B.7	BT-11 - Cirkel (460)	<b>-461.59</b>	-1.35	1.41	0.00	0.00	0.00
S39	14000.000	NC_UGT-Set B.12	BT-11 - Cirkel (460)	<b>137.68</b>	-40.26	-1.65	0.04	3.21	-86.99
S38	12500.000+	NC_UGT-Set B.7	BT-11 - Cirkel (460)	-400.14	<b>-44.81</b>	-1.78	0.02	5.43	-33.14
S7	12500.000+	NC_UGT-Set B.14	BT-11 - Cirkel (460)	-244.01	<b>23.65</b>	1.73	0.01	-5.43	20.36
S5	6984.000+	NC_UGT-Set B.11	BT-11 - Cirkel (460)	-196.51	0.59	<b>-15.77</b>	0.00	-29.11	2.87
S5	13500.000	NC_UGT-Set B.6	BT-11 - Cirkel (460)	-206.77	-6.16	<b>33.41</b>	-0.07	-13.16	-14.94
S5	14000.000	NC_UGT-Set B.12	BT-11 - Cirkel (460)	-323.20	-37.28	18.79	<b>-0.12</b>	26.12	-92.60
S5	14000.000	NC_UGT-Set B.5	BT-11 - Cirkel (460)	-270.72	-32.89	5.88	<b>0.09</b>	32.80	-81.70
S5	10573.333-	NC_UGT-Set B.11	BT-11 - Cirkel (460)	-186.36	-2.28	-5.36	-0.01	<b>-70.60</b>	-0.36
S5	14000.000	NC_UGT-Set B.14	BT-11 - Cirkel (460)	-228.15	-8.73	20.02	-0.02	<b>40.35</b>	-24.52
S38	14000.000	NC_UGT-Set B.7	BT-11 - Cirkel (460)	-392.85	-44.25	-1.83	0.05	2.72	<b>-100.02</b>
S7	14000.000	NC_UGT-Set	BT-11 -	-235.77	23.49	1.72	0.03	-2.85	<b>55.74</b>



Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S8	0.000	B.14 NC_UGT-Set B.14	Cirkel (460) ST-17 - HEA450	<b>-229.28</b>	3.12	-45.91	-0.12	116.74	-5.98
S15	0.000	NC_UGT-Set B.10	ST-17 - HEA450	<b>-2.97</b>	-7.80	66.34	-0.55	-70.48	0.61
S15	4117.000-	NC_UGT-Set B.7	ST-17 - HEA450	-27.56	<b>-10.90</b>	109.19	-0.78	321.25	-36.59
S8	8550.000+	NC_UGT-Set B.11	ST-17 - HEA450	-164.69	<b>13.29</b>	-30.71	0.75	-208.21	-35.50
S15	17790.000	NC_UGT-Set B.14	ST-17 - HEA450	-61.84	-3.54	<b>-195.06</b>	1.04	-483.80	-0.23
S15	0.000	NC_UGT-Set B.14	ST-17 - HEA450	-43.82	-7.29	<b>207.64</b>	-1.97	-409.38	3.00
S11	11820.000	NC_UGT-Set B.6	ST-17 - HEA450	-181.57	9.58	60.19	<b>-4.02</b>	469.45	4.29
S15	0.000	NC_UGT-Set B.11	ST-17 - HEA450	-30.20	10.34	160.70	<b>2.71</b>	-300.11	-1.14
S15	17790.000	NC_UGT-Set B.7	ST-17 - HEA450	-76.35	-4.80	-194.72	0.36	<b>-557.26</b>	-0.85
S11	11820.000	NC_UGT-Set B.7	ST-17 - HEA450	-194.48	5.38	76.93	-2.65	<b>574.36</b>	0.50
S11	7750.000-	NC_UGT-Set B.11	ST-17 - HEA450	-163.34	-9.30	54.66	-1.02	191.61	<b>-41.95</b>
S8	8550.000+	NC_UGT-Set B.5	ST-17 - HEA450	-98.13	-9.49	-6.86	-0.34	-102.87	<b>28.59</b>
S10	0.000	NC_UGT-Set B.7	ST-11 - IPE600	<b>-310.08</b>	-1.63	20.70	0.02	3.19	0.00
S10	11820.000	NC_UGT-Set B.11	ST-11 - IPE600	<b>34.74</b>	-2.25	-127.36	-0.10	56.64	-10.07
S10	5910.000+	NC_UGT-Set B.7	ST-11 - IPE600	-198.57	<b>-5.90</b>	20.14	0.34	124.29	6.45
S9	11820.000	NC_UGT-Set B.7	ST-11 - IPE600	1.29	<b>3.72</b>	-96.48	0.12	42.67	7.45
S10	0.000	NC_UGT-Set B.6	ST-11 - IPE600	-158.23	0.49	<b>33.91</b>	0.00	-29.83	0.01
S10	11820.000	NC_UGT-Set B.6	ST-11 - IPE600	33.01	-2.51	<b>-138.92</b>	<b>-0.12</b>	61.25	-11.40
S9	10320.000+	NC_UGT-Set B.7	ST-11 - IPE600	-0.99	2.31	-96.49	<b>0.37</b>	187.40	2.99
S10	0.000	NC_UGT-Set B.11	ST-11 - IPE600	-137.82	0.43	32.44	0.01	<b>-37.47</b>	0.01
S10	10320.000+	NC_UGT-Set B.6	ST-11 - IPE600	30.63	-2.45	-137.61	-0.11	<b>268.62</b>	-7.69
S10	11820.000	NC_UGT-Set B.14	ST-11 - IPE600	-0.73	-2.45	-116.38	-0.05	50.53	<b>-12.25</b>
S9	11820.000	NC_UGT-Set B.14	ST-11 - IPE600	-3.66	2.27	-95.57	0.08	40.40	<b>10.66</b>
S12	8000.000+	NC_UGT-Set B.7	ST-12 - IPE450	<b>-48.04</b>	-7.79	-62.10	-0.23	60.52	7.22
S13	12000.000	NC_UGT-Set B.6	ST-12 - IPE450	<b>118.53</b>	0.84	88.10	0.20	-88.32	-0.22
S13	8000.000+	NC_UGT-Set B.7	ST-12 - IPE450	-17.21	<b>-8.15</b>	-62.23	0.02	20.20	6.14
S13	10500.000-	NC_UGT-Set B.6	ST-12 - IPE450	-41.75	0.28	<b>-71.16</b>	0.63	-185.49	-1.08
S12	4000.000-	NC_UGT-Set B.7	ST-12 - IPE450	-45.74	6.34	28.26	<b>-0.49</b>	125.99	0.58
S13	10500.000-	NC_UGT-Set B.7	ST-12 - IPE450	-17.29	-0.11	-64.57	<b>0.69</b>	-138.36	-3.82
S13	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	118.24	0.71	<b>89.88</b>	0.56	<b>-221.72</b>	-1.11



Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S12	4000.000+	NC_UGT-Set B.14	ST-12 - IPE450	-18.03	1.40	-14.23	-0.26	<b>126.94</b>	-3.85
S12	2000.000	NC_UGT-Set B.7	ST-12 - IPE450	-45.69	0.11	30.19	-0.18	67.52	<b>-6.04</b>
S13	8000.000-	NC_UGT-Set B.7	ST-12 - IPE450	23.36	<b>8.71</b>	-22.17	-0.17	10.69	<b>9.10</b>
S23	3000.000	NC_UGT-Set B.7	ST-13 - HEA180	<b>-59.12</b>	0.00	-0.44	0.00	0.65	0.00
S16	500.000+	NC_UGT-Set B.14	ST-13 - HEA180	<b>1.62</b>	1.03	34.79	0.02	-1.72	<b>0.44</b>
S18	4500.000-	NC_UGT-Set B.11	ST-13 - HEA180	-30.89	<b>-3.09</b>	-29.90	0.01	-14.40	-0.30
S18	4500.000-	NC_UGT-Set B.14	ST-13 - HEA180	-30.50	-1.64	<b>-35.77</b>	0.00	-17.08	-0.11
S17	500.000+	NC_UGT-Set B.14	ST-13 - HEA180	-17.82	0.64	<b>35.41</b>	0.02	-4.13	0.40
S18	500.000+	NC_UGT-Set B.6	ST-13 - HEA180	-29.57	2.90	32.95	<b>0.06</b>	-14.52	-0.02
S18	4500.000-	NC_UGT-Set B.7	ST-13 - HEA180	-50.08	-1.70	-34.10	0.03	<b>-17.33</b>	-0.10
S16	2500.000-	NC_UGT-Set B.14	ST-13 - HEA180	-0.62	-0.56	-0.36	0.02	<b>32.74</b>	0.98
S16	500.000+	NC_UGT-Set B.11	ST-13 - HEA180	-2.08	<b>3.80</b>	29.50	<b>-0.02</b>	-2.47	<b>-3.40</b>
S18	2500.000-	NC_UGT-Set B.6	ST-13 - HEA180	-31.48	-0.07	-0.42	0.03	18.09	<b>2.96</b>
S22	0.000	NC_UGT-Set B.6	ST-14 - HEA120	<b>-227.36</b>	0.00	0.19	0.00	0.00	0.00
S21	2121.320	NC_UGT-Set B.2	ST-14 - HEA120	<b>-41.80</b>	0.00	-0.14	0.00	0.00	0.00
S21	2121.320	NC_UGT-Set B.14	ST-14 - HEA120	-152.18	<b>-0.01</b>	-0.21	-0.01	0.00	0.00
S22	2121.320	NC_UGT-Set B.8	ST-14 - HEA120	-183.02	<b>0.00</b>	-0.19	0.00	0.00	0.00
S22	2121.320	NC_UGT-Set B.14	ST-14 - HEA120	-191.47	0.00	<b>-0.21</b>	<b>0.01</b>	0.00	0.00
S22	0.000	NC_UGT-Set B.14	ST-14 - HEA120	-191.87	0.00	<b>0.21</b>	0.01	0.00	0.00
S21	2121.320	NC_UGT-Set B.6	ST-14 - HEA120	-185.46	0.00	-0.19	<b>-0.01</b>	0.00	0.00
S21	0.000	NC_UGT-Set B.7	ST-14 - HEA120	-154.09	0.00	0.19	-0.01	<b>0.00</b>	0.00
S22	1060.660	NC_UGT-Set B.14	ST-14 - HEA120	-191.67	0.00	0.00	0.01	<b>0.11</b>	0.00
S22	1590.990	NC_UGT-Set B.7	ST-14 - HEA120	-183.19	0.00	-0.10	0.00	0.08	<b>0.00</b>
S21	530.330	NC_UGT-Set B.7	ST-14 - HEA120	-154.00	0.00	0.09	-0.01	0.08	<b>0.00</b>
S25	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	<b>122.97</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
S25	0.000	NC_UGT-Set B.4	ST-15 - FLA80/10	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>
S35	0.000	NC_UGT-Set B.7	ST-16 - L60X6	<b>53.49</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>
S33	0.000	NC_UGT-Set B.1	ST-16 - L60X6	<b>0.00</b>	0.00	0.00	0.00	0.00	<b>0.00</b>
S40	2423.000-	NC_UGT-Set B.5	ST-18 - UNP200	<b>-13.49</b>	-0.43	-0.83	-0.01	-1.12	-1.13
S41	7423.000	NC_UGT-Set B.11	ST-18 - UNP200	<b>21.92</b>	-0.64	0.17	0.00	0.00	0.00
S41	5000.000+	NC_UGT-Set	ST-18 -	8.11	<b>-1.39</b>	0.93	-0.02	-1.35	3.20



Naam	dx [mm]	Belasting	Doorsnede	N [kN]	V <sub>y</sub> [kN]	V <sub>z</sub> [kN]	M <sub>x</sub> [kNm]	M <sub>y</sub> [kNm]	M <sub>z</sub> [kNm]
S41	5000.000-	B.7 NC_UGT-Set B.14	ST-18 - UNP200	0.00	0.35	-1.15	-0.01	-1.49	1.75
S40	2423.000+	B.14 NC_UGT-Set B.14	ST-18 - UNP200	0.00	-0.04	1.15	0.00	-1.48	0.23
S41	5000.000-	B.7 NC_UGT-Set B.7	ST-18 - UNP200	-0.01	0.64	-1.03	-0.02	-1.35	3.20
S40	2423.000+	B.1 NC_UGT-Set B.1	ST-18 - UNP200	0.00	-0.11	1.10	0.00	-1.23	0.56
S41	5000.000+	B.14 NC_UGT-Set B.14	ST-18 - UNP200	6.37	-0.75	1.03	-0.01	-1.49	1.75
S41	2000.000	B.1 NC_UGT-Set B.1	ST-18 - UNP200	0.00	0.11	-0.07	0.00	0.53	0.23
S40	2423.000+	B.12 NC_UGT-Set B.12	ST-18 - UNP200	0.00	0.33	0.79	-0.01	-1.08	-1.62

### 2.2.2.2. Resultaten - N

Waardes: N

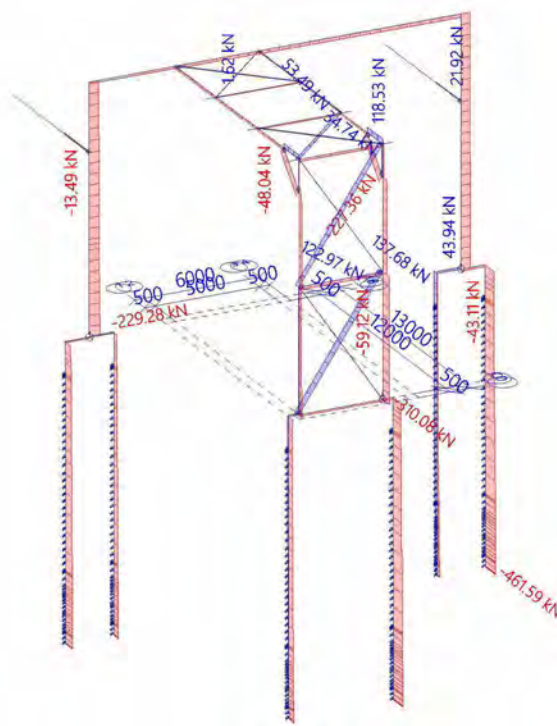
Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Hoofd

Extreme 1D: Doorsnede

Selectie: Alle

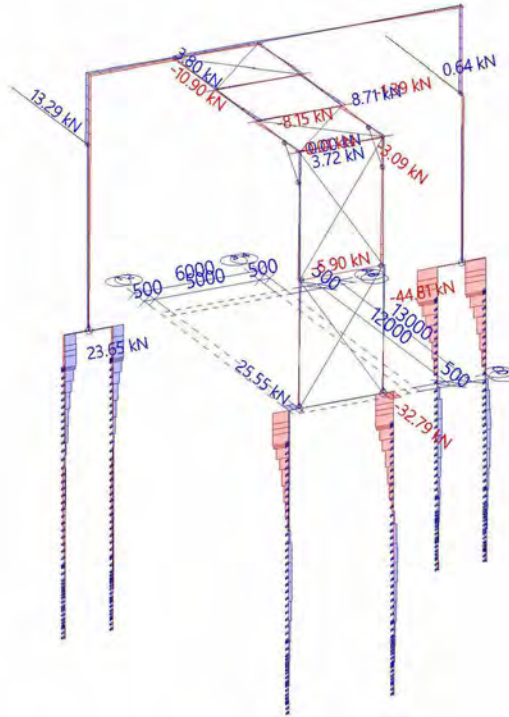




Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 23/32

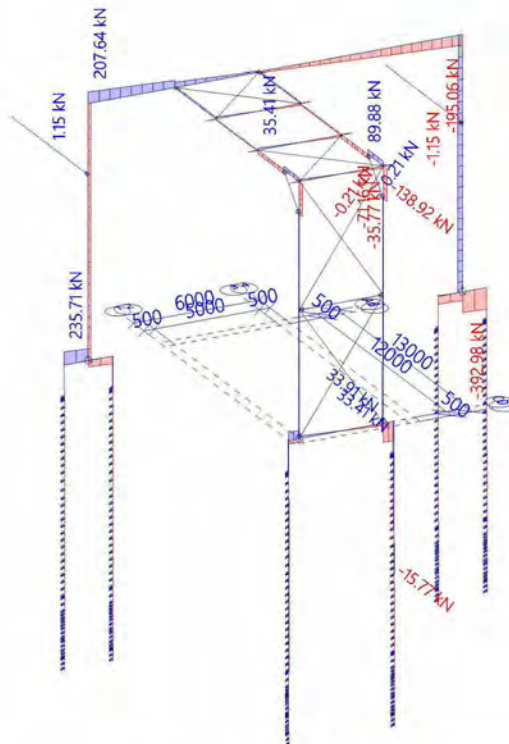
### 2.2.2.3. Resultaten - $V_y$

Waardes:  $V_y$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.2.4. Resultaten - $V_z$

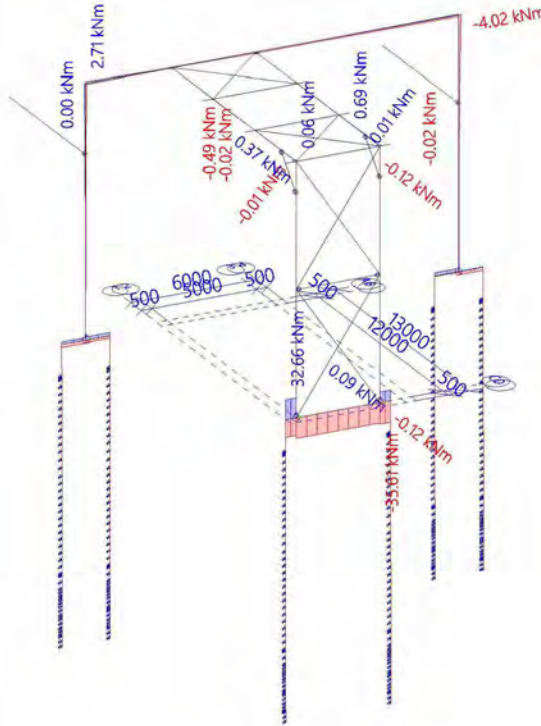
Waardes:  $V_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





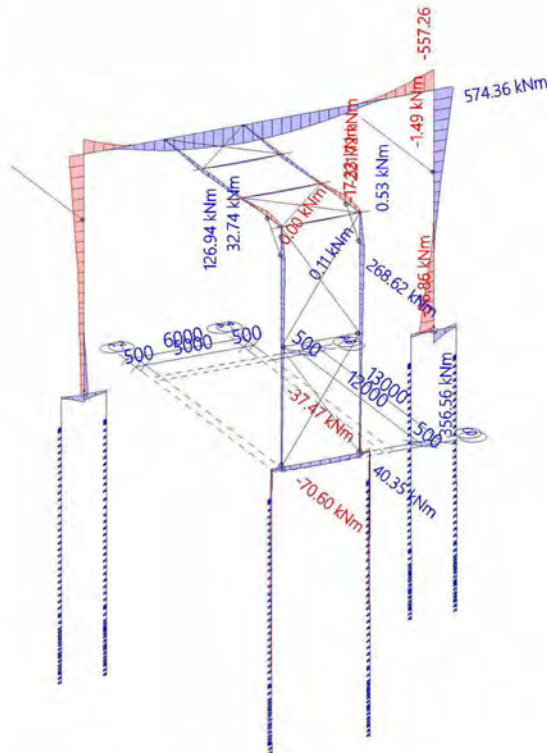
### 2.2.2.5. Resultaten - $M_x$

Waardes:  $M_x$   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle



### 2.2.2.6. Resultaten - $M_y$

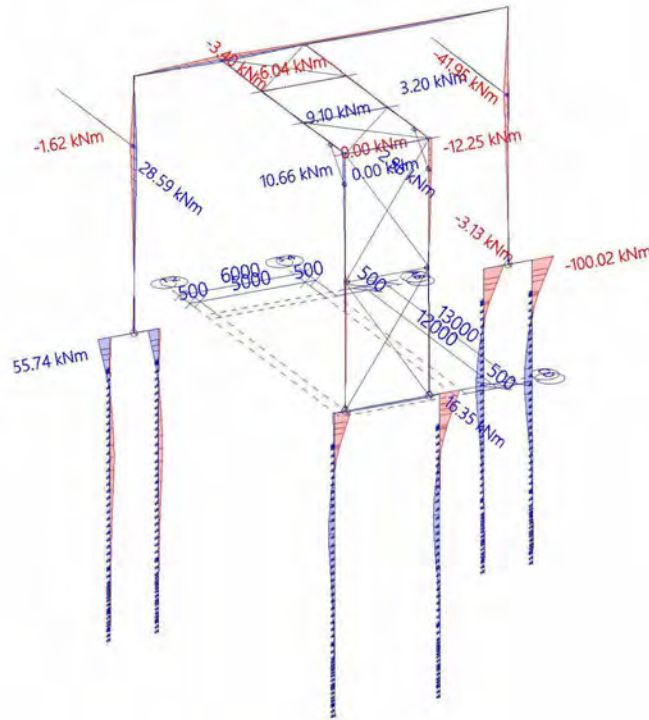
Waardes:  $M_y$   
 Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Doorsnede  
 Selectie: Alle





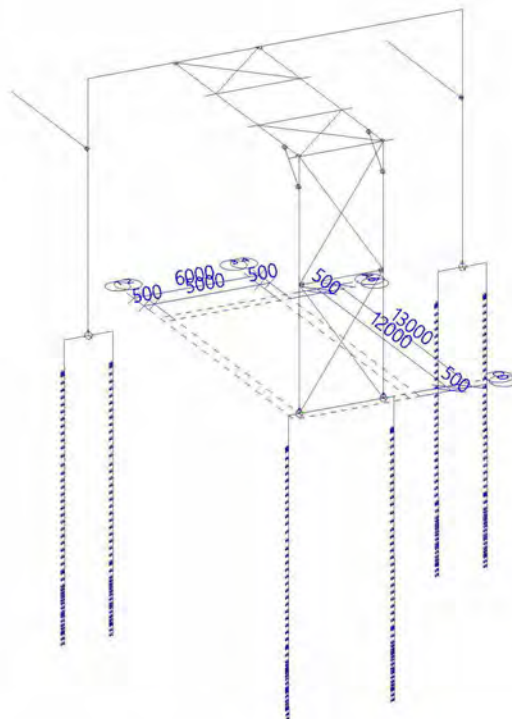
### 2.2.2.7. Resultaten - $M_z$

Waardes:  $M_z$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.2.8. Resultaten - $V_r$

Waardes:  $V_r$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle







## 2.2.3. 3D stress

### 2.2.3.1. 3D spanning

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Selectie: Alle

Locatie: In knooppunten geen gem., Systeem: LCS net element

Hoofd grootheden

#### Resultaten op 1D-element

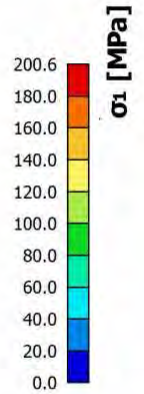
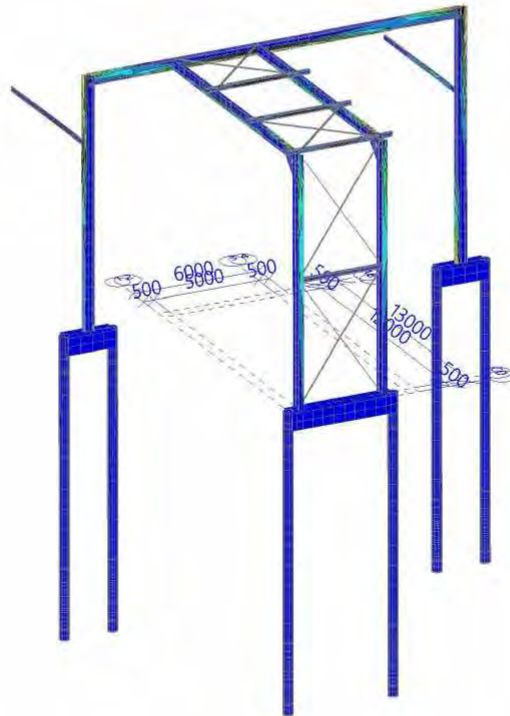
Extreme 1D: Doorsnede

Naam	dx [mm]	Vezel	Belasting	Doorsnede	$\sigma_1$ [MPa]	$\sigma_2$ [MPa]	$T_{tot}$ [MPa]	$\sigma_E$ [MPa]
S37	1150.000+	5	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	0.0	-4.3	0.0	<b>4.3</b>
S38	14000.000	16	NC_UGT-Set B.7	BT-11 - Cirkel (460)	0.0	-12.8	0.0	<b>12.8</b>
S11	11820.000	14	NC_UGT-Set B.7	ST-17 - HEA450	3.5	-212.6	27.4	<b>214.4</b>
S10	10320.000-	15	NC_UGT-Set B.6	ST-11 - IPE600	0.0	-120.8	1.3	<b>120.8</b>
S13	10500.000+	13	NC_UGT-Set B.6	ST-12 - IPE450	166.8	-0.9	12.2	<b>167.3</b>
S16	2500.000-	13	NC_UGT-Set B.14	ST-13 - HEA180	0.0	-121.1	1.3	<b>121.1</b>
S22	1060.660	15	NC_UGT-Set B.6	ST-14 - HEA120	0.0	-90.6	0.6	<b>90.6</b>
S25	7136.393	1	NC_UGT-Set B.7	ST-15 - FLA80/10	153.7	0.0	0.0	<b>153.7</b>
S35	0.000	1	NC_UGT-Set B.7	ST-16 - L60X6	77.4	0.0	0.0	<b>77.4</b>
S41	5000.000-	5	NC_UGT-Set B.7	ST-18 - UNP200	0.4	-126.3	6.7	<b>126.5</b>



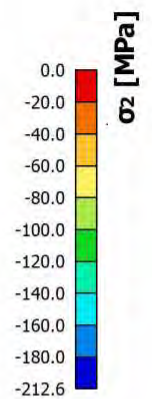
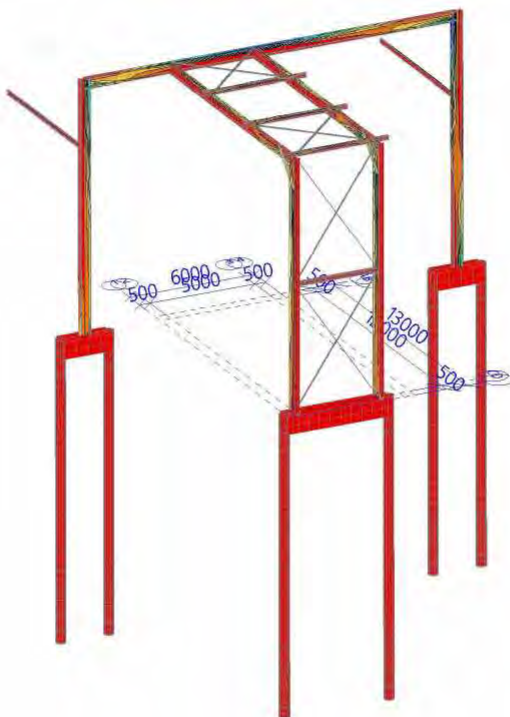
### 2.2.3.2. Resultaten - $\sigma_1$

Waardes:  $\sigma_1$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden



### 2.2.3.3. Resultaten - $\sigma_2$

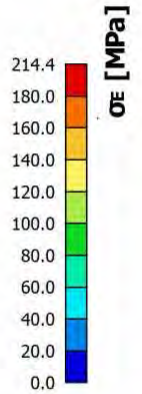
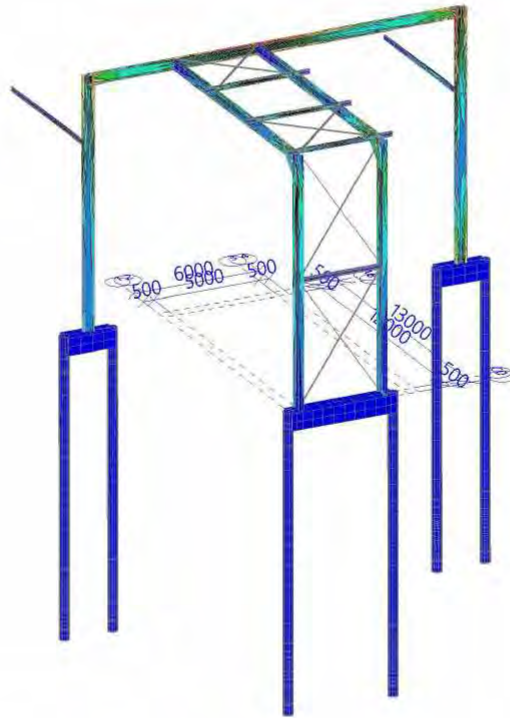
Waardes:  $\sigma_2$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden





