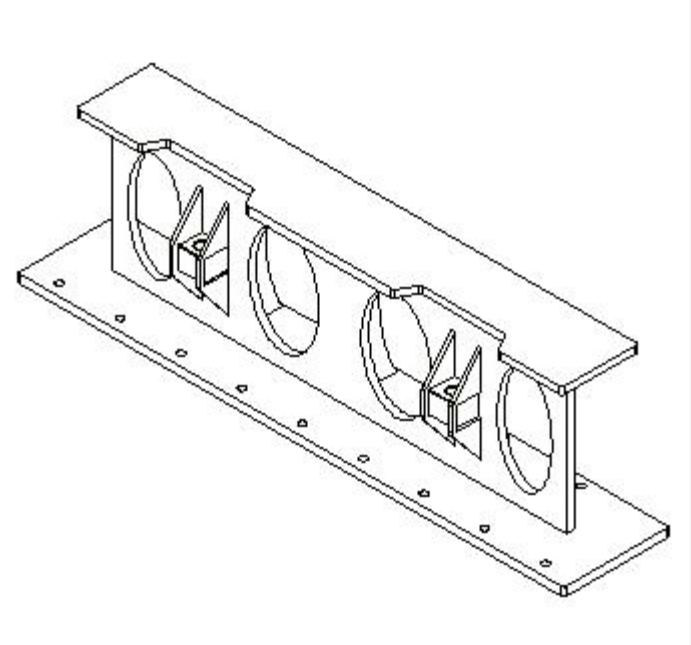
Project: ***HKM Crane***

Project number:

Customer: ***Nymo As***

Structural Calculations

HKM Crane



Rev.	Date	Description	Signature	Check. by	Appr. by
01	07.11.2012	For approval	GG	CS	CS

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1 INTRODUCTION

The objective of this document is to verify the structural capacity of the supporting beams of the given crane.

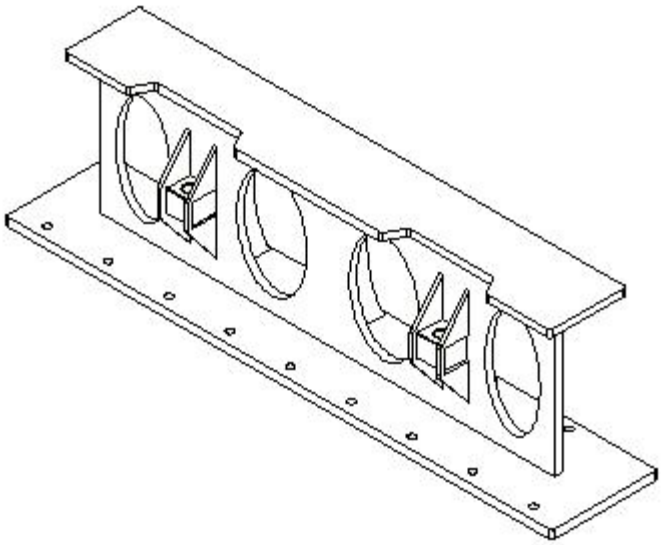


Figure 1: Supporting beam

2 SUMMARY

The analysis of the support structure was performed for the following conditions:

- Ultimate Limit State (ULS) for capacity check

Based on the overall evaluations of the analysis results, the supporter beams has met the design criteria and found to be acceptable. The utilization ratios are shown on the following table.

Utilization	
Member	Utilization
	%
Bolts	95
Brackets	81
Web	38
Bottom plate	93
Weldings	91
Anchor bolts	16

Table 1: Table of utilization

3 DESIGN BASIS

The general structural design requirement is that the structures should resist all relevant loads during the in-place without structural failure or permanent deformations (ULS).

A summary of the main design parameters are given in the following chapters:

3.1 Design Codes and Regulations

The structures of the topside structures will be designed in accordance with the following rules and standards:

/1/ Technical specification, crane TECHNICAL DATA HMF-2020K.PDF
/2/ EN 1993-1-1:2005, General rules and rules for buildings
/3/ EN 1993-1-8:2005, Design of Joints
/4/ Maskinforeskriften
/5/ STAAD.Pro 2006, Technical Reference.

3.2 Structural Steel Class

The structural steel is S355J0.

3.3 Analysis Tools

The analysis tool and methodology used for the design work can be summarized as follows:

- The FE-analysis program Staad V8i has been used for the structural analysis
- MathCAD has been used for local hand calculations

3.4 System of Units

The System International (SI) is used for all structural design.

- Length: meters (m)
- Force: kilo Newton (kN)
- Mass: kilogram (kg)
- Acceleration: m/s^2 ($g = 9.81\ m/s^2$)
- Density: kg/m^3
- Stresses: MPa (N/mm^2)
- Time: s (seconds)
- Temperature: degrees Celsius
- Energy/Work: J (Joule) = Nm
- Pressure: 1 bar ($= 0.1\ N/mm^2 = 100\ kN/m^2$)

3.5 Code Checking Standards

Member check has been calculated in MathCad. The reference /2/, /3/, /4/ and /5/ have been used for local checks.

3.6 Coordinate system

A local coordinate system is chosen for the computer model and is shown in the figure below.

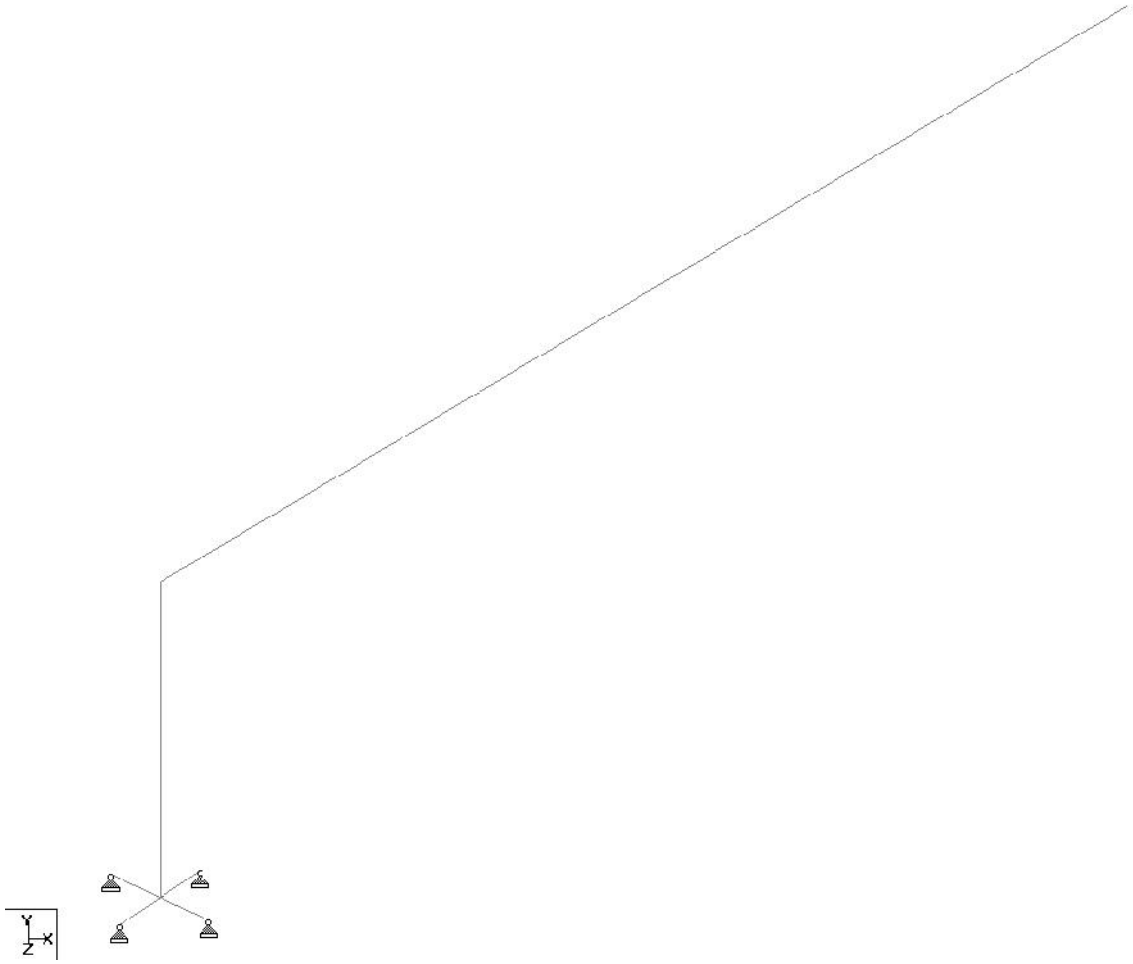


Figure 2: Global Coordinate System

3.7 Limit states

The structural performance can be described with reference to a specified set of limit states; beyond the structure no longer satisfies the design requirements.

ULS: Limit states that generally correspond to the resistance to maximum applied actions. Action factors and action combinations including ULS are given in section 5.2 Action combinations. Acceptance criteria for ULS are further detailed in ref. /2/ and /3/.

3.8 Physical properties

3.8.1 Material properties

The following material properties for structural steel apply:

- General
- Young's Modulus:
- Young's Modulus: $E = 2.0 \times 10^5$ MPa
- Shear Module: $G = 0.8 \times 10^5$ MPa
- Density: $\rho = 8.2 \times 10^3$ kg /m^3
- Poisson's Ratio: $\nu = 0.3$
- Thermal expansion coefficient: $\alpha = 0.92 \times 10^{-5}$ 1/ ^{o}C

- Plates and sections:
- Yield stress t≤16 mm: $f_y = 170$ MPa
- Ultimate stress t≤100mm: $f_u = 485$ MPa

Hot finished tubulars:
- Yield stress t ≤16mm: $f_y = 275$ MPa
- Ultimate stress t≤100mm: $f_u = 430$ MPa

- Bolts:
- Bolt Class: 8.8
- Yield stress: $f_y = 640$ MPa
- Ultimate stress: $f_u = 800$ MPa

3.8.2 Material factors

The following material factors are applied in the design.

- Material factor for ultimate limit state (ULS): **1.00**
- Material factor for resistance of bolt holes, welded and bolted connections: **1.25**

4 STRUCTURAL COMPUTER MODEL

4.1 Modelling

Throughout the analysis the latest possible information has been incorporated. For circumstances where information has not been available or finalized, the applied data have been based on the best possible estimates.

4.2 Geometry

The geometry and section properties are based on the drawings listed in Appendix 4 of this document.

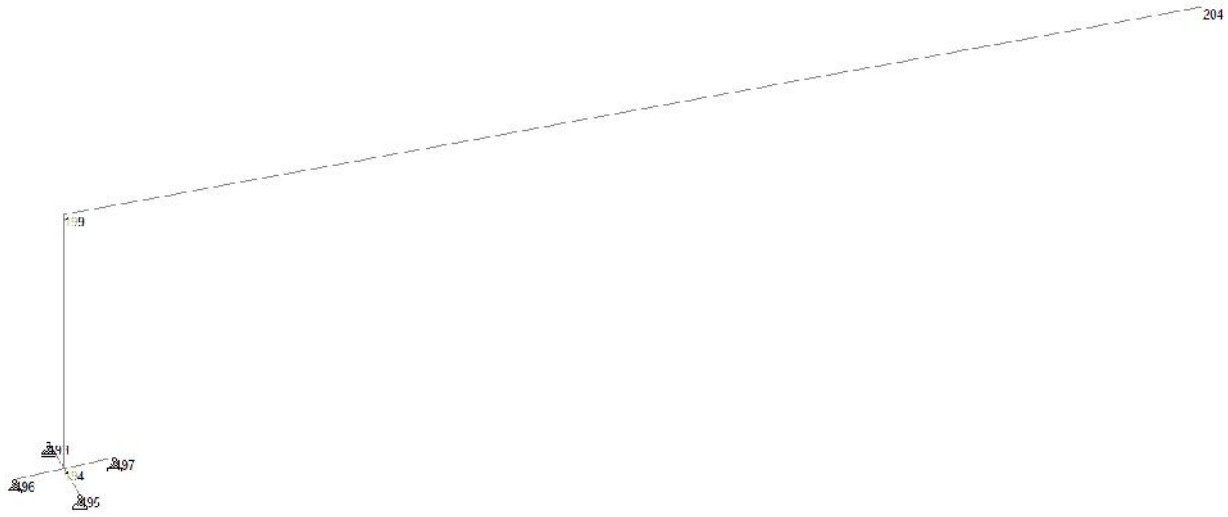


Figure 3: Joint No. for support structure

4.3 Boundary Conditions

The boundary conditions for the structures are shown below.

Support Conditions						
Node	X	Y	Z	rX	rY	rZ
	(kN/mm)	(kN/mm)	(kN/mm)	(kN-m/deg)	(kN-m/deg)	(kN-m/deg)
193	Fixed	Fixed	Fixed	Free	Free	Free
195	Fixed	Fixed	Fixed	Free	Free	Free
196	Fixed	Fixed	Fixed	Free	Free	Free
197	Fixed	Fixed	Fixed	Free	Free	Free

Table 2: Boundary conditions

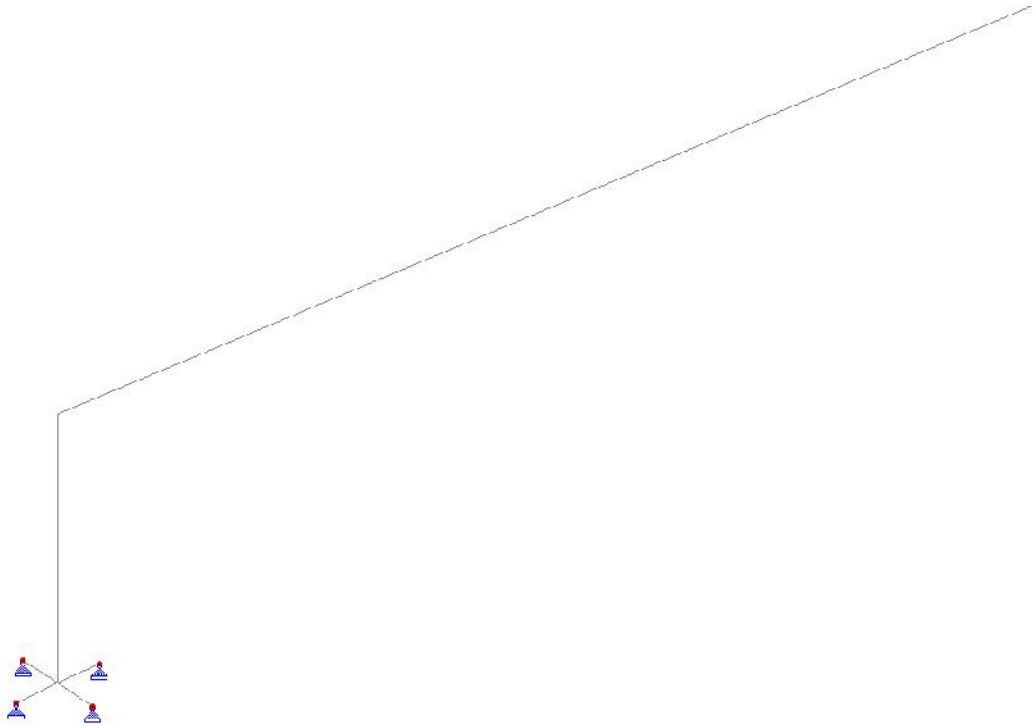


Figure 4 Support conditions

4.4 Sections

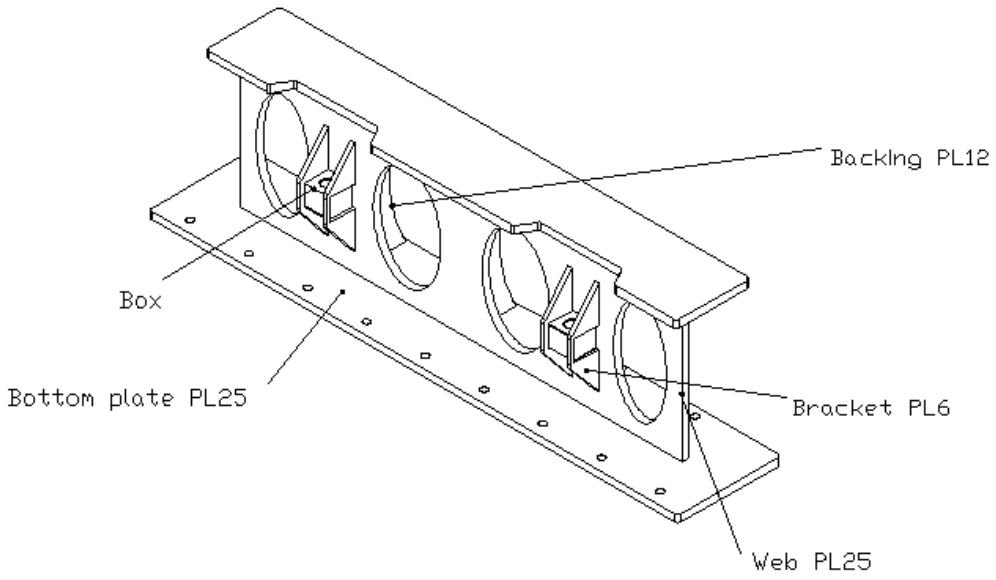


Figure 5 Section of the support beam

5 LOADS AND LOAD COMBINATION

5.1 Load factors

Safety factors applied working procedure. Load factors have been defined according Regulativ /4/ "Maskinforeskriften".

- Load factor: $\gamma_f = 2.0$

Load factors for Limit States

Ultimate Limit State:

$\gamma_{ULS} = \gamma_d * \gamma_f$ $\gamma_{ULS} = 2.0$

5.2 Basic Loads

The Basic Load Cases (BLC) were applied for the structural analysis as following:

Number	Name	Total Reactions (kN)		
		X	Y	Z
100	SELFWEIGHT OF LOADER -Y	0	44.375	0
101	WEIGHT OF EQUIPEMTS		13.847	
200	LIFTING CAPACITY		Various according to distance	

Table 3 Basic load case

5.2.1 Permanent loads (BLC 1)

Weight of the structure is based on the technical data, had received from client.

5.2.2 Live load

Lifting capacities with 10% transverse forces have been applied at the necessary positions.

5.2.3 Wind load

The wind loading has not been considered.

5.3 Load combinations

The basic load combination factors are described in the subchapters below. A complete listing of Basic load cases and load combination table is included in Supplement 1.In the following tables, the load combinations are shown as the input in Staad model.

Comb.	Combination L/C Name	Primary	Primary L/C Name	Factor
1	LIFTING_COMB	200	LIFT -Y	2.00

Table 4 Load combinations

5.3.1 Accidental Limit State – ALS

No ALS condition

6 RESULTS OF ANALYSIS

6.1 General

This chapter presents the results of the global analysis for the crane.

The stability code check for each member is performed according to Eurocode. Combined member utilization factors with respect to yielding and stability are presented.

6.2 Ultimate Limit State – ULS

The results from the analysis are presented in this sub-chapter.

6.2.1 Reaction forces

Staad signs convention of forces, have been used in the table below. Note that FX, FY, FZ, MX, MY and MZ refer to global coordinate system.

