

DEGREE OF FREEDOM

PROJECT	Frederikke – Rehabilitering fasade og tekniske anlegg					
PHASE						
TITLE	Beregning av stålbjelker for nye installasjoner på tak					
CLIENT	Universitetet i Oslo					
DATE	01.06.2026					
REPORT ID	25086-R02					
SAMMENDRAG Denne beregningsrapporten omhandler nye stålbjelkekonstruksjoner på tak for nye RIV installasjoner på tak. Det skal installeres en isvannsmaskin og isvannstank på taket. Taket består av lettbetong elementer (siporex el.l, t=150mm) opplagt på prefabrikkerte betongbjelker. Konstruksjonstegninger for disse elementene har ikke vært mulig å oppdrive. Det har derfor ikke vært mulig å beregne kapasiteten for disse elementene. For å kunne etablere nye installasjoner på taket med tilhørende laster, så skal laget med elvestein som ligger på taket i tak fjernes. Lasten fra nye installasjoner på taket tilsvarer vekten av elvesteinslaget på taket, så det totale lastbildet for takkonstruksjonen forblir uendret. Denne tilnærmingen gir kun et grovt overslag av størrelsesorden og tilstanden til konstruksjonen, og skal ikke betraktes som en endelig eller pålitelig vurdering av de prefabrikkerte bjelkenes bæreevne. PROSJEKTERINGSFORUTSETNINGER SOM MÅ BEKREFTES PÅ BYGGEPLASS • Lettbetongdekket skal ha minimum trykkfasthet på 10 MPa. Dette må verifiseres før arbeidene igangsettes. • Friksjonskoeffisienten mellom ståplate og eksisterende lettbetongdekke skal være minimum 0,45.						
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1 INTRODUCTION

Degree of Freedom (DOF) has been requested to assess the structural behaviour of the prestressed beams supporting the terrace area of the Frederikke building at the University of Oslo, in relation to the modifications associated with the building refurbishment. These modifications include the replacement of existing heavy equipment and the installation of new units, which will alter the loading conditions for which the beams were originally designed. On the other hand, the beams needed to support the new machines on the roof are calculated and their support to the existing structure.



Figure 1-1. Frederikke building location within the Oslo University campus.



Figure 1-2. Frederikke terrace area under evaluation.

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1.1 SCOPE OF WORKS

As previously mentioned, due to the new refurbishment of the Frederikke building, several modifications will be carried out in the terrace area, including the installation of new equipment such as cooling units and ice tanks. On the other hand, it will be undertaken the removal of the existing 4 cm gravel layer on the whole roof area, as shown in the attached image.



Figure 1-3. Current situation at the roof area (gravel layer)

Based on the architectural drawings provided by ARK, a comparison can be made between the existing and the proposed roof layouts, showing the planned removal of certain equipment and their replacement with new units.



Figure 1-4. Existing equipment removal at terrace

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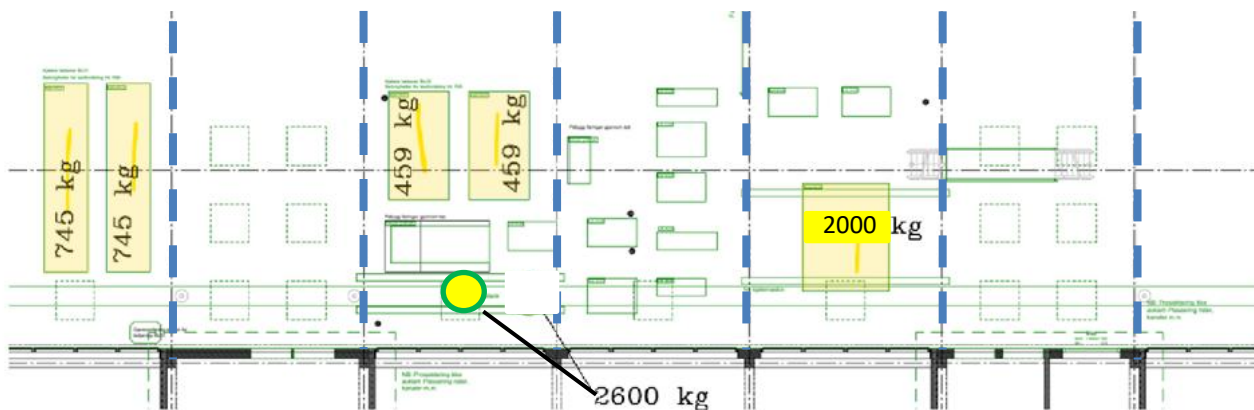


Figure 1-5. New equipment locations at the terrace, showing the existing prestressed beams (blue dotted lines)

The structural system supporting the roof consists of 900 mm deep prestressed beams spanning 15 m across the terrace area and supported at both ends by reinforced concrete columns. The beams are arranged at a regular spacing of 5 m.