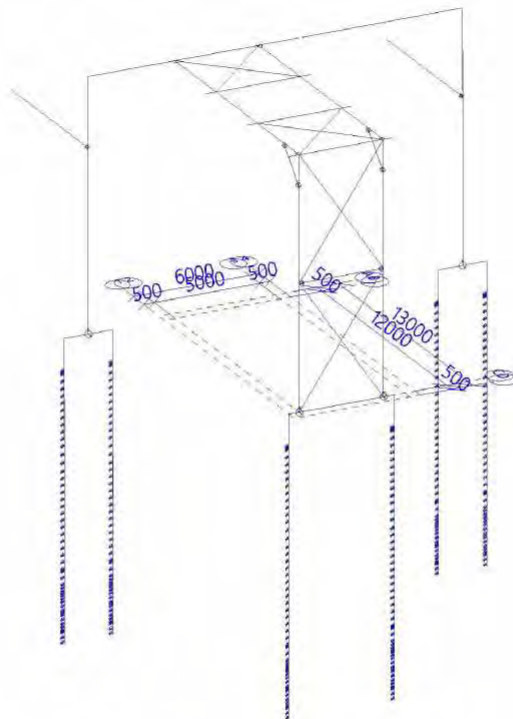
### 2.2.3.4. Resultaten - $\sigma_E$

Waardes:  $\sigma_E$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden



### 2.2.3.5. Resultaten - $\tau_{max,b}$ (2D)

Waardes:  $\tau_{max,b}$  (2D)  
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

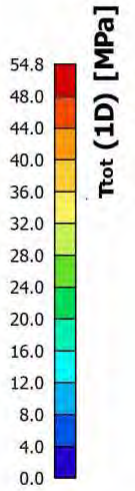
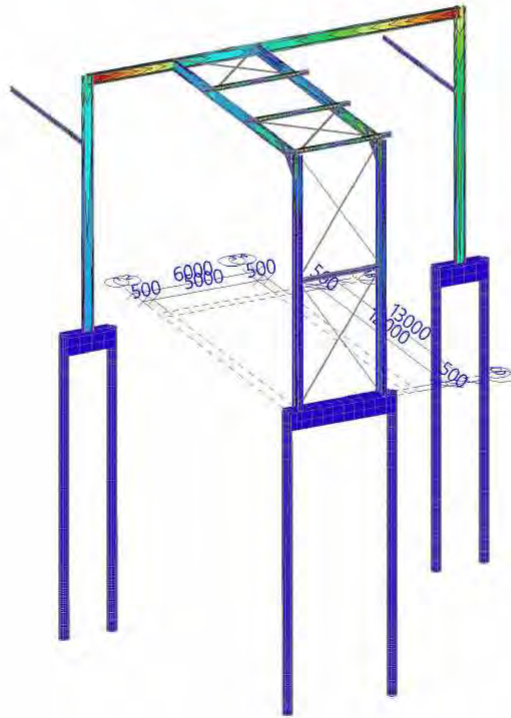
Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.6  
29/32

### 2.2.3.6. Resultaten - $\tau_{tot}$ (1D)

Waardes:  $\tau_{tot}$  (1D)

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Selectie: Alle  
Locatie: In knooppunten geen gem..  
Systeem: LCS net element  
Hoofd grootheden





## 2.2.4. 1D stress

### 2.2.4.1. 1D-spanningen

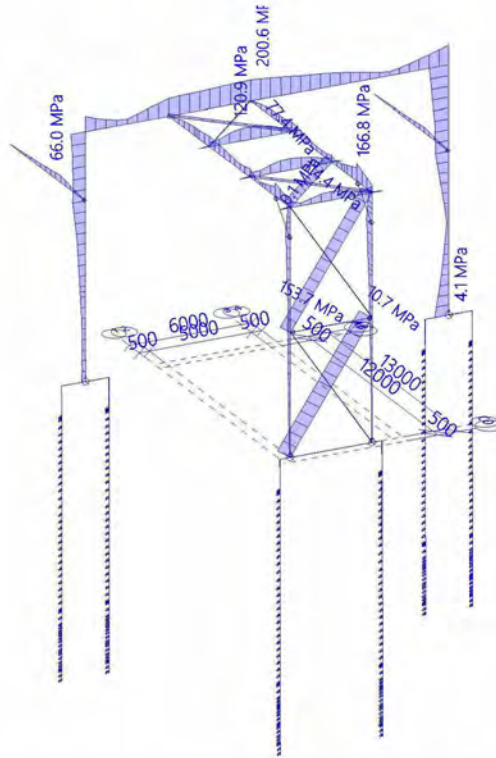
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle

Naam	dx [mm]	Vezel	Belasting	Doorsnede	$\sigma_1$ [MPa]	$\sigma_2$ [MPa]	T <sub>tot</sub> [MPa]	$\sigma_E$ [MPa]
S37	1150.000+	5	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	0.0	-4.3	0.0	<b>4.3</b>
S38	14000.000	16	NC_UGT-Set B.7	BT-11 - Cirkel (460)	0.0	-12.8	0.0	<b>12.8</b>
S11	11820.000	14	NC_UGT-Set B.7	ST-17 - HEA450	3.5	-212.6	27.4	<b>214.4</b>
S10	10320.000-	15	NC_UGT-Set B.6	ST-11 - IPE600	0.0	-120.8	1.3	<b>120.8</b>
S13	10500.000+	13	NC_UGT-Set B.6	ST-12 - IPE450	166.8	-0.9	12.2	<b>167.3</b>
S16	2500.000-	13	NC_UGT-Set B.14	ST-13 - HEA180	0.0	-121.1	1.3	<b>121.1</b>
S22	1060.660	15	NC_UGT-Set B.6	ST-14 - HEA120	0.0	-90.6	0.6	<b>90.6</b>
S25	7136.393	1	NC_UGT-Set B.7	ST-15 - FLA80/10	153.7	0.0	0.0	<b>153.7</b>
S35	0.000	1	NC_UGT-Set B.7	ST-16 - L60X6	77.4	0.0	0.0	<b>77.4</b>
S41	5000.000-	5	NC_UGT-Set B.7	ST-18 - UNP200	0.4	-126.3	6.7	<b>126.5</b>



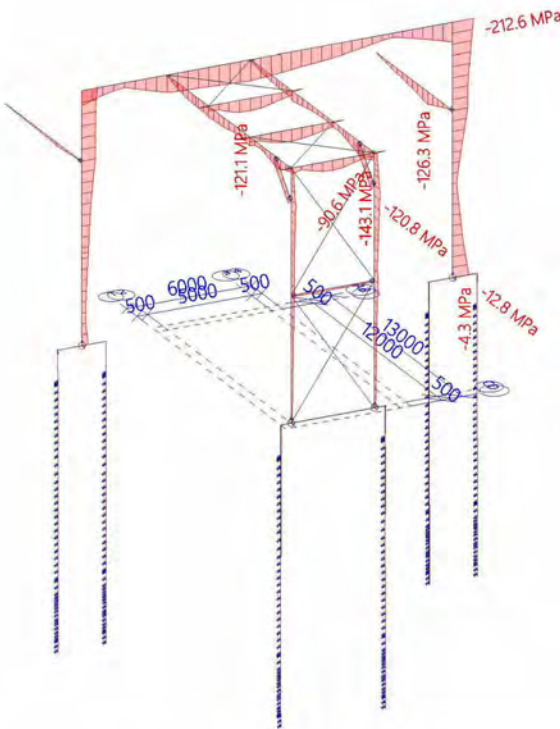
### 2.2.4.2. Resultaten - $\sigma_1$

Waardes:  $\sigma_1$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.4.3. Resultaten - $\sigma_2$

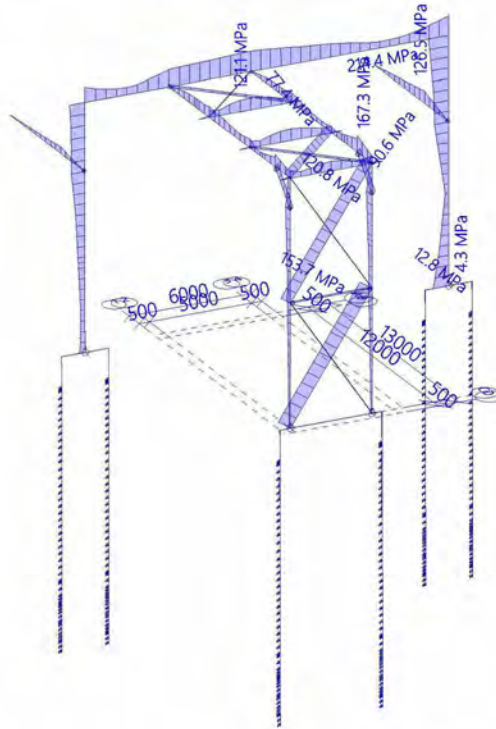
Waardes:  $\sigma_2$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





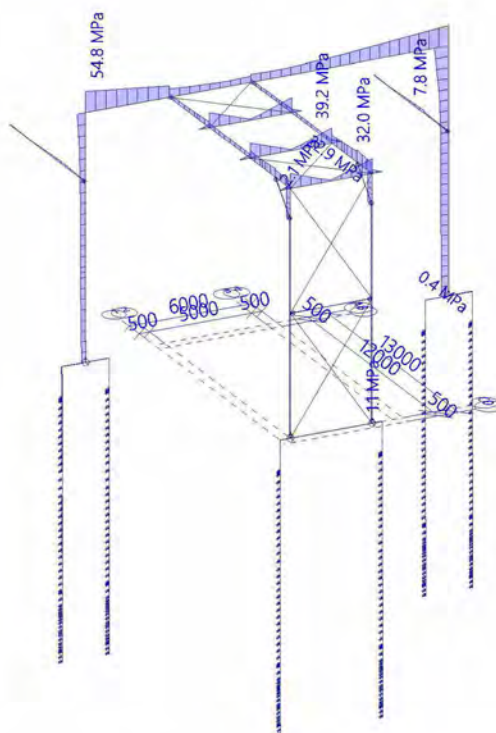
### 2.2.4.4. Resultaten - $\sigma_E$

Waardes:  $\sigma_E$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle



### 2.2.4.5. Resultaten - $\tau_{tot}$

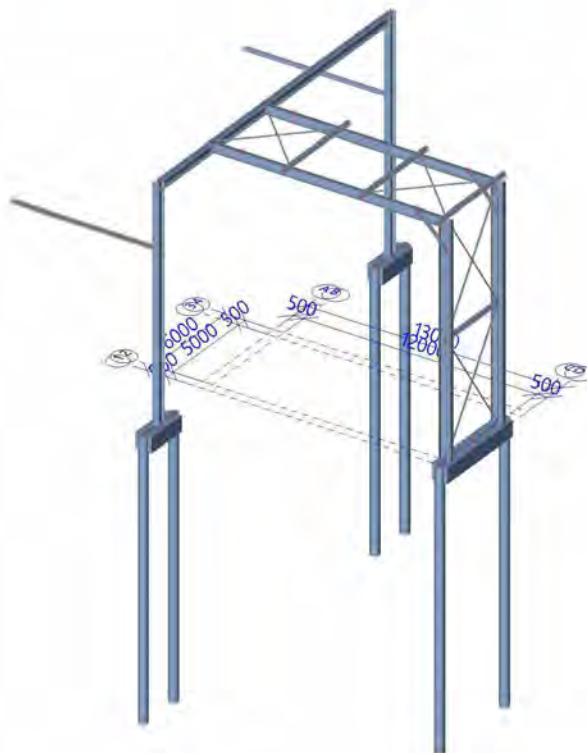
Waardes:  $\tau_{tot}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Doorsnede  
Selectie: Alle





# Bijlage 3.

## Uitvoer Staalcontrole







Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	<small>S.1.2.e</small> 2/39

## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Staal	3
2.1. Slangheid staal	3
2.2. Iy	5
2.3. Iz	6
2.4. EC-EN 1993 UGT: staalcontrole	6
2.5. EC-EN 1993 UGT: staalcontrole	9
2.6. EC-EN 1993 BGT staalcontrole	33



## 2. Staal

### 2.1. Slankheid staal

Lineaire berekening

Staal	CS Naam	Onderdeel	Ongesch. y		Ly	ky	ly	Lam y	lyz	I kip
			Ja	Nee	[mm]	[-]	[mm]	[-]	[mm]	
			Ongesch. z		Lz	kz	lz	Lam z		
			Ja	Nee	[mm]	[-]	[mm]	[-]		
S8	ST-17	1	Ja	Nee	11820.000	1.45	17163.403	90.73	8550.000	8550.000
					8550.000	0.58	4934.604	67.65		
S8	ST-17	2	Ja	Nee	11820.000	1.45	17163.403	90.73	3270.000	3270.000
					3270.000	0.86	2806.197	38.47		
S9	ST-11	1	Ja	Nee	10320.000	3.06	31619.955	130.15	5910.000	5910.000
					5910.000	0.85	5005.589	107.43		
S9	ST-11	2	Ja	Nee	10320.000	3.06	31619.955	130.15	5910.000	5910.000
					5910.000	0.72	4272.646	91.70		
S9	ST-11	3	Ja	Nee	1500.000	7.08	10625.702	43.74	5910.000	5910.000
					5910.000	0.72	4272.646	91.70		
S10	ST-11	1	Ja	Nee	10320.000	3.05	31427.763	129.36	5910.000	5910.000
					5910.000	0.85	5006.286	107.44		
S10	ST-11	2	Ja	Nee	10320.000	3.05	31427.763	129.36	5910.000	5910.000
					5910.000	0.72	4253.747	91.29		
S10	ST-11	3	Ja	Nee	1500.000	8.23	12338.969	50.79	5910.000	5910.000
					5910.000	0.72	4253.747	91.29		
S11	ST-17	1	Ja	Nee	11820.000	1.62	19147.516	101.22	7750.000	7750.000
					7750.000	0.61	4761.195	65.28		
S11	ST-17	2	Ja	Nee	11820.000	1.62	19147.516	101.22	4070.000	4070.000
					4070.000	0.78	3193.537	43.78		
S12	ST-12	1	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
					4000.000	0.78	3133.085	76.07		
S12	ST-12	2	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
					4000.000	0.78	3133.085	76.07		
S12	ST-12	3	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
					4000.000	0.54	2149.664	52.19		
S12	ST-12	4	Ja	Nee	10500.000	2.39	25092.043	135.78	4000.000	4000.000
					4000.000	0.77	3070.091	74.54		
S12	ST-12	5	Ja	Nee	1500.000	3.77	5648.894	30.57	4000.000	4000.000
					4000.000	0.77	3070.091	74.54		
S13	ST-12	1	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
					4000.000	0.79	3146.298	76.39		
S13	ST-12	2	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
					4000.000	0.79	3146.298	76.39		
S13	ST-12	3	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
					4000.000	0.54	2159.187	52.42		
S13	ST-12	4	Ja	Nee	10500.000	2.69	28227.659	152.75	4000.000	4000.000
					4000.000	0.77	3083.137	74.86		
S13	ST-12	5	Ja	Nee	1500.000	4.59	6884.252	37.25	4000.000	4000.000
					4000.000	0.77	3083.137	74.86		
S15	ST-17	1	Ja	Nee	17790.001	1.35	24031.170	127.03	4117.000	4117.000
					4117.000	0.87	3575.907	49.03		
S15	ST-17	2	Ja	Nee	17790.001	1.35	24031.170	127.03	4000.000	4000.000
					4000.000	0.75	2992.277	41.02		
S15	ST-17	3	Ja	Nee	17790.001	1.35	24031.170	127.03	9673.000	9673.000
					9673.000	0.81	7818.268	107.19		
S16	ST-13	1	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
					500.000	1.00	499.988	11.06		
S16	ST-13	2	Ja	Nee	5000.000	1.00	5000.000	67.17	4000.000	4000.000
					4000.000	0.55	2212.633	48.97		
S16	ST-13	3	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
					500.000	1.00	499.988	11.06		
S17	ST-13	1	Ja	Nee	5000.000	1.00	5000.000	67.17	500.000	500.000
					500.000	1.00	499.988	11.06		

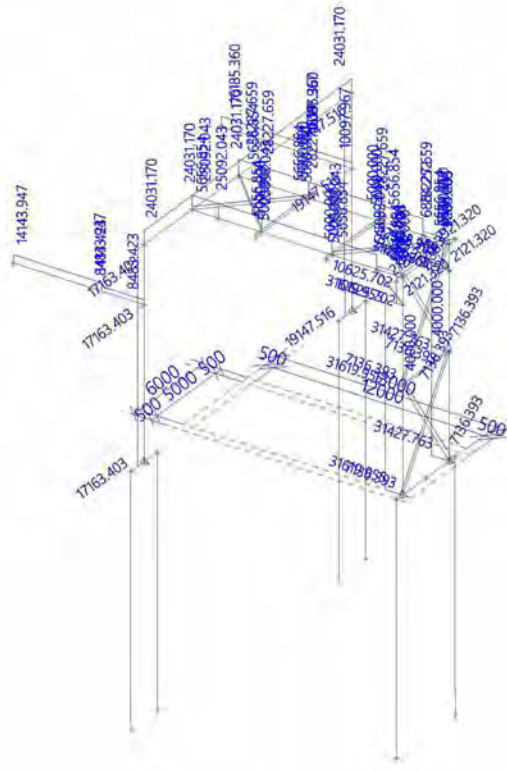


Staal	CS Naam	Onderdeel	Ongesch. y	ly	ky	ly	Lam y	lyz	l kip
				[mm]	[-]	[mm]	[-]	[mm]	
			Ongesch. z	Lz	kz	lz	Lam z		
				[mm]	[-]	[mm]	[-]		
S17	ST-13	2	Ja	5000.000	1.00	5000.000	67.17	4000.000	4000.000
			Nee	4000.000	0.52	2084.736	46.13		
S17	ST-13	3	Ja	5000.000	1.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S18	ST-13	1	Ja	5000.000	10.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S18	ST-13	2	Ja	4000.000	1.82	7284.203	97.86	4000.000	4000.000
			Nee	4000.000	0.99	3967.218	87.79		
S18	ST-13	3	Ja	500.000	10.00	5000.000	67.17	500.000	500.000
			Nee	500.000	1.00	499.988	11.06		
S21	ST-14	1	Ja	2121.320	1.00	2121.320	43.34	2121.320	2121.320
			Nee	2121.320	1.00	2121.267	70.20		
S22	ST-14	1	Ja	2121.320	1.00	2121.320	43.34	2121.320	2121.320
			Nee	2121.320	1.00	2121.267	70.20		
S23	ST-13	1	Ja	4000.000	1.00	4000.000	53.74	4000.000	4000.000
			Nee	4000.000	1.00	3999.900	88.52		
S25	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S26	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S27	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S28	ST-15	1	Ja	7136.393	1.00	7136.393	<b>2472.12</b>	7136.393	7136.393
			Nee	7136.393	1.00	7136.214	309.01		
S33	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S34	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S35	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S36	ST-16	1	Ja	5656.854	1.00	5656.854	247.49	5656.854	5656.854
			Nee	5656.854	1.00	5656.713	484.23		
S40	ST-18	1	Ja	2423.000	3.50	8483.423	110.15	2423.000	2423.000
			Nee	2423.000	0.89	2158.816	100.70		
S40	ST-18	2	Ja	5000.000	2.83	14143.947	183.65	5000.000	5000.000
			Nee	5000.000	0.84	4210.659	196.40		
S41	ST-18	1	Ja	5000.000	3.24	16185.360	210.15	5000.000	5000.000
			Nee	5000.000	0.84	4210.456	196.39		
S41	ST-18	2	Ja	2423.000	4.17	10097.967	131.11	2423.000	2423.000
			Nee	2423.000	0.89	2158.719	100.69		



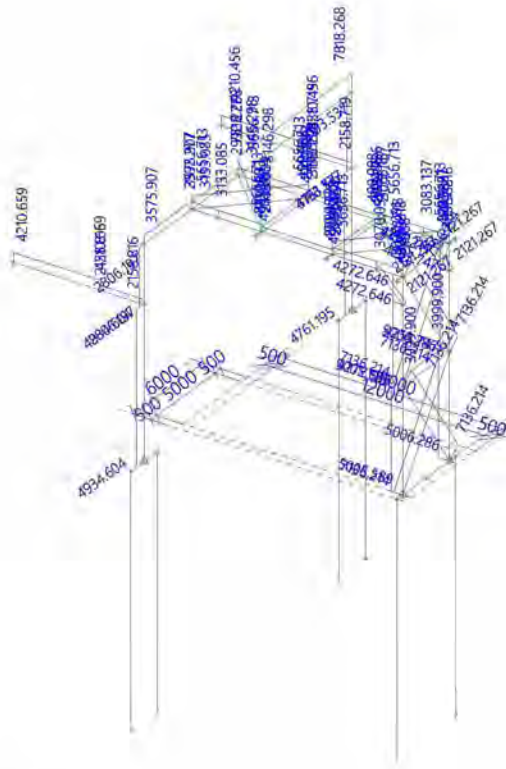
Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.12.8 5/39

## 2.2. Iy





## 2.3. IZ



## 2.4. EC-EN 1993 UGT: staalcontrole

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle

### Algehele eenheidscontrole

Naam	dx [mm]	Belasting	Doorsnede	Materiaal	Algehele eenh. controle [-]	Doorsnede controle [-]	Stab. controle [-]
S8	0.000	NC_UGT-Set B.14	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.67</b>	0.16	0.67
S9	5910.000+	NC_UGT-Set B.6	ST-11 - IPE600	S 235 JR (EN 10025-2)	<b>0.50</b>	0.19	0.50
S10	5910.000+	NC_UGT-Set B.6	ST-11 - IPE600	S 235 JR (EN 10025-2)	<b>0.70</b>	0.20	0.70
S11	0.000	NC_UGT-Set B.7	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.89</b>	0.57	0.89
S12	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	S 235 JR (EN 10025-2)	<b>0.49</b>	0.42	0.49
S13	10500.000+	NC_UGT-Set B.6	ST-12 - IPE450	S 235 JR (EN 10025-2)	<b>0.66</b>	0.55	0.66
S15	8117.000-	NC_UGT-Set B.7	ST-17 - HEA450	S 235 JR (EN 10025-2)	<b>0.78</b>	0.68	0.78
S16	3000.000	NC_UGT-Set B.14	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.50</b>	0.40	0.50
S17	3000.000	NC_UGT-Set B.14	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.50</b>	0.38	0.50
S18	4500.000-	NC_UGT-Set B.7	ST-13 - HEA180	S 235 JR (EN 10025-2)	<b>0.34</b>	0.23	0.34
S21	0.000	NC_UGT-Set B.6	ST-14 - HEA120	S 235 JR (EN 10025-2)	<b>0.45</b>	0.31	0.45
S22	0.000	NC_UGT-Set B.6	ST-14 - HEA120	S 235 JR (EN 10025-2)	<b>0.55</b>	0.38	0.55

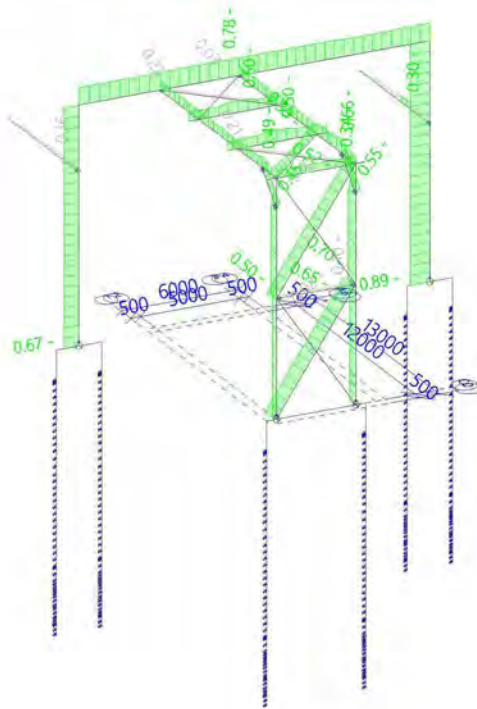


Naam	dx [mm]	Belasting	Doorsnede	Materiaal	Algehele eenh. controle [-]	Doorsnede controle [-]	Stab. controle [-]
S23	3000.000	NC_UGT-Set B.7	ST-13 - HEA180	10025-2) S 235 JR (EN 10025-2)	0.10	0.06	0.10
S25	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.65	0.65	0.00
S26	7136.393	NC_UGT-Set B.9	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.02	0.02	0.00
S27	7136.393	NC_UGT-Set B.9	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.02	0.02	0.00
S28	7136.393	NC_UGT-Set B.7	ST-15 - FLA80/10	S 235 JR (EN 10025-2)	0.52	0.52	0.00
S33	0.000	NC_UGT-Set B.12	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.22	0.22	0.00
S34	0.000	NC_UGT-Set B.1	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.03	0.03	0.00
S35	0.000	NC_UGT-Set B.7	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.33	0.33	0.00
S36	0.000	NC_UGT-Set B.6	ST-16 - L60X6	S 235 JR (EN 10025-2)	0.21	0.21	0.00
S40	2423.000-	NC_UGT-Set B.12	ST-18 - UNP200	S 235 JR (EN 10025-2)	0.16	0.16	0.12
S41	5000.000+	NC_UGT-Set B.7	ST-18 - UNP200	S 235 JR (EN 10025-2)	0.30	0.30	0.00

**Resultaten - Gehele controle**

Waardes: **Algehele eenh. controle**

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme 1D: Element  
 Selectie: Alle





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

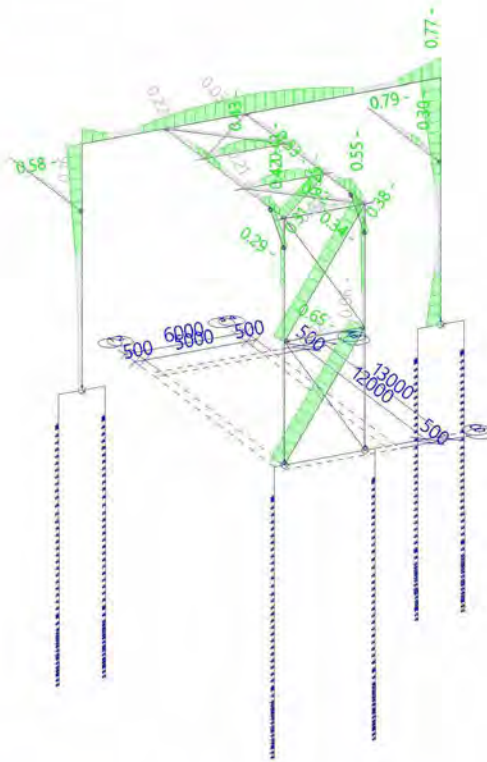
Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
8/39

## Resultaten - Doorsnedecontrole

Waardes: **Doorsnede controle**

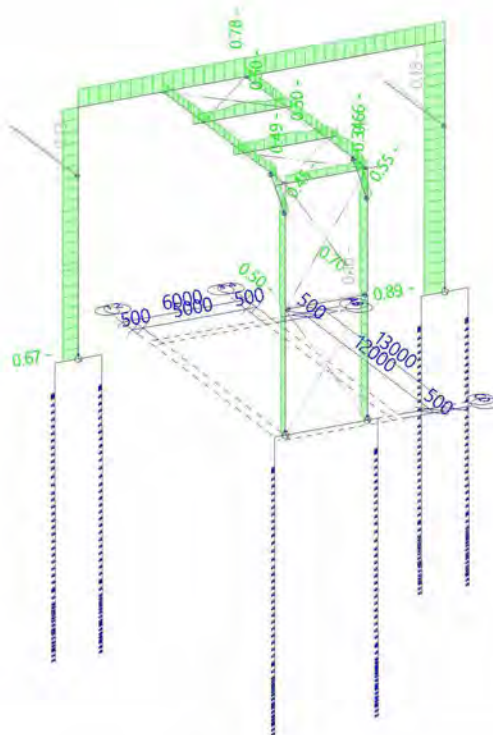
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - Stabiliteitscontrole

Waardes: **Stab. controle**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





## 2.5. EC-EN 1993 UGT: staalcontrole

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Hoofd  
 Extreme ID: Doorsnede  
 Selectie: Alle

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S10	5.910 / 11.820 m	IPE600	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.70 -
-------------	------------------	--------	-----------------------	-----------------	--------

<b>Combinatiesleutel</b>
RK_NC_UGT-Set B / NC_UGT-Set B.6

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>			
Vloeisterkte $f_y$	225.0	MPa	
Treksterkte $f_u$	360.0	MPa	
Bouwwijze	Gewalst		

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 5.910 m

Interne krachten		Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-136.05	kN
Dwarskracht	$V_{y,Ed}$	-2.39	kN
Dwarskracht	$V_{z,Ed}$	28.23	kN
Torsie	$T_{Ed}$	0.18	kNm
Buigend moment	$M_{y,Ed}$	154.23	kNm
Buigend moment	$M_{z,Ed}$	2.63	kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	80	19	-4.226e+04	-4.848e+04								
3	SO	80	19	-3.759e+04	-3.137e+04								
4	I	514	12	-3.432e+04	5.176e+04	-0.66		0.55	42.83	63.76	74.32	91.82	1
5	SO	80	19	5.970e+04	6.592e+04	0.91	0.44	1.00	4.21	9.20	10.22	14.19	1
7	SO	80	19	5.503e+04	4.881e+04	0.89	0.47	1.00	4.21	9.20	10.22	14.73	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.  
 De doorsnede is geclassificeerd als klasse 1

### Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	1.5600e-02	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	3510.00	kN
Eenheidscontrole		0.04	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.5120e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	790.20	kNm
Eenheidscontrole		0.20	-





### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	4.8600e-04	$m^3$
Plastisch buigend moment	$M_{pl,z,Rd}$	109.35	kNm
Eenheidscontrole		0.02	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	8.7920e-03	$m^2$
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	1142.11	kN
Eenheidscontrole		0.00	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	8.3800e-03	$m^2$
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	1088.59	kN
Eenheidscontrole		0.03	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	15	
Totaal torsiemoment	$T_{Ed}$	2.0	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	129.9	MPa
Eenheidscontrole		0.02	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	790.20	kNm
Exponent van buigingsratio y	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	109.35	kNm
Exponent van buigingsratio z	$\beta$	1.00	

Eenheidscontrole (6.41) =  $0.04 + 0.02 = 0.06$  -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

.....**STABILITEITSCONTROLE**.....

### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 0.985 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2



Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	80	19	8.623e+03	7.449e+03	0.86	0.48	1.00	4.21	9.20	10.22	14.87	1
3	SO	80	19	9.504e+03	1.068e+04	0.89	0.44	1.00	4.21	9.20	10.22	14.21	1
4	I	514	12	9.177e+03	1.092e+04	0.84		1.00	42.83	28.62	34.74	41.11	4
5	SO	80	19	1.148e+04	1.265e+04	0.91	0.44	1.00	4.21	9.20	10.22	14.19	1
7	SO	80	19	1.060e+04	9.421e+03	0.89	0.47	1.00	4.21	9.20	10.22	14.72	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 4

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

### Effectieve doorsnede N-

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_w$ [mm]	$b_{w1}$ [mm]	$b_{w2}$ [mm]
1	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
3	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
4	I	514	2.250e+05	2.250e+05	1.00	4.00	0.74	0.95	489	244	244
5	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
7	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		

### Effectieve doorsnede My+

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_e$ [mm]	$b_{e1}$ [mm]	$b_{e2}$ [mm]
1	SO	80	-2.250e+05	-2.250e+05							
3	SO	80	-2.250e+05	-2.250e+05							
4	I	514	1.991e+05	-1.991e+05	-1.00	23.90	0.30	1.00	257	103	154
5	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		
7	SO	80	2.250e+05	2.250e+05	1.00	0.43	0.22	1.00	80		

### Effectieve doorsnede Mz+

#### Berekening effectieve breedte

Volgens EN 1993-1-5 artikel 4.4

Id	Type	$b_p$ [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\lambda_p$ [-]	$\rho$ [-]	$b_e$ [mm]	$b_{e1}$ [mm]	$b_{e2}$ [mm]
1	SO	80	-6.136e+04	-2.250e+05							
3	SO	80	2.250e+05	6.136e+04	0.27	0.52	0.20	1.00	80		
4	I	514	0.000e+00	0.000e+00							
5	SO	80	2.250e+05	6.136e+04	0.27	0.52	0.20	1.00	80		
7	SO	80	-6.136e+04	-2.250e+05							

### Effectieve eigenschappen

Effectieve oppervlakte	$A_{eff}$	1.5300e-02	m <sup>2</sup>				
Effectieve traagheidsmoment	$I_{eff,y}$	9.2100e-04	m <sup>4</sup>	$I_{eff,z}$	3.3874e-05	m <sup>4</sup>	
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>	$W_{eff,z}$	3.0795e-04	m <sup>3</sup>	
Verschuiving van het zwaartepunt	$e_{N,y}$	0	mm	$e_{N,z}$	0	mm	

### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)



Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	10.320	5.910	m
Knikfactor	k	3.05	0.72	
Kniklengte	$l_{cr}$	31.428	4.254	m
Kritische Euler last	$N_{cr}$	1932.22	3879.64	kN
Slankheid	$\lambda$	129.36	91.29	
Relatieve slankheid	$\lambda_{rel}$	1.33	0.94	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		a	b	
Imperfectie	$\alpha$	0.21	0.34	
Reductie factor	$\chi$	0.45	0.63	
Knikweerstand	$N_{b,Rd}$	1553.52	2183.05	kN

Buigingsknikverificatie			
Effectieve oppervlakte van de doorsnede	$A_{eff}$	1.5300e-02	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	1553.52	kN
Eenheidscontrole		0.09	-

### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	938.34	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.86	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		c	
Imperfectie	$\alpha_{LT}$	0.49	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.73	
Correctiefactor	$k_c$	0.91	
Correctiefactor	f	0.96	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.76	
Rekenwaarde knikweerstand	$M_{b,Rd}$	525.52	kNm
Eenheidscontrole		0.29	-

M <sub>cr</sub> parameters			
LTB lengte	$l_{LT}$	5.910	m
Vorklengte	$L_g$	5.910	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	858.55	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	C	5.70	
Factor	S	2118	mm
Kip moment factor	$C_1$	1.20	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Effectieve oppervlakte van de doorsnede	$A_{eff}$	1.5300e-02	m <sup>2</sup>
Effectieve doorsnedemodulus	$W_{eff,y}$	3.0700e-03	m <sup>3</sup>
Effectieve doorsnedemodulus	$W_{eff,z}$	3.0795e-04	m <sup>3</sup>



Buig- en axiale drukcontrole parameters			
Ontwerpdrukkracht	$N_{Ed}$	136.05	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	268.62	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	-11.40	kNm
Additioneel moment	$\Delta M_{y,Ed}$	0.00	kNm
Additioneel moment	$\Delta M_{z,Ed}$	0.00	kNm
Karakteristieke drukweerstand	$N_{Rk}$	3442.39	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	690.75	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	69.29	kNm
Reductie factor	$\chi_y$	0.45	
Reductie factor	$\chi_z$	0.63	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.76	
Interactiefactor	$k_{yy}$	0.95	
Interactiefactor	$k_{yz}$	0.77	
Interactiefactor	$k_{zy}$	1.00	
Interactiefactor	$k_{zz}$	0.77	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S10 positie 10.320 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S10 positie 11.820 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.2	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalent moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		puntlast F	
Uiteinde moment	$M_{h,z}$	-11.40	kNm
Veldmoment	$M_{s,z}$	-7.69	kNm
Factor	$\alpha_{s,z}$	0.67	
Ratio van uiteinde momenten	$\psi_z$	-0.23	
Equivalent moment factor	$C_{mz}$	0.74	
Resultierend belastingtype LT		puntlast F	
Uiteinde moment	$M_{h,LT}$	154.23	kNm
Veldmoment	$M_{s,LT}$	268.62	kNm
Factor	$\alpha_{h,LT}$	0.57	
Ratio van uiteinde momenten	$\psi_{LT}$	0.40	
Equivalent moment factor	$C_{mLT}$	0.96	

Eenheidscontrole (6.61) = 0.09 + 0.48 + 0.13 = 0.70 -

Eenheidscontrole (6.62) = 0.06 + 0.51 + 0.13 = 0.70 -

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	11.820	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	562	mm
Lijfdikte	t	12	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

Plooverificatie		
Lijf slankheid	$h_w/t$	46.83
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S11	0.000 / 11.820 m	HEA450	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.89 -
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### Combinatiesleutel

RK\_NC\_UGT-Set B / NC\_UGT-Set B.7

### Partiële veiligheidsfactoren

$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

### Materiaal

Vloei sterkte	$f_y$	225.0	MPa
Trek sterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 0.000 m

Interne krachten		Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-213.51	kN
Dwarskracht	$V_{y,Ed}$	-3.56	kN
Dwarskracht	$V_{z,Ed}$	87.68	kN
Torsie	$T_{Ed}$	-0.17	kNm
Buigend moment	$M_{y,Ed}$	-413.41	kNm
Buigend moment	$M_{z,Ed}$	5.90	kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\sigma$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	117	21	1.458e+05	1.385e+05	0.95	0.45	1.00	5.58	9.20	10.22	14.37	1
3	SO	117	21	1.499e+05	1.572e+05	0.95	0.43	1.00	5.58	9.20	10.22	14.13	1
4	I	344	12	1.236e+05	-9.958e+04	-0.81		0.62	29.91	53.44	63.03	104.02	1
5	SO	117	21	-1.219e+05	-1.146e+05								
7	SO	117	21	-1.259e+05	-1.332e+05								

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

### Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	4005.00	kN
Eenheidscontrole		0.05	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.2167e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	723.75	kNm
Eenheidscontrole		0.57	-

### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	9.6667e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	217.50	kNm
Eenheidscontrole		0.03	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.3043e-02	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	1694.30	kN
Eenheidscontrole		0.00	-

#### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	6.5755e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	854.18	kN
Eenheidscontrole		0.10	-

#### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	1.4	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	129.9	MPa
Eenheidscontrole		0.01	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

#### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	723.75	kNm
Exponent van buigingsratio $y$	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	217.50	kNm
Exponent van buigingsratio $z$	$\beta$	1.00	

Eenheidscontrole (6.41) = 0.33 + 0.03 = 0.35 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

#### .....STABILITEITSCONTROLE:.....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 4.359 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	117	21	2.658e+04	3.871e+04	0.69	0.46	1.00	5.58	9.20	10.22	14.54	1
3	SO	117	21	1.981e+04	7.677e+03	0.39	0.79	1.00	5.58	9.20	10.22	19.13	1
4	I	344	12	2.111e+04	1.984e+03	0.09		1.00	29.91	28.62	34.74	56.64	2
5	SO	117	21	-3.489e+03	-1.562e+04								
7	SO	117	21	3.287e+03	1.542e+04	0.21	0.53	1.00	5.58	9.20	10.22	15.60	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 2

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.



Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.6  
16/39

## Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	11.820	7.750	m
Knikfactor	k	1.62	0.61	
Kniklengte	$l_{cr}$	19.148	4.761	m
Kritische Euler last	$N_{cr}$	3601.09	8658.39	kN
Slankheid	$\lambda$	101.22	65.28	
Relatieve slankheid	$\lambda_{rel}$	1.05	0.68	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		a	b	
Imperfectie	$\alpha$	0.21	0.34	
Reductie factor	$\chi$	0.63	0.79	
Knikweerstand	$N_{b,Rd}$	2512.80	3183.25	kN

Buigingsknikverificatie			
Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	2512.80	kN
Eenheidscontrole		0.08	-

## Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

## Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Plastische doorsnedemodulus	$W_{pl,y}$	3.2167e-03	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	2425.10	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.55	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		b	
Imperfectie	$\alpha_{LT}$	0.34	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.94	
Correctiefactor	$k_c$	0.66	
Correctiefactor	f	0.85	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	1.00	
Rekenwaarde knikweerstand	$M_{b,Rd}$	723.75	kNm
Eenheidscontrole		0.57	-

Mcr parameters			
LTB lengte	$l_{LT}$	7.750	m
Vorklengte	$L_g$	7.750	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	575.00	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	C	9.49	
Factor	S	2102	mm
Kip moment factor	$C_1$	2.30	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

## Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)



Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	A	1.7800e-02	m <sup>2</sup>
Plastische doorsnedemodulus	W <sub>pl,y</sub>	3.2167e-03	m <sup>3</sup>
Plastische doorsnedemodulus	W <sub>pl,z</sub>	9.6667e-04	m <sup>3</sup>
Ontwerpdrukkracht	N <sub>Ed</sub>	213.51	kN
Ontwerp buigend moment (maximum)	M <sub>y,Ed</sub>	574.36	kNm
Ontwerp buigend moment (maximum)	M <sub>z,Ed</sub>	-20.91	kNm
Karakteristieke drukweerstand	N <sub>Rk</sub>	4005.00	kN
Karakteristieke momentweerstand	M <sub>y,Rk</sub>	723.75	kNm
Karakteristieke momentweerstand	M <sub>z,Rk</sub>	217.50	kNm
Reductie factor	χ <sub>y</sub>	0.63	
Reductie factor	χ <sub>z</sub>	0.79	
Gewijzigde reductiefactor	χ <sub>LT,mod</sub>	1.00	
Interactiefactor	k <sub>yy</sub>	0.96	
Interactiefactor	k <sub>yz</sub>	0.40	
Interactiefactor	k <sub>zy</sub>	0.58	
Interactiefactor	k <sub>zz</sub>	0.67	

Maximum moment M<sub>y,Ed</sub> is afgeleid van balk S11 positie 11.820 m.

Maximum moment M<sub>z,Ed</sub> is afgeleid van balk S11 positie 7.750 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.1	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalente moment factor	C <sub>my</sub>	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	M <sub>h,z</sub>	-20.91	kNm
Veldmoment	M <sub>s,z</sub>	-11.48	kNm
Factor	α <sub>s,z</sub>	0.55	
Ratio van uiteinde momenten	ψ <sub>z</sub>	-0.28	
Equivalente moment factor	C <sub>mz</sub>	0.64	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	M <sub>h,LT</sub>	-413.41	kNm
Veldmoment	M <sub>s,LT</sub>	-35.43	kNm
Factor	α <sub>s,LT</sub>	0.09	
Ratio van uiteinde momenten	ψ <sub>LT</sub>	-0.60	
Equivalente moment factor	C <sub>mLT</sub>	0.40	

Eenhedencontrole (6.61) = 0.08 + 0.76 + 0.04 = 0.89 -

Eenhedencontrole (6.62) = 0.07 + 0.46 + 0.06 = 0.59 -

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	11.820	m
Lijf		niet-verstijfd	
Lijfhoogte	h <sub>w</sub>	398	mm
Lijfdikte	t	12	mm
Materiaal coëfficiënt	ε	1.00	
Correctiefactor voor dwarskracht	η	1.20	

Plooi verificatie		
Lijf slankheid	h <sub>w</sub> /t	34.61
Lijfslankheid IImlet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA



Element S13	10.500 / 12.000 m	IPE450	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.66 -
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<b>Combinatiesleutel</b>	
RK_NC_UGT-Set B / NC_UGT-Set B.6	

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>			
Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 10.500 m

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	118.24 kN
Dwarskracht	$V_{y,Ed}$	0.71 kN
Dwarskracht	$V_{z,Ed}$	89.88 kN
Torsie	$T_{Ed}$	0.56 kNm
Buigend moment	$M_{y,Ed}$	-221.72 kNm
Buigend moment	$M_{z,Ed}$	-1.11 kNm

#### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_a$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	69	15	1.327e+05	1.373e+05	0.97	0.43	1.00	4.75	9.00	10.00	13.81	1
3	SO	69	15	1.294e+05	1.248e+05	0.96	0.44	1.00	4.75	9.00	10.00	13.98	1
4	I	379	9	1.125e+05	-1.364e+05	-1.21		0.43	40.30	83.85	96.66	151.08	1
5	SO	69	15	-1.567e+05	-1.612e+05								
7	SO	69	15	-1.533e+05	-1.487e+05								

**Opmerking:** De classificatielimiets zijn ingesteld volgens Semi-Comp+. De doorsnede is geclassificeerd als klasse 1

#### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	9.8800e-03	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	2321.80	kN
Uiterste trekweerstand	$N_{u,Rd}$	2560.90	kN
Trekweerstand	$N_{t,Rd}$	2321.80	kN
Eenhedscontrole		0.05	-

#### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	1.7020e-03	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	399.97	kNm
Eenhedscontrole		0.55	-

#### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	2.7600e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	64.86	kNm
Eenhedscontrole		0.02	-

#### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)



Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	5.8338e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	791.51	kN
Eenheidscontrole		0.00	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	5.0824e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	689.57	kN
Eenheidscontrole		0.13	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	12.2	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	135.7	MPa
Eenheidscontrole		0.09	-

### Controle van gecombineerde afschuiving en torsie voor $V_y$ en $\tau_{t,Ed}$

Volgens EN 1993-1-1 artikel 6.2.6 & 6.2.7 en formule (6.25),(6.26)

Plastische dwarskrachtweerstand voor $V_y$ en $T_{Ed}$	$V_{pl,T,y,Rd}$	762.53	kN
Eenheidscontrole		0.00	-

### Controle van gecombineerde afschuiving en torsie voor $V_z$ en $\tau_{t,Ed}$

Volgens EN 1993-1-1 artikel 6.2.6 & 6.2.7 en formule (6.25),(6.26)

Plastische dwarskrachtweerstand voor $V_z$ en $T_{Ed}$	$V_{pl,T,z,Rd}$	664.32	kN
Eenheidscontrole		0.14	-

### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	399.97	kNm
Exponent van buigingsratio $y$	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	64.86	kNm
Exponent van buigingsratio $z$	$\beta$	1.00	

Eenheidscontrole (6.41) = 0.31 + 0.02 = 0.32 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

### .....STABILITEITSCONTROLE:.....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 0.000 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2



Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_{\sigma}$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	69	15	1.162e+03	1.167e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.78	1
3	SO	69	15	1.158e+03	1.153e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.81	1
4	I	379	9	1.207e+03	1.841e+03	0.66		1.00	40.30	28.00	34.00	43.16	3
5	SO	69	15	1.887e+03	1.882e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.81	1
7	SO	69	15	1.891e+03	1.896e+03	1.00	0.43	1.00	4.75	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 3

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

Eigenschappen Semi-Comp+			
Materiaal coëfficiënt	$\epsilon$	1.00	
Slankheidslimiet flensklasse 2	$\beta_{2,y,f}$	10.00	
Slankheidslimiet flensklasse 3	$\beta_{3,y,f}$	14.00	
Slankheidslimiet lijfklasse 2	$\beta_{2,y,w}$	83.00	
Slankheidslimiet lijfklasse 3	$\beta_{3,y,w}$	124.00	
Slankheidslimiet flensklasse 2	$\beta_{2,z,f}$	10.00	
Slankheidslimiet flensklasse 3	$\beta_{3,z,f}$	16.00	
Verhouding lijfslankheid	c/t <sub>w</sub>	40.30	
Verhouding flensslankheid	c/t <sub>f</sub>	4.75	
Verhouding referentieslankheid	c/t <sub>ref,y</sub>	0.00	
Verhouding referentieslankheid	c/t <sub>ref,z</sub>	0.00	
Geïnterpoleerde doorsnedemodulus	W <sub>3,y</sub>	1.7020e-03	m <sup>3</sup>
Geïnterpoleerde doorsnedemodulus	W <sub>3,z</sub>	2.7600e-04	m <sup>3</sup>

**Opmerking:** De weerstand voor deze semi-compacte doorsnede is berekend volgens Semi-Comp+.

### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Alternatief geval	
Geïnterpoleerde doorsnedemodulus	W <sub>3,y</sub>	1.7020e-03	m <sup>3</sup>
Elastisch kritisch moment	M <sub>cr</sub>	725.92	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.74	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		c	
Imperfectie	$\alpha_{LT}$	0.49	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.80	
Correctiefactor	k <sub>c</sub>	0.90	
Correctiefactor	f	0.95	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.84	
Rekenwaarde knikweerstand	M <sub>b,Rd</sub>	337.25	kNm
Eenheidscontrole		0.66	-

Mcr parameters			
LTB lengte	l <sub>LT</sub>	4.000	m
Vorklengte	L <sub>g</sub>	4.000	m
Invloed van lastpositie		geen invloed	
Factor	$\alpha$	2602.01	
Reductie factor	k <sub>red</sub>	1.00	
Coëfficiënt	C	6.66	
Factor	S	1753	mm
Kip moment factor	C <sub>1</sub>	1.25	
Kip moment factor	C <sub>2</sub>	0.00	

**Opmerking:** M<sub>cr</sub> is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor k<sub>c</sub> wordt bepaald op basis van C<sub>1</sub>.



## Buig- en axiale trekcontrole

Volgens EN 1993-1-3 artikel 6.3

Normaalkracht	$N_{Ed}$	118.24	kN
Buigend moment	$M_{y,Ed}$	-221.72	kNm
Buigend moment	$M_{z,Ed}$	-1.11	kNm
Trekweerstand	$N_{t,Rd}$	2321.80	kN
Buigweerstand	$M_{b,y,Rd}$	337.25	kNm
Vezel		1	
Elastische doorsnedemodulus	$W_{el,z,com}$	2.7600e-04	m <sup>3</sup>
Buigweerstand	$M_{c,z,Rd,com}$	64.86	kNm

Eenheidscontrole =  $0.66 + 0.02 - 0.05 = 0.62$  -

## Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	12.000	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	421	mm
Lijfdikte	t	9	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

Plooi verificatie		
Lijf slankheid	$h_w/t$	44.77
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

## EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S17	3.000 / 5.000 m	HEA180	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.50 -
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Combinatiesleutel	
RK_NC_UGT-Set B / NC_UGT-Set B.14	

Partiële veiligheidsfactoren	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

Materiaal			
Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 3.000 m

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	-20.37 kN
Dwarskracht	$V_{y,Ed}$	-1.17 kN
Dwarskracht	$V_{z,Ed}$	-8.75 kN
Torsie	$T_{Ed}$	0.03 kNm
Buigend moment	$M_{y,Ed}$	29.29 kNm
Buigend moment	$M_{z,Ed}$	-0.02 kNm

## Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2



Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\alpha$ [-]	c/t [-]	Limiet klasse 1 [-]	Limiet klasse 2 [-]	Limiet klasse 3 [-]	Klasse
1	SO	72	10	-8.967e+04	-8.950e+04								
3	SO	72	10	-8.975e+04	-8.992e+04								
4	I	122	6	-6.667e+04	7.567e+04	-0.88		0.56	20.33	60.71	70.90	109.42	1
5	SO	72	10	9.866e+04	9.850e+04	1.00	0.43	1.00	7.58	9.00	10.00	13.80	1
7	SO	72	10	9.875e+04	9.892e+04	1.00	0.43	1.00	7.58	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+. De doorsnede is geclassificeerd als klasse 1

### Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	4.5300e-03	m <sup>2</sup>
Drukweerstand	$N_{c,Rd}$	1064.55	kN
Eenheidscontrole		0.02	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	76.38	kNm
Eenheidscontrole		0.38	-

### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	1.5667e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	36.82	kNm
Eenheidscontrole		0.00	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	3.5460e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	481.11	kN
Eenheidscontrole		0.00	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.4520e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	197.00	kN
Eenheidscontrole		0.04	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	$T_{Ed}$	1.7	MPa
Elastische dwarskrachtweerstand	$T_{Rd}$	135.7	MPa
Eenheidscontrole		0.01	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.9.1 en formule (6.41)

Plastisch buigend moment	$M_{pl,y,Rd}$	76.38	kNm
Exponent van buigingsratio y	$\alpha$	2.00	
Plastisch buigend moment	$M_{pl,z,Rd}$	36.82	kNm
Exponent van buigingsratio z	$\beta$	1.00	

Eenhedencontrole (6.41) = 0.15 + 0.00 = 0.15 -

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan beide criteria (6.33) en (6.34) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de y-y-as genegeerd.

**Opmerking:** Aangezien de axiale kracht voldoet aan het criterium (6.35) van EN 1993-1-1 artikel 6.2.9.1(4) wordt het effect ervan op de momentweerstand bij de z-z-as genegeerd.

De staaf voldoet aan de doorsnedecontrole.

....:STABILITEITSCONTROLE:....

#### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 2.500 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_\sigma$ [-]	$\sigma$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	72	10	-9.774e+04	-1.018e+05								
3	SO	72	10	-9.573e+04	-9.171e+04								
4	I	122	6	-7.200e+04	8.081e+04	-0.89		0.56	20.33	60.91	71.12	110.52	1
5	SO	72	10	1.065e+05	1.106e+05	0.96	0.43	1.00	7.58	9.00	10.00	13.81	1
7	SO	72	10	1.045e+05	1.005e+05	0.96	0.44	1.00	7.58	9.00	10.00	13.99	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

#### Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	5.000	4.000	m
Knikfactor	k	1.00	0.52	
Kniklengte	$l_{cr}$	5.000	2.085	m
Kritische Euler last	$N_{cr}$	2080.91	4411.22	kN
Slankheid	$\lambda$	67.17	46.13	
Relatieve slankheid	$\lambda_{rel}$	0.72	0.49	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	

**Opmerking:** De slankheid of compressie kracht is zodanig dat Buigknik effecten kunnen worden genegeerd volgens EN 1993-1-1 artikel 6.3.1.2(4).

#### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

#### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.3 en formule (6.54)

Kip parameters			
Methodie voor Kipcurve		Alternatief geval	
Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Elastisch kritisch moment	$M_{cr}$	176.02	kNm
Relatieve slankheid	$\lambda_{rel,LT}$	0.66	
Limietlankheid	$\lambda_{rel,LT,0}$	0.40	
Kipcurve		b	
Imperfectie	$\alpha_{LT}$	0.34	
Kipfactor	$\beta$	0.75	
Reductie factor	$\chi_{LT}$	0.89	



Kip parameters			
Correctiefactor	$k_c$	0.93	
Correctiefactor	$f$	0.97	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.92	
Rekenwaarde knikweerstand	$M_{b,Rd}$	70.15	kNm
Eenhedscontrole		0.42	-

Mcr parameters			
LTB lengte	$l_{LT}$	4.000	m
Vorklengte	$L_g$	4.000	m
Inloed van lastpositie		geen invloed	
Factor	$\alpha$	2611.40	
Reductie factor	$k_{red}$	1.00	
Coëfficiënt	$C$	4.62	
Factor	$S$	1028	mm
Kip moment factor	$C_1$	1.14	
Kip moment factor	$C_2$	0.00	

**Opmerking:**  $M_{cr}$  is berekend volgens de Nederlandse NEN-EN NA.

**Opmerking:** De correctiefactor  $k_c$  wordt bepaald op basis van  $C_1$ .

#### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	$A$	4.5300e-03	m <sup>2</sup>
Plastische doorsnedemodulus	$W_{pl,y}$	3.2500e-04	m <sup>3</sup>
Plastische doorsnedemodulus	$W_{pl,z}$	1.5667e-04	m <sup>3</sup>
Ontwerpdrukkracht	$N_{Ed}$	20.37	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	31.45	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	-2.98	kNm
Karakteristieke drukweerstand	$N_{Rk}$	1064.55	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	76.38	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	36.82	kNm
Reductie factor	$\chi_y$	1.00	
Reductie factor	$\chi_z$	1.00	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	0.92	
Interactiefactor	$k_{yy}$	0.91	
Interactiefactor	$k_{yz}$	0.24	
Interactiefactor	$k_{zy}$	1.00	
Interactiefactor	$k_{zz}$	0.40	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S17 positie 2.500 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S17 positie 4.500 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.2	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalent moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	$M_{h,z}$	-2.98	kNm
Veldmoment	$M_{s,z}$	0.52	kNm
Factor	$\alpha_{s,z}$	-0.17	
Ratio van uiteinde momenten	$\psi_z$	-0.13	
Equivalent moment factor	$C_{mz}$	0.40	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	$M_{h,LT}$	-4.13	kNm
Veldmoment	$M_{s,LT}$	31.45	kNm
Factor	$\alpha_{h,LT}$	-0.13	
Ratio van uiteinde momenten	$\psi_{LT}$	0.90	
Equivalent moment factor	$C_{mLT}$	0.94	



Eenhedencontrole (6.61) = 0.02 + 0.41 + 0.02 = 0.45 -  
 Eenhedencontrole (6.62) = 0.02 + 0.45 + 0.03 = 0,50 -

### Plooicontrole

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooiparameters			
Knik veldlengte	a	5.000	m
Lijf		niet-verstijfd	
Lijfhoogte	h <sub>w</sub>	152	mm
Lijfdikte	t	6	mm
Materiaal coëfficiënt	ε	1.00	
Correctiefactor voor dwarskracht	η	1.20	

Plooi verificatie		
Lijf slankheid	h <sub>w</sub> /t	25.33
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element	S22	0.000 / 2.121 m	HEA120	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.55 -
---------	-----	-----------------	--------	-----------------------	-----------------	--------

Combinatiesleutel	
RK_NC_UGT-Set B / NC_UGT-Set B.6	

Partiële veiligheidsfactoren	
γ <sub>M0</sub> voor weerstand van doorsneden	1.00
γ <sub>M1</sub> voor weerstand tegen instabiliteit	1.00
γ <sub>M2</sub> voor weerstand van nettosecties	1.25

Materiaal			
Vloelsterkte	f <sub>y</sub>	235.0	MPa
Treksterkte	f <sub>u</sub>	360.0	MPa
Bouwwijze		Gewalst	

### ....:DOORSNEDECONTROLE:....

De kritische controle is op positie 0.000 m

Interne krachten		Berekende	Eenheid
Normaalkracht	N <sub>Ed</sub>	-227.36	kN
Dwarskracht	V <sub>y,Ed</sub>	0.00	kN
Dwarskracht	V <sub>z,Ed</sub>	0.19	kN
Torsie	T <sub>Ed</sub>	0.00	kNm
Buigend moment	M <sub>y,Ed</sub>	0.00	kNm
Buigend moment	M <sub>z,Ed</sub>	0.00	kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	σ <sub>1</sub> [kN/m <sup>2</sup> ]	σ <sub>2</sub> [kN/m <sup>2</sup> ]	ψ [-]	k <sub>σ</sub> [-]	α [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1
3	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
4	I	74	5	8.972e+04	8.972e+04	1.00		1.00	14.80	28.00	34.00	38.00	1
5	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1
7	SO	46	8	8.972e+04	8.972e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1





Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.12.8  
26/39

## Drukcontrole

Volgens EN 1993-1-1 artikel 6.2.4 en formule (6.9)

Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Drukweerstand	N <sub>c,Rd</sub>	594.55	kN
Eenhedscontrole		0.38	-

## Controle buigend moment voor M<sub>z</sub>

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	W <sub>pl,z</sub>	5.8750e-05	m <sup>3</sup>
Plastisch buigend moment	M <sub>pl,z,Rd</sub>	13.81	kNm
Eenhedscontrole		0.00	-

## Dwarskrachtcontrole voor V<sub>y</sub>

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	η	1.20	
Afschuifoppervlak	A <sub>v</sub>	2.0050e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor V <sub>y</sub>	V <sub>pl,y,Rd</sub>	272.03	kN
Eenhedscontrole		0.00	-

## Dwarskrachtcontrole voor V<sub>z</sub>

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	η	1.20	
Afschuifoppervlak	A <sub>v</sub>	8.4200e-04	m <sup>2</sup>
Plastische dwarskrachtweerstand voor V <sub>z</sub>	V <sub>pl,z,Rd</sub>	114.24	kN
Eenhedscontrole		0.00	-

## Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)

Vezelindex	Vezel	2	
Totaal torsiemoment	T <sub>Ed</sub>	0.6	MPa
Elastische dwarskrachtweerstand	T <sub>Rd</sub>	135.7	MPa
Eenhedscontrole		0.00	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0.05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

De staaf voldoet aan de doorsnedecontrole.