			Horizontal	Vertical	Horizontal	Moment		
	Node	L/C	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
Max Fx	64	1 LIFTING_COMB	10.599	-377.888	8.420	0	0	0
Min Fx	89	1 LIFTING_COMB	-15.612	485.959	-1.967	0	0	0
Max Fy	197	1 LIFTING_COMB	-10.156	553.452	-8.986	0	0	0
Min Fy	196	1 LIFTING_COMB	10.012	-518.063	9.070	0	0	0
Max Fz	88	1 LIFTING_COMB	3.658	-399.561	15.283	0	0	0
Min Fz	4	1 LIFTING_COMB	3.665	509.783	-15.278	0	0	0

Table 5 Reaction forces for Support structure – ULS

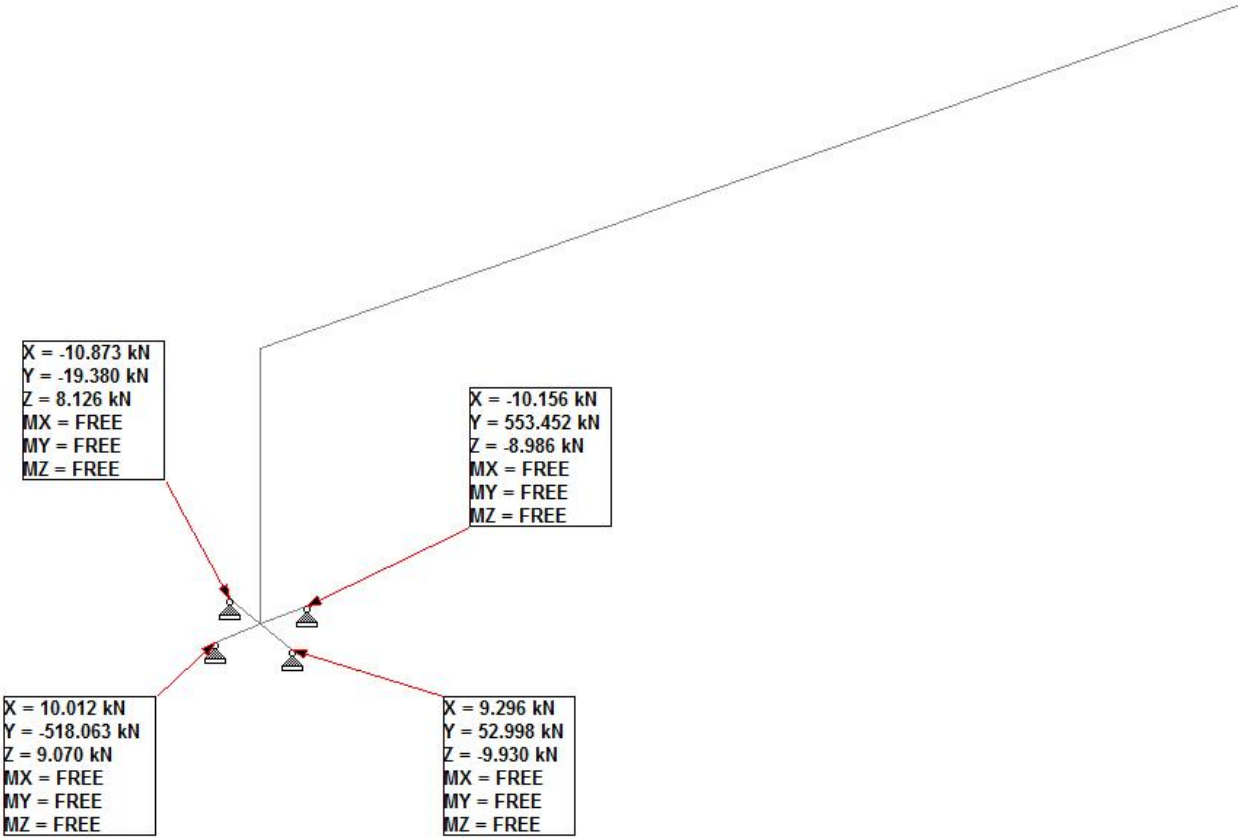


Figure 6: Reactions for Crane

6.2.2 Accidental Limit States

No Accidental load on structure.

APPENDIX 1

STAAD ANALYSES

Job Information

	Engineer	Checked	Approved
Name:	GG	CHS	CHS
Date:	07-Nov-12		

Structure Type	SPACE FRAME

Number of Nodes	126	Highest Node	216
Number of Elements	108	Highest Beam	123

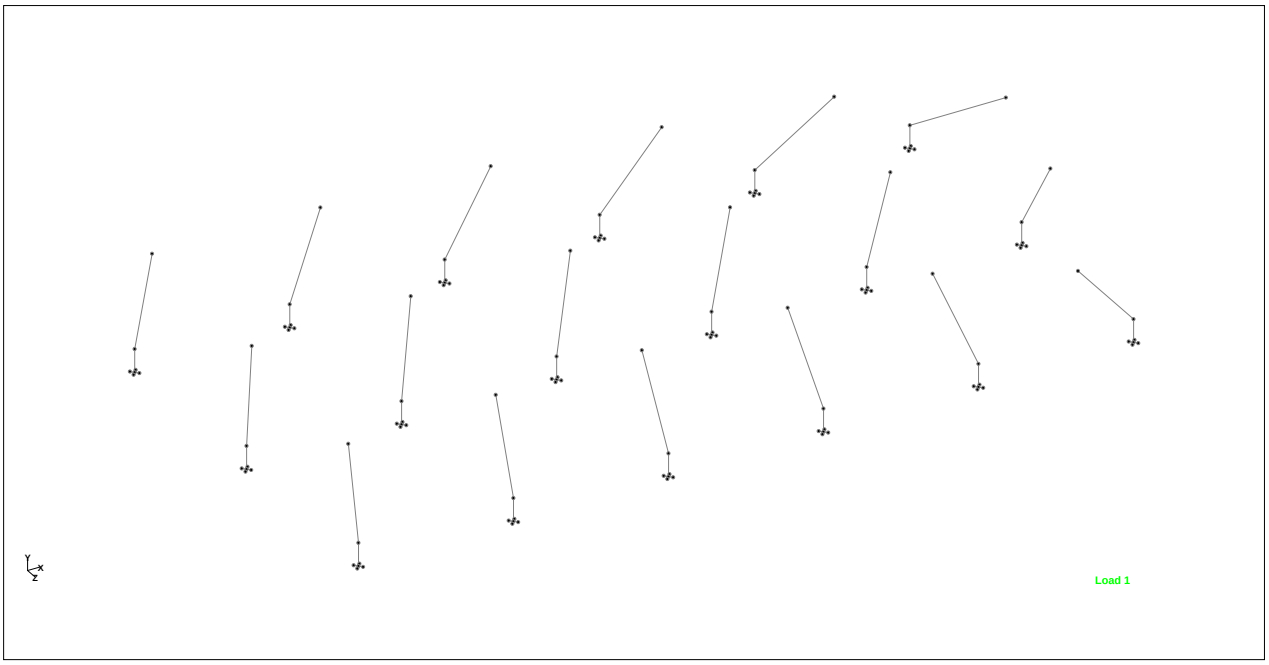
Number of Basic Load Cases	3
Number of Combination Load Cases	1

Included in this printout are data for:

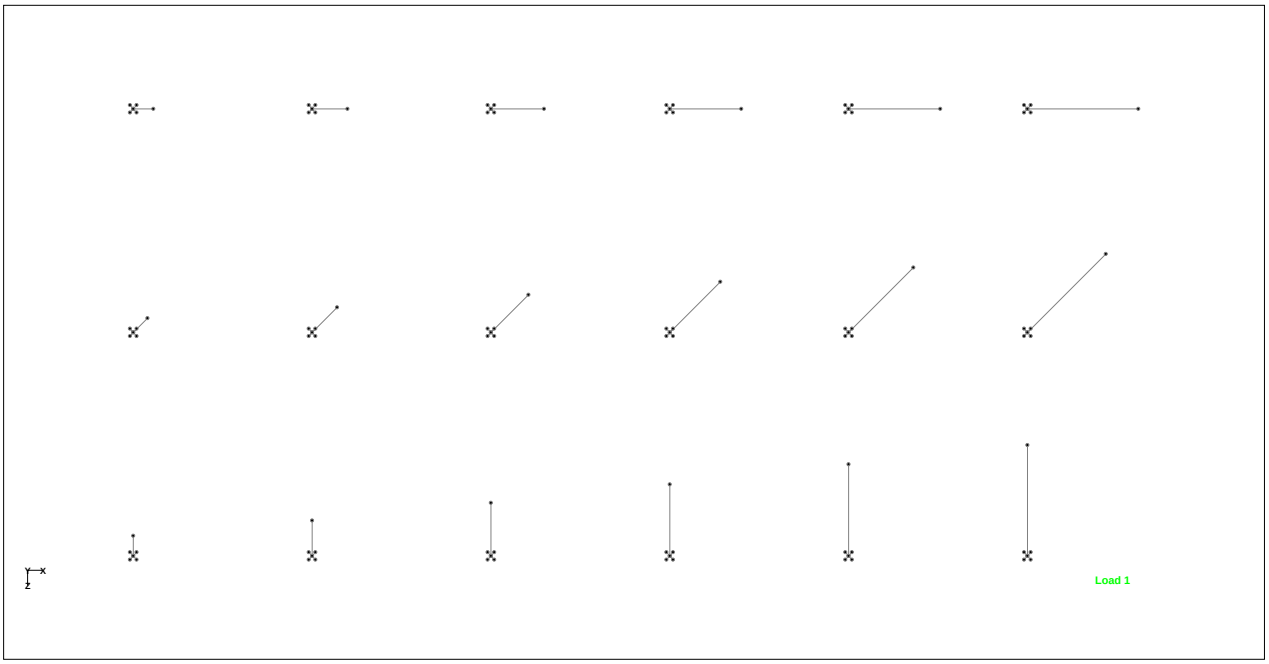
All	The Whole Structure

Included in this printout are results for load cases:

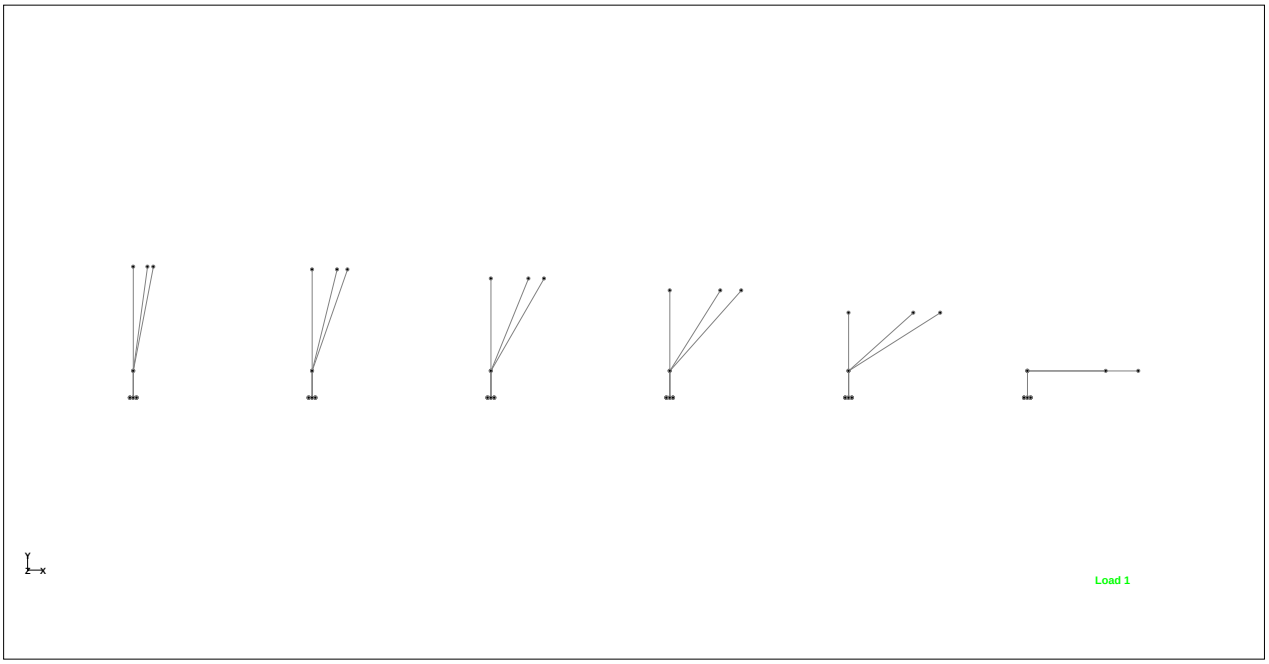
Type	L/C	Name
Combination	1	LIFTING_COMB
Primary	100	LOADER
Primary	101	EQUIPMENTS
Primary	200	LIFT