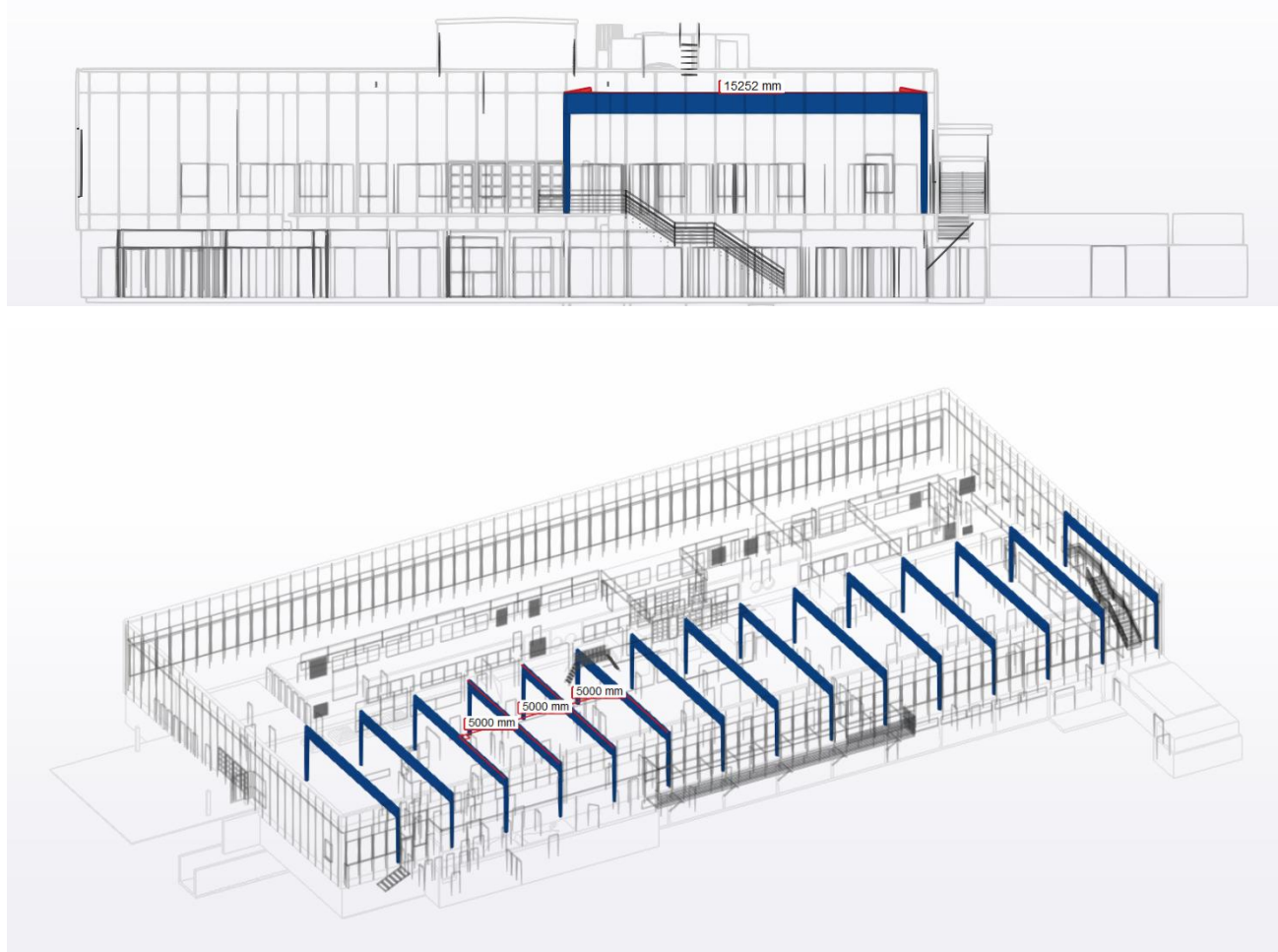


Figure 1-6. Structural system of the prestressed beams under the terrace.

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Figure 1-7. In-situ picture of the prestressed beam current status.