## ....:STABILITEITSCONTROLE:....

### Classificatie voor staafknikontwerp

Beslissende positie voor stabiliteitsclassificatie: 1.061 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	σ <sub>1</sub> [kN/m <sup>2</sup> ]	σ <sub>2</sub> [kN/m <sup>2</sup> ]	ψ [-]	k <sub>σ</sub> [-]	α [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse	
										klasse	klasse	klasse		
											1	2	3	
											[-]	[-]	[-]	
1	SO	46	8	8.874e+04	8.874e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1	
3	SO	46	8	8.874e+04	8.874e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1	
4	I	74	5	8.901e+04	9.028e+04	0.99		1.00	14.80	28.00	34.00	38.19	1	
5	SO	46	8	9.055e+04	9.055e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.79	1	
7	SO	46	8	9.055e+04	9.055e+04	1.00	0.43	1.00	5.69	9.00	10.00	13.77	1	

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

## Buigingsknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)



Knikparameters		yy	zz	
Zijd. flex. type		Zijdelings flexibel	Zijdelings stijf	
Systeemplengte	L	2.121	2.121	m
Knikfactor	k	1.00	1.00	
Kniklengte	$l_{cr}$	2.121	2.121	m
Kritische Euler last	$N_{cr}$	2791.12	1064.00	kN
Slankheid	$\lambda$	43.34	70.20	
Relatieve slankheid	$\lambda_{rel}$	0.46	0.75	
Limietlankheid	$\lambda_{rel,0}$	0.20	0.20	
Knikcurve		b	c	
Imperfectie	$\alpha$	0.34	0.49	
Reductie factor	$\chi$	0.90	0.70	
Knikweerstand	$N_{b,Rd}$	535.61	413.26	kN

Buigingsknikverificatie			
Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Knikweerstand	$N_{b,Rd}$	413.26	kN
Eenhedscontrole		0.55	-

#### Torsieknikcontrole

Volgens EN 1993-1-1 artikel 6.3.1.1 en formule (6.46)

**Opmerking:** Voor deze I-sectie de Torsieknikweerstand is hoger dan de weerstand van Buigknik. Om deze reden is de Torsieknik niet afgedrukt in de uitvoer.

#### Gecombineerde buig- en axiale drukcontrole

Volgens EN 1993-1-1 artikel 6.3.3 en formule (6.61),(6.62)

Buig- en axiale drukcontrole parameters			
Interactie methode		alternatieve methode 2	
Oppervlakte van de doorsnede	A	2.5300e-03	m <sup>2</sup>
Plastische doorsnedemodulus	$W_{pl,y}$	1.1958e-04	m <sup>3</sup>
Plastische doorsnedemodulus	$W_{pl,z}$	5.8750e-05	m <sup>3</sup>
Ontwerpdrukkracht	$N_{Ed}$	227.36	kN
Ontwerp buigend moment (maximum)	$M_{y,Ed}$	0.10	kNm
Ontwerp buigend moment (maximum)	$M_{z,Ed}$	0.00	kNm
Karakteristieke drukweerstand	$N_{Rk}$	594.55	kN
Karakteristieke momentweerstand	$M_{y,Rk}$	28.10	kNm
Karakteristieke momentweerstand	$M_{z,Rk}$	13.81	kNm
Reductie factor	$\chi_y$	0.90	
Reductie factor	$\chi_z$	0.70	
Gewijzigde reductiefactor	$\chi_{LT,mod}$	1.00	
Interactiefactor	$k_{yy}$	1.00	
Interactiefactor	$k_{yz}$	0.84	
Interactiefactor	$k_{zy}$	0.60	
Interactiefactor	$k_{zz}$	1.40	

Maximum moment  $M_{y,Ed}$  is afgeleid van balk S22 positie 1.061 m.

Maximum moment  $M_{z,Ed}$  is afgeleid van balk S22 positie 1.591 m.

Interactie methode 2 parameters			
Methode voor interactiefactoren		Tabel B.1	
Zijdelings flexibel type y		Zijdelings flexibel	
Equivalente moment factor	$C_{my}$	0.90	
Resultierend belastingtype z		lijnlast q	
Uiteinde moment	$M_{h,z}$	0.00	kNm
Veldmoment	$M_{s,z}$	0.00	kNm
Factor	$\alpha_{h,z}$	-0.23	
Ratio van uiteinde momenten	$\psi_z$	0.97	
Equivalente moment factor	$C_{mz}$	0.94	
Resultierend belastingtype LT		lijnlast q	
Uiteinde moment	$M_{h,LT}$	0.00	kNm
Veldmoment	$M_{s,LT}$	0.10	kNm
Factor	$\alpha_{h,LT}$	0.00	
Ratio van uiteinde momenten	$\psi_{LT}$	1.00	



Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.6  
28/39

Interactie methode 2 parameters		
Equivalente moment factor	$C_{mLT}$	0.95

Eenhedscontrole (6.61) =  $0.42 + 0.00 + 0.00 = 0.43$  -  
Eenhedscontrole (6.62) =  $0.55 + 0.00 + 0.00 = 0.55$  -

#### Plooi controle

Volgens EN 1993-1-5 artikel 5 & 7.1 en formule (5.10) & (7.1)

Plooi parameters			
Knik veldlengte	a	2.121	m
Lijf		niet-verstijfd	
Lijfhoogte	$h_w$	98	mm
Lijfdikte	t	5	mm
Materiaal coëfficiënt	$\epsilon$	1.00	
Correctiefactor voor dwarskracht	$\eta$	1.20	

Plooi verificatie		
Lijf slankheid	$h_w/t$	19.60
Lijfslankheid limiet		60.00

**Opmerking:** De slankheid van het lijf is zo dat de Plooi effecten kunnen worden genegeerd volgens EN 1993-1-5 artikel 5.1(2).

De staaf voldoet aan de stabiliteitscontrole.

#### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S25	7.136 / 7.136 m	FLA80/10	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.65 -
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Combinatiesleutel	
RK_NC_UGT-Set B / NC_UGT-Set B.7	

Partiële veiligheidsfactoren	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

Materiaal			
Vloeisterkte	$f_y$	235.0	MPa
Treksterkte	$f_u$	360.0	MPa
Bouwwijze		Gewalst	

#### ....:DOORSNEDECONTROLE:....

De kritische controle is op positie 7.136 m

Asdefinitie:

- y-hoofdas in deze normcontrole verwijst naar de z-hoofdas in SCIA Engineer
- z-hoofdas in deze normcontrole verwijst naar de y-hoofdas in SCIA Engineer

Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$	122.97 kN
Dwarskracht	$V_{y,Ed}$	0.00 kN
Dwarskracht	$V_{z,Ed}$	0.00 kN
Torsie	$T_{Ed}$	0.00 kNm
Bulgend moment	$M_{y,Ed}$	0.00 kNm
Bulgend moment	$M_{z,Ed}$	0.00 kNm

#### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	8.0000e-04	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	188.00	kN
Uiterste trekweerstand	$N_{u,Rd}$	207.36	kN
Trekweerstand	$N_{t,Rd}$	188.00	kN
Eenhedscontrole		0.65	-



De staaf voldoet aan de doorsnedecontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S35	0.000 / 5.657 m	L60X6	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.33 -
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<b>Combinatiesleutel</b>
RK_NC_UGT-Set B / NC_UGT-Set B.7

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>		
Vloeisterkte $f_y$	235.0	MPa
Treksterkte $f_u$	360.0	MPa
Bouwwijze	Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 0.000 m

Interne krachten	Berekende	Eenheid
Normaalkracht $N_{Ed}$	53.49	kN
Dwarskracht $V_{y,Ed}$	0.00	kN
Dwarskracht $V_{z,Ed}$	0.00	kN
Torsie $T_{Ed}$	0.00	kNm
Buigend moment $M_{y,Ed}$	0.00	kNm
Buigend moment $M_{z,Ed}$	0.00	kNm

### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede $A$	6.9100e-04	m <sup>2</sup>
Plastische trekweerstand $N_{pl,Rd}$	162.38	kN
Uiterste trekweerstand $N_{u,Rd}$	179.11	kN
Trekweerstand $N_{t,Rd}$	162.38	kN
Eenheidscontrole	0.33	-

De staaf voldoet aan de doorsnedecontrole.

### EN 1993-1-1 Normcontrole

Nationale bijlage: Nederlandse NEN-EN NA

Element S41	5.000 / 7.423 m	UNP200	S 235 JR (EN 10025-2)	RK_NC_UGT-Set B	0.30 -
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<b>Combinatiesleutel</b>
RK_NC_UGT-Set B / NC_UGT-Set B.7

<b>Partiële veiligheidsfactoren</b>	
$\gamma_{M0}$ voor weerstand van doorsneden	1.00
$\gamma_{M1}$ voor weerstand tegen instabiliteit	1.00
$\gamma_{M2}$ voor weerstand van nettosecties	1.25

<b>Materiaal</b>		
Vloeisterkte $f_y$	235.0	MPa
Treksterkte $f_u$	360.0	MPa
Bouwwijze	Gewalst	

....:DOORSNEDECONTROLE:....

De kritische controle is op positie 5.000 m



Interne krachten	Berekende	Eenheid
Normaalkracht	$N_{Ed}$ 8.11	kN
Dwarskracht	$V_{y,Ed}$ -1.39	kN
Dwarskracht	$V_{z,Ed}$ 0.93	kN
Torsie	$T_{Ed}$ -0.02	kNm
Buigend moment	$M_{y,Ed}$ -1.35	kNm
Buigend moment	$M_{z,Ed}$ 3.20	kNm

### Classificatie voor doorsnede-ontwerp

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	$\sigma_1$ [kN/m <sup>2</sup> ]	$\sigma_2$ [kN/m <sup>2</sup> ]	$\psi$ [-]	$k_o$ [-]	$\alpha$ [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse
										klasse 1 [-]	klasse 2 [-]	klasse 3 [-]	
1	UO	55	12	5.985e+02	1.033e+05	0.01	0.57	1.00	4.78	9.00	10.00	15.84	1
3	I	154	9	-3.000e+04	-4.057e+04								
5	UO	55	12	-1.233e+04	9.040e+04	-0.14	0.60	0.88	4.78	10.23	11.36	16.27	1

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

### Trekcontrole

Volgens EN 1993-1-1 artikel 6.2.3 en formule (6.5)

Oppervlakte van de doorsnede	A	3.2200e-03	m <sup>2</sup>
Plastische trekweerstand	$N_{pl,Rd}$	756.70	kN
Uiterste trekweerstand	$N_{u,Rd}$	834.62	kN
Trekweerstand	$N_{t,Rd}$	756.70	kN
Eenheidscontrole		0.01	-

### Controle buigend moment voor $M_y$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,y}$	2.2800e-04	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,y,Rd}$	53.58	kNm
Eenheidscontrole		0.03	-

### Controle buigend moment voor $M_z$

Volgens EN 1993-1-1 artikel 6.2.5 en formule (6.12),(6.13)

Plastische doorsnedemodulus	$W_{pl,z}$	5.1800e-05	m <sup>3</sup>
Plastisch buigend moment	$M_{pl,z,Rd}$	12.17	kNm
Eenheidscontrole		0.26	-

### Dwarskrachtcontrole voor $V_y$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.7250e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_y$	$V_{pl,y,Rd}$	234.04	kN
Eenheidscontrole		0.01	-

### Dwarskrachtcontrole voor $V_z$

Volgens EN 1993-1-1 artikel 6.2.6 en formule (6.17)

Correctiefactor voor dwarskracht	$\eta$	1.20	
Afschuifoppervlak	$A_v$	1.7250e-03	m <sup>2</sup>
Plastische dwarskrachtweerstand voor $V_z$	$V_{pl,z,Rd}$	234.04	kN
Eenheidscontrole		0.00	-

### Torsiecontrole

Volgens EN 1993-1-1 artikel 6.2.7 en formule (6.23)



Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 31/39

Vezelindex	Vezel	3	
Totaal torsiemoment	T <sub>Ed</sub>	2.2	MPa
Elastische dwarskrachtweerstand	T <sub>Rd</sub>	135.7	MPa
Eenheidscontrole		0.02	-

**Opmerking:** De eenheidscontrole voor torsie is lager dan de grenswaarde van 0,05. Hierdoor wordt torsie beschouwd als niet-significant en wordt deze genegeerd in de gecombineerde controles.

#### Controle voor gecombineerde buiging, axiale kracht en Dwarskracht

Volgens EN 1993-1-1 artikel 6.2.1 en formule (6.2)

Plastische trekweerstand	N <sub>pl,Rd</sub>	756.70	kN
Plastisch buigend moment	M <sub>pl,y,Rd</sub>	53.58	kNm
Plastisch buigend moment	M <sub>pl,z,Rd</sub>	12.17	kNm

Eenheidscontrole (6.2) = 0.01 + 0.03 + 0.26 = 0.30 -

**Opmerking:** Er is geen specifieke interactieformule volgens EN 1993-1-1 artikel 6.2.9.1 van toepassing.

Daarom wordt de plastisch lineaire som volgens EN 1993-1-1 artikel 6.2.1(7) getoetst.

**Opmerking:** Aangezien de dwarskrachten minder dan de helft van de plastische dwarskrachtweerstand bedragen, wordt het effect ervan op de momentweerstand genegeerd.

De staaf voldoet aan de doorsnedecontrole.

#### ....:STABILITEITSCONTROLE:....

#### Classificatie voor staafknikontwerp

Bestissende positie voor stabiliteitsclassificatie: 5.000 m

Classificatie volgens EN 1993-1-1 Artikel 5.5.2

Classificatie van interne en uitkragende onderdelen volgens EN 1993-1-1 tabel 5.2 blad 1 en 2

Id	Type	c [mm]	t [mm]	σ <sub>1</sub> [kN/m <sup>2</sup> ]	σ <sub>2</sub> [kN/m <sup>2</sup> ]	ψ [-]	k <sub>σ</sub> [-]	α [-]	c/t [-]	Limiet	Limiet	Limiet	Klasse	
										klasse	klasse	klasse		
											1	2	3	
											[-]	[-]	[-]	
1	UO	55	12	3.068e+03	1.058e+05	0.03	0.56	1.00	4.78	9.00	10.00	15.77	1	
3	I	154	9	-2.753e+04	-3.810e+04									
5	UO	55	12	-9.862e+03	9.287e+04	-0.11	0.59	0.90	4.78	9.96	11.06	16.17	1	

**Opmerking:** De classificatielimieten zijn ingesteld volgens Semi-Comp+.

De doorsnede is geclassificeerd als klasse 1

**Opmerking:** De stabiliteitsclassificatie is gebaseerd op de maximale doorsnedeklasse langs het element.

#### Kipcontrole

Volgens EN 1993-1-1 artikel 6.3.2.1 & 6.3.2.2 en formule (6.54)

Kip parameters			
Methode voor Kipcurve		Algemeen geval	
Plastische doorsnedemodulus	W <sub>pl,y</sub>	2.2800e-04	m <sup>3</sup>
Elastisch kritisch moment	M <sub>cr</sub>	185.95	kNm
Relatieve slankheid	λ <sub>rel,LT</sub>	0.54	
Limietslankheid	λ <sub>rel,LT,0</sub>	0.20	

**Opmerking:** De slankheid of het buigend moment is zo dat de kipeffecten genegeerd kunnen worden volgens EN 1993-1-1 artikel 6.3.2.2(4).

**Opmerking:** L/h is buiten de limieten, de gewijzigde ontwerpregel voor kip van U-profielen kan niet worden toegepast.

**Opmerking:** L/h is buiten de limieten, de gewijzigde ontwerpregel voor kip van U-profielen kan niet worden toegepast.

Mcr parameters			
LTB lengte	l <sub>LT</sub>	2.423	m
Invloed van lastpositie		geen invloed	
Correctiefactor	k	1.00	
Correctiefactor	k <sub>w</sub>	1.00	
Kip moment factor	C <sub>1</sub>	2.22	
Kip moment factor	C <sub>2</sub>	0.12	
Kip moment factor	C <sub>3</sub>	1.00	
Afschuifmiddenpuntafstand	d <sub>z</sub>	0	mm
Afstand tot lastoepassing	z <sub>g</sub>	0	mm
Mono-symmetrische constante	β <sub>y</sub>	0	mm



Project	4922005	Huidige datum	15.12.2022
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.e 32/39

#### Mcr parameters

Mono-symmetrische constante	$z_j$	0	mm
-----------------------------	-------	---	----

**Waarschuwing:** Er wordt niet voldaan aan alle voorwaarden van de Nederlandse NEN-EN NA (Art. NB.NB.1) en daarom wordt de standaard EC-EN-benadering gebruikt.

**Opmerking:** C parameters zijn bepaald volgens de ECCS 119 2006 / Galea 2002.

De staaf voldoet aan de stabiliteitscontrole.



## 2.6. EC-EN 1993 BGT staalcontrole

Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-quasi  
 Assenstelsel: Hoofd  
 Extreme 1D: Element  
 Selectie: Alle

### Algehele eenheidscontrole

Naam	dx [mm]	Belasting	U <sub>y,max</sub>	U <sub>y,ver</sub>	Limiet van	Limiet van	Controle van	Controle van	Zaag de u <sub>r</sub> (mm) Zaag [mm]	Check [-]
			[mm] U <sub>y,max</sub> [mm]	[mm] U <sub>y,ver</sub> [mm]	U <sub>y,max</sub> [mm] Limiet van U <sub>y,max</sub> [mm]	U <sub>y,ver</sub> [mm] Limiet van U <sub>y,ver</sub> [mm]	U <sub>y,max</sub> [-] Controle van U <sub>y,max</sub> [-]	U <sub>y,ver</sub> [-] Controle van U <sub>y,ver</sub> [-]		
S8	11820.000	NC_BGT-quasi.1	11.4 0.0	- -	21.8 39.4	21.8 39.4	0.52 0.00	- -	- -	<b>0.52</b>
S9	0.000	NC_BGT-quasi.1	0.0 -21.2	- -	19.7 68.8	19.7 68.8	0.00 0.31	- -	- -	<b>0.31</b>
S10	0.000	NC_BGT-quasi.1	0.0 -22.4	- -	19.7 68.8	19.7 68.8	0.00 0.33	- -	- -	<b>0.33</b>
S11	11820.000	NC_BGT-quasi.4	-5.3 0.0	-8.6 0.0	27.1 39.4	27.1 39.4	0.20 0.00	0.32 0.00	- -	<b>0.32</b>
S12	1000.000	NC_BGT-quasi.4	0.1 -35.4	0.0 -14.7	13.3 70.0	13.3 70.0	0.01 0.51	0.00 0.21	- -	<b>0.51</b>
S13	0.000	NC_BGT-quasi.4	0.0 -57.2	0.0 -23.1	13.3 70.0	13.3 70.0	0.00 0.82	0.00 0.33	- -	<b>0.82</b>
S15	8600.650	NC_BGT-quasi.4	-0.9 -65.6	-0.4 -22.3	64.5 59.3	64.5 59.3	0.01 1.11	0.01 0.38	- -	<b>1.11</b>
S16	2500.000+	NC_BGT-quasi.4	-0.4 -9.2	-0.3 -3.6	13.3 16.7	13.3 16.7	0.03 0.55	0.02 0.21	- -	<b>0.55</b>
S17	2500.000+	NC_BGT-quasi.4	-0.1 -8.7	-0.2 -3.7	13.3 16.7	13.3 16.7	0.01 0.52	0.01 0.22	- -	<b>0.52</b>
S18	0.000	NC_BGT-quasi.4	0.5 0.9	0.8 0.3	3.3 3.3	3.3 3.3	0.15 0.28	0.23 0.10	- -	<b>0.28</b>
S21	1060.660	NC_BGT-quasi.4	0.0 0.0	0.0 0.0	7.1 7.1	7.1 7.1	0.00 0.00	0.00 0.00	- -	<b>0.00</b>
S22	1060.660	NC_BGT-quasi.4	0.0 0.0	0.0 0.0	7.1 7.1	7.1 7.1	0.00 0.00	0.00 0.00	- -	<b>0.00</b>
S23	2000.000	NC_BGT-quasi.4	0.0 -0.2	0.0 0.0	13.3 13.3	13.3 13.3	0.00 0.02	0.00 0.00	- -	<b>0.02</b>
S25	3568.196+	NC_BGT-quasi.1	0.0 0.0	- -	23.8 23.8	23.8 23.8	0.00 0.00	- -	- -	<b>0.00</b>
S26	0.000	NC_BGT-quasi.4	20.9 0.0	4.0 0.0	47.6 23.8	47.6 23.8	0.44 0.00	0.08 0.00	- -	<b>0.44</b>
S27	3568.196-	NC_BGT-quasi.1	0.0 0.0	- -	23.8 23.8	23.8 23.8	0.00 0.00	- -	- -	<b>0.00</b>
S28	0.000	NC_BGT-quasi.1	-18.9 0.0	- -	47.6 23.8	47.6 23.8	0.40 0.00	- -	- -	<b>0.40</b>
S33	5656.854	NC_BGT-quasi.4	-8.3 -5.4	-4.2 3.4	37.7 37.7	37.7 37.7	0.22 0.14	0.11 0.09	- -	<b>0.22</b>
S34	5656.854	NC_BGT-quasi.4	16.4 19.4	3.3 11.0	37.7 37.7	37.7 37.7	0.44 0.52	0.09 0.29	- -	<b>0.52</b>
S35	0.000	NC_BGT-quasi.4	-17.5 -20.5	-1.5 -8.6	37.7 37.7	37.7 37.7	0.46 0.54	0.04 0.23	- -	<b>0.54</b>
S36	0.000	NC_BGT-quasi.4	-14.7 -17.6	-1.6 -9.0	37.7 37.7	37.7 37.7	0.39 0.47	0.04 0.24	- -	<b>0.47</b>
S40	0.000	NC_BGT-quasi.1	8.0 0.0	- -	16.2 8.1	16.2 8.1	0.50 0.00	- -	- -	<b>0.50</b>
S41	7423.000	NC_BGT-quasi.4	20.2 0.0	11.0 0.0	16.2 8.1	16.2 8.1	1.25 0.00	0.68 0.00	- -	<b>1.25</b>





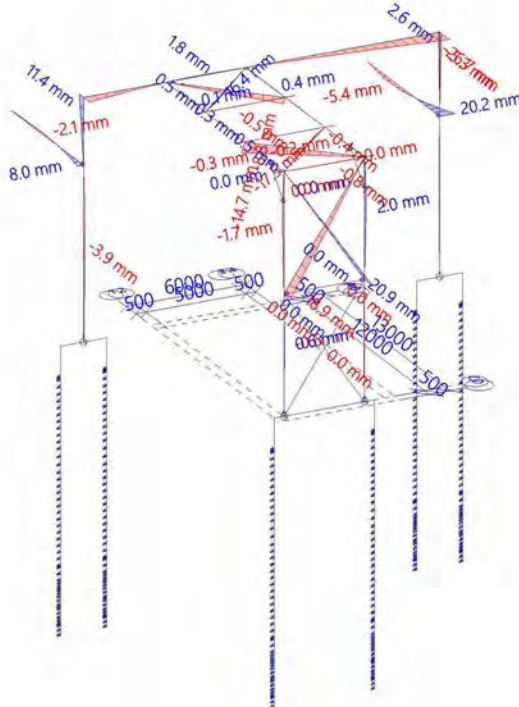
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.12.e  
34/39

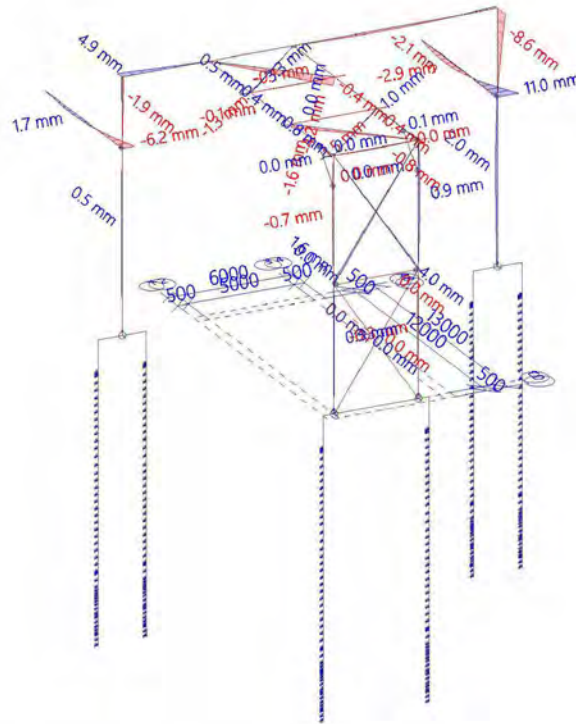
## Resultaten - $u_{y,max}$

Waardes:  $u_{y,max}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - $u_{y,var}$

Waardes:  $u_{y,var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





Project  
Omschrijving  
Onderdeel

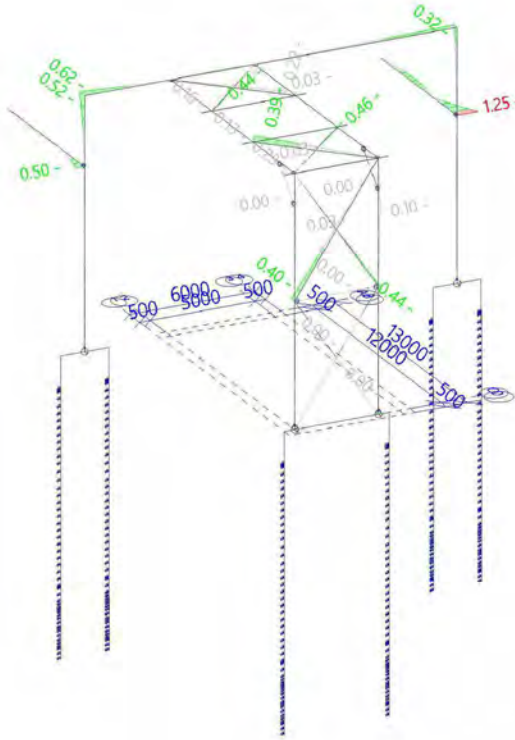
4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
35/39

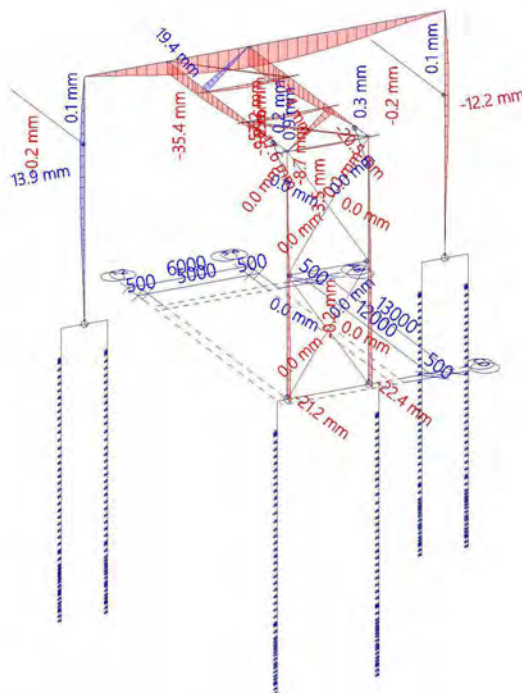
## Resultaten - Controle $u_y$

Waardes: **Controle  $u_y$**   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - $u_{z,max}$

Waardes:  **$u_{z,max}$**   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





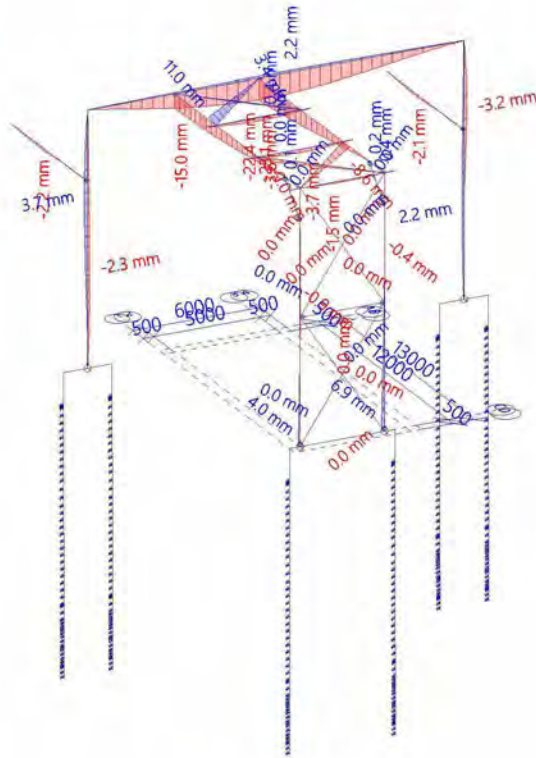
Project  
Omschrijving  
Onderdeel

4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum 15.12.2022  
Constructie Algemeen XYZ  
Auteur  
5.1.2.e  
36/39