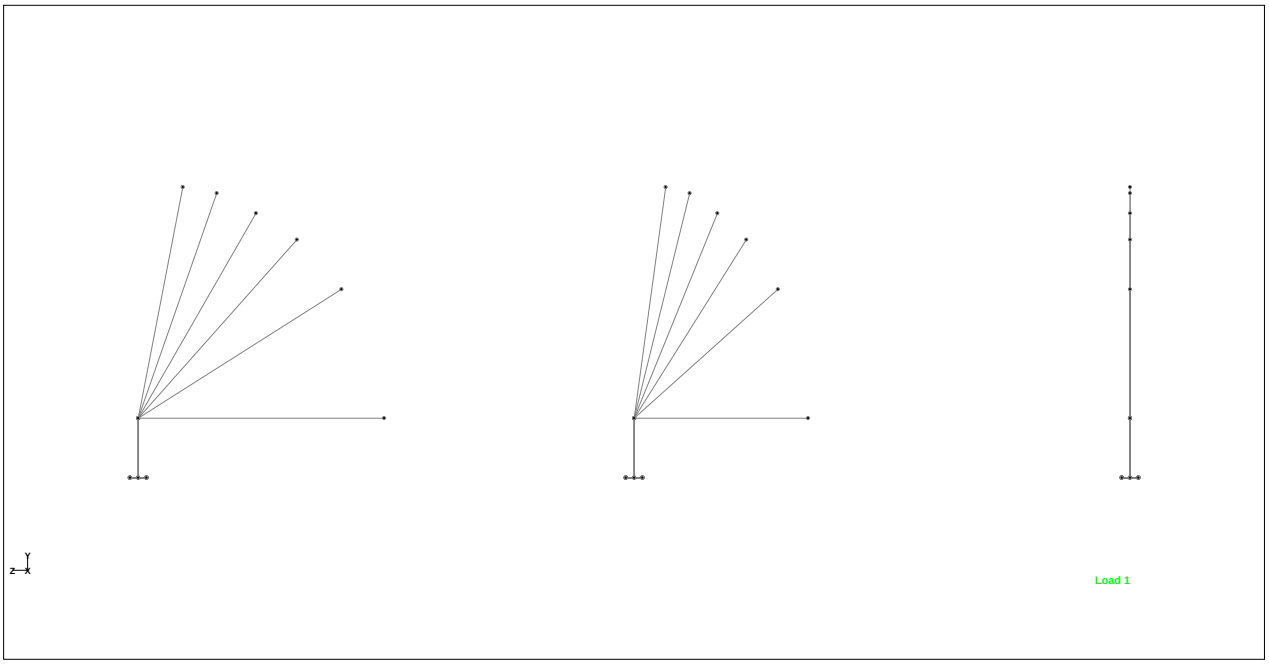
Whole Structure_3D



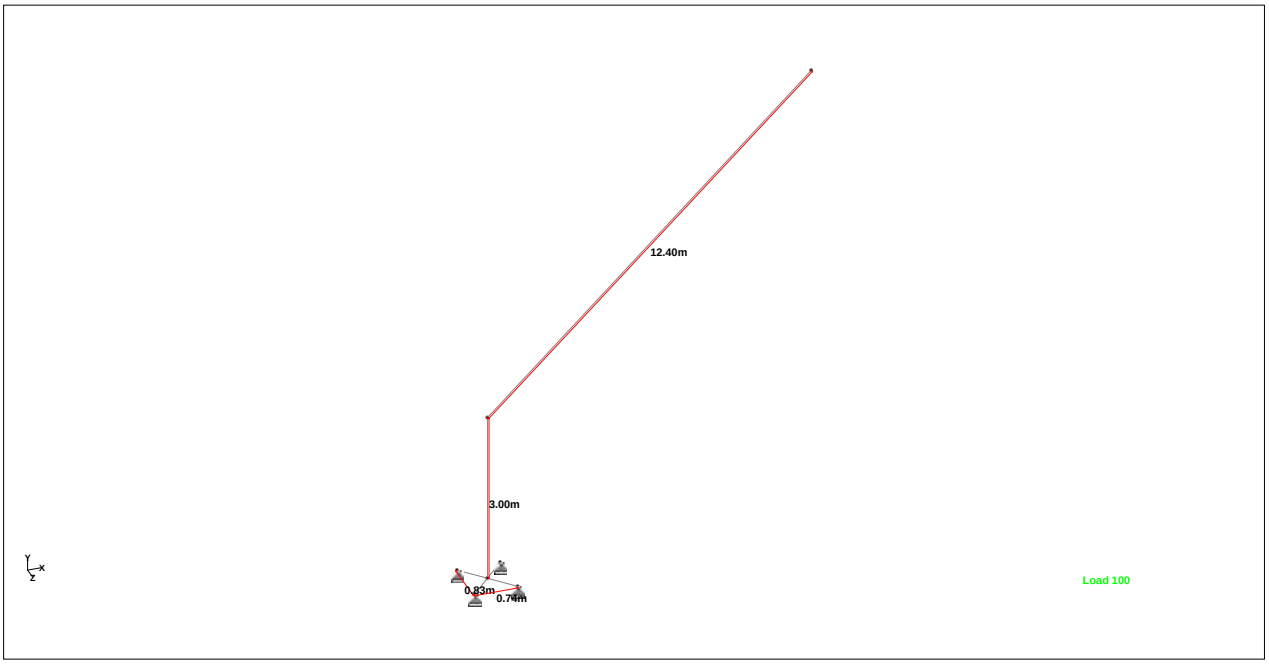
Whole Structure_TOP



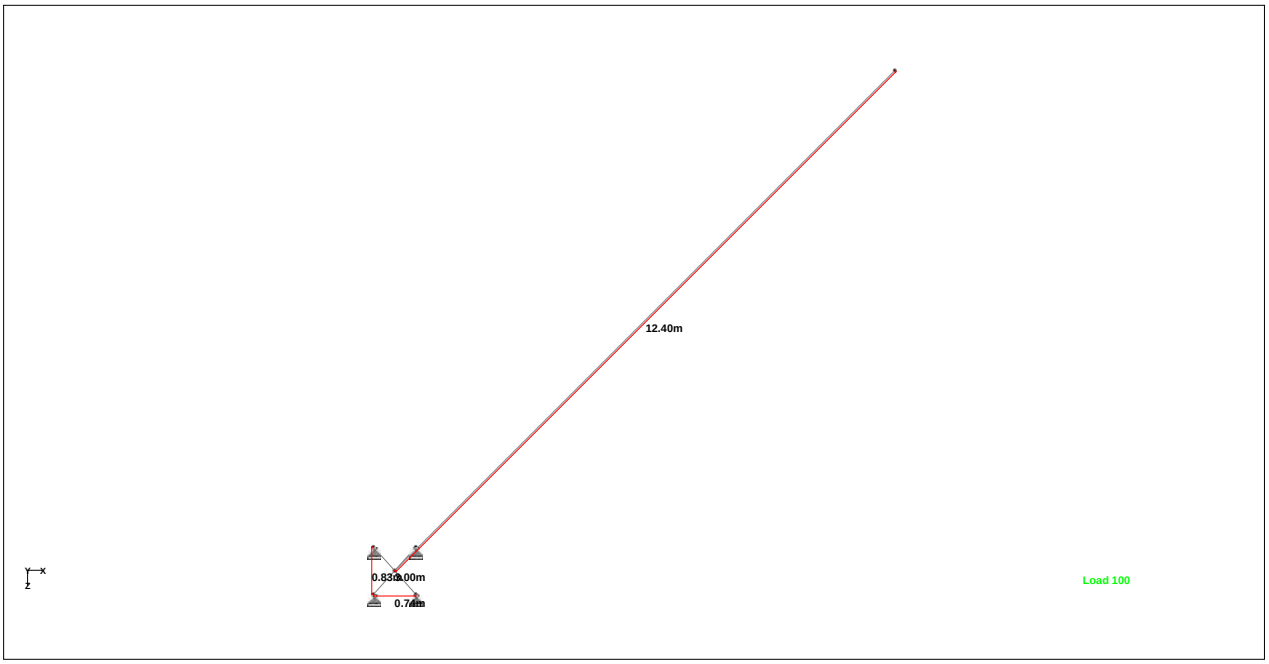
Whole Structure_1.3



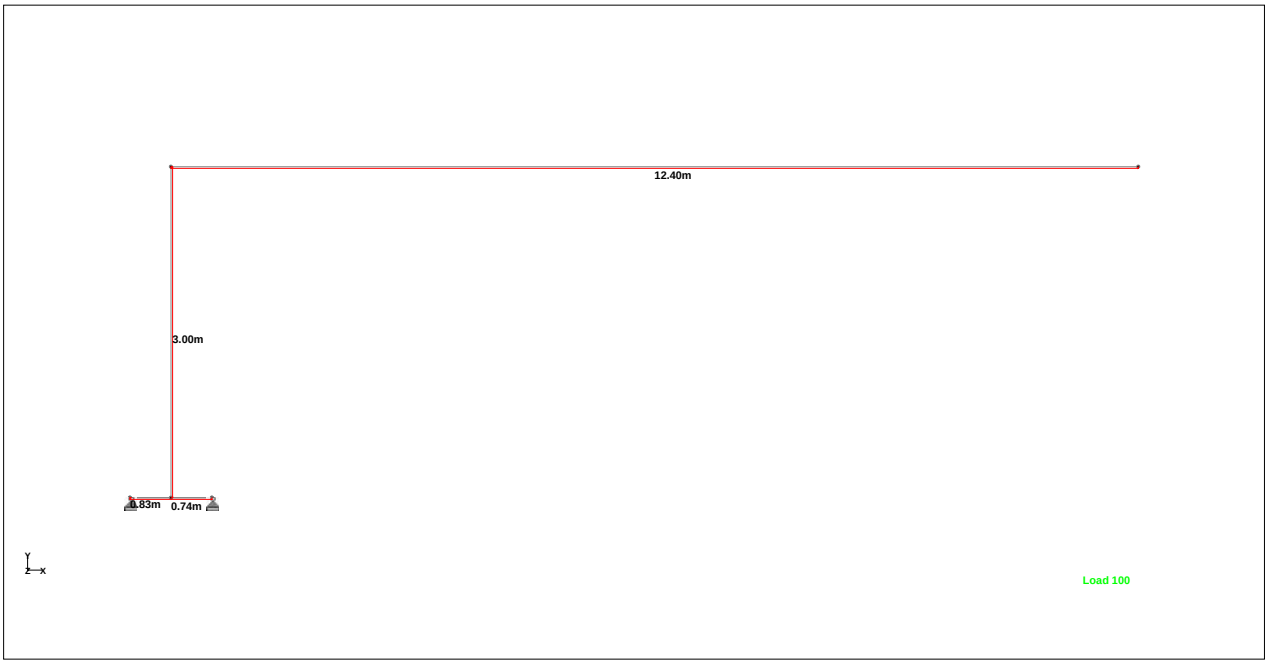
Whole Structure_SIDE



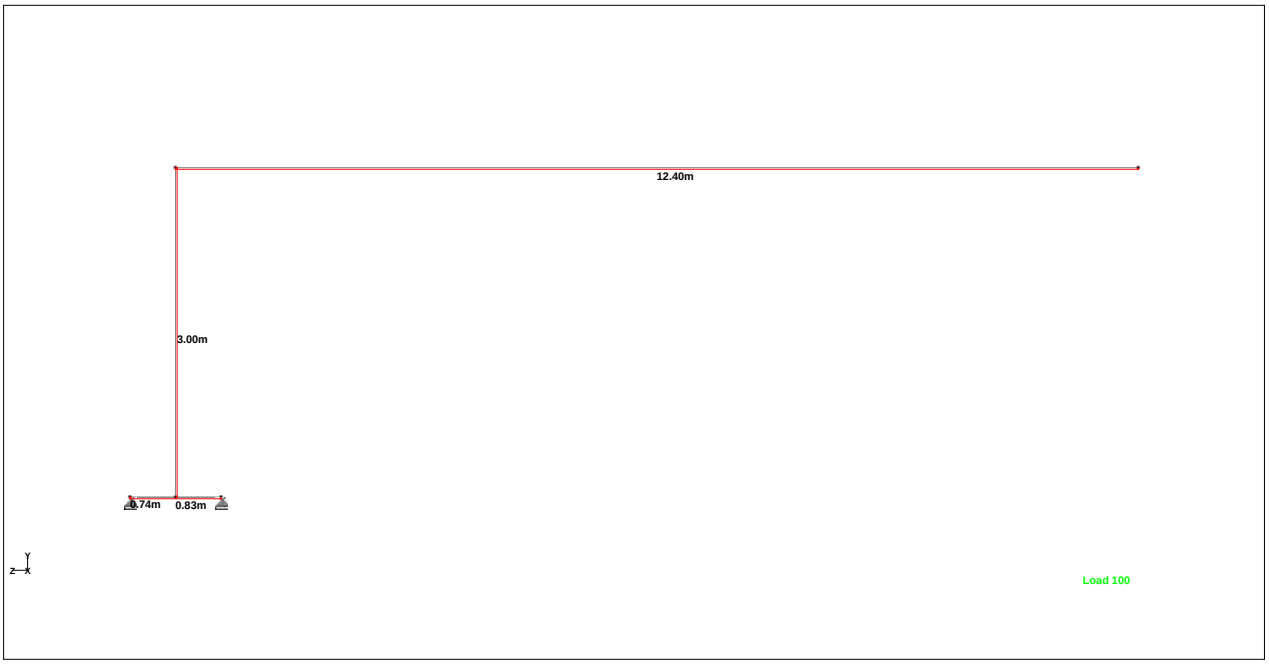
Governing Position ISO



Governing Position TOP



Governing Position FRONT



Governing Position SIDE

Supports

Node	X (kN/mm)	Y (kN/mm)	Z (kN/mm)	rX (kN-m/deg)	rY (kN-m/deg)	rZ (kN-m/deg)
1	Fixed	Fixed	Fixed	-	-	-
2	Fixed	Fixed	Fixed	-	-	-
3	Fixed	Fixed	Fixed	-	-	-
4	Fixed	Fixed	Fixed	-	-	-
13	Fixed	Fixed	Fixed	-	-	-
15	Fixed	Fixed	Fixed	-	-	-
16	Fixed	Fixed	Fixed	-	-	-
17	Fixed	Fixed	Fixed	-	-	-
25	Fixed	Fixed	Fixed	-	-	-
27	Fixed	Fixed	Fixed	-	-	-
28	Fixed	Fixed	Fixed	-	-	-
29	Fixed	Fixed	Fixed	-	-	-
37	Fixed	Fixed	Fixed	-	-	-
39	Fixed	Fixed	Fixed	-	-	-
40	Fixed	Fixed	Fixed	-	-	-
41	Fixed	Fixed	Fixed	-	-	-
49	Fixed	Fixed	Fixed	-	-	-
51	Fixed	Fixed	Fixed	-	-	-
52	Fixed	Fixed	Fixed	-	-	-
53	Fixed	Fixed	Fixed	-	-	-
61	Fixed	Fixed	Fixed	-	-	-
63	Fixed	Fixed	Fixed	-	-	-
64	Fixed	Fixed	Fixed	-	-	-
65	Fixed	Fixed	Fixed	-	-	-
73	Fixed	Fixed	Fixed	-	-	-
75	Fixed	Fixed	Fixed	-	-	-
76	Fixed	Fixed	Fixed	-	-	-

Supports Cont...

Node	X (kN/mm)	Y (kN/mm)	Z (kN/mm)	rX (kN-m/deg)	rY (kN-m/deg)	rZ (kN-m/deg)
77	Fixed	Fixed	Fixed	-	-	-
85	Fixed	Fixed	Fixed	-	-	-
87	Fixed	Fixed	Fixed	-	-	-
88	Fixed	Fixed	Fixed	-	-	-
89	Fixed	Fixed	Fixed	-	-	-
97	Fixed	Fixed	Fixed	-	-	-
99	Fixed	Fixed	Fixed	-	-	-
100	Fixed	Fixed	Fixed	-	-	-
101	Fixed	Fixed	Fixed	-	-	-
109	Fixed	Fixed	Fixed	-	-	-
111	Fixed	Fixed	Fixed	-	-	-
112	Fixed	Fixed	Fixed	-	-	-
113	Fixed	Fixed	Fixed	-	-	-
121	Fixed	Fixed	Fixed	-	-	-
123	Fixed	Fixed	Fixed	-	-	-
124	Fixed	Fixed	Fixed	-	-	-
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160	Fixed	Fixed	Fixed	-	-	-
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169	Fixed	Fixed	Fixed	-	-	-
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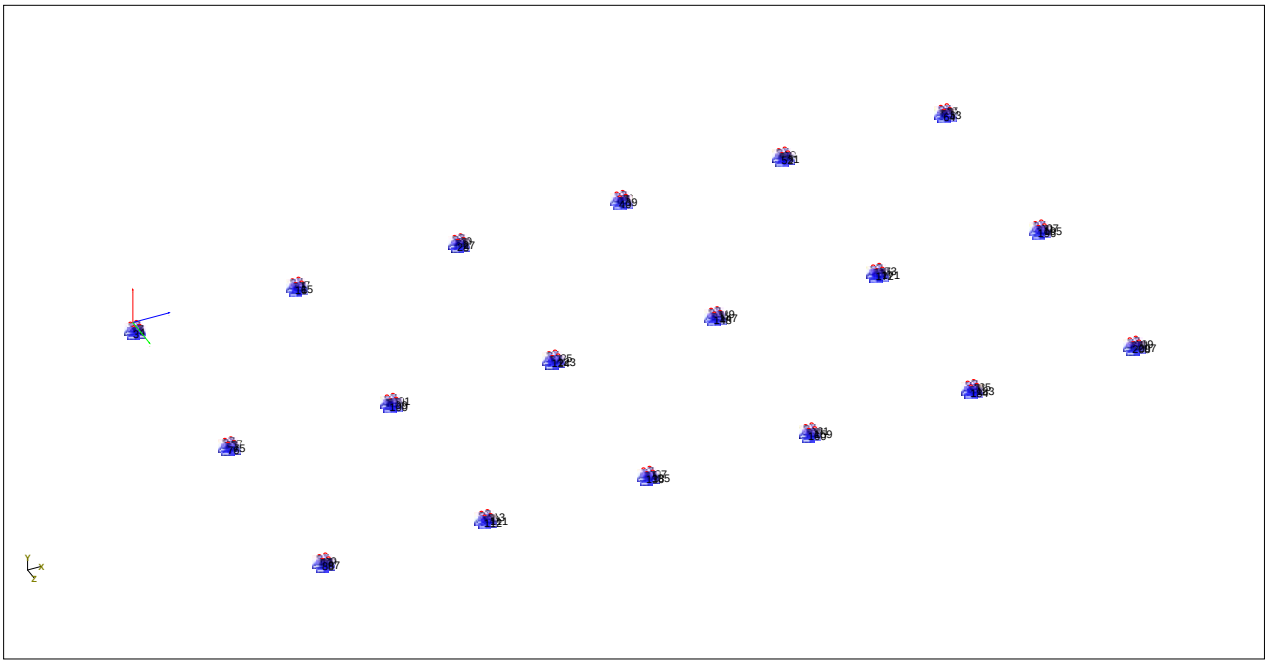
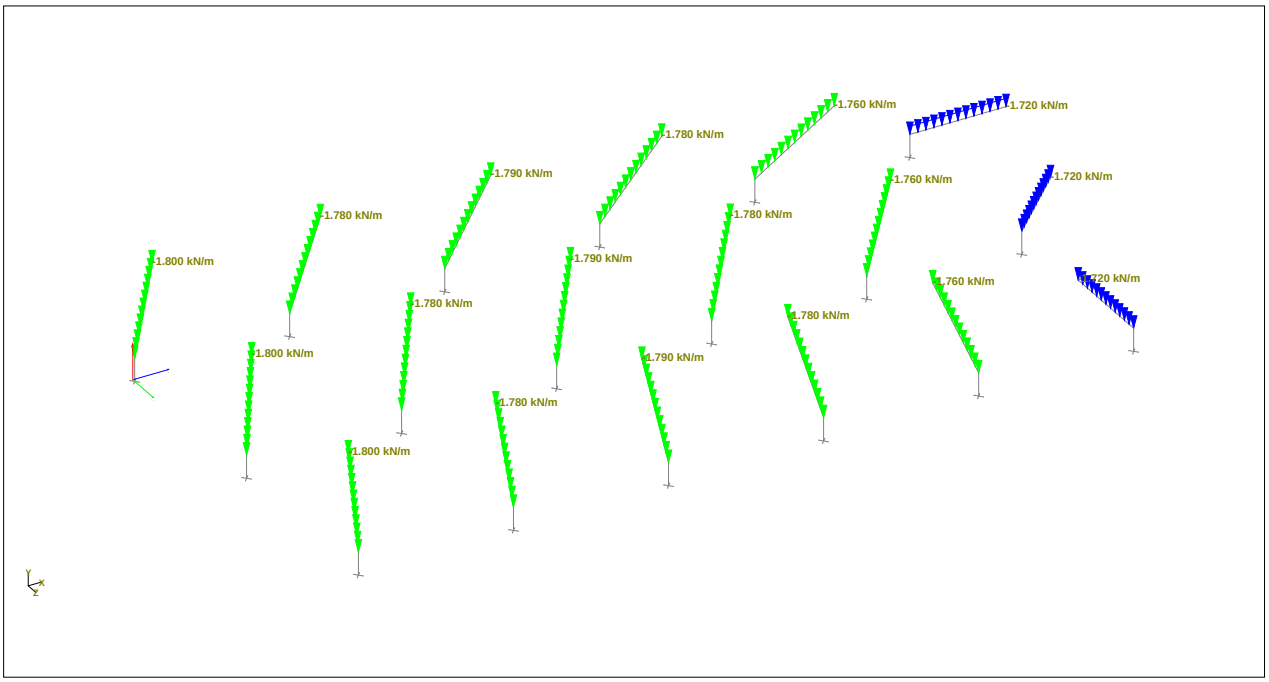
183	Fixed	Fixed	Fixed	-	-	-
184	Fixed	Fixed	Fixed	-	-	-
185	Fixed	Fixed	Fixed	-	-	-
193	Fixed	Fixed	Fixed	-	-	-
195	Fixed	Fixed	Fixed	-	-	-
196	Fixed	Fixed	Fixed	-	-	-
197	Fixed	Fixed	Fixed	-	-	-
205	Fixed	Fixed	Fixed	-	-	-
207	Fixed	Fixed	Fixed	-	-	-
208	Fixed	Fixed	Fixed	-	-	-
209	Fixed	Fixed	Fixed	-	-	-



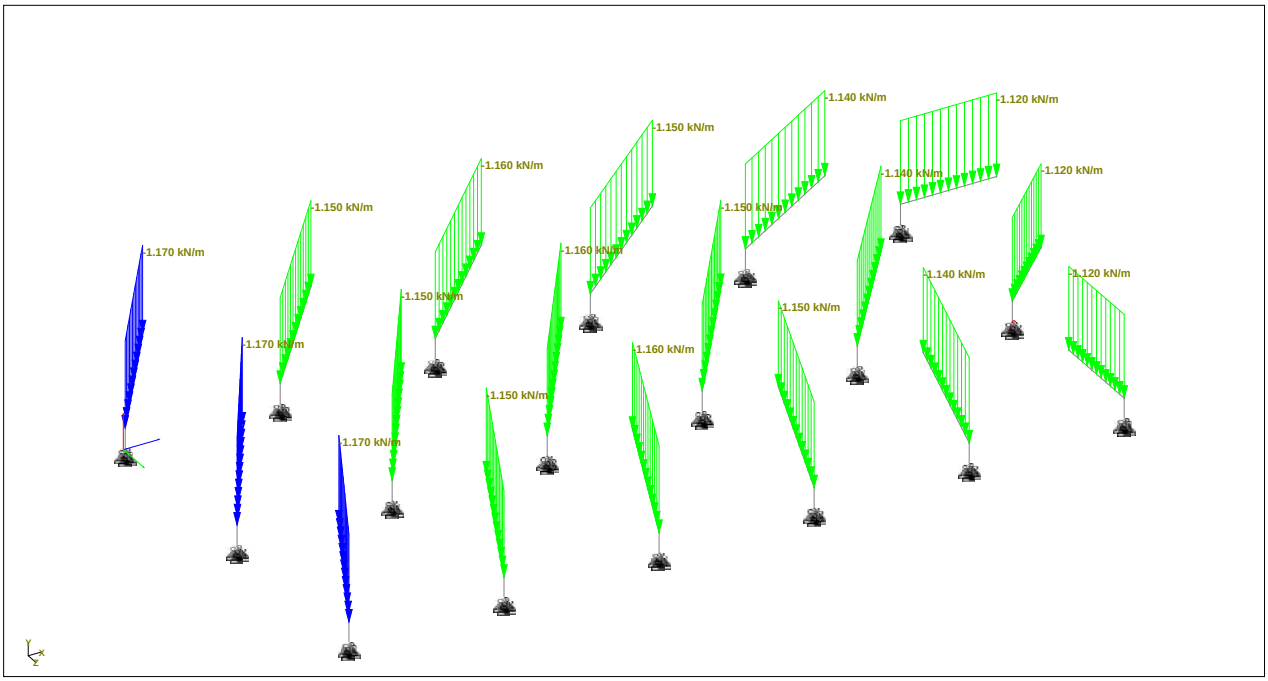
Pinned supports

Basic Load Cases

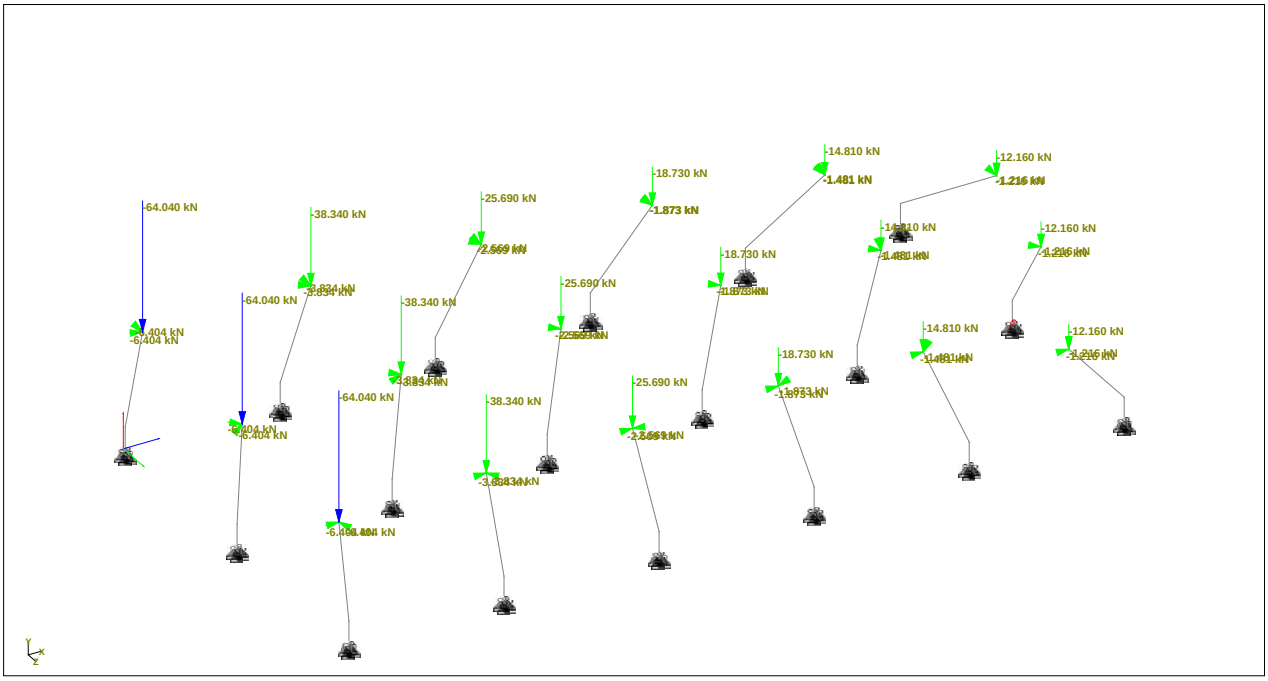
Number	Name
100	LOADER
101	EQUIPMENTS
200	LIFT