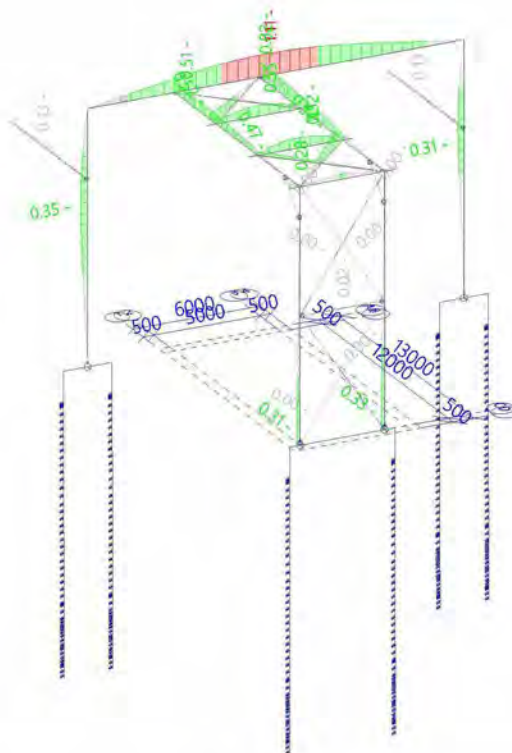
## Resultaten - $u_{z,var}$

Waardes:  $u_{z,var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



## Resultaten - Controle $u_z$

Waardes: **Controle  $u_z$**   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





Project  
Omschrijving  
Onderdeel

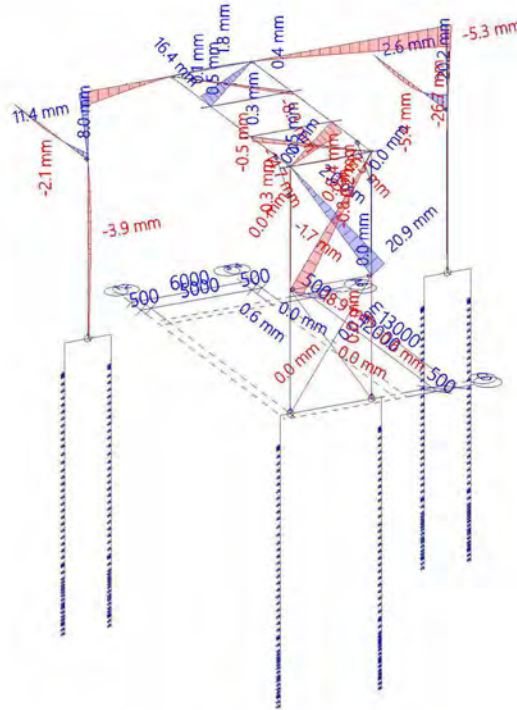
4922005  
Statische berekening  
Piperack Compressorhuis naar Rack 108

Huidige datum  
Constructie  
Auteur

15.12.2022  
Algemeen XYZ  
5.1.2.e  
37/39

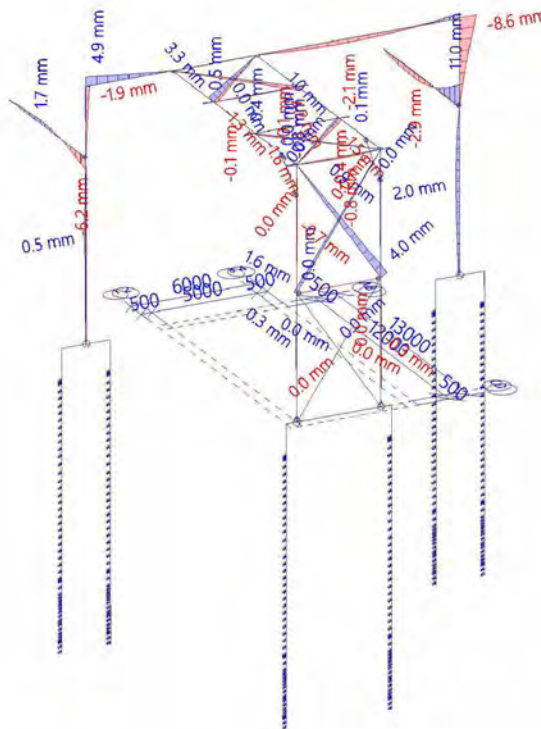
### Resultaten - $u_{y,max}$

Waardes:  $u_{y,max}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle



### Resultaten - $u_{y,var}$

Waardes:  $u_{y,var}$   
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle

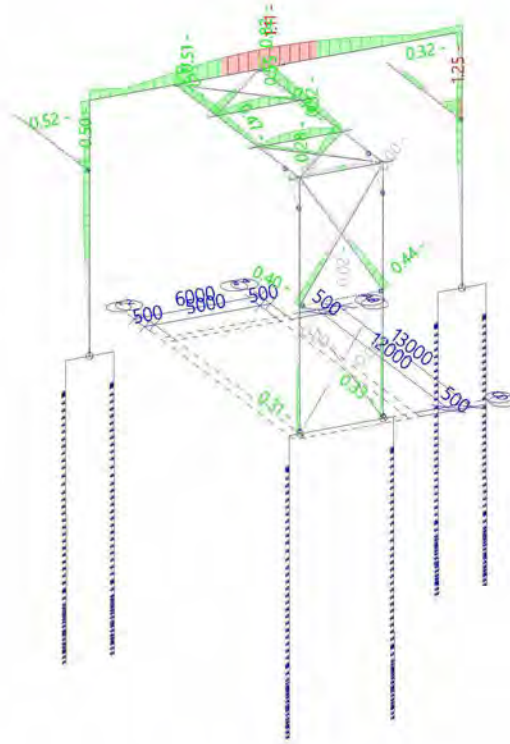






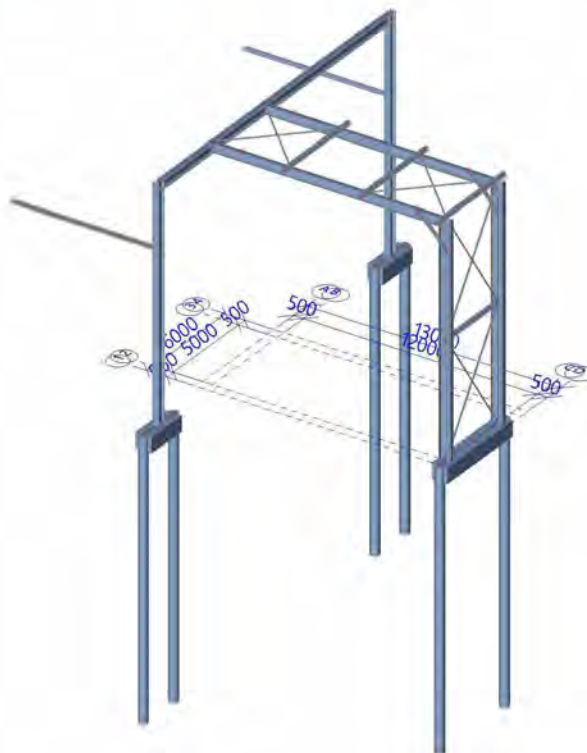
## Resultaten - Check Overall

Waardes: **Check Overall**  
Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-quasi  
Assenstelsel: Hoofd  
Extreme 1D: Element  
Selectie: Alle





# Bijlage 4. Betoncontrole





## 1. Inhoudsopgave

1. Inhoudsopgave	2
2. Betoncontrole	3
2.1. Liggers	3
2.1.1. Ontwerpkrachten	3
2.1.1.1. Interne krachten (Ontwerp)	3
2.1.1.2. Rekenmodel - N	4
2.1.1.3. Rekenmodel - NEd	4
2.1.1.4. Rekenmodel - M	5
2.1.1.5. Rekenmodel - M-MEd	5
2.1.1.6. Rekenmodel - MEd	6
2.1.1.7. Rekenmodel - Mx	6
2.1.1.8. Rekenmodel - MEdx	7
2.1.1.9. Rekenmodel - V	7
2.1.1.10. Rekenmodel - V-VEd	8
2.1.1.11. Rekenmodel - VEd	8
2.1.2. Slankheid(Controle)	9
2.1.3. Voorstelling van stijfheid	9
2.1.4. Wapeningscontrole UGT	9
2.1.5. Controle capaciteits-response	10
2.1.6. Controle capaciteits-interactie diagram	15
2.1.7. Controleer afschuiving+torsie (UGT)	19
2.1.8. Controle limietspanning	29
2.1.9. Controle scheurwijdte (BGT)	33





## 2. Betoncontrole

### 2.1. Liggers

#### 2.1.1. Ontwerpkrachten

##### 2.1.1.1. Interne krachten (Ontwerp)

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Staaf

Extremes 1D: Globaal

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

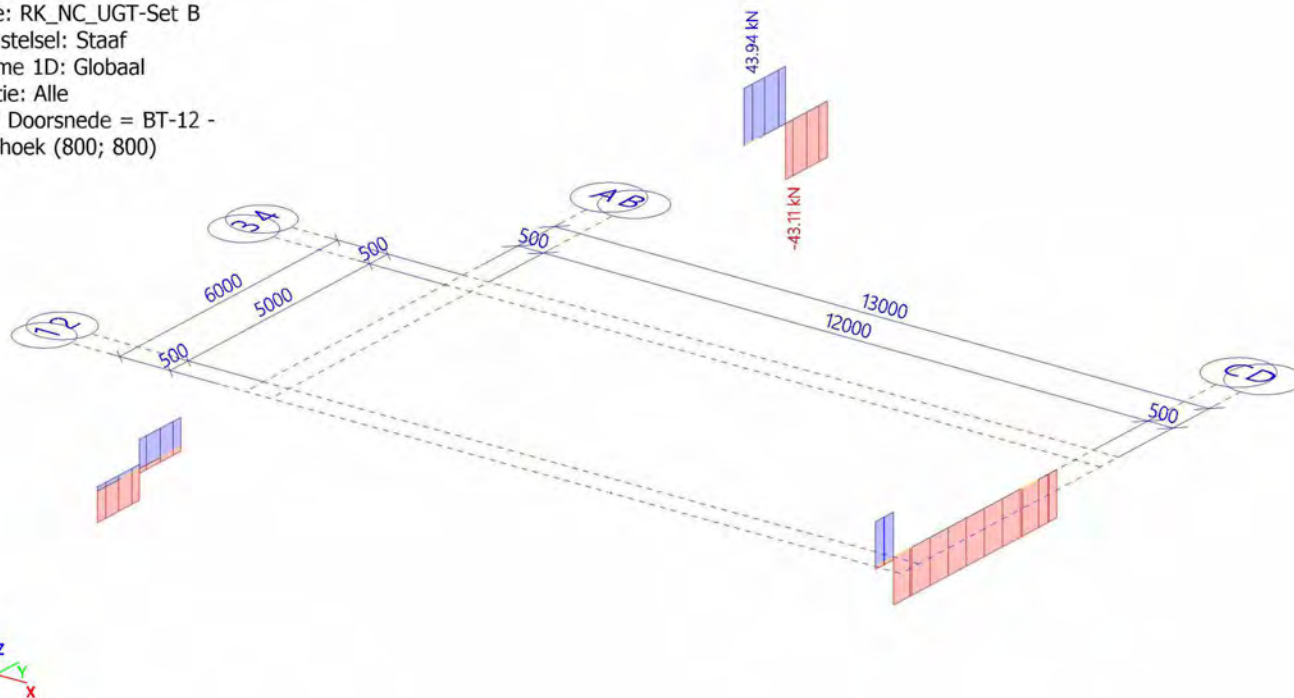
Naam	dx [mm]	Belasting	Doorsnede	N	V <sub>y</sub>	V <sub>z</sub>	M <sub>x</sub>	M <sub>y</sub>	M <sub>z</sub>
				[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
				N <sub>Ed</sub>	V <sub>Edy</sub>	V <sub>Edz</sub>	M <sub>Edx</sub>	M <sub>Edy</sub>	M <sub>Edz</sub>
				[kN]	[kN]	[kN]	[kNm]	[kNm]	[kNm]
S37	0.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>43.94</b> <b>43.94</b>	-1.20 0.00	-135.82 -135.82	3.68 3.68	77.08 77.08	-0.31 0.00
S2	5000.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.51 -5.51	<b>-32.79</b> <b>-32.79</b>	-204.43 -27.91	9.16 9.16	-15.79 -15.79	-0.03 -0.03
S2	0.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	1.93 1.93	<b>25.55</b> <b>25.55</b>	153.11 30.58	-21.84 -21.84	1.54 59.11	-0.03 -0.03
S37	2300.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	-43.07 -43.07	3.01 0.00	<b>-392.98</b> <b>-375.05</b>	-3.86 -3.86	-82.89 -82.89	0.33 0.00
S1	0.000	NC_UGT-Set B.14	BT-12 - Rechthoek (800; 800)	-24.20 -24.20	1.01 0.00	<b>235.71</b> <b>215.57</b>	-3.21 -3.21	-46.08 -46.08	0.14 0.00
S2	4500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	-3.02 -3.02	-5.38 0.00	-132.87 -32.43	<b>-35.61</b> <b>-35.61</b>	59.30 73.67	2.62 0.00
S2	0.000	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	0.06 0.06	3.95 0.00	121.50 33.26	<b>32.66</b> <b>32.66</b>	-1.68 -1.68	0.10 0.00
S37	1150.000-	NC_UGT-Set B.12	BT-12 - Rechthoek (800; 800)	40.66 40.66	-1.23 0.00	-153.81 -153.81	3.72 3.72	<b>-96.86</b> <b>-96.86</b>	-1.70 0.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>-43.11</b> <b>-43.11</b>	3.00 0.00	-371.28 -371.28	-3.85 -3.85	<b>356.56</b> <b>356.56</b>	<b>-3.13</b> 0.00
S2	4500.000+	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	-5.52 -5.52	-32.74 -32.74	-195.00 -27.91	9.13 9.13	84.06 96.67	<b>16.35</b> <b>16.35</b>
S37	950.000	NC_UGT-Set B.6	BT-12 - Rechthoek (800; 800)	30.22 30.22	-1.32 -1.32	-67.63 -67.63	5.44 5.44	-1.82 -15.02	-1.47 <b>-1.74</b>



### 2.1.1.2. Rekenmodel - N

Waardes: **N**

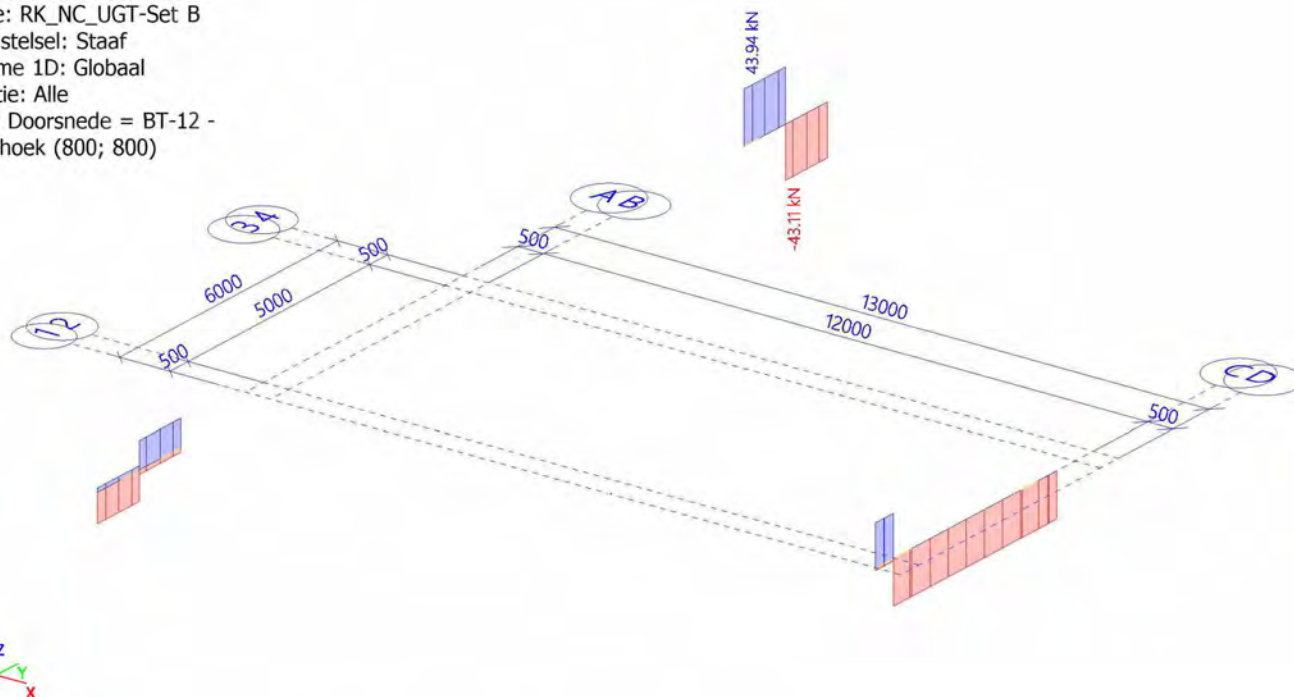
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.3. Rekenmodel - NEd

Waardes: **NEd**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

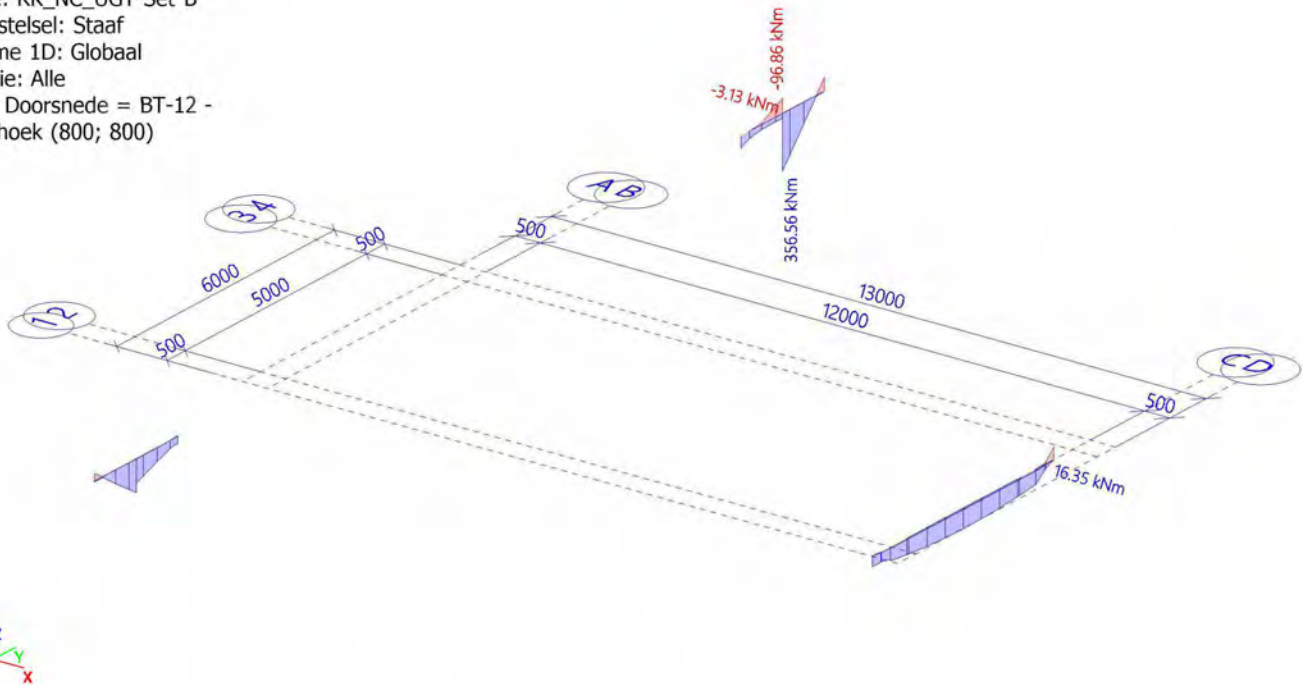




### 2.1.1.4. Rekenmodel - M

Waardes: **M**

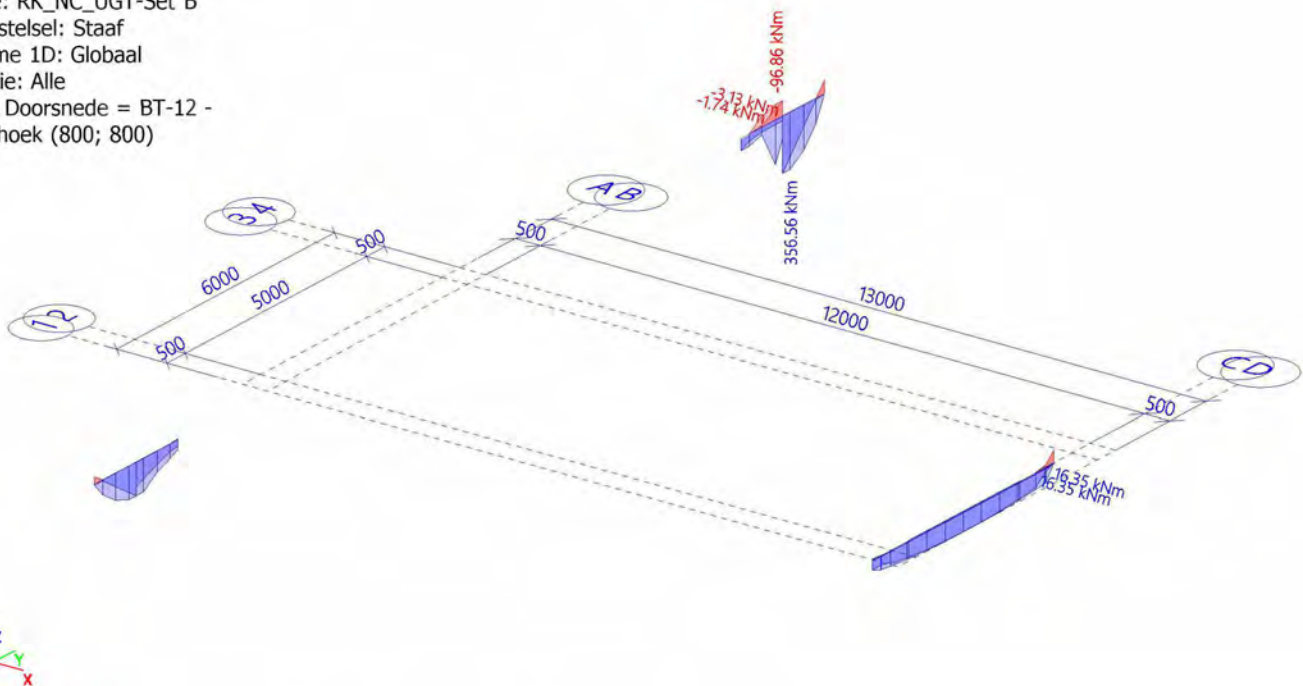
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.5. Rekenmodel - M-MEd

Waardes: **M-MEd**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

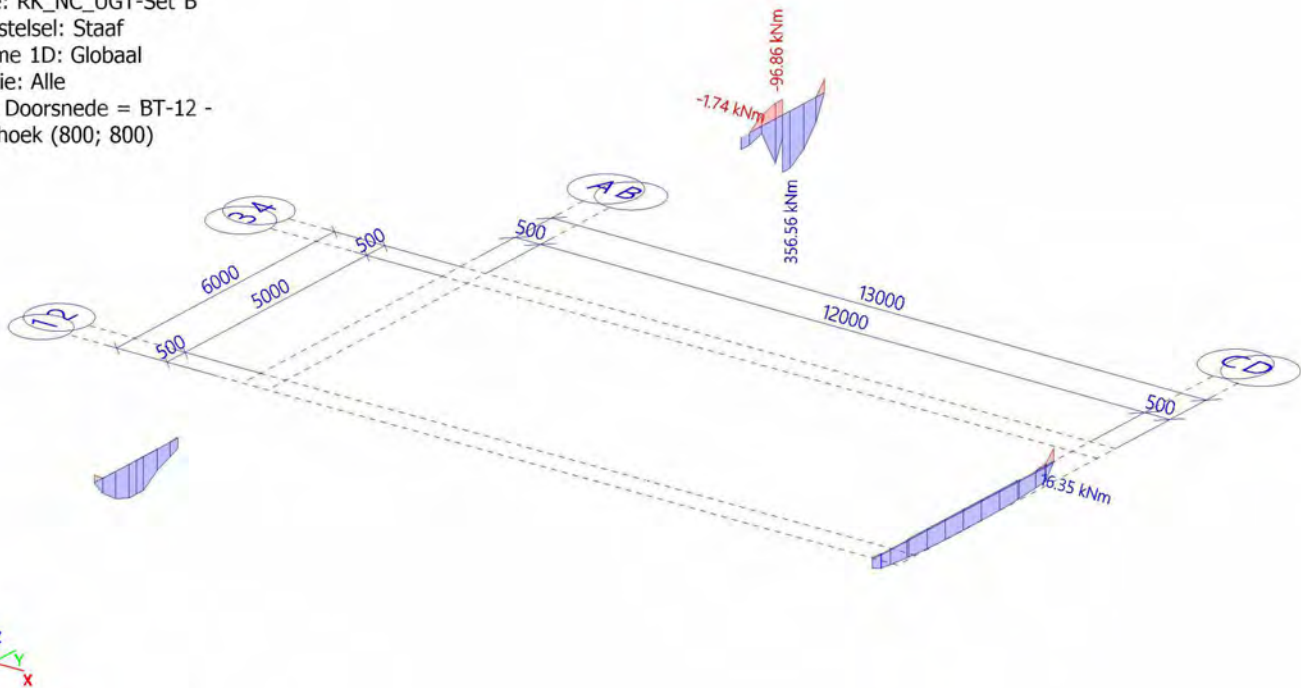




### 2.1.1.6. Rekenmodel - MEd

Waardes: **MEd**

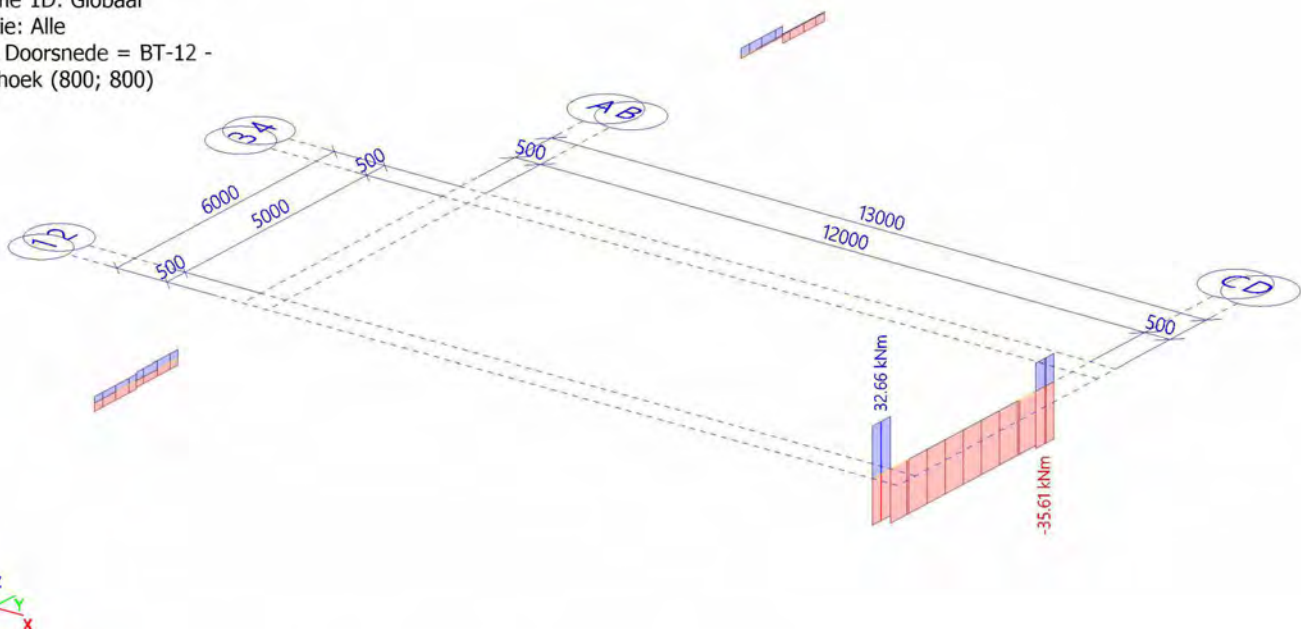
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.7. Rekenmodel - Mx

Waardes: **Mx**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

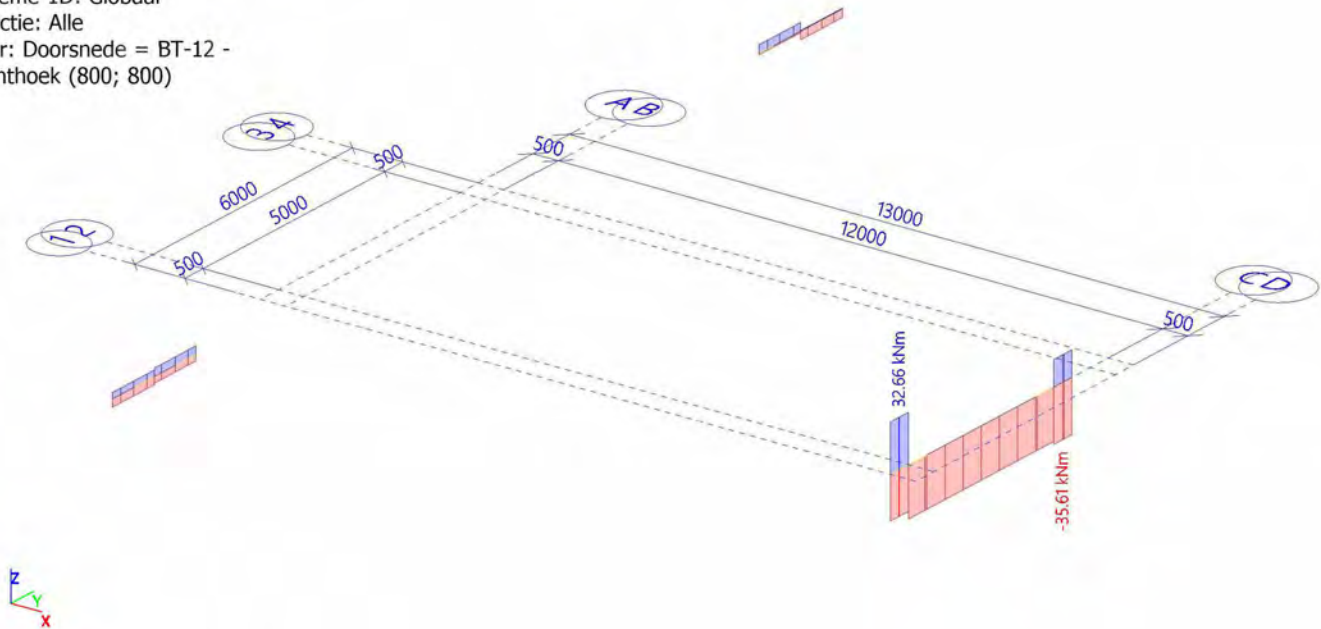




### 2.1.1.8. Rekenmodel - MEdx

Waardes:  $M_{Edx}$

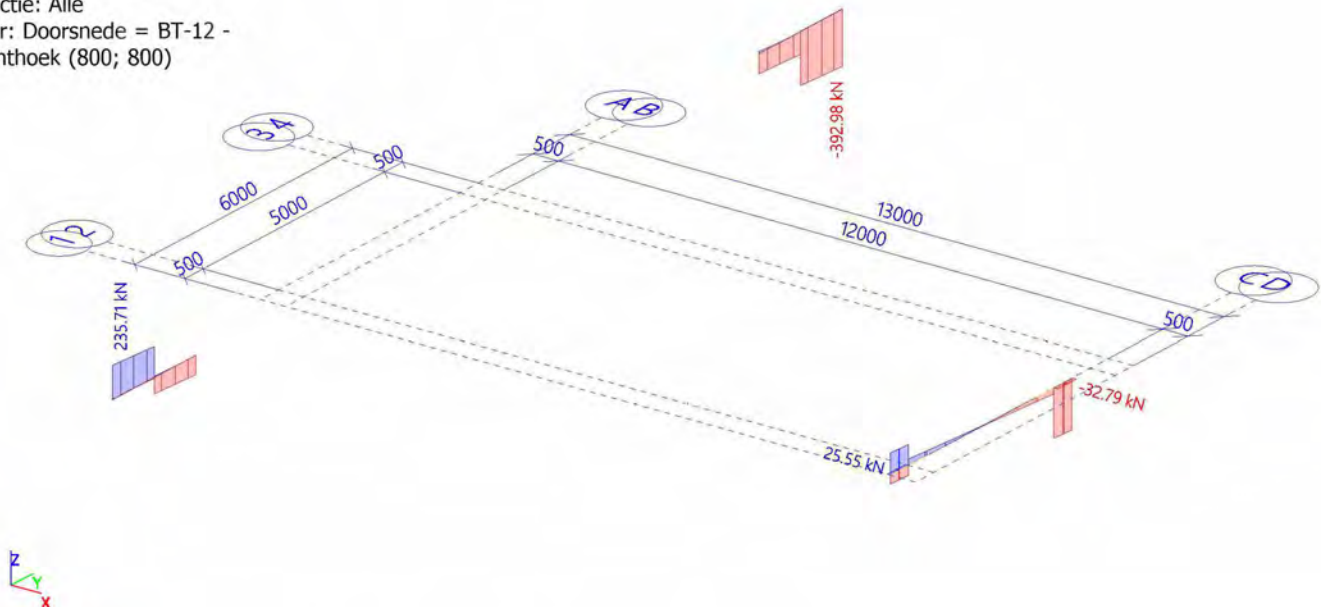
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.9. Rekenmodel - V

Waardes:  $V$

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)

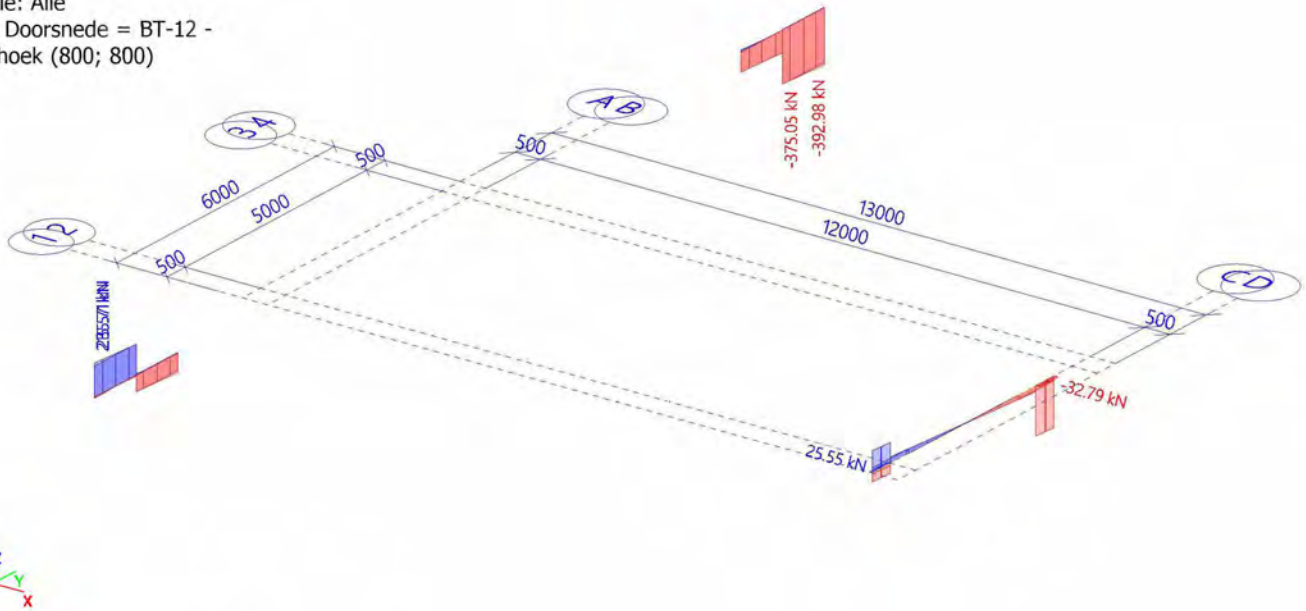




### 2.1.1.10. Rekenmodel - V-VEd

Waardes: **V-VEd**

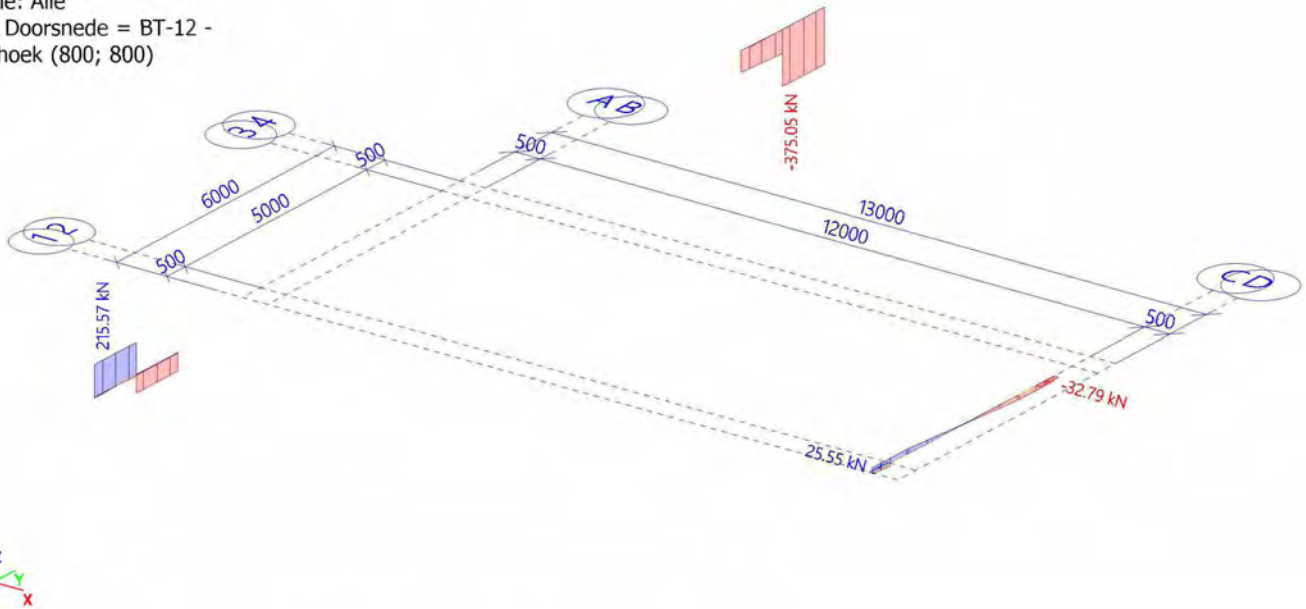
Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)



### 2.1.1.11. Rekenmodel - VEd

Waardes: **VEd**

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Globaal  
Selectie: Alle  
Filter: Doorsnede = BT-12 -  
Rechthoek (800; 800)





### 2.1.2. Slankheid(Controle)

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Globaal  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$L_y$	$\beta_{zz}$	$i_{oy}$	$i_{oy}$	$\lambda_y$	$\lambda_{limy}$
				$L_z$	$\beta_{yy}$	$i_{oz}$	$i_{oz}$	$\lambda_z$	$\lambda_{limz}$
				[mm]	[-]	[mm]	[m]	[-]	[-]
S2	500.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	4000.000	1.00	40000.000	2.3094e-01	173.21	724.97
				5000.000	10.00	5000.000	2.3094e-01	21.65	724.97
S1	1150.000+	NC_UGT-Set B.1	BT-12 - Rechthoek (800; 800)	1150.000	1.00	11500.000	2.3094e-01	49.80	0.00
				2300.000	10.00	2300.000	2.3094e-01	9.96	0.00
S1	2300.000	NC_UGT-Set B.5	BT-12 - Rechthoek (800; 800)	1150.000	1.00	11500.000	2.3094e-01	49.80	4277.63
				2300.000	10.00	2300.000	2.3094e-01	9.96	4277.63

### 2.1.3. Voorstelling van stijfheid

Niet-lineaire berekening  
 Klasse: RK\_NC\_BGT-kar  
 Assenstelsel: Staaf  
 Extreme 1D: Globaal  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$N_{cr}$	$M_{y,cr}$	State	$f_{\sigma,eff}$	$\sigma_s$	$x_{l,cr}$	EA [MN]	$EI_y$
				[kN]	[kNm]		$\sigma_{cc}$	$\sigma_{sr}$	$\zeta$		[MNm <sup>2</sup> ]
				$N_{char}$	$M_{y,char}$		[MPa]	[MPa]	[-]		$EI_z$
S1	0.000	NC_BGT-kar.1	BT-12 - Rechthoek (800; 800)	0.00	0.00	Korte termijn	3.20	0.0	0	2.2236e+04	1.1968e+03
				-12.15	-22.65		0.00	0.0	0.00		1.1915e+03

### 2.1.4. Wapeningscontrole UGT

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Doorsnede  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

Naam	dx [mm]	Belasting	Doorsnede	$UC_{trep}$	$UC_{lmt}$	$UC_{VT}$	$UC_{trep,crack}$	$UC_{crack}$	$UC_{diff}$	$UC_{det}$	$UC$
				[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
S37	1350.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	1.00	0.98	0.16	-	-	-	-	1.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	1.00	0.98	0.89	-	-	-	-	1.00

### Gehele controle

Niet-lineaire berekening  
 Klasse: RK\_NC\_UGT-Set B  
 Assenstelsel: Staaf  
 Extreme 1D: Doorsnede  
 Selectie: Alle  
 Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



Naam	dx [mm]	Belasting	Doorsnede	UC <sub>resp</sub> [-]	UC <sub>int</sub> [-]	UC <sub>vr</sub> [-]	UC <sub>stress</sub> [-]	UC <sub>crack</sub> [-]	UC <sub>defl</sub> [-]	UC <sub>det</sub> [-]	UC [-]
S37	1350.000	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	<b>1.00</b>	<b>0.98</b>	0.16	-	-	-	-	1.00
S37	1150.000+	NC_UGT-Set B.7	BT-12 - Rechthoek (800; 800)	1.00	0.98	<b>0.89</b>	-	-	-	-	<b>1.00</b>

### Rekenmodel - UC

Waardes: **UC**

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

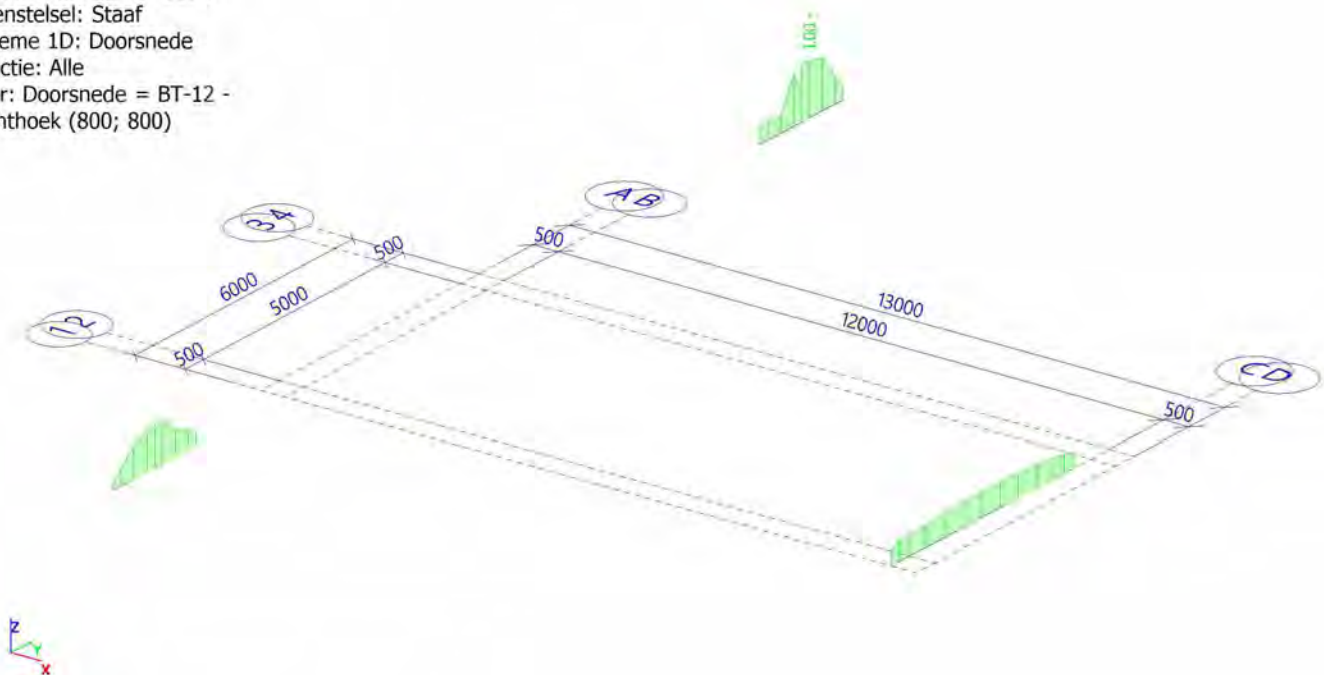
Assenstelsel: Staaf

Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 -

Rechthoek (800; 800)



### 2.1.5. Controle capaciteits-responsie

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Staaf

Extreme 1D: Doorsnede

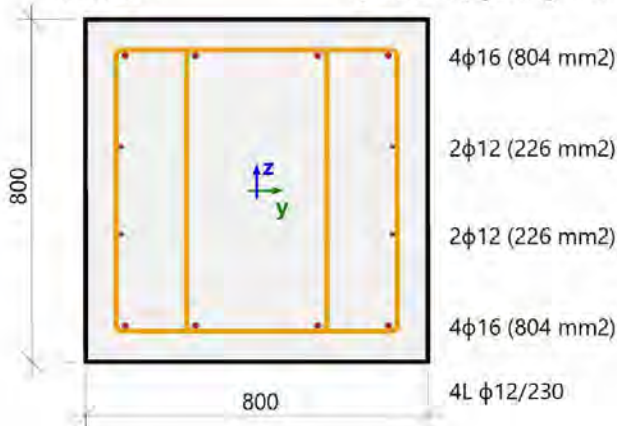
Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)





<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 7 [dx = 1.35 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y $\perp$	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z $\perp$	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4 $\phi$ 12+8 $\phi$ 16 (2061 mm <sup>2</sup> )
		$\rho_l = 0.322\%$ (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L $\phi$ 12/230 (452 mm <sup>2</sup> )
		$\rho_w = 0.246\%$ (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Materiaalkarakteristieken

Ontwerpbetondruksterkte

$$f_{cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$$

Ontwerpvloei spanning van langswapening

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa} \quad (3.15)$$

## Krachten

Inhoud van de combinatie: NC\_UGT-SetB.7

Van EEM analyse:

$$N = -43.1 \text{ kN} \quad M_y = 281 \text{ kNm} \quad M_z = -2.53 \text{ kNm}$$

## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0.1 \cdot (23.3 \cdot 10^6 \cdot 0.64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -43 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).

Herberekende buigmomenten:

Momentreductie boven steunpunt: Nee

Reductie van afschuifkrachten boven steunpunt: Nee

Verschuivingsregel gebruiken: Ja

$$N_{Ed} = -43.1 \text{ kN} \quad M_{Edy} = 357 \text{ kNm} \quad M_{Edz} = 0 \text{ kNm}$$



## Status van scheuren in buiging

$$\sigma_{ct,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow \text{doorsnede gescheurd bij buiging}$$

## Toetsing van beperkte hoogte van drukzone gebaseerd op 6.1(9) van NEN EN 1992-1-1

Grenswaarde van ontwerpnormaalkracht

$$N_{lim} = 0.1 \cdot A_c \cdot f_{cd} = 0.1 \cdot 0.64 \cdot 23.3 = 1493 \text{ kN}$$

Ontwerpwaarde van normaalkracht

$$N_{Ed} = -43.1 \text{ kN}$$

De waarde  $x_u$  berekend op basis van de weerstanden uit het interactiediagram

$$N_{Rd} = -43.9 \text{ kN}$$

$$M_{Rdy} = 363 \text{ kN}$$

$$M_{Rdz} = 0 \text{ kN}$$

Beperkte hoogte van drukzone

$$x_{u,lim} = \frac{500 \cdot 10^6 \cdot d}{500 \cdot 10^6 + f} = \frac{500 \cdot 10^6 \cdot 0.456}{500 \cdot 10^6 + 435 \cdot 10^6} = 0.244 \text{ m}$$

$$x_u < x_{u,lim} \Rightarrow 60.4 \text{ mm} < 244 \text{ mm}$$

Controlewaarde gerelateerd aan de beperking van de drukzone

$$UC_{x_u} = \frac{x_u}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248$$

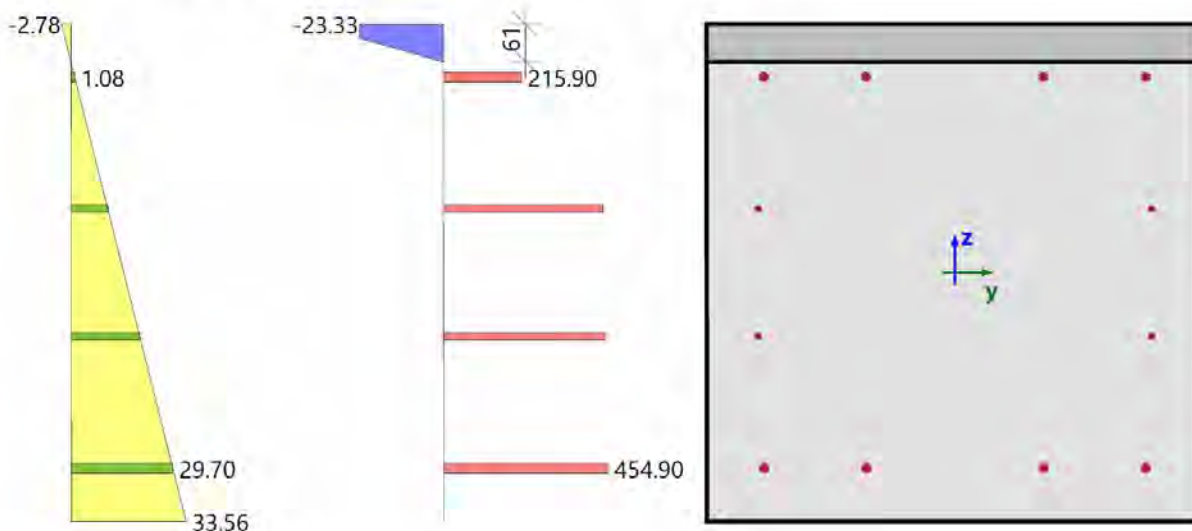
## Overzicht van controle

Type component	Vezel / Staaf	$\epsilon_{extr}$ [‰]	$\sigma_{extr}$ [MPa]	Controle rek [-]	Controle spanning [-]	$UC_{x_u}$ [-]	E.C. [-]	Grenswaarde [-]	Status
Beton	3	-2.78	-23.3	0.79	1.00	0.25	1.00	1	OK
Wapening	3	29.7	455	0.66	0.98				



Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

## Spanning en rek verdeling



## Extreme waarden van spanning/rek in component

Type component	Vezel / StAAF	$\epsilon$ [‰]	$\epsilon_{lim}$ [‰]	$\sigma$ [MPa]	$\sigma_{lim}$ [MPa]	E.C. [-]	Status
Beton - druk	3	-2.78	-3.5	-23.3	-23.3	1.00	OK
Beton - trek	1	33.6	0	0	0	0.00	OK
Wapening - druk	1	0	0	0	0	0.00	OK
Wapening - trek	3	29.7	45	455	466	0.98	OK

## Vlak van vervorming

Rek in het midden van het zwaartepunt

$$\epsilon_x = 15.4 \text{ ‰}$$

Kromming rond y-as

$$\epsilon_y = -45.4 \text{ ‰}$$

Kromming rond z-as

$$\epsilon_z = 0 \text{ ‰}$$

Hoogte van de drukzone

$$x = 61 \text{ mm}$$

Evenwichtshoogte van drukzone

$$x_{bal} = 289 \text{ mm}$$

Grenswaarde hoogte van drukzone

$$x_{lim} = 35 \text{ mm}$$

Helling van de neutrale as

$$\alpha_{NA} = 0^\circ$$

Hoogte van de doorsnede loodrecht op neutrale as

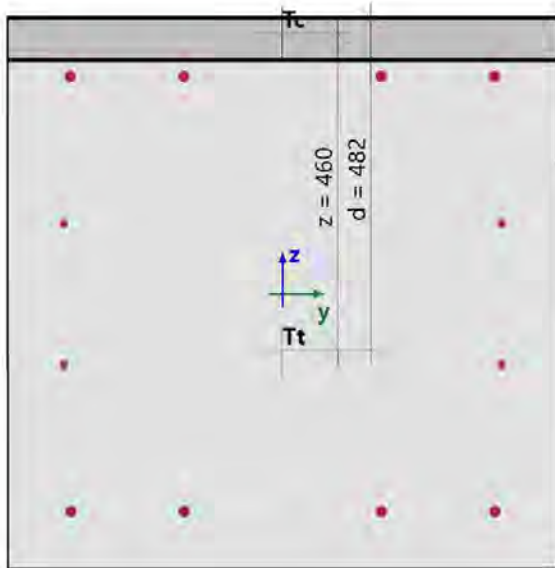
$$h = 800 \text{ mm}$$

Effectieve diepte van de doorsnede loodrecht op de neutrale as

$$d = 482 \text{ mm}$$

Hefboomsarm van de doorsnede loodrecht op neutrale as

$$z = 460 \text{ mm}$$



## Doorsnedekarakteristieken

Type component	$t_y$ [m]	$t_z$ [m]	A [m <sup>2</sup> ]	$I_y$ [m <sup>4</sup> ]	$I_z$ [m <sup>4</sup> ]
Beton - druk	0	0.369	0.049	$6.7 \cdot 10^{-3}$	$2.61 \cdot 10^{-3}$
Beton - trek	0	-0.031	0.591	0.0274	0.0315
Wapening - druk	0	0	0	0	0
Wapening - trek	0	0	$2.06 \cdot 10^{-3}$	$164 \cdot 10^{-6}$	$138 \cdot 10^{-6}$
Volledig beton	0	0	0.64	0.0341	0.0341
Alle wapeningsstaven	0	0	$2.06 \cdot 10^{-3}$	$164 \cdot 10^{-6}$	$138 \cdot 10^{-6}$

## Krachten in alle doorsnedecomponenten

Type component	$N_{res}$ [kN]	$M_{res,y}$ [kNm]	$M_{res,z}$ [kNm]	$e_y$ [m]	$e_z$ [m]
Beton - druk	-784	296	0	0	0.378
Beton - trek	0	0	0	0	0
Wapening - druk	0	0	0	0	0
Wapening - trek	741	60.7	0	0	-0.082
Alles onder druk	-784	296	0	0	0.378
Alles onder trek	741	60.7	0	0	-0.082
Overzicht	-43.1	357	0		



## Gedetailleerde resultaten van spanningen en rekken in betonvezels

Vezel	Materiaal	$y_i$ [m]	$z_i$ [m]	$\epsilon$ [‰]	$\epsilon_{lim}$ [‰]	$\sigma$ [MPa]	$\sigma_{lim}$ [MPa]	$\epsilon / \epsilon_{lim}$ [-]	$\sigma / \sigma_{lim}$ [-]	Controle
1	C35/45	0.4	-0.4	33.6	0	0	0	0	0	OK
2	C35/45	0.4	0	15.4	0	0	0	0	0	OK
3	C35/45	0.4	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
4	C35/45	0	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
5	C35/45	-0.4	0.4	-2.78	-3.5	-23.3	-23.3	0.79	1	OK
6	C35/45	-0.4	0	15.4	0	0	0	0	0	OK
7	C35/45	-0.4	-0.4	33.6	0	0	0	0	0	OK
8	C35/45	0	-0.4	33.6	0	0	0	0	0	OK

## Gedetailleerde resultaten van spanningen en rekken in wapeningsstaven

StAAF	Materiaal	$d_s$ [mm]	$y_i$ [m]	$z_i$ [m]	$\epsilon$ [‰]	$\epsilon_{lim}$ [‰]	$\sigma$ [MPa]	$\sigma_{lim}$ [MPa]	$\epsilon / \epsilon_{lim}$ [-]	$\sigma / \sigma_{lim}$ [-]	Controle
1	B 500B	16	0.143	0.315	1.08	45	216	466	0.02	0.46	OK
2	B 500B	16	-0.307	0.315	1.08	45	216	466	0.02	0.46	OK
3	B 500B	16	-0.307	-0.315	29.7	45	455	466	0.66	0.98	OK
4	B 500B	16	0.143	-0.315	29.7	45	455	466	0.66	0.98	OK
5	B 500B	16	-0.143	-0.315	29.7	45	455	466	0.66	0.98	OK
6	B 500B	16	0.307	-0.315	29.7	45	455	466	0.66	0.98	OK
7	B 500B	12	-0.317	0.102	10.7	45	441	466	0.24	0.95	OK
8	B 500B	12	-0.317	-0.102	20.1	45	448	466	0.45	0.96	OK
9	B 500B	12	0.317	-0.102	20.1	45	448	466	0.45	0.96	OK
10	B 500B	12	0.317	0.102	10.7	45	441	466	0.24	0.95	OK
11	B 500B	16	0.307	0.315	1.08	45	216	466	0.02	0.46	OK
12	B 500B	16	-0.143	0.315	1.08	45	216	466	0.02	0.46	OK

## Verklaring van fouten, waarschuwingen en opmerkingen

Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

### 2.1.6. Controle capaciteits-interactie diagram

Niet-lineaire berekening

Klasse: RK\_NC\_UGT-Set B

Assenstelsel: Staaf

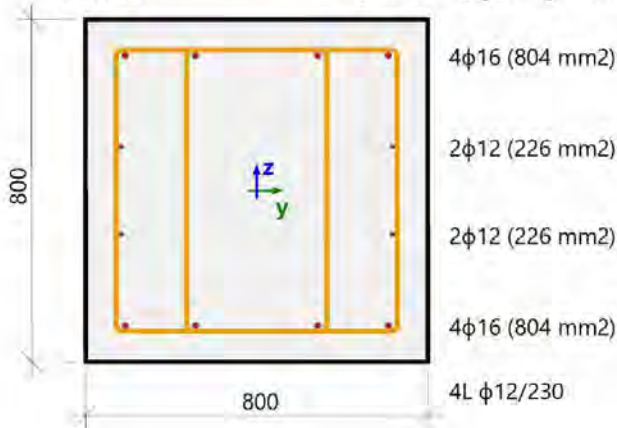
Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 7 [dx = 1.35 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y $\perp$	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z $\perp$	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4 $\phi$ 12+8 $\phi$ 16 (2061 mm <sup>2</sup> )
		$\rho_l = 0.322\%$ (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L $\phi$ 12/230 (452 mm <sup>2</sup> )
		$\rho_w = 0.246\%$ (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Materiaalkarakteristieken

Ontwerpbetondruksterkte

$$f_{cd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$$

Ontwerpvloei spanning van langswapening

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa} \quad (3.15)$$

## Krachten

Van EEM analyse

$$N = -43.1 \text{ kN} \quad M_y = 281 \text{ kNm} \quad M_z = -2.53 \text{ kNm}$$

Inhoud van de combinatie:

NC\_UGT-SetB.7

## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0.1 \cdot (23.3 \cdot 10^6 \cdot 0.64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -43 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).