Self Weight of the Crane



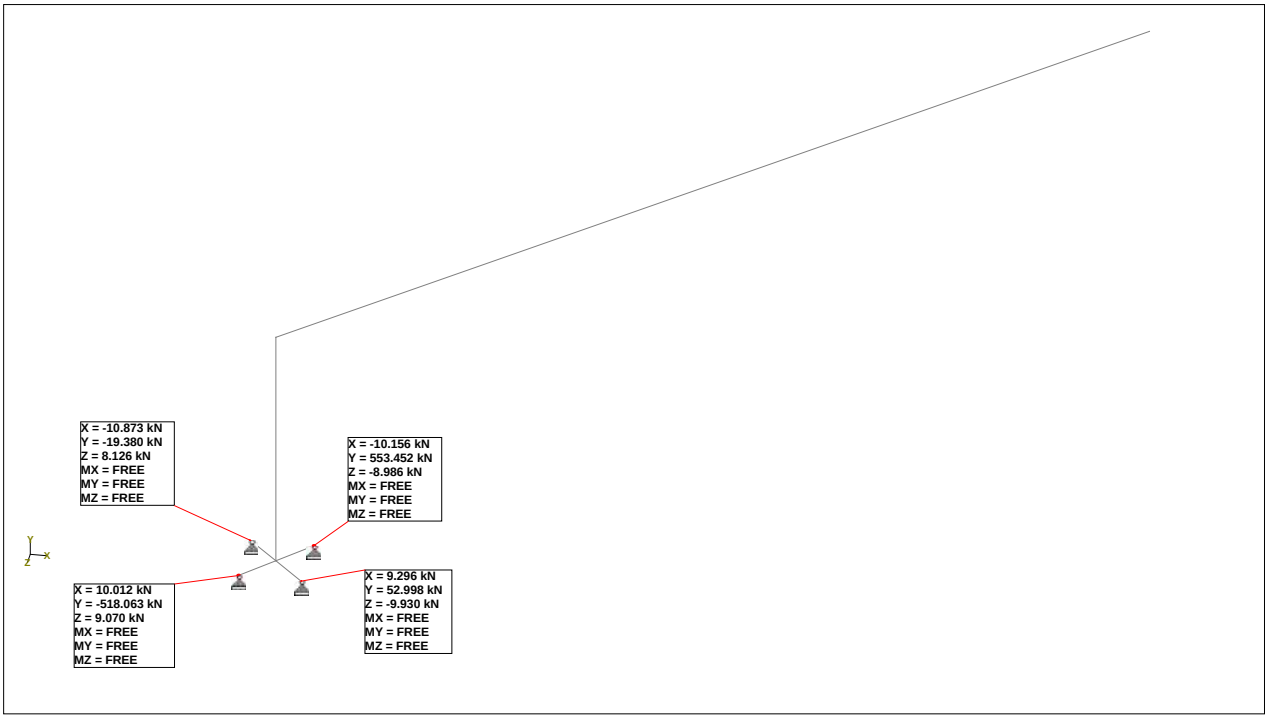
Weight of equipment



Lifted load

Reaction Summary

	Node	L/C	Horizontal FX (kN)	Vertical FY (kN)	Horizontal FZ (kN)	Moment MX (kNm)	MY (kNm)	MZ (kNm)
Max FX	64	1:LIFTING_CO	**10.599**	-377.888	8.420	0.000	0.000	0.000
Min FX	89	1:LIFTING_CO	**-15.612**	485.959	-1.967	0.000	0.000	0.000
Max FY	197	1:LIFTING_CO	-10.156	**553.452**	-8.986	0.000	0.000	0.000
Min FY	196	1:LIFTING_CO	10.012	**-518.063**	9.070	0.000	0.000	0.000
Max FZ	88	1:LIFTING_CO	3.658	-399.561	**15.283**	0.000	0.000	0.000
Min FZ	4	1:LIFTING_CO	3.665	509.783	**-15.278**	0.000	0.000	0.000
Max MX	1	1:LIFTING_CO	-15.605	-423.386	1.973	**0.000**	0.000	0.000
Min MX	1	1:LIFTING_CO	-15.605	-423.386	1.973	**0.000**	0.000	0.000
Max MY	1	1:LIFTING_CO	-15.605	-423.386	1.973	0.000	**0.000**	0.000
Min MY	1	1:LIFTING_CO	-15.605	-423.386	1.973	0.000	**0.000**	0.000
Max MZ	1	1:LIFTING_CO	-15.605	-423.386	1.973	0.000	0.000	**0.000**
Min MZ	1	1:LIFTING_CO	-15.605	-423.386	1.973	0.000	0.000	**0.000**



Governing Reaction Forces

APPENDIX 2

DETAIL CALCULATIONS

Load on structure

Constants: N := newton kN := 1000N

ORIGIN := 1 i := 1

Selfweight load

Calculation of structural force coefficient is based on EC 1993-3-1;

Material property, and constans:

- Density steel: $\gamma := 7850 \cdot \frac{kg}{m^3}$
- Gravitiy acceleration $g = 9.807 \frac{m}{s^2}$
- Density ice: $\gamma_{ice} := 700 \cdot \frac{kg}{m^3}$
- Young modulus of steel: $E := 210000 \cdot \frac{N}{mm^2}$
- Sensity of air: $\gamma_{air} := 1.25 \cdot \frac{kg}{m^3}$

Geometry and weight survey of structure

- SELFWEIGHT of basic loader: $G_{crane} := 2180kg \cdot g$ $G_{crane} = 21.378 \cdot kN$

Applied as uniformly distributed line load on the crane length

- WEIGHT of equipment: $G_{equip} := 1412kg \cdot g$ $G_{equip} = 13.847 \cdot kN$

Applied as uniformly distributed line load on the crane length

- Lifting capacity

$$l_{arm} := \begin{pmatrix} 2.2 \\ 4.5 \\ 6.4 \\ 8.3 \\ 10.3 \\ 12.4 \end{pmatrix} m \qquad Q_{arm} := \begin{pmatrix} 6530 \\ 3910 \\ 2620 \\ 1910 \\ 1510 \\ 1240 \end{pmatrix} kg \cdot g \qquad Q_{arm} = \begin{pmatrix} 64.037 \\ 38.344 \\ 25.693 \\ 18.731 \\ 14.808 \\ 12.16 \end{pmatrix} \cdot kN$$

10% of the capacaty has been applied at the end of the arm in order to modelling the transverse forces.

LOAD COMBINATIONS

ULS Combinations

1.2 x Selfweight + 1.2 x Equipment weight + 2.0 x Live load

Reference to:

/1/ EN 1993-1-1:2005, General rules and rules for buildings
/2/ EN 1993-1-8:2005, Design of Joints
/3/ Maskinforeskriften

Detail Calculation

PROPERTIES OF APPLIED MATERIALS

ORIGIN := 1 kNm := kN·m

materialfactor ULS conditions

GENERAL SAFETY FACTOR FOR STRUCTURE:

- Safety Class I. $\gamma_n := 1.00$

PARTIAL FACTOR FOR STEEL:

- material: $\gamma_m := 1.05$
- bolts and welds $\gamma_{m2} := 1.25$
- stability: $\gamma_{m1} := 1.00$

PROPERTIES OF STEEL

Steel:

- yield stress of steel: $f_y = 355 \cdot \frac{N}{mm^2}$
- ultimate stress of steel: $f_u = 510 \cdot \frac{N}{mm^2}$

- design values: $f_{yd} := \frac{f_y}{\gamma_m \cdot \gamma_n}$ $f_{yd} = 338.095 \cdot \frac{N}{mm^2}$

- shear stress: $\tau_d := \frac{f_{yd}}{\sqrt{3}}$ $\tau_d = 195.199 \cdot \frac{N}{mm^2}$

Properties of steel

Poisson factor

Elastic modulus of steel: $E = 2.1 \times 10^5 \cdot \frac{N}{mm^2}$ $\nu := 0.3$

Shear modulus of steel: $G := \frac{E}{2(1+\nu)}$ $G = 80.769 \cdot \frac{kN}{mm^2}$

Weld:

$\beta_w = 0.9$ correction factor for S355

Weld allowable stress: $f_{wd} := \frac{f_u}{\gamma_{m2} \cdot \beta_w} = 453 \cdot MPa$

Factorized reactions on one support:

$F_{v.leg.1} := 10.16kN$

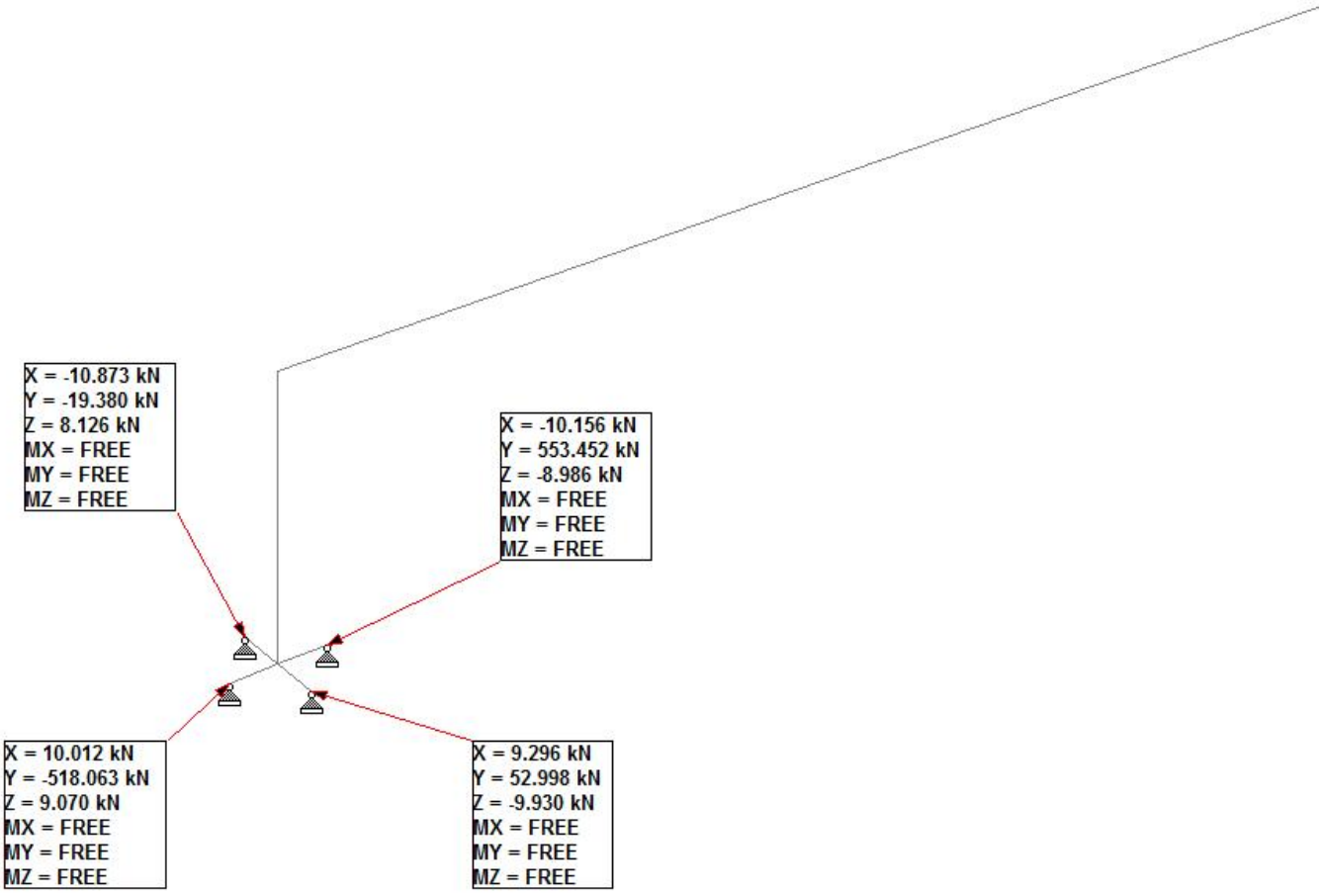
$F_{v.leg.2} := 8.99kN$

$F_{v.leg} := \sqrt{F_{v.leg.1}^{2} + F_{v.leg.2}^{2}}$

$F_{t.leg} := 518.06kN$

$F_{v.leg} = 13.566 \cdot kN$

$F_{c.leg} := 553.45kN$



CHECK ANCHOR BOLTS

Number of bolts per support (1M33):

$n_{ancb} := 1$

$$F_{tEd} := \frac{F_{t.leg}}{n_{ancb}} \qquad F_{tEd} = 518.06 \cdot kN$$

$$F_{cEd} := \frac{F_{c.leg}}{n_{ancb}} \qquad F_{cEd} = 553.45 \cdot kN$$

$$F_{vEd} := \frac{F_{v.leg}}{n_{ancb}} \qquad F_{vEd} = 13.566 \cdot kN$$

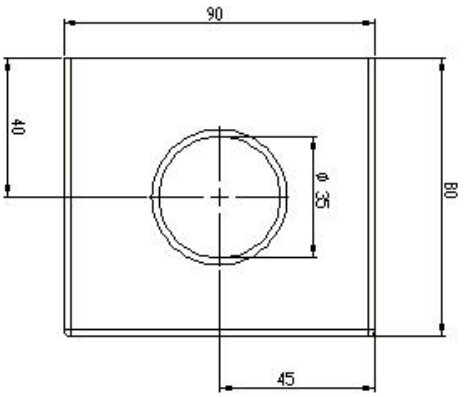
Anchor bolt properties:

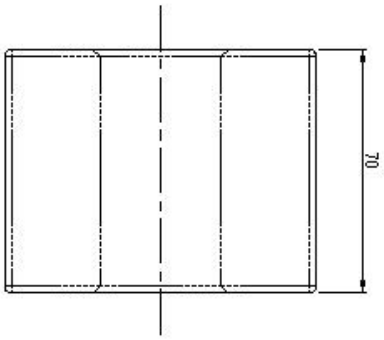
Net area of M33 bolts: $A_n := 855 \cdot mm^2$

Diameter: $\phi_b := 33mm$

Length: $L_0 := 150mm$

Tension area of bolts: $A_s := 694 \cdot mm^2$





- Material:

Density of steelwork $\rho_{st} := 7850 \cdot kg \cdot m^{-3}$ $g := 9.81 \cdot m \cdot sec^{-2}$

Tensile strength of material $f_u = 510 \cdot \frac{N}{mm^2}$

Ultimate stress of 8.8 bolts $f_{ub} := 800 \cdot \frac{N}{mm^2}$ $\gamma_{M2} := 1.25$

- Anchor bolts

M33x1000 (full thread)

Material factor: $\gamma_{M2} = 1.25$

Area of bolts $A_n = 855 \cdot mm^2$

Length of bolts: $L_0 = 150 \cdot mm$

Yield stress $f_{ub} = 800 \cdot \frac{N}{mm^2}$

Diameter: $\phi_b = 33 \cdot mm$

Number of shear planes $n := 2$

Shear resistance $F_{vRd} := n \cdot \frac{0.6 \cdot f_{ub} \cdot A_n}{\gamma_{M2}}$ $F_{vRd} = 656.64 \cdot kN$

Tension resistance $F_{tRd} := \frac{0.9 \cdot f_{ub} \cdot A_s}{\gamma_{M2}}$ $F_{tRd} = 399.744 \cdot kN$

Combined stress Eurocode part 1.1. clause 6.5.5.5 $U_{B_1} := \frac{F_{vEd}}{F_{vRd}} + \frac{F_{tEd}}{1.4 \cdot F_{tRd}}$

Bolt use factor $U_{B_1} = 0.946$ **< 1.0 /OK**

$e_1 := 40mm$ $e_2 := 40mm$ $t := 70mm$ (t: height of box)

$k_1 := \min\left(2.8 \cdot \frac{e_2}{\phi_b}, 2.5\right)$ $k_1 = 2.5$

$\alpha_b := \min\left(\frac{e_2}{3 \cdot \phi_b}, \frac{f_{ub}}{f_u}, 1.0\right)$ $\alpha_b = 0.404$

Bearing resistance $F_{bRd} := k_1 \cdot \frac{\alpha_b \cdot f_u \cdot \phi_b \cdot t}{\gamma_{M2}}$ $F_{bRd} = 952 \cdot kN$

Bearing resistance utilization $U_{B_2} := \frac{F_{vEd}}{F_{bRd}}$ $U_{B_2} = 0.014$ **< 1.0 /OK**

Punching shear diameter For M33: $d_m := 54.45mm$

Punching shear resistance $B_{pRd} := \frac{0.6 \cdot \pi \cdot d_m \cdot t \cdot f_u}{\gamma_{M2}}$ $B_{pRd} = 2.931 \times 10^3 \cdot kN$

Punching shear resistance utilization $U_{B_3} := \frac{F_{tEd}}{B_{pRd}}$ $U_{B_3} = 0.177$ **< 1.0 /OK**

Bolt utilizations

$$U_B = \begin{pmatrix} 0.946 \\ 0.014 \\ 0.177 \end{pmatrix}$$

CHECK BRACKETS (2pc)

Note : Conservative check has done on the member

- Material:

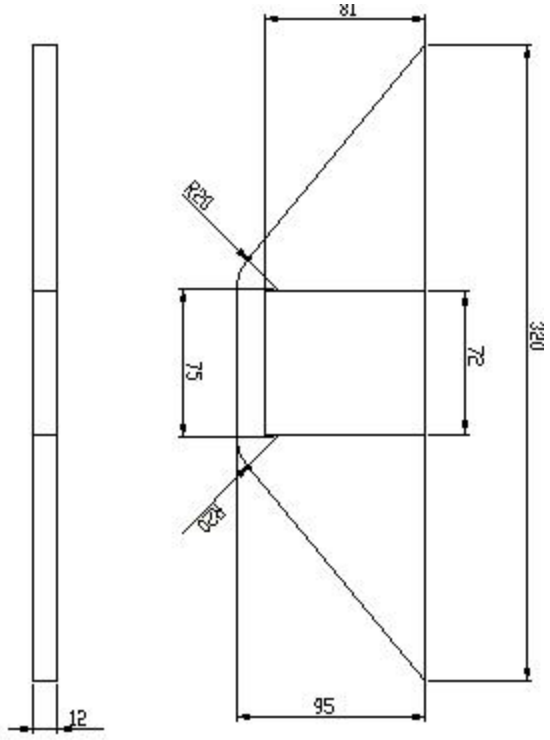
Material factor: $\gamma_{M0} := 1.0$

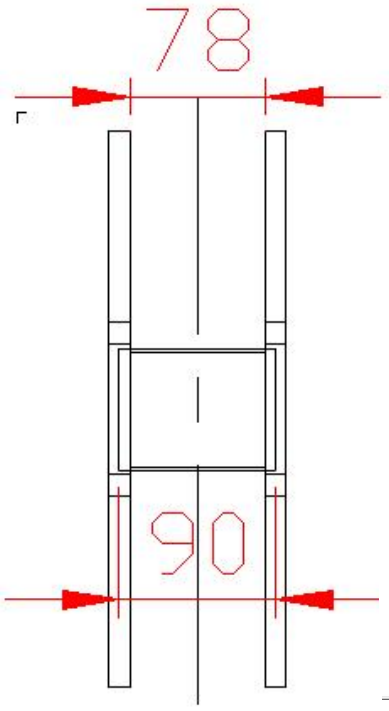
Yield stress $f_y = 355 \cdot \frac{N}{mm^2}$

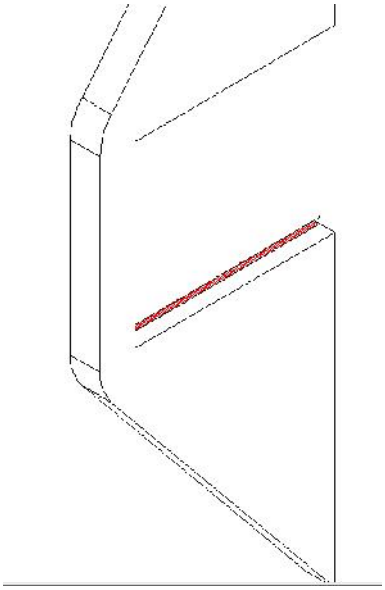
Number of shear planes $n := 2$

$a := 80mm$ $b := 90mm$ $t := 6mm$ $n = 2$

$l_{eff} := a$ $l_{eff} = 80 \cdot mm$ $A_v := l_{eff} \cdot t$







- Shear force on brackets due to Vertical forces:

$$V_{Ed} := \frac{F_{vEd}}{n} \qquad V_{Ed} = 6.783 \cdot kN$$

- Shear resistance of brackets:

$$V_{cRd} := \frac{A_v \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} \qquad V_{cRd} = 98.38 \cdot kN$$

Utilization $U_{Br_1} := \frac{V_{Ed}}{V_{cRd}}$ $U_{Br_1} = 0.069$ **< 1.0 /OK**

Number of planes $n := 2$

$a := 80mm$ $b := 90mm$ $t := 6mm$ $n = 2$

$l_{eff} := a$ $l_{eff} = 80 \cdot mm$ $A_v := l_{eff} \cdot t$

- Normal force on brackets due to Vertical forces:

$$N_{Ed} := \frac{1}{2}\left(\frac{\max\left(F_{tEd}, F_{cEd}\right)}{n}\right) \qquad N_{Ed} = 138.363\ kN$$

Half of the forces transverse throught the weldings, the other half on the brackets as normal forces.

- Resistance of brackets:

$$N_{cRd} := \frac{A_v \cdot f_y}{\gamma_{M0}} \qquad N_{cRd} = 170.4 \cdot kN$$

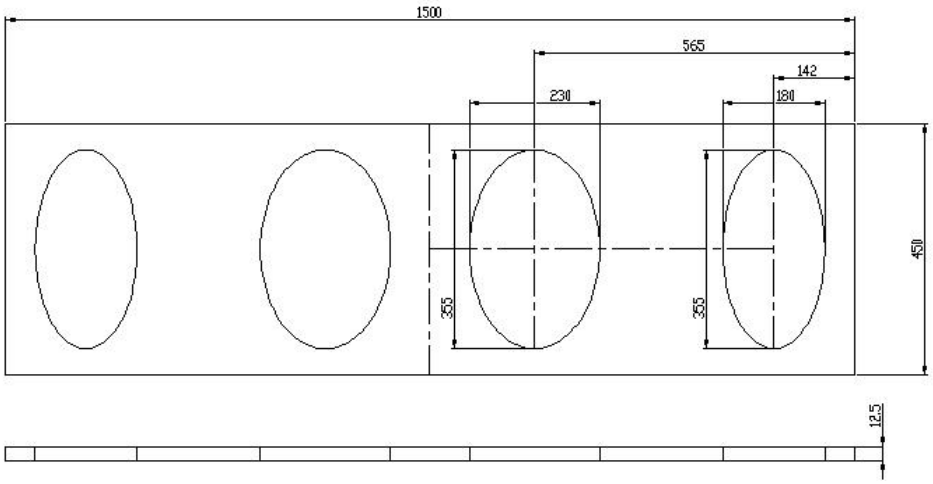
Utilization $U_{Br_2} := \frac{N_{Ed}}{N_{cRd}}$ $U_{Br_2} = 0.812$ **< 1.0 /OK**

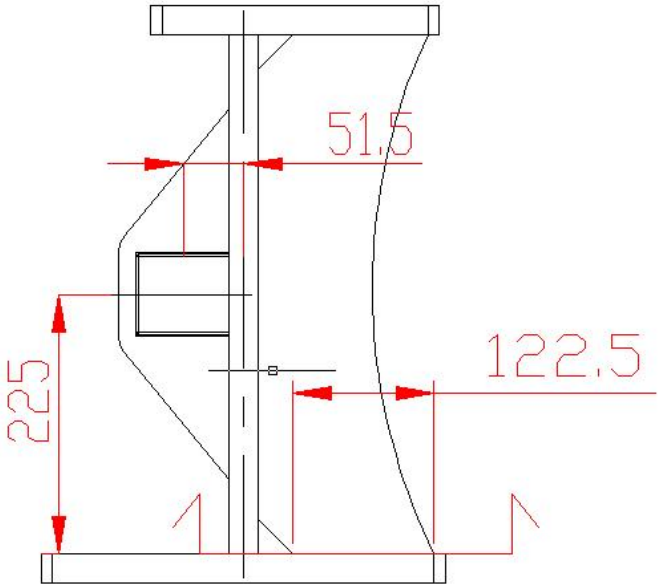
Bracket utilizations

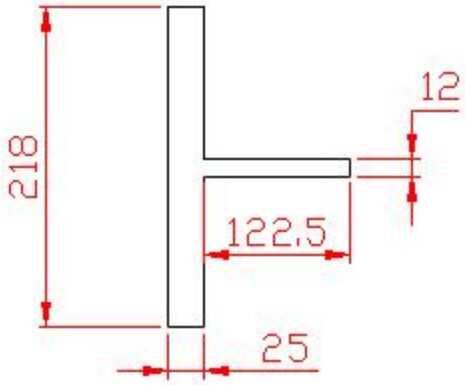
$$U_{Br} = \begin{pmatrix} 0.069 \\ 0.812 \end{pmatrix}$$

CHECK WEB

Note : Conservative check has done on the member







Note : gap (between web and backing) has not been considered, so W is smaller.

- Material:

Material factor: $\gamma_{M0} = 1$

Yield stress $f_y = 355 \cdot \frac{N}{mm^2}$

- Factorized reactions on one section:

$F_{tEd} = 518.06 \cdot kN$

$F_{cEd} = 553.45 \cdot kN$

$F_{vEd} = 13.566 \cdot kN$

Eccentricity $ecc := 85mm$

Design moment $M_{web} := \max(F_{tEd}, F_{cEd}) \cdot ecc$ $M_{web} = 47.043 \cdot kNm$

- Section properties

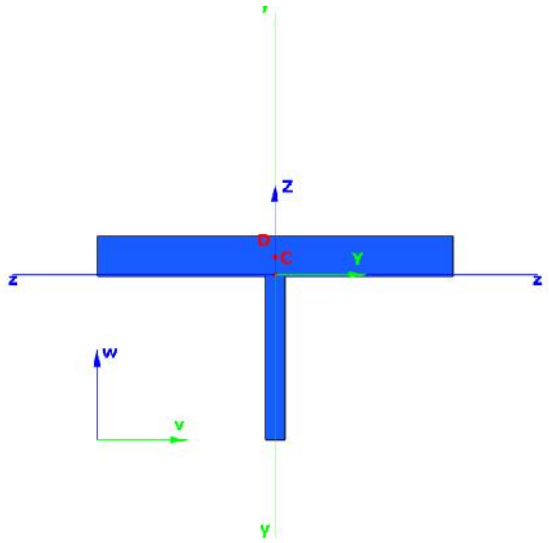
$A_a := 6650mm^2$

$A_v := 1293mm^2$

Centroid of gravity: $b_1 := 23.78mm$ $b_2 := 101.22mm$

Based on Consteel $I_z := 21598217mm^4$

$W_{pl} := 198149 \cdot mm^3$



Basic properties	
v_s	109,0 mm
w_s	101,2 mm
α	90,0 degree
A	6 650 mm^2
General properties in the principal axis system (y,z)	
I_y	21 598 217 mm^4
I_z	5 125 490 mm^4
i_y	57,0 mm
i_z	27,8 mm
$W^1_{el.y}$	198 149 mm^3
$W^1_{el.z}$	215 554 mm^3
$W^2_{el.y}$	198 149 mm^3
$W^2_{el.z}$	50 636 mm^3
General properties in the section edit system translated to the centroid of gravity of the section (Y,Z)	
I_Y	5 125 490 mm^4
I_Z	21 598 217 mm^4
I_{YZ}	0 mm^4
i_Y	27,8 mm
i_Z	57,0 mm
$W^1_{el.Y}$	215 554 mm^3
$W^1_{el.Z}$	198 149 mm^3
$W^2_{el.Y}$	50 636 mm^3
$W^2_{el.Z}$	198 149 mm^3
Torsional properties	
y_0	10,9 mm
z_0	0,0 mm
Y_0	0,0 mm
Z_0	10,9 mm
I_t	1 159 981 mm^4
I_w	1 136 849 635 mm^6
Shear properties	
A_{sY}	4 611 mm^2
A_{sZ}	1 293 mm^2
ρ_Y	0,6934
ρ_Z	0,1944

- Stresses in the section

Due to normal force

$$\sigma_T := \frac{\max(F_{tEd}, F_{cEd})}{A_a} \qquad \sigma_T = 83.226 \cdot \frac{N}{mm^2}$$

Due to bending

$$\sigma_{M1} := \frac{M_{web}}{I_z} \cdot b_1 \qquad \sigma_{M1} = 51.795 \cdot \frac{N}{mm^2}$$

$$\sigma_{M2} := \frac{M_{web}}{I_z} \cdot b_2 \qquad \sigma_{M2} = 220.468 \cdot \frac{N}{mm^2}$$

Due to shear

$$\tau := \frac{F_{vEd}}{A_v} \qquad \tau = 10.492 \cdot \frac{N}{mm^2}$$

Combined stress

$$\sigma_1 := \sigma_T + \sigma_{M1} \qquad \sigma_1 = 135.021 \cdot \frac{N}{mm^2}$$

- Allowable stress

$$V_{cRd} := \frac{A_v \cdot f_y}{\sqrt{3} \cdot \gamma_{M0}} \qquad V_{cRd} = 265.012 \cdot kN$$

$$M_{cRd} := \frac{W_{pl} \cdot f_y}{\gamma_{M0}} \qquad M_{cRd} = 70.343 \cdot kNm$$

Utilization

$$U_{web_1} := \frac{F_{vEd}}{V_{cRd}} \qquad U_{web_1} = 0.051 \quad \textbf{< 1.0 /OK}$$

$$U_{web_2} := \frac{\sigma_1}{f_y} \qquad U_{web_2} = 0.38 \quad \textbf{< 1.0 /OK}$$

$$U_{web} = \begin{pmatrix} 0.051 \\ 0.38 \end{pmatrix}$$

CHECK FOOT PLATE

Note : Conservative check has done on the member

- Material:

Material factor: $\gamma_{M0} = 1$

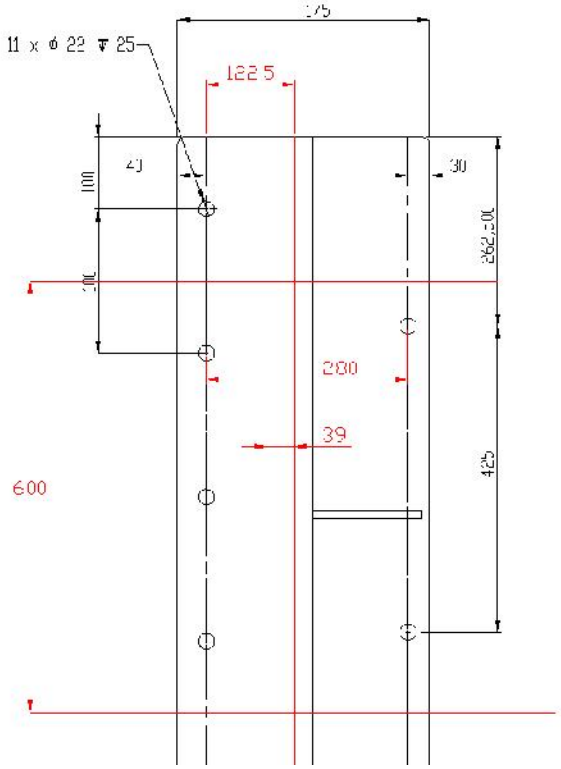
Yield stress $f_y = 355 \cdot \frac{N}{mm^2}$

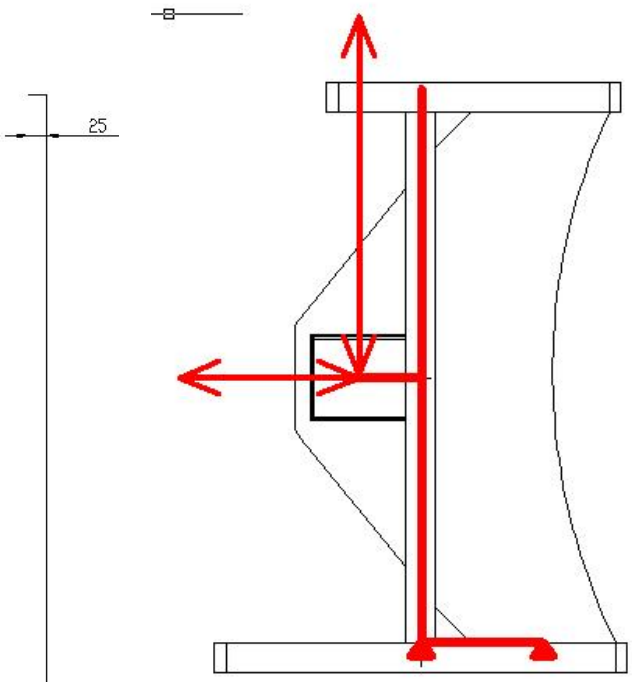
$F_{tEd} = 518.06 \cdot kN$ $F_{cEd} = 553.45 \cdot kN$

Eccentricity $ecc := 51.5mm$

Design moment $M_{bfED} := M_{web}$ $M_{bfED} = 47.043 \cdot kNm$

Section of foot plate





$A_b := 25mm$ $arm_M := 280mm$

$B_b := 600mm$ $arm_P := 122.5mm$

Section modulus	$W_{bf} := \frac{A_b^2 \cdot B_b}{6}$	$W_{bf} = 62.5 \cdot cm^3$	
Reaction forces due to Moment	$R_M := \frac{M_{bfED}}{arm_M}$	$R_M = 168.012 \cdot kN$	
Design Moment	$M_{FEd} := R_M \cdot arm_P$	$M_{FEd} = 20.581 \cdot kNm$	
Stress in plate due to Reaction	$\sigma_M := \frac{M_{FEd}}{W_{bf}}$	$\sigma_M = 329.303 \cdot \frac{N}{mm^2}$	
Utilization	$U_{bf_1} := \frac{\sigma_M}{f_y}$	$U_{bf_1} = 0.928$	**< 1.0 /OK**

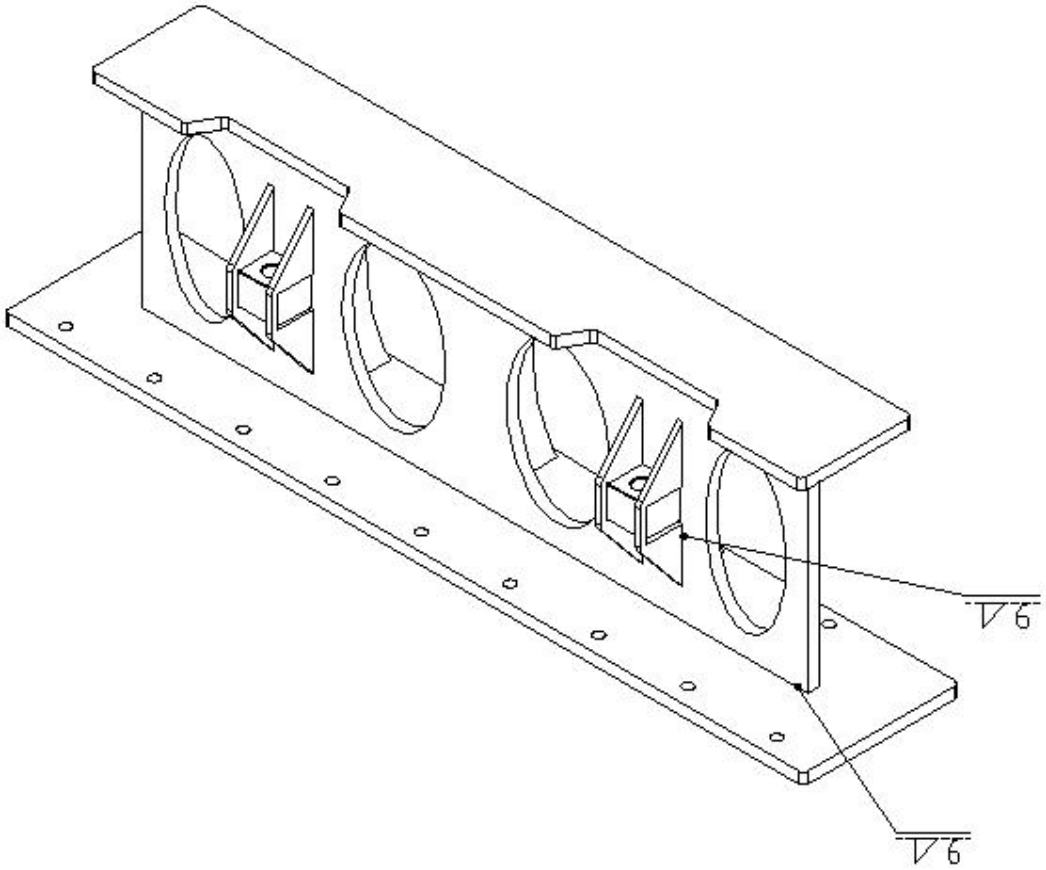
Utilization of web plate

$U_{bf} = (0.928)$

Connections

Note : Conservative check has done

Safety factor	$\gamma_{M2} = 1.25$
Correlation factor	$\beta_w = 0.9$



Box - bracket

Note : Conservative check has done

Number of welding: $n := 2 \cdot 2$ (two weldings on each bracket)

Shear force on welding (from tension): $F_{wEd} := \frac{F_{tEd}}{n}$ → $F_{wEd} = 129.515 \cdot kN$

Throat thickness of fillet weldings: $a := 5mm$

Length of fillet welding: $l_0 := 80mm$

Area of welding: $A_w := l_0 \cdot a$ → $A_w = 400 \cdot mm^2$

Stresses of weld

based on shear force: $\tau_{par} := 0$ → $\tau_{par} = 0 \cdot \frac{N}{mm^2}$

based on moment: $\tau_{per} := \frac{F_{wEd}}{2 \cdot A_w} \cdot \frac{1}{\sqrt{2}}$ → $\tau_{per} = 114.476 \cdot \frac{N}{mm^2}$

$\sigma_{per} := \tau_{per}$ → $\sigma_{per} = 114.476 \cdot \frac{N}{mm^2}$

Combined stress

$$C_{Ed} := \sqrt{\sigma_{per}^2 + 3 \cdot \left(\tau_{par}^2 + \tau_{per}^2\right)}$$ → $C_{Ed} = 228.952 \cdot \frac{N}{mm^2}$

Checking

$C_{Rd} := \frac{f_u}{\beta_w \cdot \gamma_{M2}}$ → $C_{Rd} = 453.333 \cdot \frac{N}{mm^2}$

$U_{w_1} := \frac{C_{Ed}}{C_{Rd}}$ → $U_{w_1} = 0.505$ **< 1.0 /OK**

Brackets - web

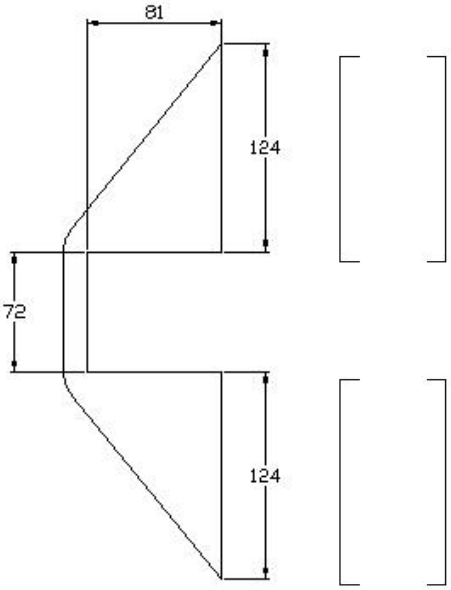
Note : Conservative check has done

Shear force on welding (from tension) $F_{wEd} := \max(F_{tEd}, F_{cEd})$ $F_{wEd} = 553.45 \cdot kN$

Eccentricity $ecc := 40mm$

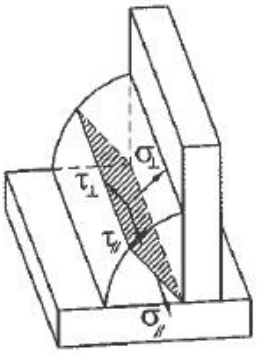
Moments on welding $M_{Ed} := F_{wEd} \cdot ecc$ $M_{Ed} = 2.214 \times 10^3 \cdot kN \cdot cm$

Throat thickness of fillet weldings $a := 6mm$



$l_{total} := 320mm$

$l_{gap} := 72mm$



Length of fillet welding $l_0 := l_{total} - l_{gap}$ $l_0 = 248\,mm$

Area of welding $A_w := l_0 \cdot a$ $A_w = 1.488 \times 10^3 \cdot mm^2$

Section modulus of welding $W_{yw} := 4 \cdot \left[\frac{(l_{total} - 4 \cdot a)^2 \cdot a}{6} - \frac{l_{gap}^2 \cdot a}{6} \right]$ $W_{yw} = 329.728 \cdot cm^3$