Herberekende buigmomenten:

Momentreductie boven steunpunt: Nee

Reductie van afschuifkrachten boven steunpunt: Nee

Verschuivingsregel gebruiken: Ja

$N_{Ed} = -43.1 \text{ kN}$   $M_{Edy} = 357 \text{ kNm}$   $M_{Edz} = 0 \text{ kNm}$

## Invoergegevens voor het genereren van interactiediagrammen

Methode van interactieve diagramma controle	$N_u M_u$
Verdeling van verticale rekken	250
Aantal verticale snedes	18
Resultante waarde van buigmoment	$M_{res} = 357 \text{ kNm}$
Hoek van resulterend buigmoment is gerelateerd aan $M_y$ richting in horizontaal vlak $M_y$ - $M_z$	$\alpha_{M_y M_z} = 180^\circ$
Hoek van resulterend buigmoment is gerelateerd aan $N$ richting in verticaal vlak $N$ - $M_{res}$	$\alpha_{NM} = -6.89^\circ$

## Status van scheuren in buiging

$\sigma_{ct,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow$  doorsnede gescheurd bij buiging

## Toetsing van beperkte hoogte van drukzone gebaseerd op 6.1(9) van NEN EN 1992-1-1

Grenswaarde van ontwerpnormaalkracht

$$N_{lim} = 0.1 \cdot A_c \cdot f_{cd} = 0.1 \cdot 0.64 \cdot 23.3 = 1493 \text{ kN}$$

Ontwerpwaarde van normaalkracht

$$N_{Ed} = -43.1 \text{ kN}$$

De waarde  $x_u$  berekend op basis van de weerstanden uit het interactiediagram

$$N_{Rd} = -43.9 \text{ kN}$$

$$M_{Rdy} = 363 \text{ kNm}$$

$$M_{Rdz} = 0 \text{ kNm}$$

Beperkte hoogte van drukzone

$$x_{u,lim} = \frac{500 \cdot 10^6 \cdot d}{500 \cdot 10^6 + f} = \frac{500 \cdot 10^6 \cdot 0.456}{500 \cdot 10^6 + 435 \cdot 10^6} = 0.244 \text{ m}$$

$$x_u < x_{u,lim} \Rightarrow 60.4 \text{ mm} < 244 \text{ mm}$$

Controlewaarde gerelateerd aan de beperking van de drukzone

$$UC_{x_u} = \frac{x_u}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248$$

## Berekening van weerstanden

Weerstanden in positieve richting  $N_{Rd+} = 41 \text{ kN}$   $M_{Rdy+} = 363 \text{ kNm}$   $M_{Rdz+} = 0 \text{ kNm}$

Weerstanden in negatieve richting  $N_{Rd-} = -44 \text{ kN}$   $M_{Rdy-} = -336 \text{ kNm}$   $M_{Rdz-} = 0 \text{ kNm}$



## Overzicht van controle

Krachten:  $N_{Ed} = -43.1 \text{ kN}$   $M_{Edy} = 357 \text{ kNm}$   $M_{Edz} = 0 \text{ kNm}$

Weerstand:  $N_{Rd} = -44 \text{ kN}$   $M_{Rdy} = 363 \text{ kNm}$   $M_{Rdz} = 0 \text{ kNm}$

Berekenen van de eenheidscontrole:

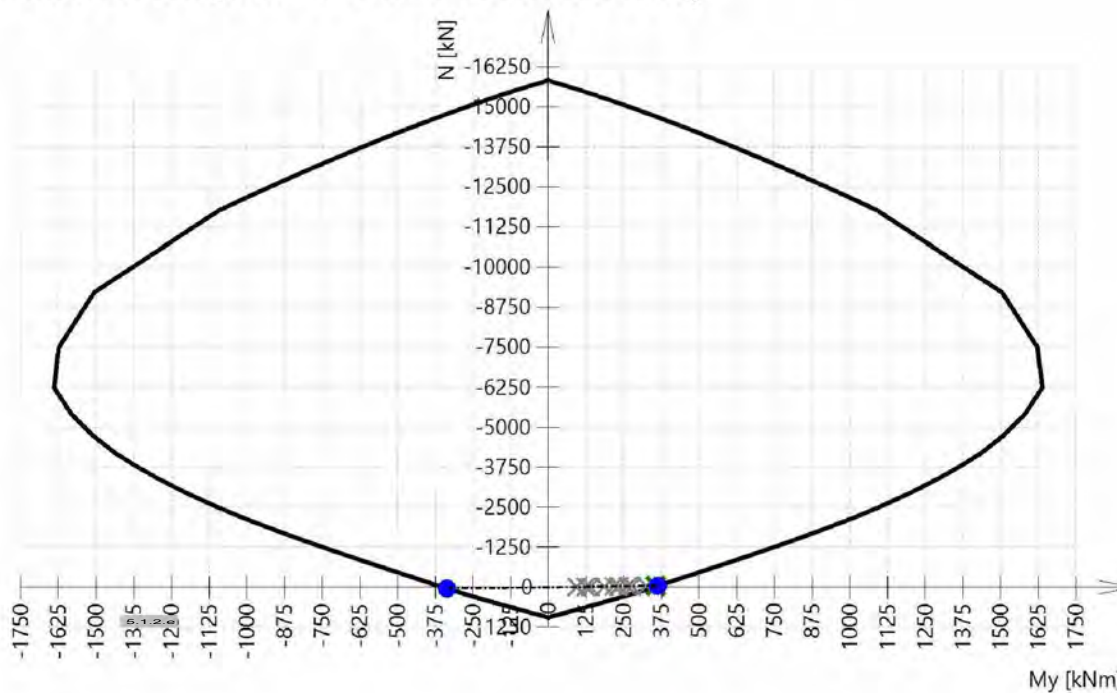
$$UC = \frac{\sqrt{N_{Ed}^2 + M_{Edy}^2 + M_{Edz}^2}}{\sqrt{N_{Rd}^2 + M_{Rdy}^2 + M_{Rdz}^2}} = \frac{\sqrt{-43.1^2 + 357^2 + 0^2}}{\sqrt{-43.9^2 + 363^2 + 0^2}} = 0.981$$

Eenheidscontrole gebaseerd op  $x_{u,lim}$  volgens 6.1(9) van NEN EN 1992-1-1

$$UC_{xu} = \frac{x}{x_{u,lim}} = \frac{0.0604}{0.244} = 0.248 \leq 1 \quad \text{OK}$$

Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

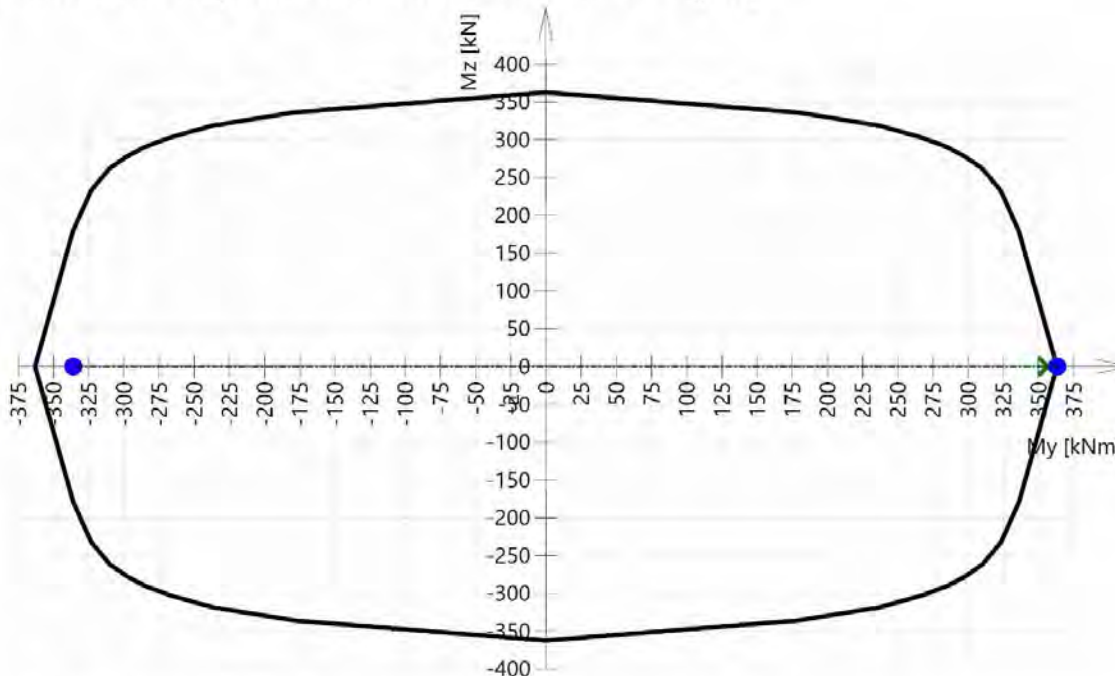
## 3D-interactiediagram - Verticale doorsnede N- $M_y$







### 3D-interactiediagram - Horizontale doorsnede $M_y$ - $M_z$



### Verklaring van fouten, waarschuwingen en opmerkingen

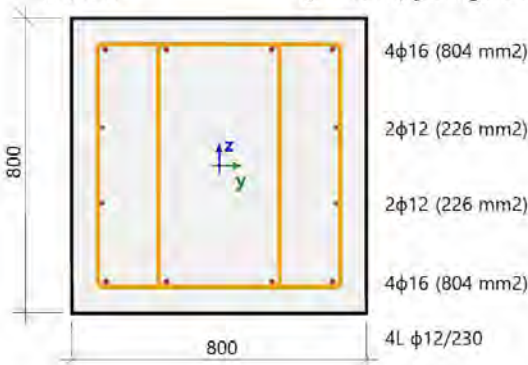
Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

### 2.1.7. Controleer afschuiving+torsie (UGT)

Niet-lineaire berekening  
Klasse: RK\_NC\_UGT-Set B  
Assenstelsel: Staaf  
Extreme 1D: Doorsnede  
Selectie: Alle  
Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 6 [dx = 1.15 m]
<b>Staaf lengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
		Boven: XC4, XD3, XF2, XA2
		Onder: XC2, XD3, XF2, XA2
		<b>Langswapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4φ12+8φ16 (2061 mm <sup>2</sup> )
		ρ <sub>l</sub> = 0.322 % (16.2 kg/m)
		<b>Dwarskrachtwapening: B 500B</b>
		Bilineair met oplopende bovenvertakking
		4L φ12/230 (452 mm <sup>2</sup> )
		ρ <sub>w</sub> = 0.246 % (15.4 kg/m)
		<b>Dekking (beugel)</b>
		Bovenzijde: 65 mm
		Onderzijde: 65 mm
		Links: 65 mm
		Rechts: 65 mm



## Instellingen

Methode voor berekening afschuifweerstand: Standaard  
 Grenswaarde van de hoek tussen buigende momenten en resultante afschuifkrachten voor het gebruik van de standaardmethode:  $\alpha_{VM,lim} = 15^\circ$   
 Equivalente dunwandige doorsnede: Automatisch  
 De hoek tussen de betondrukschoor en de staaf: Gebruikersinvoer:  $\theta_{inp} = 40^\circ \Rightarrow \cot(\theta_{inp}) = 1.19$

## Krachten

Inhoud van de combinatie: NC\_UGT-SetB.7  
 $N_{Ed} = -43.1 \text{ kN}$   $M_{Edy} = 357 \text{ kNm}$   $M_{Edz} = 0 \text{ kNm}$   $V_{Edy} = 0 \text{ kN}$   $V_{Edz} = -371 \text{ kN}$   $T_{Ed} = -3.85 \text{ kNm}$   
 Hoek van gradiënt van rekvlak Hoek van resultante van afschuiving  
 $\alpha_M = 90^\circ$   $\alpha_V = -90^\circ$   
 Resultante van dwarskracht  $\alpha_V = \alpha_V + 180 = -90 + 180 = 90^\circ$   
 $V_{Ed} = \sqrt{V_{Edy}^2 + V_{Edz}^2} = \sqrt{0^2 + (-371)^2} = 371 \text{ kN}$  Verschil tussen hoeken  $\alpha_M$  en  $\alpha_V$   
 $\alpha_{MV} = \text{abs}(\alpha_M - \alpha_V) = \text{abs}(90 - 90) = 0^\circ$

## Materiaalkarakteristieken

Ontwerpbetondruksterkte Ontwerp betontreksterkte  
 $f_{ctd} = \frac{\alpha_{cc} \cdot f_{ck}}{\gamma_c} = \frac{1 \cdot 35}{1.5} = 23.3 \text{ MPa}$   $f_{ctd} = \frac{\alpha_{ct} \cdot f_{ctk005}}{\gamma_c} = \frac{1 \cdot 2.2}{1.5} = 1.47 \text{ MPa}$  (3.15, 3.16)



### Berekening van hoek tussen betondrukschoor en staafas

- minimale waarde:

$$\theta_{\min} = 21.8^\circ \Rightarrow \cot(\theta_{\min}) = 2.5 \quad (\S 6.2.3(2))$$

- maximale waarde:

$$\theta_{\max} = 45^\circ \Rightarrow \cot(\theta_{\max}) = 1 \quad (\S 6.2.3(2))$$

- invoer/berekende waarde:

$$\theta = \theta_{\text{inp}} = 40^\circ, \cot(\theta) = 1.19$$

Opm.: Automatische berekening van hoek is uitgeschakeld, gebruikerswaarde wordt in rekening genomen



## Controleer afschuiving en bereken afschuifweerstand

### Doorsnedeparameters

Minimale breedte van doorsnede in trekzone

$$y_{bw} = 0 \text{ mm} \quad z_{bw} = 339 \text{ mm} \quad b_w = 800 \text{ mm}$$

Opm.: Waarde  $b_w$  is berekend als de kleinste breedte van de doorsnede in het trekoppervlak loodrecht op de resultante van de afschuifkracht.

Minimale breedte van de doorsnede tussen trek- en drukschoor

$$y_{bw1} = 0 \text{ mm} \quad z_{bw1} = 378 \text{ mm} \quad b_{w1} = 800 \text{ mm}$$

Opm.: Waarde  $b_{w1}$  is berekend als de kleinste breedte van de doorsnede tussen het trek- en drukkoord loodrecht op de resultante van de afschuifkracht.

Hoogte van doorsnede is herberekend in de richting van de resultante van de dwarskracht

$$h = 800 \text{ mm}$$

Opm.: De waarde  $h$  wordt berekend als de breedte van de doorsnede op het zwaartepunt in de richting van de resultante van de dwarskracht.

Oppervlakte betondoorsnede

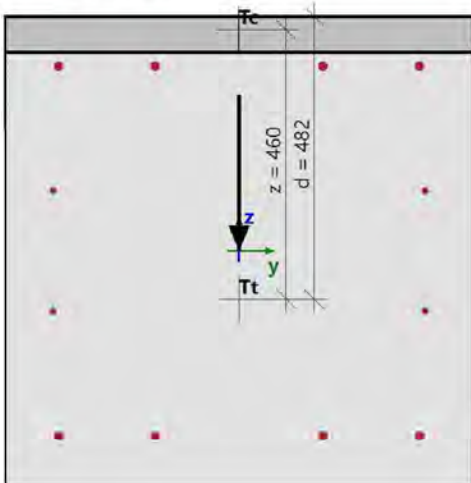
$$A_c = 0.64 \text{ m}^2$$

Effectieve diepte omgerekend naar richting van resultante van dwarskracht

$$d = 482 \text{ mm}$$

Hefboomsarm van interne krachten omgerekend naar richting van resultante van dwarskracht

$$z = 460 \text{ mm}$$





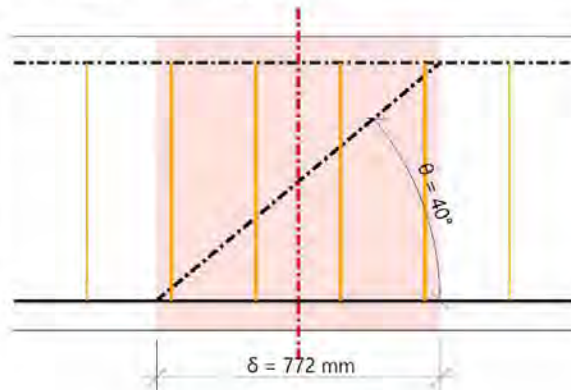
## Parameters van dwarswapening

### Invoerparameters

Beugels over de lengte van scheurafschuifprojectie  $\delta = z \cdot \cot(\theta) = 772 \text{ mm}$ , interval (-386; 386)

$$z = \text{Coeff}_d \cdot \text{Coeff}_z \cdot h = 0.9 \cdot 0.9 \cdot 0.8 = 648 \text{ mm} \quad \delta = z \cdot \cotg(\theta) = 0.648 \cdot \cotg(40) = 772 \text{ mm}$$

ID	Zone	$x_s$ [mm]	$\phi_s$ [mm]	$s_s$ [mm]	$n_s$ []	$\alpha_s$ [°]	$f_{ywk}$ [MPa]
1	1	-345	12	230	4	90	500
2	1	-115	12	230	4	90	500
3	1	115	12	230	4	90	500
4	1	345	12	230	4	90	500
Avg.	-	-	12	230	4	90	500



Aantal snedes per beugel

Diameter van de wapening

Hart - op - hartafstand van beugel in langsrichting

Hoek van beugels van staafas

Karakteristieke vloeigrens

Doorsnedeoppervlakte van dwarswapening

$$A_{sw} = n_s \cdot \pi \cdot \left(\frac{\phi_s}{2}\right)^2 = 4 \cdot 3.14 \cdot \left(\frac{12}{2}\right)^2 = 452 \text{ mm}^2$$

Maximale longitudinale tussenafstand van beugelwapening

$$s_l = s_{inp} = 230 \text{ mm}$$

Doorsnedeoppervlak per meter

$$A_{swm} = \frac{A_{sw}}{s_l} = \frac{452 \cdot 10^{-6}}{0.23} = 1967 \text{ mm}^2/\text{m}$$

$$n_s = 4$$

$$\phi_s = 12 \text{ mm}$$

$$s_{inp} = 0.23 \text{ m}$$

$$\alpha_s = 90^\circ$$

$$f_{ywk} = 500 \text{ MPa}$$

## Parameters van langswapening

Het oppervlak van de trekwapening

$$A_{sl} = 2061 \text{ mm}^2$$



## Berekening van afschuifweerstand

Ontwerpschuifweerstand van de staaf zonder dwarswapening

$$\sigma_{cl,max} = 4.11 \text{ MPa} \geq f_{ctd} = 1.47 \text{ MPa} \Rightarrow \text{doorsnede gescheurd bij buiging}$$

Berekening ontwerp dwarskrachtweerstand van de staaf zonder dwarskrachtwapening volgens artikel 6.2.2(1).

Coëfficiënt voor hoogte van de doorsnede

$$k = \min\left(1 + \left(\frac{200}{d}\right)^{\frac{1}{2}}; 2\right) = \min\left(1 + \left(\frac{200}{482}\right)^{\frac{1}{2}}; 2\right) = 1.64 \quad (\$6.2.2(1))$$

Geometrische wapeningsverhouding

$$\rho_1 = \min\left(\frac{A_{sl}}{b_w \cdot d}; 0.02\right) = \min\left(\frac{2.06 \cdot 10^{-3}}{0.8 \cdot 0.482}; 0.02\right) = 5.34 \cdot 10^{-3} \quad (\$6.2.2(1))$$

Axiale spanning in de doorsnede

$$\sigma_{cp} = \min\left(\frac{-N_{Ed}}{A_c}; 0.2 \cdot f_{cd}\right) = \min\left(\frac{-43.1}{0.64}; 0.2 \cdot 23.3\right) = 0.0674 \text{ MPa} \quad (\$6.2.2(1))$$

Andere coëfficiënten

$$C_{Rdc} = 0.12 \quad v_{min} = 0.437 \text{ MPa} \quad k_1 = 0.15$$

Berekening van de rekenwaarde

$$\begin{aligned} V_{Rdc} &= 10^6 \cdot \left( C_{Rdc} \cdot k \cdot \left( 100 \cdot \rho_1 \cdot f_{ck} \right)^{\frac{1}{3}} + k_1 \cdot \sigma_{cp} \right) \cdot b_w \cdot d \quad (6.2.a) \\ &= 10^6 \cdot \left( 0.12 \cdot 1.64 \cdot \left( 100 \cdot 5.34 \cdot 10^{-3} \cdot 35 \right)^{\frac{1}{3}} + 0.15 \cdot 0.0674 \right) \cdot 0.8 \cdot 0.482 = 206 \text{ kN} \end{aligned}$$

$$\begin{aligned} V_{Rdcmin} &= 10^6 \cdot \left( v_{min} + k_1 \cdot \sigma_{cp} \right) \cdot b_w \cdot d \quad (6.2.b) \\ &= 10^6 \cdot \left( 0.437 + 0.15 \cdot 0.0674 \right) \cdot 0.8 \cdot 0.482 = 172 \text{ kN} \end{aligned}$$

$$V_{Rdc} = \max(V_{Rdc}; V_{Rdcmin}; 0) = \max(205851; 172222; 0) = 206 \text{ kN}$$

Opm.: Ontwerp afschuifweerstand van de staaf zonder de afschuifwapening is berekend volgens Artikel 6.2.2(1), omdat de doorsnede is gescheurd in flexure in UGT of de doorsnede is niet belast door normaalkracht en buigmomenten.



## Ontwerpafschuifweerstand van de staaf met dwarswapening

Ontwerpspanning van dwarswapening

$$A_{sw} = n_s \cdot \pi \cdot \left(\frac{\phi_s}{2}\right)^2 = 4 \cdot 3.14 \cdot \left(\frac{12}{2}\right)^2 = 452 \text{ mm}^2$$

$$\sigma_{swd} = \frac{\frac{V_{Ed}}{z} \cdot s_i}{A_{sw} \cdot (\cotg(\theta) + \cotg(\alpha_s) \cdot \sin(\alpha_s))} = \frac{\frac{371276}{0.46} \cdot 0.23}{452 \cdot 10^{-6} \cdot (\cotg(40) + \cotg(90) \cdot \sin(90))} = 345 \text{ MPa}$$

Ontwerpvloei spanning van dwarswapening

$$f_{ywd} = 0.8 \cdot f_{ywk} = 0.8 \cdot 500 = 400 \text{ MPa} \quad , \text{ omdat } \sigma_{swd} < 0.8 \cdot f_{ywk}$$

Opm.: Ontwerp vloei sterkte van de dwarswapening is gereduceerd tot 0.8 x  $f_{ywk}$  (EN 1992-1-1, Artikel 6.2.3(3)), omdat de ontwerpspanning van de dwarswapening onder de 80% van de karakteristieke vloei spanning  $f_{yk}$  is.

Ontwerpafschuifweerstand van de staaf met dwarswapening

$$V_{Rds} = \frac{A_{sw}}{s_i} \cdot z \cdot f_{ywd} \cdot \cotg(\theta) = \frac{452 \cdot 10^{-6}}{0.23} \cdot 0.46 \cdot 400 \cdot 10^6 \cdot \cotg(40) = 431 \text{ kN} \quad (6.8)$$

## Rekenwaarde van de max. afschuifkracht welke kan worden verdragen door de staaf

Sterktereductiefactor voor beton gescheurd in afschuiving - waarde  $v$

$$v = 0.6 \cdot \left(1 - \frac{f_{ck}}{250}\right) = 0.6 \cdot \left(1 - \frac{35}{250}\right) = 0.516 \quad (6.6N)$$

Sterktereductiefactor voor beton gescheurd in afschuiving - waarde  $v_1$

$$\sigma_{cp} = \min\left(\frac{-N_{Ed}}{A_c}; 0.2 \cdot f_{cd}\right) = \min\left(\frac{-43.1}{0.64}; 0.2 \cdot 23.3\right) = 0.0674 \text{ MPa}$$

$$v_1 = 0.6 \quad (6.10.aN)$$

Coëfficiënt voor de bepaling van de spanning in de drukdiagonaal

$$\alpha_{cw} = 1 \quad (\text{voor niet-voorgespannen element}) \quad (56.2.3(3)N3)$$

Rekenwaarde van de max. afschuifkracht welke kan worden verdragen door de staaf

$$V_{Rdmax} = \frac{\alpha_{cw} \cdot b_{w1} \cdot z \cdot v_1 \cdot f_{cd}}{(\cotg(\theta) + \tg(\theta))} = \frac{1 \cdot 0.8 \cdot 0.46 \cdot 0.6 \cdot 23.3 \cdot 10^6}{(\cotg(40) + \tg(40))} = 2534 \text{ kN} \quad (6.9)$$

Maximale dwarskracht bij het steunpunt (zonder gebruik van factor  $\beta$ )

$$V_{Edmax} = 0.5 \cdot b_{w1} \cdot d \cdot v \cdot f_{cd} = 0.5 \cdot 0.8 \cdot 0.482 \cdot 0.516 \cdot 23.3 \cdot 10^6 = 2321 \text{ kN} \quad (6.5)$$

Afschuifweerstand van de staaf

$$V_{Rd} = \min(V_{Rds} + V_{cdd} + V_{td}; V_{Rdmax} + V_{cdd} + V_{td}; V_{Edmax} + V_{cdd} + V_{td}) = \min(431 + 0 + 0; 2534 + 0 + 0; 2321 + 0 + 0) = 431 \text{ kN}$$



## Afschuifcontrole

Controle  $V_{Rdmax}$

$$V_{Ed} = 371 \text{ kN} \leq V_{Rdmax} + V_{ccd} + V_{td} = 2534 \text{ kN}$$

Opm.: De controle voldoet voor het verbrijzelen van de drukschoor ( $V_{Ed} \leq V_{Rd,max} + V_{td} + V_{ccd}$ ).

Controle  $V_{Edmax}$

$$V_{Ed} = 371 \text{ kN} \leq V_{Edmax} + V_{ccd} + V_{td} = 2321 \text{ kN}$$

Opm.: De controle voldoet voor dwarskracht nabij de ondersteuning ( $V_{Ed} \leq V_{Ed,max} + V_{td} + V_{ccd}$ ).

Controle  $V_{Rdc}$  en  $V_{Rds}$

$$V_{Ed} = 371 \text{ kN} < V_{Rds} + V_{ccd} + V_{td} = 431 \text{ kN}$$

Opm.: De controle voldoet voor dwarswapening ( $V_{Ed} < V_{Rds} + V_{ccd} + V_{td}$ ).

## Eenh. Controle

$$UC = \frac{V_{Ed}}{V_{Rd}} = \frac{371 \text{ kN}}{431 \text{ kN}} = 0.862$$

## Controleer torsie en bereken torsieweerstand

Totale oppervlakte van doorsnede

$$A_c = 640000 \text{ mm}^2$$

Totale oppervlakte van doorsnede

$$u_c = 3200 \text{ mm}$$

De oppervlakte van langswapening voor torsie

$$A_{sl} = 1433 \text{ mm}^2$$

De minimum afstand tussen wapeningsstaven binnen beugel voor torsie en rand van doorsnede

$$a_{sl} = 83 \text{ mm}$$

Effectieve wanddikte

$$t_{ef} = \max\left(\frac{A_c}{u_c}; 2 \cdot a_{sl}\right) = \max\left(\frac{640000}{3200}; 2 \cdot 83\right) = 200 \text{ mm} \quad (\S 6.3.2(1))$$

Omtrek en oppervlakte van de zone binnen de centrale lijn van de effectieve doorsnede

$$u_k = 2071 \text{ mm}$$

$$A_k = 261300 \text{ mm}^2$$

Opm.: Torsieparameters [waardes van  $A_k$  en  $u_k$ ] zijn berekend volgens de automatisch ingestelde methode [Methode = Van torsiebeugel].