Stresses of weld

based on shear force $\tau_{par} := \frac{F_{wEd}}{2 \cdot A_w}$ $\tau_{par} = 185.971 \cdot \frac{N}{mm^2}$

based on mement $\tau_{per} := \frac{1}{\sqrt{2}} \cdot \frac{M_{Ed}}{W_{yw}}$ $\tau_{per} = 47.475 \cdot \frac{N}{mm^2}$

$\sigma_{per} := \tau_{per}$ $\sigma_{per} = 47.475 \cdot \frac{N}{mm^2}$

Combined stress

$$C_{Ed} := \sqrt{\sigma_{per}^{2} + 3 \cdot \left(\tau_{par}^{2} + \tau_{per}^{2}\right)} \qquad C_{Ed} = 335.814 \cdot \frac{N}{mm^2}$$

Checking

$$C_{Rd} := \frac{f_u}{\beta_w \cdot \gamma_{M2}} \qquad C_{Rd} = 453.333 \cdot \frac{N}{mm^2}$$

$$U_{w_2} := \frac{C_{Ed}}{C_{Rd}} \qquad U_{w_2} = 0.741 \qquad \textbf{< 1.0 /OK}$$

$$\sigma_{max} := \frac{f_u}{\gamma_{M2}}$$

$$U_{w_3} := \frac{\sigma_{per}}{\sigma_{max}} \qquad U_{w_3} = 0.116 \qquad \textbf{< 1.0 /OK}$$

Web - foot plate

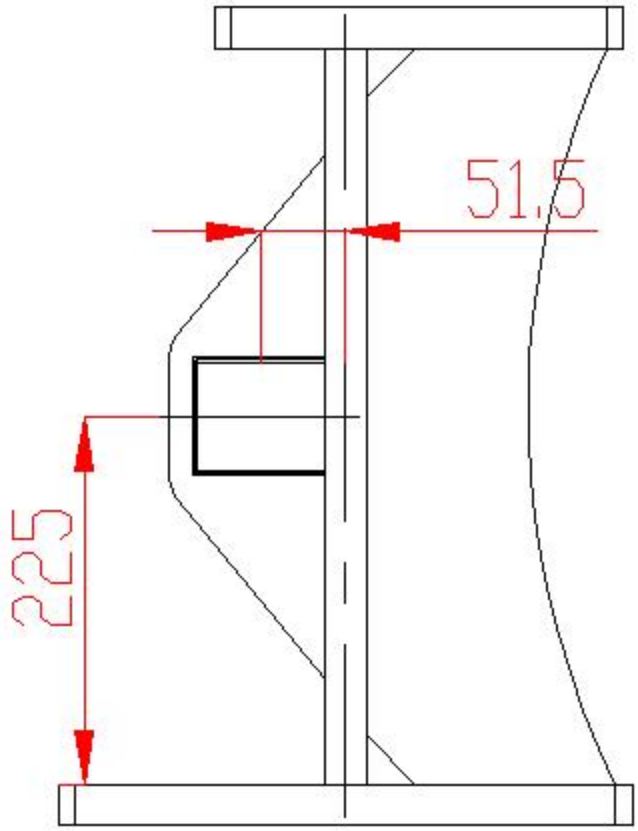
Note : Conservative check has done

Shear force on welding (from shear) $F_{w.VEd} := F_{vEd}$ $F_{w.VEd} = 13.566 \cdot kN$

Due to normal forces $F_{w.NEd} := \max(F_{tEd}, F_{cEd})$ $F_{w.NEd} = 553.45 \cdot kN$

Eccentricity $ecc_V := 225mm$

$ecc_H := 51.5mm$



Moments on welding

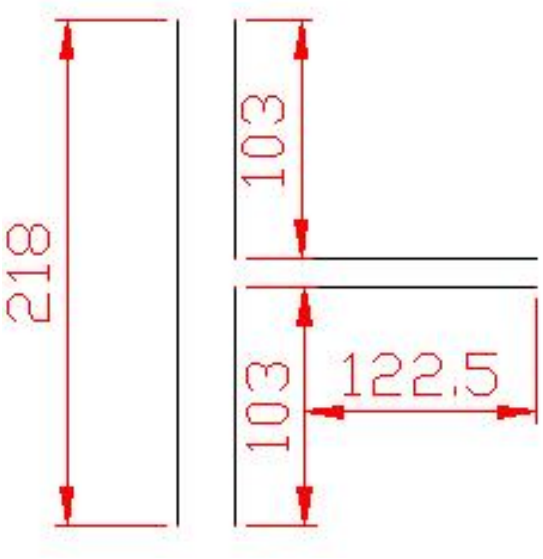
$M_{w.VEd} := F_{w.VEd} \cdot ecc_V$ $M_{w.VEd} = 305.243 \cdot kN \cdot cm$

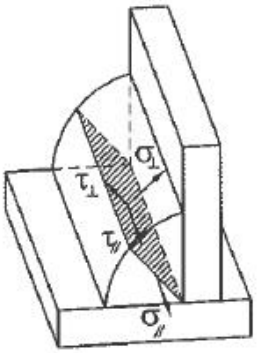
$M_{w.NEd} := F_{w.NEd} \cdot ecc_H$ $M_{w.NEd} = 2.85 \times 10^3 \cdot kN \cdot cm$

$M_{w.Ed} := M_{w.VEd} + M_{w.NEd}$ $M_{w.Ed} = 3.156 \times 10^3 \cdot kN \cdot cm$

Throat thickness of fillet weldings $a := 6mm$

Length of fillet welding $l_0 := 245mm$ (For the backing - Moment and Shear forces)





Area of welding $A_w := l_0 \cdot a$ $A_w = 1.47 \times 10^3 \cdot mm^2$

Section modulus of welding $W_w := 2 \cdot \left[\frac{(l_0 - 2 \cdot a)^2 \cdot a}{6} \right]$ $W_{yw} = 329.728 \cdot cm^3$

Stresses of weld

based on shear force $\tau_{par} := \frac{F_{w.VEd}}{2 \cdot A_w}$ $\tau_{par} = 4.614 \cdot \frac{N}{mm^2}$

based on mement $\tau_{per} := \frac{1}{\sqrt{2}} \cdot \frac{M_{w.Ed}}{W_w}$ $\tau_{per} = 205.5 \cdot \frac{N}{mm^2}$

$\sigma_{per} := \tau_{per}$ $\sigma_{per} = 205.5 \cdot \frac{N}{mm^2}$

Combined stress

$C_{Ed} := \sqrt{\sigma_{per}^2 + 3 \cdot \left(\tau_{par}^2 + \tau_{per}^2 \right)}$ $C_{Ed} = 411.079 \cdot \frac{N}{mm^2}$

Checking

$C_{Rd} := \frac{f_u}{\beta_w \cdot \gamma_{M2}}$ $C_{Rd} = 453.333 \cdot \frac{N}{mm^2}$

$U_{w_4} := \frac{C_{Ed}}{C_{Rd}}$ $U_{w_4} = 0.907$ **< 1.0 /OK**

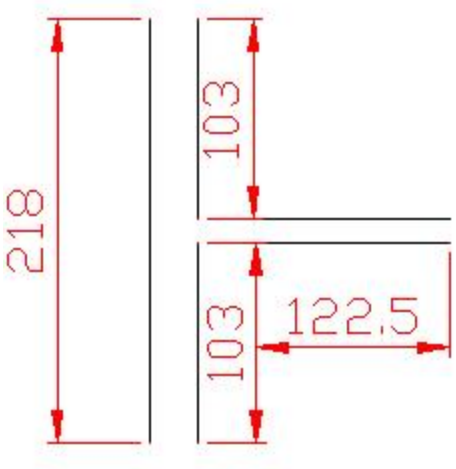
$$\sigma_{max} := \frac{f_u}{\gamma_{M2}}$$

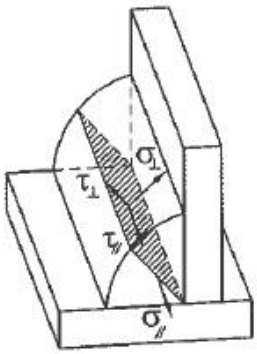
$$U_{w_5} := \frac{\sigma_{per}}{\sigma_{max}} \qquad U_{w_5} = 0.504$$

< 1.0 /OK

Throat thickness of fillet weldings $a := 6mm$

Length of fillet welding $l_0 := 424mm$ (For the web - Shear forces)





Area of welding $A_w := l_0 \cdot a$ $A_w = 2.544 \times 10^3 \cdot mm^2$

Section modulus of welding $W_w := 2 \cdot \left[\frac{(l_0 - 2 \cdot a)^2 \cdot a}{6} \right]$ $W_{yw} = 329.728 \cdot cm^3$

Stresses of weld

based on shear force $\tau_{par} := \frac{F_{w.VEd}}{2 \cdot A_w}$ $\tau_{par} = 2.666 \cdot \frac{N}{mm^2}$

based on mement $\tau_{per} := \frac{\sqrt{2}}{2} \cdot \frac{M_{w.NEd}}{W_w}$ $\tau_{per} = 59.367 \cdot \frac{N}{mm^2}$

$\sigma_{per} := \tau_{per}$ $\sigma_{per} = 59.367 \cdot \frac{N}{mm^2}$

Combined stress

$$C_{Ed} := \sqrt{\sigma_{per}^{2} + 3\cdot\left(\tau_{par}^{2} + \tau_{per}^{2}\right)} \qquad C_{Ed} = 118.824\cdot\frac{N}{mm^2}$$

Checking

$$C_{Rd} := \frac{f_u}{\beta_w\cdot\gamma_{M2}} \qquad C_{Rd} = 453.333\cdot\frac{N}{mm^2}$$

$$U_{w_6} := \frac{C_{Ed}}{C_{Rd}} \qquad U_{w_6} = 0.262 \qquad \textbf{< 1.0 /OK}$$

$$\sigma_{max} := \frac{f_u}{\gamma_{M2}}$$

$$U_{w_7} := \frac{\sigma_{per}}{\sigma_{max}} \qquad U_{w_7} = 0.146 \qquad \textbf{< 1.0 /OK}$$

Utilization of weldings

$$U_w = \begin{pmatrix} 0.505 \\ 0.741 \\ 0.116 \\ 0.907 \\ 0.504 \\ 0.262 \\ 0.146 \end{pmatrix}$$

Foot plate - foundation

Note : Conservative check has done

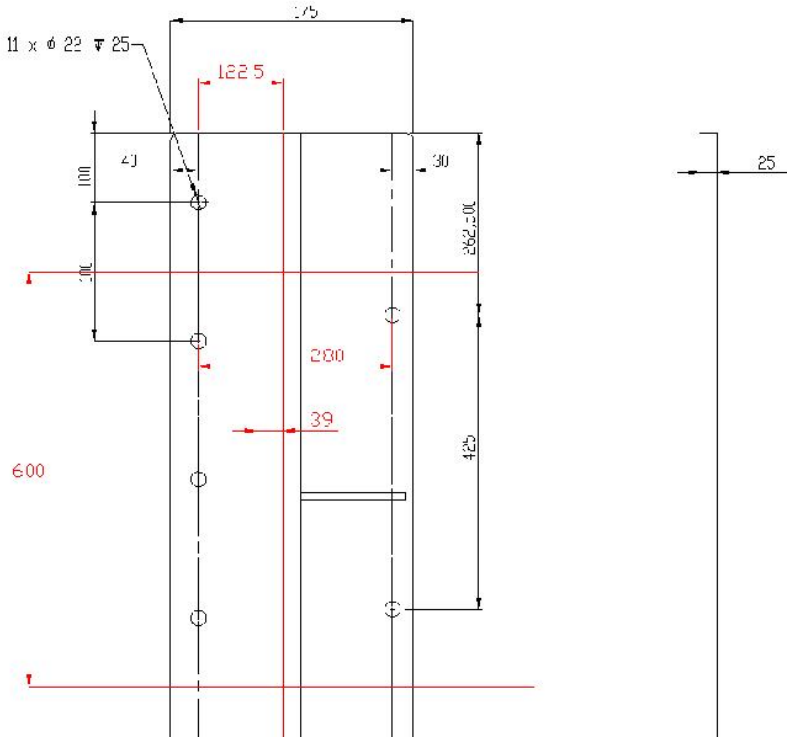
Factorized reactions on one support:

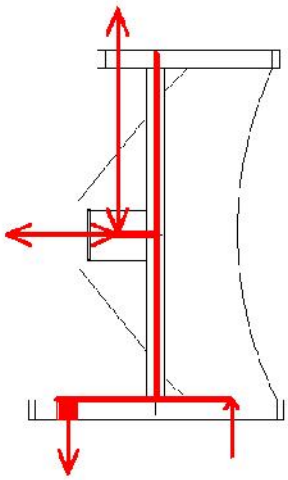
$F_{t.leg} = 518.06 \cdot kN$

$F_{v.leg} = 13.566 \cdot kN$

$F_{c.leg} = 553.45 \cdot kN$

$M_{bfED} = 47.043 \cdot kNm$





Number of bolts per support (2M20):

$n_{ancb} := 2$

Lever arm

$arm := 280mm$

Conservative method is used (2 bolts instead of 3) due to in compression only two bolts work against bending

$$F_{tEd} := \frac{M_{bfED}}{arm \cdot n_{ancb}}$$

$$F_{vEd} := \frac{F_{v.leg}}{n_{ancb}}$$

Footing bolt properties:

Net area of M20 bolts: $A_n := 3 \cdot 314 \cdot mm^2$

Diameter: $\phi_b := 20mm$

Length: $L_0 := 150mm$

Tension area of bolts: $A_s := 3 \cdot 245 \cdot mm^2$

- Material:

Density of steelwork: $\rho_{st} = 7.85 \times 10^3 \frac{kg}{m^3}$

$g = 9.81 \frac{m}{s^2}$

Tensile strength of material: $f_u = 510 \cdot \frac{N}{mm^2}$

Ultimute stress of 8.8 bolts: $f_{ub} = 800 \cdot \frac{N}{mm^2}$

$\gamma_{M2} = 1.25$

Anchor bolts

Note : Conservative check has done

M20x150 (full thread)

Material factor: $\gamma_{M2} = 1.25$

Area of bolts $A_n = 942 \cdot mm^2$

Length of bolts: $L_0 = 150 \cdot mm$

Diameter: $\phi_b = 20 \cdot mm$

Yield stress $f_{ub} = 800 \cdot \frac{N}{mm^2}$

Number of shear planes $n := 1$

Shear resistance $F_{vRd} := n \cdot \frac{0.6 \cdot f_{ub} \cdot A_n}{\gamma_{M2}}$ $F_{vRd} = 361.728 \cdot kN$

Tension resistance $F_{tRd} := \frac{0.9 \cdot f_{ub} \cdot A_s}{\gamma_{M2}}$ $F_{tRd} = 423.36 \cdot kN$

Combined stress Eurocode part 1.1. clause 6.5.5.5

$U_{F_1} := \frac{F_{vEd}}{F_{vRd}} + \frac{F_{tEd}}{1.4 \cdot F_{tRd}}$

Bolt use factor $U_{F_1} = 0.16$ **< 1.0 /OK**

$e_1 := 40mm$ $e_2 := 100mm$ $t := 25mm$

$k_1 := \min\left(2.8 \cdot \frac{e_2}{\phi_b}, 2.5\right)$ $k_1 = 2.5$

$\alpha_b := \min\left(\frac{e_2}{3 \cdot \phi_b}, \frac{f_{ub}}{f_u}, 1.0\right)$ $\alpha_b = 1$

Bearing resistance

$$F_{bRd} := k_1 \cdot \frac{\alpha_b \cdot f_u \cdot \phi_b \cdot t}{\gamma_{M2}}$$

$F_{bRd} = 510 \cdot kN$

Bearing resistance utilization

$$U_{F_2} := \frac{F_{vEd}}{F_{bRd}}$$

$U_{F_2} = 0.013$

< 1.0 /OK

$d_m := 32.4mm$

Punching shear resistance

$$B_{pRd} := \frac{0.6 \cdot \pi \cdot d_m \cdot t \cdot f_u}{\gamma_{M2}}$$

$B_{pRd} = 622.94 \cdot kN$

Punching shear resistance utilization

$$U_{F_3} := \frac{F_{tEd}}{B_{pRd}}$$

$U_{F_3} = 0.135$

< 1.0 /OK

Bolt utilization

$$U_F = \begin{pmatrix} 0.16 \\ 0.013 \\ 0.135 \end{pmatrix}$$

Survey of utilizations

Utilization of support bolts:

$$U_B = \begin{pmatrix} 0.946 \\ 0.014 \\ 0.177 \end{pmatrix}$$

Utilization of brackets:

$$U_{Br} = \begin{pmatrix} 0.069 \\ 0.812 \end{pmatrix}$$

Utilization of web:

$$U_{web} = \begin{pmatrix} 0.051 \\ 0.38 \end{pmatrix}$$

Utilization of foot plate:

$$U_{bf} = (0.928)$$

Utilization of weldings:

$$U_w = \begin{pmatrix} 0.505 \\ 0.741 \\ 0.116 \\ 0.907 \\ 0.504 \\ 0.262 \\ 0.146 \end{pmatrix}$$

Utilization of anchor bolts:

$$U_F = \begin{pmatrix} 0.16 \\ 0.013 \\ 0.135 \end{pmatrix}$$

APPENDIX 3

TECHNICAL DATA OF CRANE
(DATA FROM CUSTOMER)

Performance		2020-K2	2020-K3	2020-K4	2020-K5	2020-K6	2020-K7	2020-K8
Loading group (EN12999)		H1/B3	H1/B3	H1/B3	H1/B3	H1/B3	H1/B3	H1/B3
Load moment	tm	18,4	18	17,5	17,1	16,6	16,2	15,9
Hydraulic reach	m	8,3	10,3	12,5	14,8	17,2	19,4	21,7
Hydraulic telescopic movement	mm	3830	5840	7930	10130	12440	14580	16790
Lifting capacity, hydraulic	kg-m	4260 - 4,3	4080 - 4,4	3910 - 4,5	3740 - 4,6	3590 - 4,6	3430 - 4,7	3320 - 4,8
		2930 - 6,2	2770 - 6,3	2620 - 6,4	2480 - 6,4	2340 - 6,5	2210 - 6,6	2120 - 6,7
		2220 - 8,2	2070 - 8,2	1910 - 8,3	1790 - 8,4	1660 - 8,5	1540 - 8,5	1460 - 8,6
			1650 - 10,2	1510 - 10,3	1370 - 10,4	1250 - 10,5	1130 - 10,5	1050 - 10,6
				1240 - 12,4	1100 - 12,5	980 - 12,6	860 - 12,6	790 - 12,7
					930 - 14,7	810 - 14,8	680 - 14,8	610 - 14,9
						690 - 17,1	570 - 17,1	490 - 17,2
							490 - 19,3	420 - 19,4
								370 - 21,6
Lifting capacity, manual extensions	kg-m			980 - 14,7	740 - 17,1	550 - 19,4	420 - 21,6	320 - 23,9
				790 - 17,1	600 - 19,4	450 - 21,7	320 - 23,9	
				640 - 19,4	500 - 21,7	325 - 24,1		
Slewing torque, gross	kNm	23,8	23,8	23,8	23,8	23,8	23,8	23,8
Slewing angle	°	400	400	400	400	400	400	400
Max. heel at max. load moment	°	5	5	5	5	5	5	5
Slewing speed	°/s	24	24	24	24	24	24	24

Dimensions

Height above chassis	mm	2295	2295	2295	2295	2295	2295	2335
Width	mm	2500	2500	2500	2500	2500	2500	2500
Length, no extra valves	mm	885	885	885	885	885	995	995
Length, with extra valves (hose guides)	mm	1005	1005	1005	1005	1005		
Length, with 1 extra valve (hose reels)	mm						995	995
Length, with 2 extra valves (hose reels)	mm						1030	1030
Length, with extra valves (int. hose routing)	mm	885	885	885	885	885		
Stabilizer spread, S1 (standard)	mm	5575	5575	5575	5575	5575	5575	5575
Stabilizer spread, D	mm	6455	6455	6455	6455	6455	6455	6455

Weights, basic loader

Standard loader 1), excl. stabilizers	kg	1840	1995	2180	2320	2445	2550	2635
Stabilizers, S1 fixed	kg	275	275	275	275	275	275	275
Stabilizers, S1 swing-up	kg	280	280	280	280	280	280	280
Stabilizers, S1 hydr. swing-up	kg	285	285	285	285	285	285	285
Stabilizers, D fixed	kg	355	355	355	355	355	355	355
Stabilizers, D swing-up	kg	355	355	355	355	355	355	355
Stabilizers, D hydr. swing-up	kg	365	365	365	365	365	365	365
Mounting kit, 4 bolts	kg	65	65	65	65	65	65	65
Mounting kit, 8 bolts	kg	60	60	60	60	60	60	60
Tank, excl. oil (fitted on loader)	kg	45	45	45	45	45	45	45
Manual extensions	kg			80	70	60	45	35
	kg			70	60	45	35	
	kg			60	45	35		
Oil in loader (stowing position)	kg	40	45	50	55	60	65	65

1) Weights ± 5% because of tolerances for plate thickness

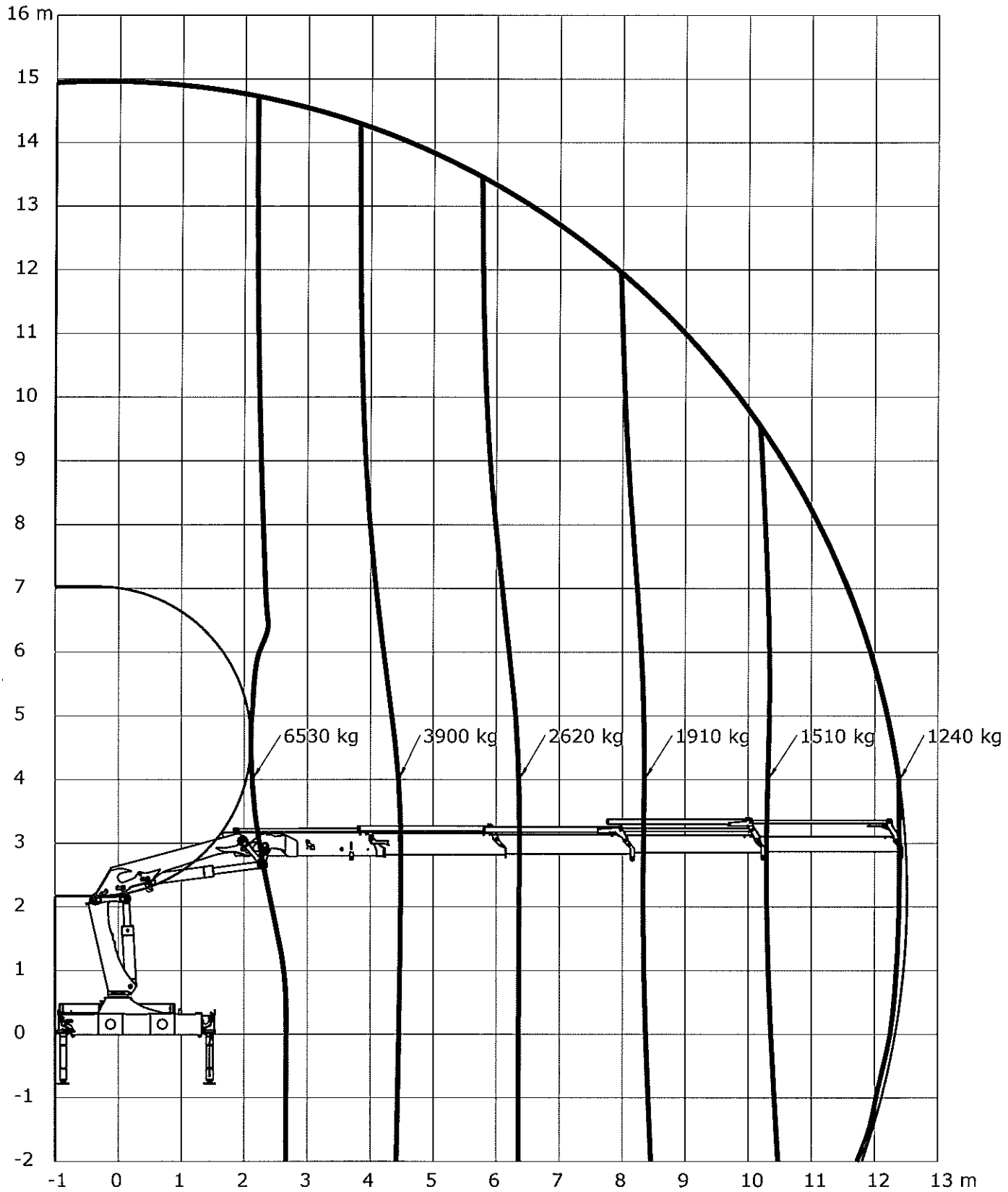
Weights, equipment		2020-K2	2020-K3	2020-K4	2020-K5	2020-K6	2020-K7	2020-K8
Stand-up controls (HS), std.	kg	60	60	60	60	60	60	60
Stand-up controls (HS), direct valve control	kg	70	70	70	70	70	70	70
Top seat (TS)	kg	90	90	90	90	90	90	90
Top seat, ladder	kg	20	20	20	20	20	20	20
1 extra valve, hose guides	kg	55	65	75	85	95		
1 extra valve, hose reels	kg						95	95
1 extra valve, int. hose routing	kg	75	75	80	80	85		
2 extra valves, hose guides	kg	75	90	105	120	135		
2 extra valves, hose reels	kg						185	185
2 extra valves, int. hose routing	kg	130	130	140	145	150		
Winch (1.5 t), single snatch block	kg	175	175	175	175	180	180	190
Winch (1.5 t), double snatch block	kg	170	170	170	170	175	175	180
Winch (2.5 t), single snatch block	kg	200	200	200	200	205	205	210
Winch (2.5 t), double snatch block	kg	195	195	195	195	200	200	205
High-pressure filiter	kg	7	7	7	7	7	7	7
Oil cooler	kg	25	25	25	25	25	25	25

Max. load on stabilizers (per stabilizer cylinder)

S1, fixed	kN	110	110	110	110	110	110	110
S1, swing-up	kN	110	110	110	110	110	110	110
S1, hydr. swing-up	kN	110	110	110	110	110	110	110
D, fixed	kN	85	85	85	85	85	85	85
D, swing-up	kN	85	85	85	85	85	85	85
D, hydr. swing-up	kN	85	85	85	85	85	85	85

Power consumption / oil capacity

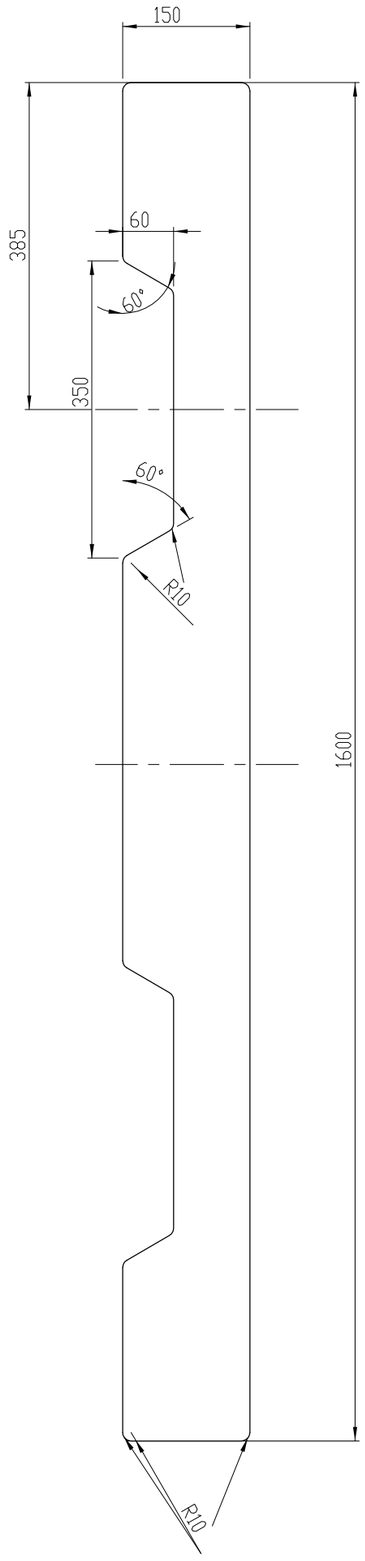
Working pressure	Bar	330	330	330	330	330	330	330
Tank capacity (fitted on loader)	L	90	90	90	90	90	90	90
Max. pump performance, Hydrocontrol, 1-circuit	L/min	55	55	55	55	55	55	55
Max. pump performance, Hydrocontrol, 2-circuit	L/min							
Max. pump performance, Danfoss fixed flow	L/min	70	70	70	70	70	70	70
Max. pump performance, Danfoss variable	L/min	100	100	100	100	100	100	100

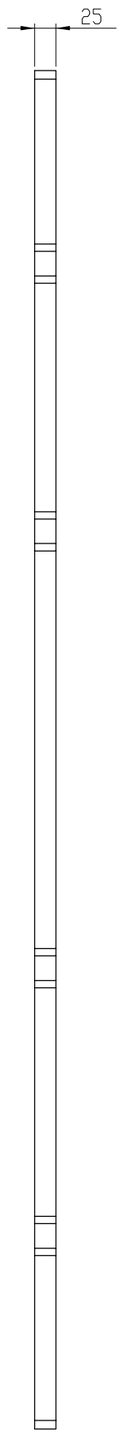


Loading group: EN12999 H1/B3

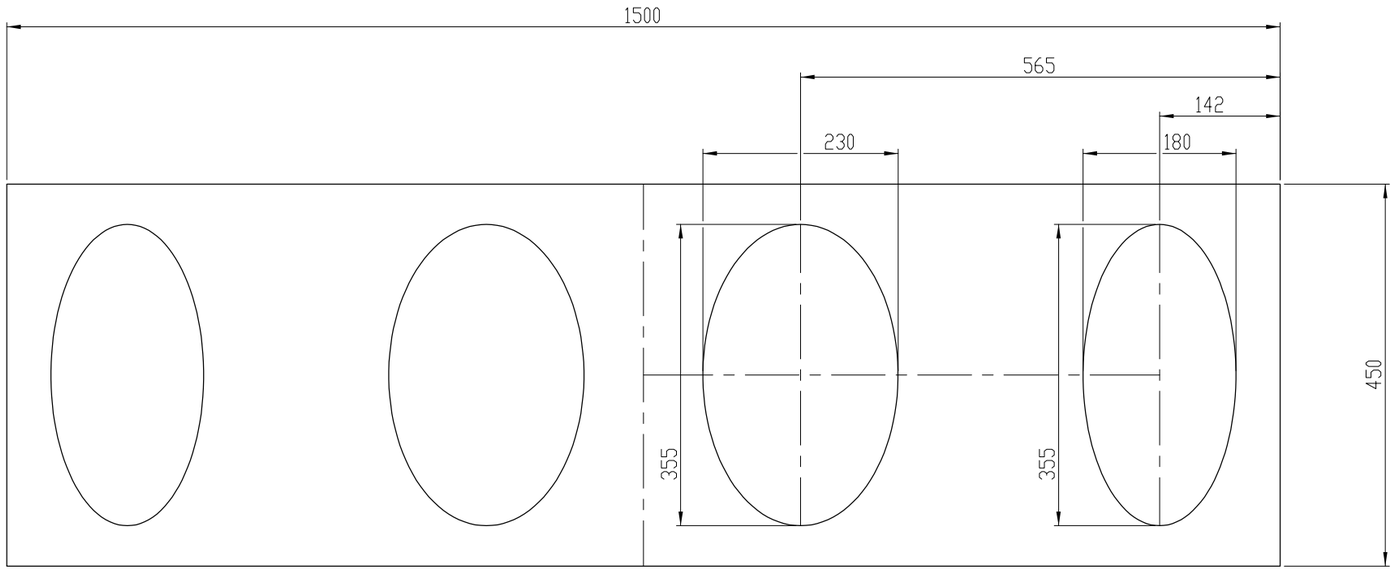
APPENDIX 4

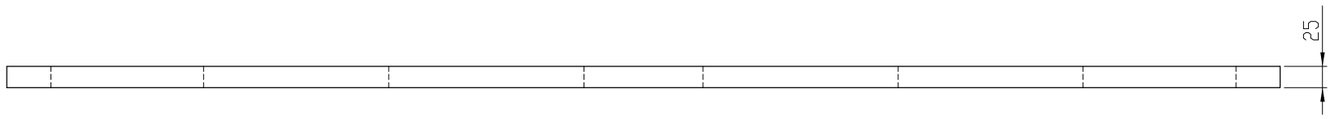
DRAWINGS
(DATA FROM CUSTOMER)

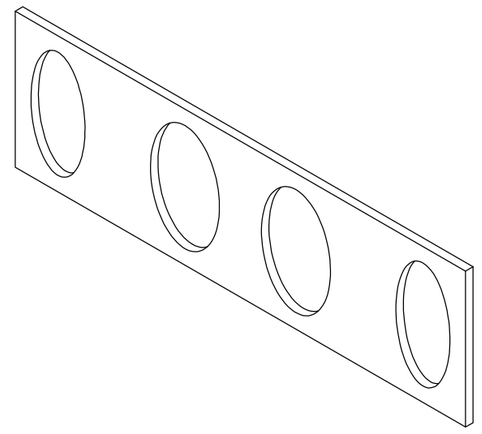




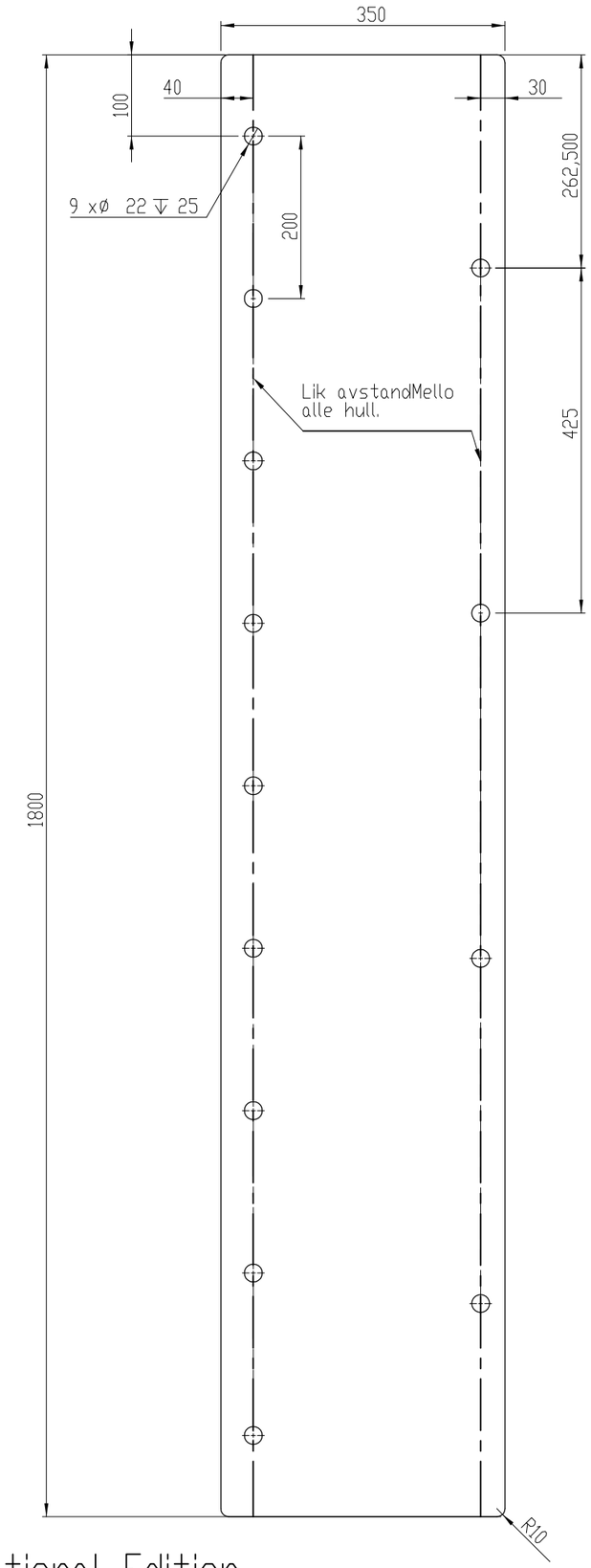
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE: PDS1 - Topp Plate	
DRAWN							
CHK'D							
APPV'D							
MFG							
QA				MATERIAL:		DWG NO. Sammenstilling	A2
				WEIGHT:		SCALE:0.5	SHEET 2 OF 8

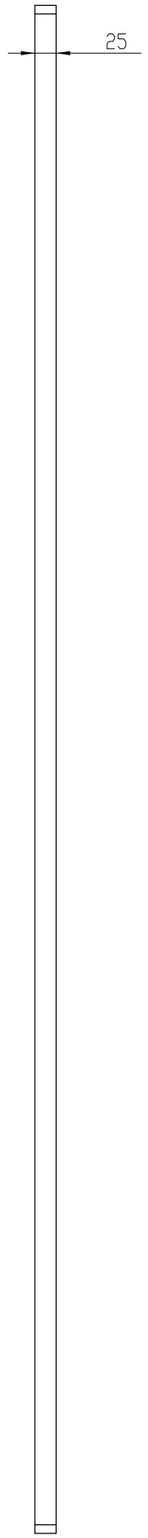




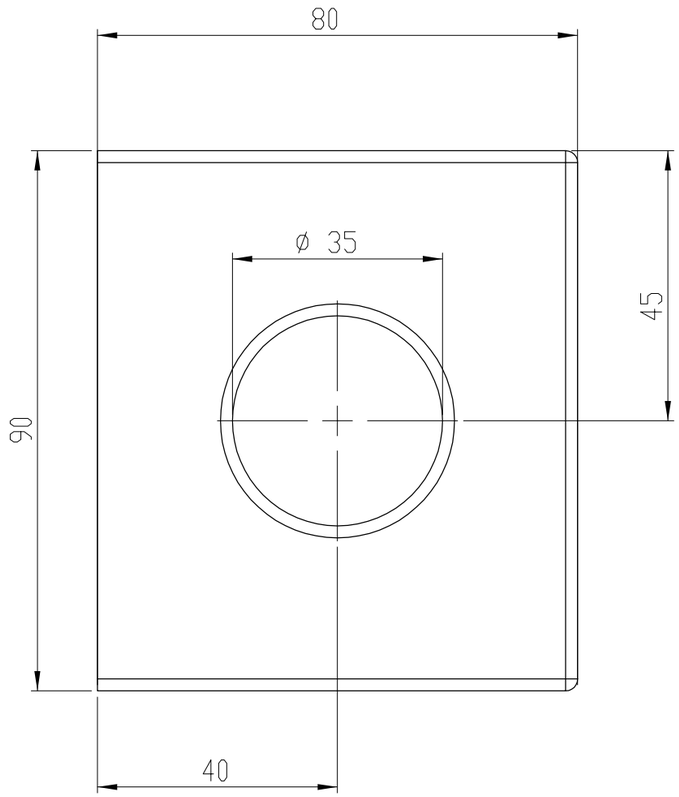


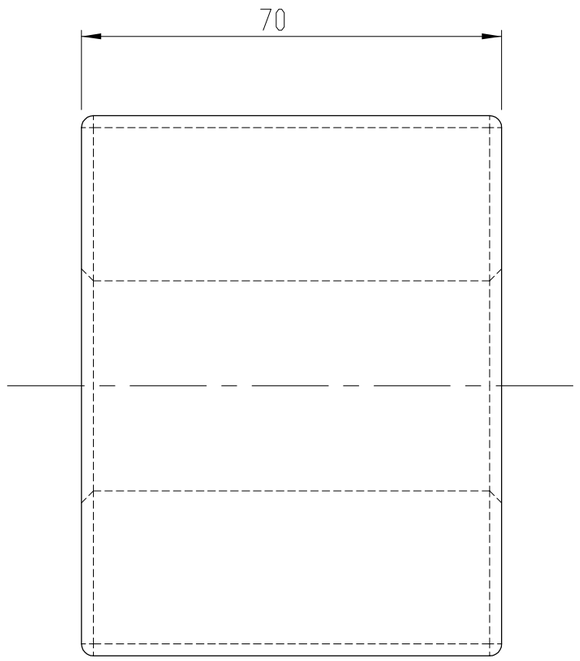
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:			FINISH:			DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE				TITLE: POS2 - Steg	
DRAWN								
CHK'D								
APPV'D								
MFG								
Q.A				MATERIAL:			DWG NO. Sammenstilling	A2
				WEIGHT:			SCALE:0.5	SHEET 3 OF 8





UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:			DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE		TITLE: POS3 - Bunnplate	
DRAWN						
CHK'D						
APPV'D						
MFG						
Q.A				MATERIAL:	DWG NO. Sammenstilling	A2
				WEIGHT:	SCALE:1:5	SHEET 4 OF 8





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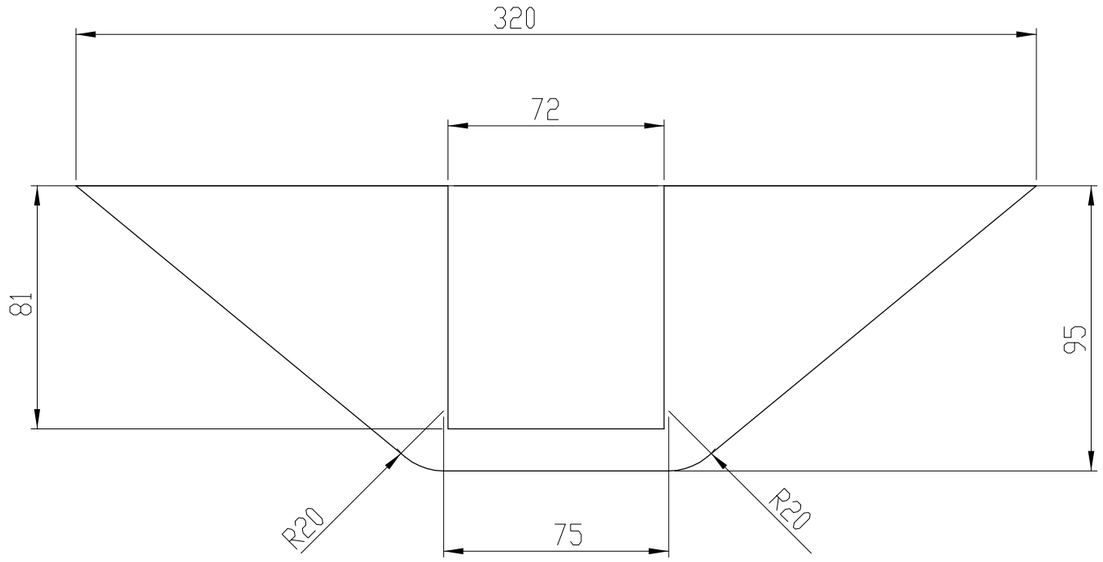
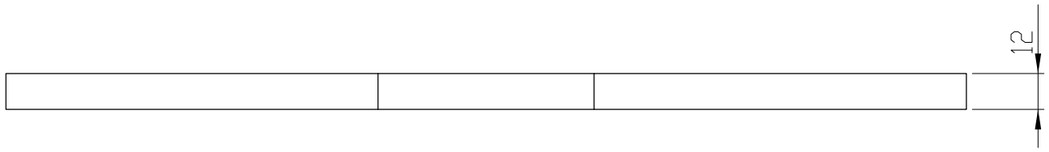
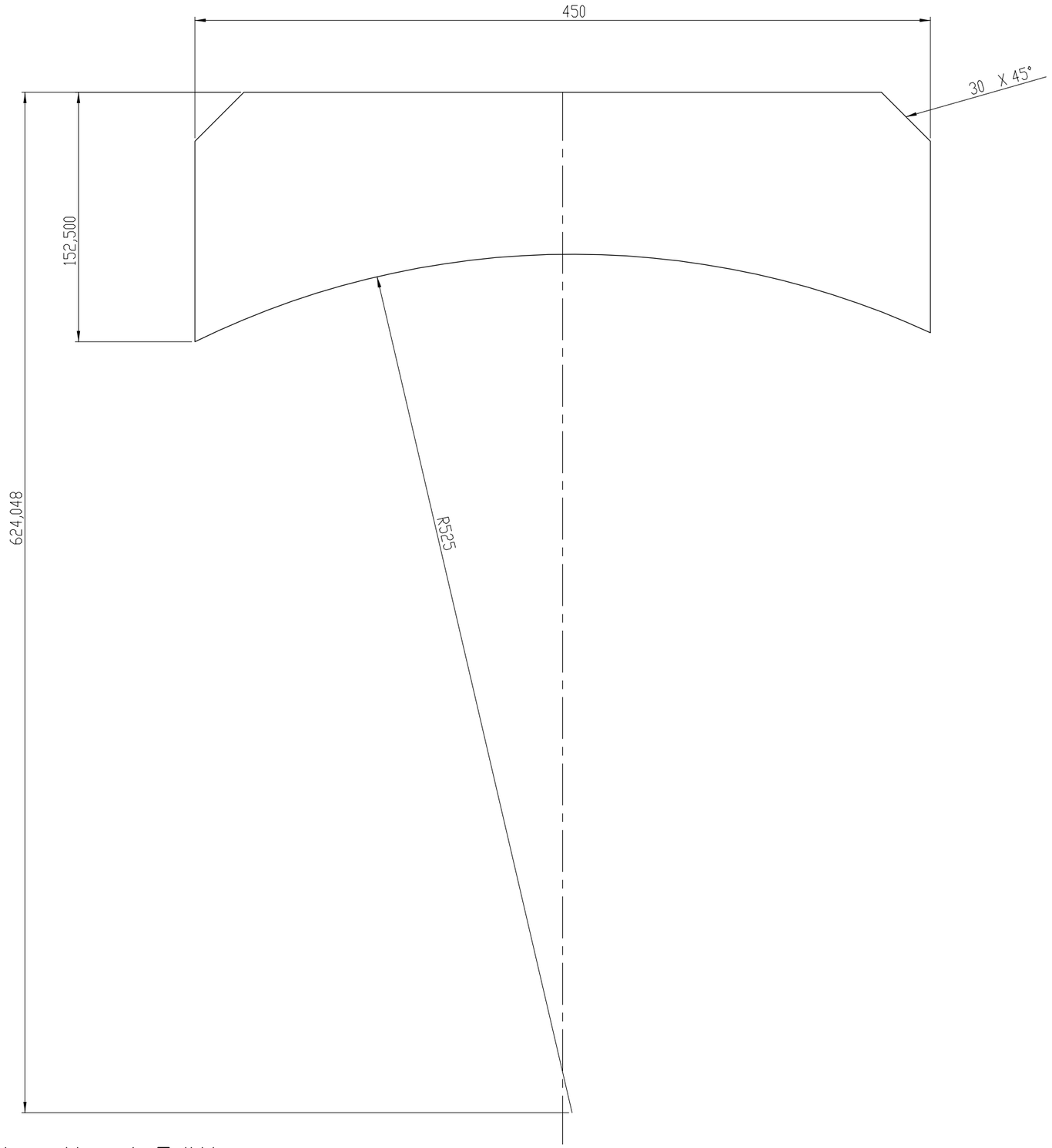
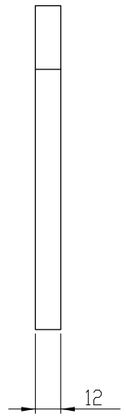
	NAME	SIGNATURE	DATE		TITLE:	
DRAWN					POS4 - Kloss	
CHK'D						
APPV'D						
MFG						
Q.A				MATERIAL:	DWG NO. Sammenstilling	A3
				WEIGHT:	SCALE:1:1	SHEET 5 OF 8



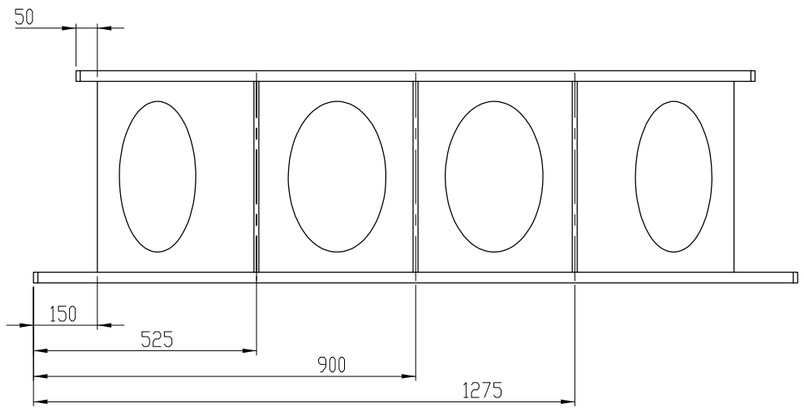


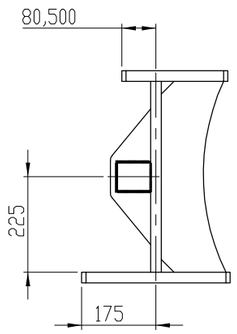
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
DRAWN						POS5 - Brakett_10mm	
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:		DWG NO. Sammenstilling	A3
				WEIGHT:		SCALE:1:2	SHEET 6 OF 8

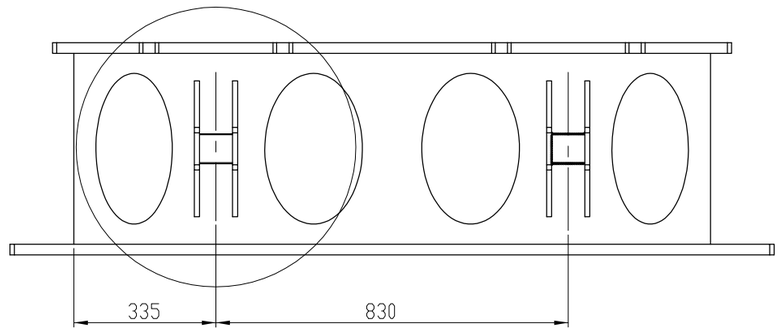


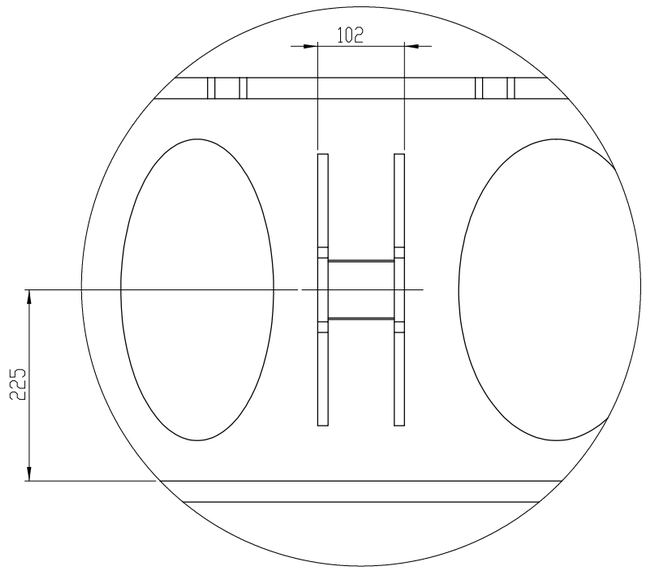


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:		DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE		TITLE: POS6 Brakett_12mm	
DRAWN						
CHK'D						
APPV'D						
MFG						
Q.A				MATERIAL:	DWG NO. Sammenstilling	A2
				WEIGHT:	SCALE:1:2	SHEET 7 OF 8

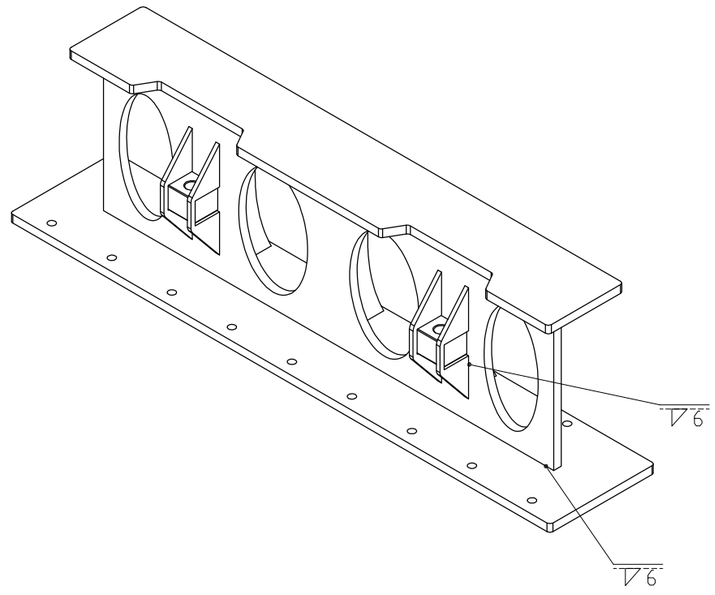






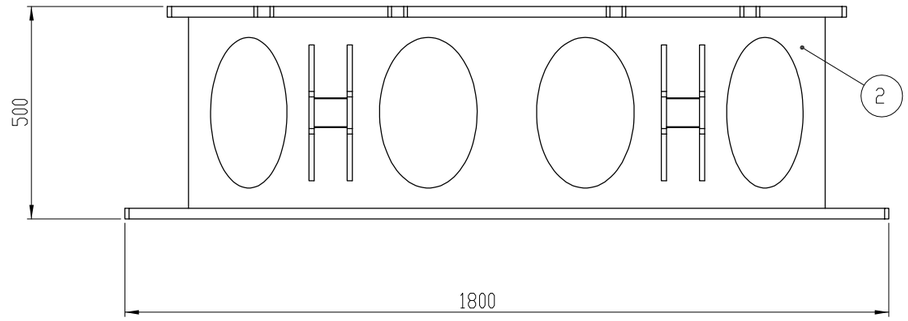


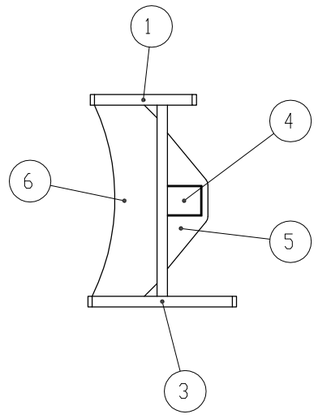
DETAIL A
SCALE 1 : 5

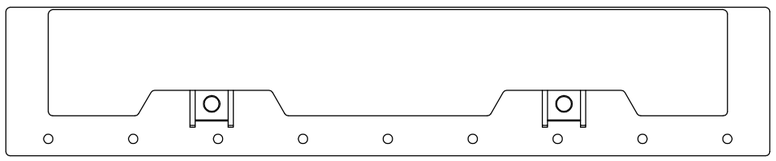


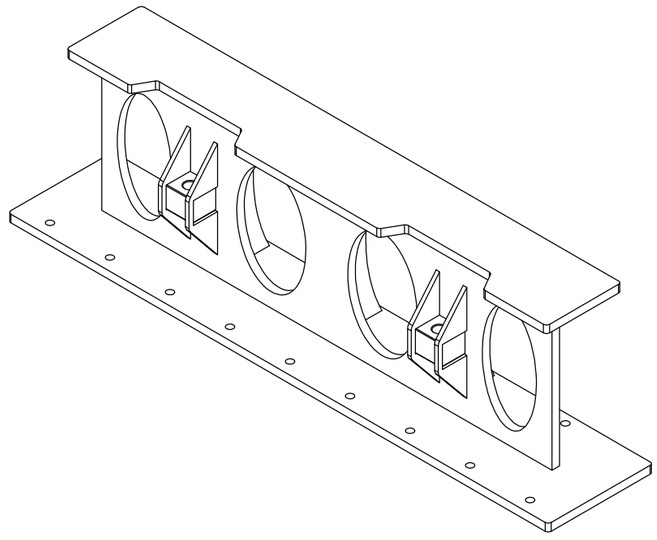
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:			FINISH:			DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING
	NAME	SIGNATURE	DATE				TITLE:
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:			DWG NO. Sammenstilling
							A2
				WEIGHT:			SCALE:010 SHEET 8 OF 8

ITEM NO.	PART NUMBER	DESCRIPTION	Default/ QTY.
1	Top_plate		1
2	Steg		1
3	Bunnplate		1
4	Kloss		2
5	Brakett_10mm		4
6	brakett_12mm		3





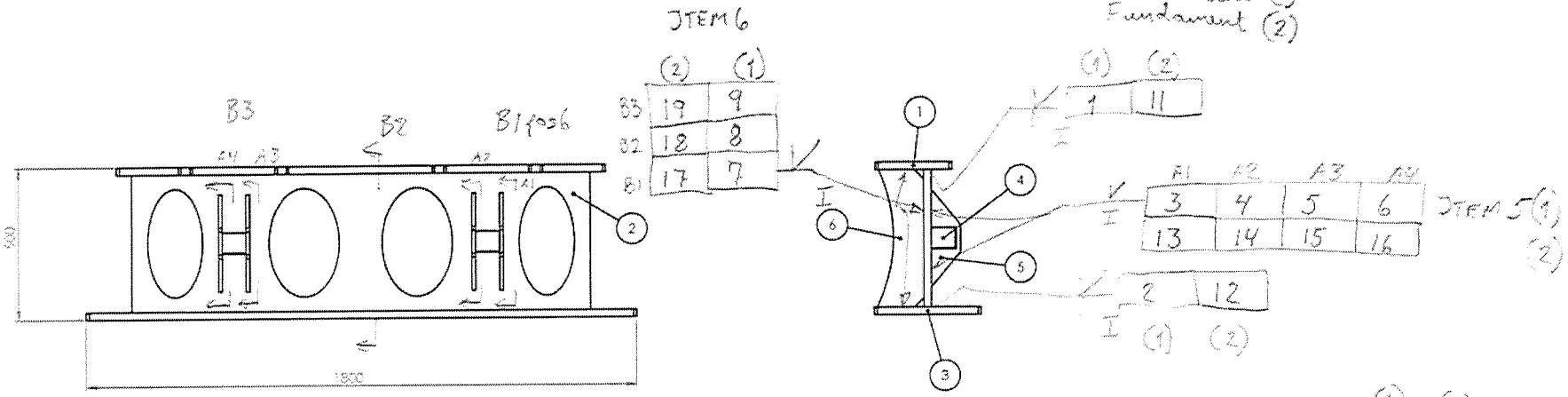


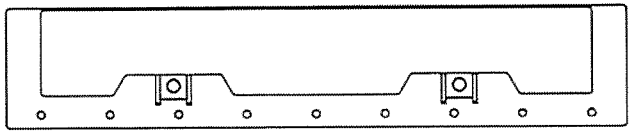


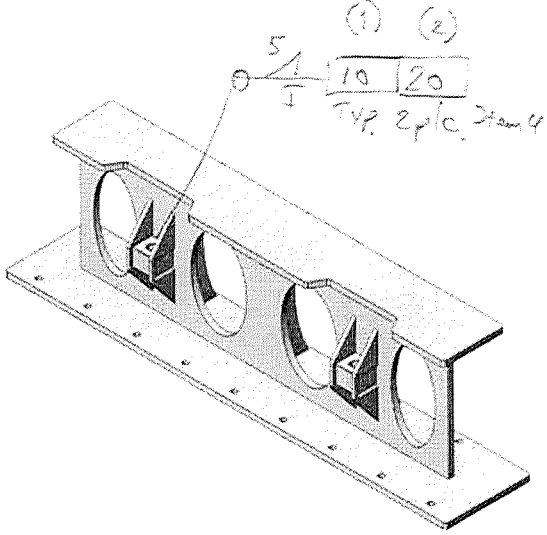
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:				DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING
	NAME	SIGNATURE	DATE				TITLE:
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:		DWG NO. Sammenstilling	A2
				WEIGHT:		SCALE:1:10	SHEET 1 OF 8

ITEM NO.	PART NUMBER	DESCRIPTION	Default/ QTY
1	Top_plate		1
2	Steg		1
3	Bunnplate		1
4	Kloss		2
5	Brakett_10mm		4
6	brakett_12mm		3

Fundament (1)
Fundament (2)







NOTE. WELDNO's 1-20 USED
ALL WELD TO BE INSP. CAT. I

Sammenstilling A2