## Parameters voor afschuif/torsie wapening

Beugels over de lengte van scheurafschuifprojectie  $\delta = z \cdot \cot(\theta) = 772 \text{ mm}$ , interval (-386; 386)

$$z = \text{Coeff}_d \cdot \text{Coeff}_z \cdot h = 0.9 \cdot 0.9 \cdot 0.8 = 648 \text{ mm} \quad \delta = z \cdot \cotg(\theta) = 0.648 \cdot \cotg(40) = 772 \text{ mm}$$

ID	Zone	$x_s$ [mm]	$\phi_s$ [mm]	$s_s$ [mm]	$n_s$ []	$\alpha_s$ [°]	$f_{ywk}$ [MPa]
1	1	-345	12	230	2	90	500
2	1	-115	12	230	2	90	500
3	1	115	12	230	2	90	500
4	1	345	12	230	2	90	500
Avg.	-	-	12	230	2	90	500

## Invoerparameters

Diameter  $\phi_{st} = 12 \text{ mm}$

Hoek van beugels van staafas  $\alpha_{st} = 90^\circ$

Karakteristieke vloeigrens  $f_{ywk} = 500 \text{ MPa}$

Doorsnedeoppervlakte van dwarswapening

$$A_{swt} = \pi \cdot \left(\frac{\phi_{st}}{2}\right)^2 = 3.14 \cdot \left(\frac{12}{2}\right)^2 = 113 \text{ mm}^2$$

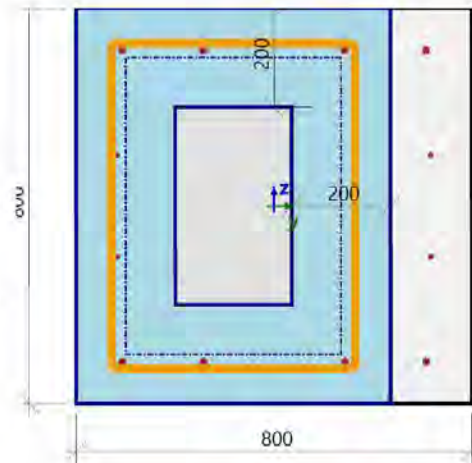
Maximale longitudinale tussenafstand van beugelwapening  $s_{lt} = 230 \text{ mm}$

Doorsnedeoppervlakte van dwarskrachtwapening per meter

$$A_{swtm} = \frac{A_{swt}}{s_{lt}} = \frac{113}{230} = 492 \text{ mm}^2/\text{m}$$

Ontwerpvloeispanning van dwarswapening

$$f_{ywd} = \frac{f_{ywk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa}$$



## Berekening van torsie weerstanden

### Ontwerp torsie scheurmoment

$$T_{Rdt} = 2 \cdot f_{ctd} \cdot t_{ef} \cdot A_k = 2 \cdot 1.47 \cdot 200 \cdot 261300 = 153 \text{ kNm}$$

### Ontwerp weerstandbiedend torsiemoment van torsiewapening

$$T_{Rds} = 2 \cdot A_k \cdot \frac{A_{swt}}{s_{lt}} \cdot f_{ywd} \cdot \cotg(\theta) = 2 \cdot 261300 \cdot \frac{113}{230} \cdot 435 \cdot \cotg(40) = 133 \text{ kNm}$$

## Maximaal ontwerptorsieweerstandsmoment

Sterkereductiefactor voor beton gescheurd in afschuiving – waarde v

$$v = 0.6 \cdot \left(1 - \frac{f_{ck}}{250}\right) = 0.6 \cdot \left(1 - \frac{35}{250}\right) = 0.516 \quad (6.6N)$$

$$v_1 = 0.6 \quad (6.10.aN)$$

Coëfficiënt voor de bepaling van de spanning in de drukdiagonaal

$$\alpha_{cw} = 1 \quad (\text{voor niet-voorgespannen element}) \quad (6.2.3(3)N3)$$

Maximaal ontwerptorsieweerstandsmoment

$$T_{Rdmax} = 2 \cdot v \cdot \alpha_{cw} \cdot f_{ctd} \cdot A_k \cdot t_{ef} \cdot \cos(\theta) \cdot \sin(\theta) \\ = 2 \cdot 0.516 \cdot 1 \cdot 23.3 \cdot 261300 \cdot 200 \cdot \cos(40) \cdot \sin(40) = 620 \text{ kNm}$$



Torsie weerstandsmoment van de staaf

$$T_{Rd} = \min(T_{Rdc}; T_{Rdmax}) = 153 \text{ kNm}$$

Additionele torsiële kracht

Ontwerp additionele spanning

$$\sigma_{sdl} = \frac{\text{abs}(T_{Ed}) \cdot u_k \cdot \cotg(\theta)}{2 \cdot A_k \cdot A_{sl}} = \frac{\text{abs}(-3.85) \cdot 2071 \cdot \cotg(40)}{2 \cdot 261300 \cdot 1433} = 12.7 \text{ MPa} \quad (6.28)$$

Ontwerp vloeigrens

$$f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1.15} = 435 \text{ MPa}$$

Ontwerp additionele trekkrachten

$$F_{sdl} = \sigma_{sdl} \cdot A_{sl} = 12.7 \cdot 1433 = 18.2 \text{ kN}$$

Maximale ontwerpkracht

$$F_{sdmax} = f_{yd} \cdot A_{sl} = 435 \cdot 1433 = 623 \text{ kN}$$

## Torsie controle

Controle  $T_{Rdmax}$

$$T_{Ed} = 3.85 \text{ kNm} \leq T_{Rdmax} = 620 \text{ kNm}$$

Opm.: De controle voldoet voor het bezwijken van de drukschoor ( $T_{Ed} < T_{Rd,max}$ ).

Controle  $T_{Rdc}$  en  $T_{Rds}$

$$T_{Ed} = -3.85 \text{ kNm} < T_{Rdc} = 153 \text{ kNm} \text{ and } T_{Ed} = 3.85 \text{ kNm} < T_{Rds} = 133 \text{ kNm}$$

Opm.: De controle voldoet, torsiemoment kan opgenomen worden door het beton ( $T_{Ed} \leq T_{Rdc}$ ), dwarswapening is niet nodig. Het is niet nodig om de torsië weerstand van de ingevoerde afschuifwapening ( $T_{Rds}$ ) te controleren. Daarom wordt de torsië weerstand berekend maar niet gecontroleerd.

Controleer  $F_{sdmax}$

$$F_{sd} = 18.2 \text{ kN} \leq F_{sdmax} = 623 \text{ kN}$$

Opm.: De controle van additionele trekkracht in langswapening is geslaagd.

## Eenh. Controle

$$UC = \max\left(\frac{\text{abs}(T_{Ed})}{T_{Rd}}, \frac{F_{sd}}{F_{sdmax}}\right) = \max\left(\frac{\text{abs}(-3.85 \text{ kNm})}{153 \text{ kNm}}, \frac{18.2 \text{ kN}}{623 \text{ kN}}\right) = 0.0292$$

## Interactie controle $V_y + V_z + T$

Interactiecontrole  $V_y + V_z + T$  (beton)

Controleer vergelijking  $(T_{Ed}/T_{Rdmax}) + (V_{Ed}/V_{Rdmax})$

$$\left(\frac{\text{abs}(T_{Ed})}{T_{Rdmax}}\right) + \left(\frac{\text{abs}(V_{Ed})}{V_{Rdmax}}\right) = \left(\frac{\text{abs}(-3.85)}{620}\right) + \left(\frac{\text{abs}(371)}{2534}\right) = 0.153 \leq 1 \quad (6.29)$$

Opm.: Interactie controle  $V_y + V_z + T$  for het bezwijken van de drukschoor voldoet.



Controleer vergelijking  $(T_{Ed}/T_{Rdc}) + (V_{Ed}/V_{Rdc})$

$$\left( \frac{\text{abs}(T_{Ed})}{T_{Rdc}} \right) + \left( \frac{\text{abs}(V_{Ed})}{V_{Rdc}} \right) = \left( \frac{\text{abs}(-3.85)}{153} \right) + \left( \frac{\text{abs}(371)}{206} \right) = 1.83 > 1 \text{ and } A_{sw} > 0 \quad (6.31)$$

Opm.: Afschuifkrachten en het torsiemoment kunnen niet worden gedragen door het beton, dwarswapening is benodigd.

Eenh. Controle

$$UC_{int,con} = 0.153$$

### Interactiecontrole $V_y + V_z + T$ (dwarswapening)

Ontwerpspanning

$$\sigma_{swd} = \left( \frac{\text{abs}(T_{Ed})}{2 \cdot A_k} + \frac{V_{Ed}}{n_s \cdot z} \right) \cdot \left( \frac{s_{lt}}{A_{swt} \cdot \cotg(\theta)} \right) = \left( \frac{\text{abs}(-3.85)}{2 \cdot 261300} + \frac{371}{4 \cdot 460} \right) \cdot \left( \frac{230}{113 \cdot \cotg(40)} \right) = 357 \text{ MPa}$$

Ontwerp vloeigrens

$$f_{ywd} = 0.8 \cdot f_{ywk} = 0.8 \cdot 500 = 400 \text{ MPa}, \text{ (omdat } \sigma_{swd} < 0.8 \cdot f_{ywk})$$

Opm.: Ontwerp vloeigrens van de dwarswapening is gereduceerd naar  $0.8 \times f_{ywk}$  (EN 1992-1-1, Artikel 6.2.3(3)) omdat de ontwerpspanning van de dwarswapening is onder 80% van de karakteristieke vloeispanning  $f_{yk}$ .

$$\sigma_{swd} = 357 \text{ MPa} < f_{ywd} = 400 \text{ MPa}$$

Opm.: Interactie controle  $V_y + V_z + T$  voor afschuifwapening voldoet.

Eenh. Controle

$$UC_{int,shear} = \frac{\sigma_{swd}}{f_{ywd}} = \frac{357}{400} = 0.893$$

### Totale eenheidscontrole van de interactie

$$UC_{int} = \max(UC_{int,con}; UC_{int,shear}) = \max(0.153; 0.893) = 0.893$$

### Totale waarde van eenheidscontrole

$$UC = \max(UC_{shear}; UC_{tor}; UC_{int,con}; UC_{int,shear}) = \max(0.862; 0.0292; 0.153; 0.893) = 0.893$$

### 2.1.8. Controle limietspanning

Niet-lineaire berekening

Klasse: RK\_NC\_BGT-kar

Assenstelsel: Staaf

Extreme 1D: Doorsnede

Selectie: Alle

Filter: Doorsnede = BT-12 - Rechthoek (800; 800)

**Balk S37**

NEN EN 1992-1-1+C2/NB+A1:2020

**Rechthoek (800; 800)**

Doorsnede 6 [dx = 1.15 m]



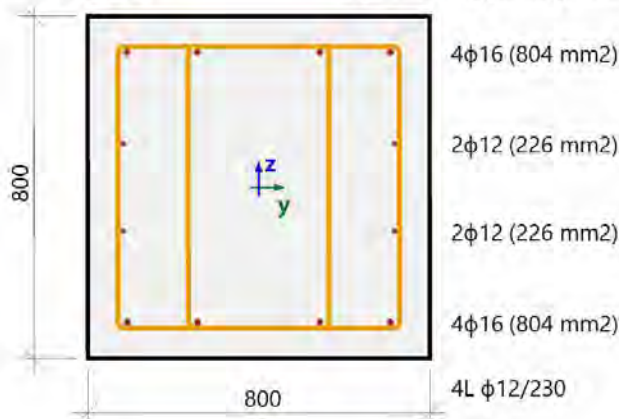
## Staaflengte:

"Knik  $y-y$   
Knik  $z-z$

$L = 2.3$  m

$L_y = 11.5$  m (zijdelings flexibel)

$L_z = 2.3$  m (zijdelings flexibel)



## Beton: C35/45

Bilineair spanning-rekdiagram

Milieuklasse:

Boven: XC4, XD3, XF2, XA2

Onder: XC2, XD3, XF2, XA2

## Langswapening: B 500B

Bilineair met oplopende bovenvertakking

$4\phi 12 + 8\phi 16$  ( $2061 \text{ mm}^2$ )

$\rho_l = 0.322$  % ( $16.2 \text{ kg/m}$ )

## Dwarskrachtwapening: B 500B

Bilineair met oplopende bovenvertakking

$4L \phi 12/230$  ( $452 \text{ mm}^2$ )

$\rho_w = 0.246$  % ( $15.4 \text{ kg/m}$ )

## Dekking (beugel)

Bovenzijde: 65 mm

Onderzijde: 65 mm

Links: 65 mm

Rechts: 65 mm

## Materiaalkarakteristieken

Karakteristieke betondruksterkte Karakteristieke vloeisterkte van de langswapening

$$f_{ck} = 35 \text{ MPa}$$

$$f_{yk} = 500 \text{ MPa}$$

Gemiddelde betontreksterkte

$$f_{ctm} = 3.2 \text{ MPa}$$

Elasticiteitsmodulus van beton:

$$E_c = 34 \text{ GPa}$$

## Krachten

Van EEM analyse

Karakteristieke waarden:

NC\_BGT-kar.5

$$N = -30.9 \text{ kN} \quad M_y = 258 \text{ kNm} \quad M_z = -1.96 \text{ kNm}$$

Quasi-permanente waarden:

NC\_BGT-kar.5

$$N_{qp} = -30.9 \text{ kN} \quad M_{y,qp} = 258 \text{ kNm} \quad M_{z,qp} = -1.96 \text{ kNm}$$

Hoek van resultante van buigmoment:  $\alpha_M = 90.4^\circ$



## Drukstaaf

Beperk normaalkracht om rekening te houden met drukstaven:

$$N_{com} = - \text{Coeff}_{com} \cdot (f_{cd} \cdot A_c) = -0,1 \cdot (23,3 \cdot 10^6 \cdot 0,64) = -1493 \text{ kN}$$

Controleer conditie:

$$N_{Ed} \geq N_{com} = -31 \text{ kN} \geq -1493 \text{ kN} \dots \text{ geen drukstaaf}$$

Opm.: Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).

Karakteristieke waarden:  $N_{char,r} = -30,9 \text{ kN}$   $M_{y,char,r} = 258 \text{ kNm}$   $M_{z,char,r} = 0 \text{ kNm}$

Quasi-permanente waarden:  $N_{qp,r} = -30,9 \text{ kN}$   $M_{y,qp,r} = 258 \text{ kNm}$   $M_{z,qp,r} = 0 \text{ kNm}$

Hoek van resultante van buigmoment:  $\alpha_{M,r} = 90^\circ$

## Overzicht van controle

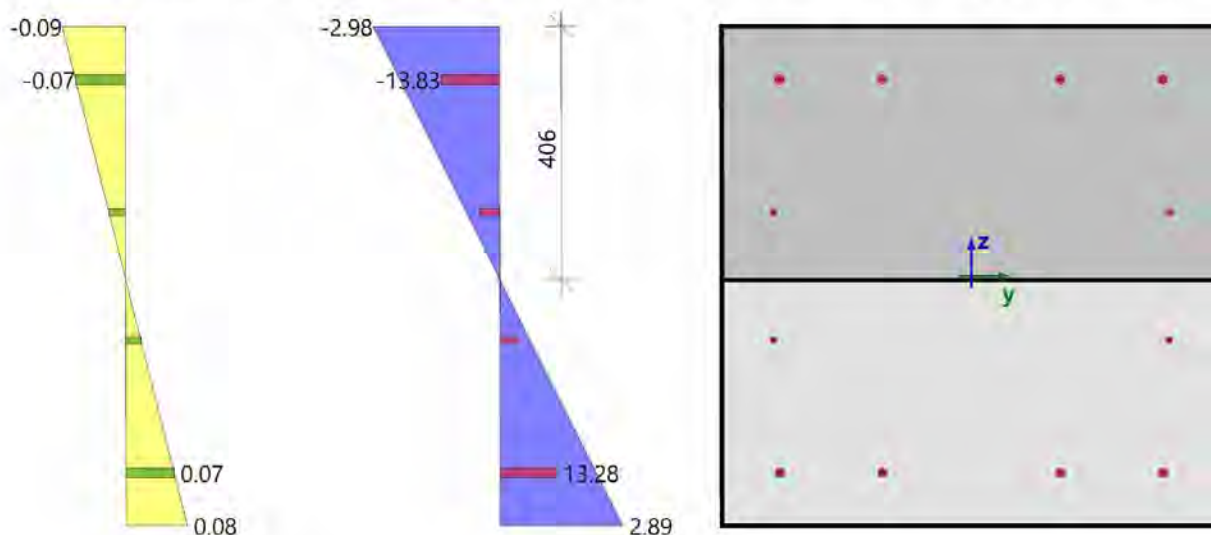
Belasting	E	$E_c$	UC	Status	UC	Status	UC	Status	UC	Grenswaarde	Status
type	[MPa]		$\$7.2(2)$	$\$7.2(2)$	$\$7.2(3)$	$\$7.2(3)$	$\$7.2(5)$	$\$7.2(5)$	[-]	[-]	
			[-]	Kar.	[-]	Q.-P.	[-]	Kar.			
Kort	$E_c$	34100	0.14	OK	0.19	OK	0.03	OK	0.19	1	OK

Lijst van fouten/waarschuwingen/opmerkingen: N2/1.

## Controle van scheuren in doorsnede

Belasting	Type	$E_c$	Combi.	$N_{Ed}$	$M_{Edy}$	$M_{Edz}$	$\sigma_{ct}$	h	$f_{ct,eff}$	Scheur-
	module	[MPa]		[kN]	[kNm]	[kNm]	[MPa]	[mm]	[MPa]	vorming.
Kort	$E_c$	34100	Kar.	-30.9	258	0	2.89	800	3.2	NEE

## Spanning-rekverdeling voor scheurvorming (ongescheurde toestand) - kortetermijnbelasting

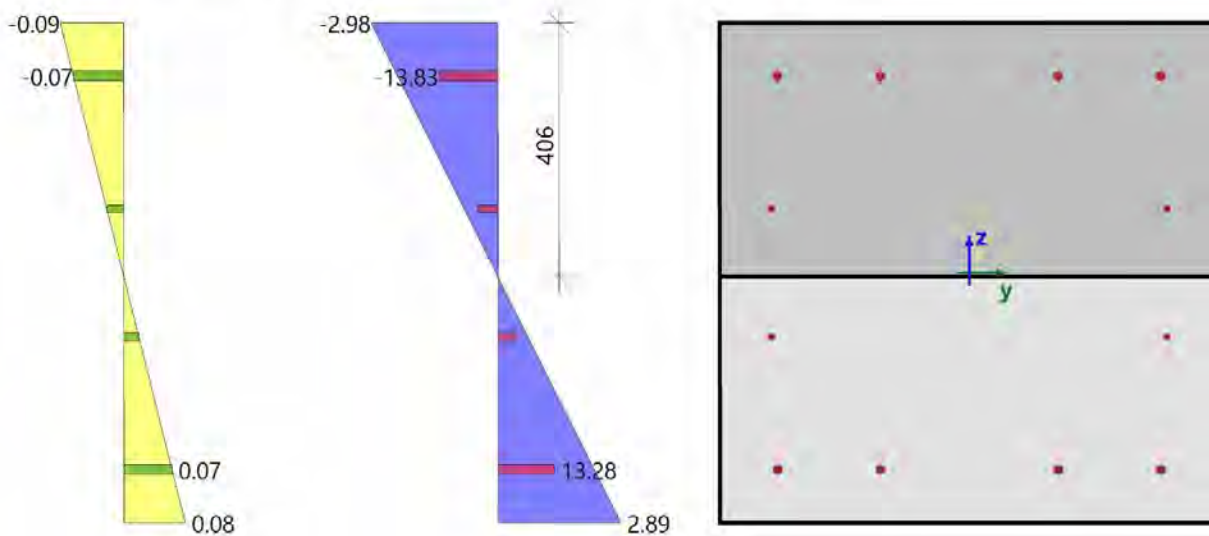




## Doorsnedekarakteristieken

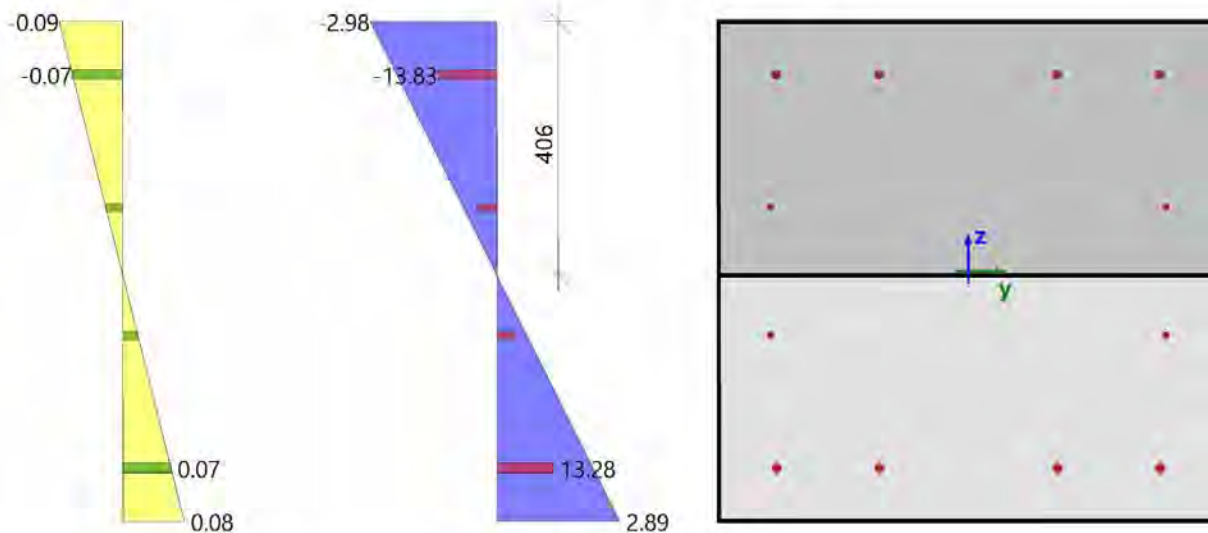
Belasting	Combi.	$t_{iy}$ [m]	$t_{iz}$ [m]	$A_i$ [m <sup>2</sup> ]	$I_{iy}$ [m <sup>4</sup> ]	$I_{iz}$ [m <sup>4</sup> ]	$x_i$ [m]	$\epsilon_{c,max}$ [‰]	$\epsilon_{c,min}$ [‰]	$\sigma_{c,max}$ [MPa]	$\sigma_{c,min}$ [MPa]
Kort	Kar.	0	0	0.652	0.0351	0.0349	0.406	0.085	-0.087	2.89	-2.98
Kort	Q.-P.	0	0	0.652	0.0351	0.0349	0.406	0.085	-0.087	2.89	-2.98

## Spanning-rekverdeling met betontreksterkte onder karakteristieke combinatie - kortetermijnbelasting





## Spanning-rekverdeling met betontreksterkte onder quasi-permanente combinatie - kortetermijnbelasting



### Spanningscontrole in beton

Controletype	Belasting	$N_{Ed}$ [kN]	$M_{Edy}$ [kNm]	$M_{Edz}$ [kNm]	$y_i$ [mm]	$z_i$ [mm]	$\sigma_c$ [MPa]	$\sigma_{c,lim}$ [MPa]	$\sigma_c/\sigma_{c,lim}$ [-]	Status
§7.2(2) Kar.	Kort	-30.9	258	0	0.4	0.4	-2.98	-21	0.142	OK
§7.2(3) Q.-P.	Kort	-30.9	258	0	0.4	0.4	-2.98	-15.8	0.189	OK

### Spanningscontrole in niet-voorgespannen wapening

Controletype	Belasting	$N_{Ed}$ [kN]	$M_{Edy}$ [kNm]	$M_{Edz}$ [kNm]	$y_i$ [mm]	$z_i$ [mm]	$\sigma_s$ [MPa]	$\sigma_{s,lim}$ [MPa]	$\sigma_s/\sigma_{s,lim}$ [-]	Status
§7.2(5) Kar.	Kort	-30.9	258	0	-0.31	-0.32	13.3	500	0.027	OK

### Verklaring van fouten, waarschuwingen en opmerkingen

Index	Type	Omschrijving	Oplossing
N2/1	Opm.	Het element moet niet worden beschouwd als een drukelement (normaalkracht is relatief klein of nul).	

### 2.1.9. Controle scheurwijdte (BGT)

Niet-lineaire berekening  
Klasse: RK\_NC\_BGT-kar  
Assenstelsel: Staaf  
Extreme 1D: Doorsnede  
Selectie: Alle  
Filter: Doorsnede = BT-12 - Rechthoek (800; 800)



<b>Balk S37</b>		<b>Rechthoek (800; 800)</b>
NEN EN 1992-1-1+C2/NB+A1:2020		Doorsnede 0 [dx = 0 m]
<b>Staaflengte:</b>	L = 2.3 m	<b>Beton: C35/45</b>
"Knik y-y <sup>⊥</sup>	L <sub>y</sub> = 11.5 m (zijdelings flexibel)	Bilineair spanning-rekdiagram
Knik z-z <sup>⊥</sup>	L <sub>z</sub> = 2.3 m (zijdelings flexibel)	Milieuklasse:
	4φ16 (804 mm <sup>2</sup> )	Boven: XC4, XD3, XF2, XA2
	2φ12 (226 mm <sup>2</sup> )	Onder: XC2, XD3, XF2, XA2
	2φ12 (226 mm <sup>2</sup> )	<b>Langswapening: B 500B</b>
	4φ16 (804 mm <sup>2</sup> )	Bilineair met oplopende bovenvertakking
	4L φ12/230	4φ12+8φ16 (2061 mm <sup>2</sup> )
		ρ <sub>l</sub> = 0.322 % (16.2 kg/m)
	<b>Dwarskrachtwapening: B 500B</b>	Bilineair met oplopende bovenvertakking
	4L φ12/230 (452 mm <sup>2</sup> )	
	ρ <sub>w</sub> = 0.246 % (15.4 kg/m)	
	<b>Dekking (beugel)</b>	
	Bovenzijde: 65 mm	
	Onderzijde: 65 mm	
	Links: 65 mm	
	Rechts: 65 mm	

## Materiaalkarakteristieken

Effectieve sterkte van beton:

$$f_{ct,eff} = f_{ctm} = 3.2 \text{ MPa}$$

Betonsterkte bij scheurvorming:

$$\sigma_{cr} = 3.2 \text{ MPa}$$

Elasticiteitsmodulus van beton:

$$E_c = E_{cm} = 34.1 \text{ GPa}$$

## Krachten

Karakteristieke waarden

NC\_BGT-kar.1

$$N_{char} = 10.4 \text{ kN} \quad M_{y,char} = 19.1 \text{ kNm} \quad M_{z,char} = 0 \text{ kNm}$$

Frequente waarden

NC\_BGT-kar.1

$$N_{freq} = 10.4 \text{ kN} \quad M_{y,freq} = 19.1 \text{ kNm} \quad M_{z,freq} = 0 \text{ kNm}$$

Hoek van de buigendmoment resultante

$$\alpha_M = 90^\circ$$

## Doorsnedekarakteristieken

Type	Doorsnede niet-gescheurd	CSS gescheurd
t <sub>iy</sub> [m]	0	0
t <sub>iz</sub> [m]	0	0.303
A <sub>i</sub> [m <sup>2</sup> ]	0.652	0.0785
I <sub>iy</sub> [m <sup>4</sup> ]	0.0351	9.53·10 <sup>-3</sup>
I <sub>iz</sub> [m <sup>4</sup> ]	0.0349	4.35·10 <sup>-3</sup>

## Berekening van scheurkrachten (ongescheurde sectie)

Maximale spanning in beton

$$\sigma_{ct} = 0.233 \text{ MPa}$$

Scheurkrachten

$$N_{cr} = 142 \text{ kN} \quad M_{cny} = 262 \text{ kNm} \quad M_{crz} = 0 \text{ kNm}$$

$$\sigma_{ct} = 0.233 \text{ MPa} < \sigma_{cr} = 3.2 \text{ MPa} \Rightarrow \text{Geen scheurvorming}$$

Opm.: De scheur is niet verschenen, omdat de maximale trekspanning is minder dan de scheursterkte.

Berekening scheurwijdte

$$w = 0 \text{ mm}$$





Project	4922005	Datum	08. 03. 2019
Omschrijving	Statische berekening	Constructie	Algemeen XYZ
Onderdeel	Piperack Compressorhuis naar Rack 108	Auteur	5.1.2.8 35/35

## Eenh. Controle

Berekening eenheidscontrole

$$UC = \frac{w}{w_{\max}} = \frac{0 \text{ mm}}{0.2 \text{ mm}} = 0$$

Controle scheurwijdte

$$w = 0 \text{ mm} = < w_{\max} = 0.2 \text{ mm}$$

Opm.: Controle scheurwijdte voldoet, omdat de scheur kleiner is dan de limietwaarde.