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2 REFERENCE FILES

- [1] 471.031 Egenlaster for bygningsmaterialer, byggevarer og bygningsdeler (v2013).pdf
- [2] ARL_Details. A50-5 Detaljer yttervegg - div. alternativer, received by email on 06/01/2026
- [3] 2026-05-13 BL03 skisse det tak, received by email on 13/05/2026
- [4] SKM_C45825100107010, received by email on 01/10/2026

3 DESIGN ASSUMPTIONS AND DISCLAIMERS

- The structural evaluation of the prestressed beams carried out by DOF at this stage is based on a highly approximate approach, as significant information is missing regarding the materials used, the prestressing system employed, and the current condition of the elements. Consequently, the assessment is limited to the analysis of the variation in loads and the evaluation of the potential theoretical impact that these changes may have on the structural system.
- The structural evaluation of the existing lightweight concrete slab is evaluated where the new machines are installed, checking if the reactions transmitted by the machinery supports can be resisted by this existing slab.
- The existing pebble stones layer has been assimilated to “gravel and sand, bulked” as defined in EN 1991-1-1 (Eurocode 1), Annex A, which provides a characteristic unit weight in the range of 15 to 20 kN/m³. Since the present analysis evaluates the permanent load that will be removed from the structure, the lower bound of the normative range has been adopted to avoid overestimating the beneficial effect of the load reduction. Accordingly, a unit weight of 15 kN/m³ has been considered.
For a layer thickness of 4 cm → $15\text{ kN/m}^3 \cdot 0,04\text{ m} \cdot 5\text{ m} = 3\text{ kN/m} = \mathbf{300\text{ kg/m}}$
- The I-shaped prestressed beam section has been assumed to correspond to the one shown in the drawing “Skjema av trapp til tak” from the original drawing set provided by ARK. If this does not correspond to the actual section of the prestressed beams under evaluation, this should be clarified. The dimensions shown in the attached screenshot have been adopted as an approximate representation of the actual dimensions.

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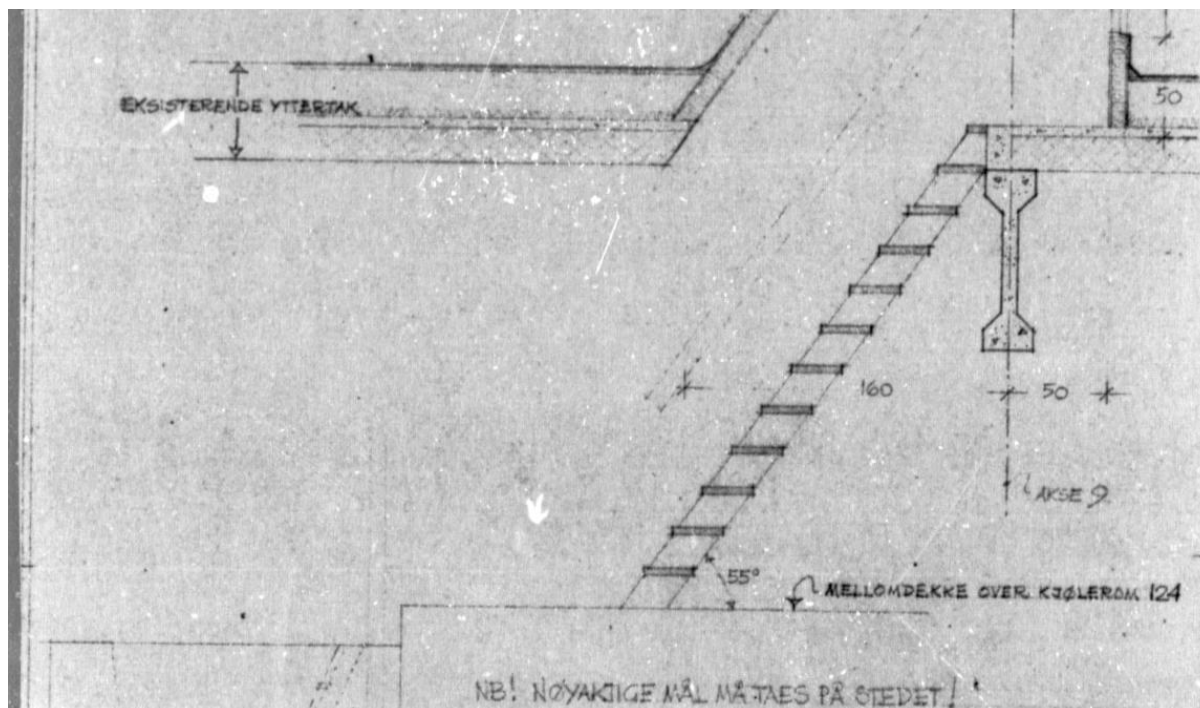


Figure 3-1. Original drawing where the cross section of the I-shaped prestressed beam is shown.

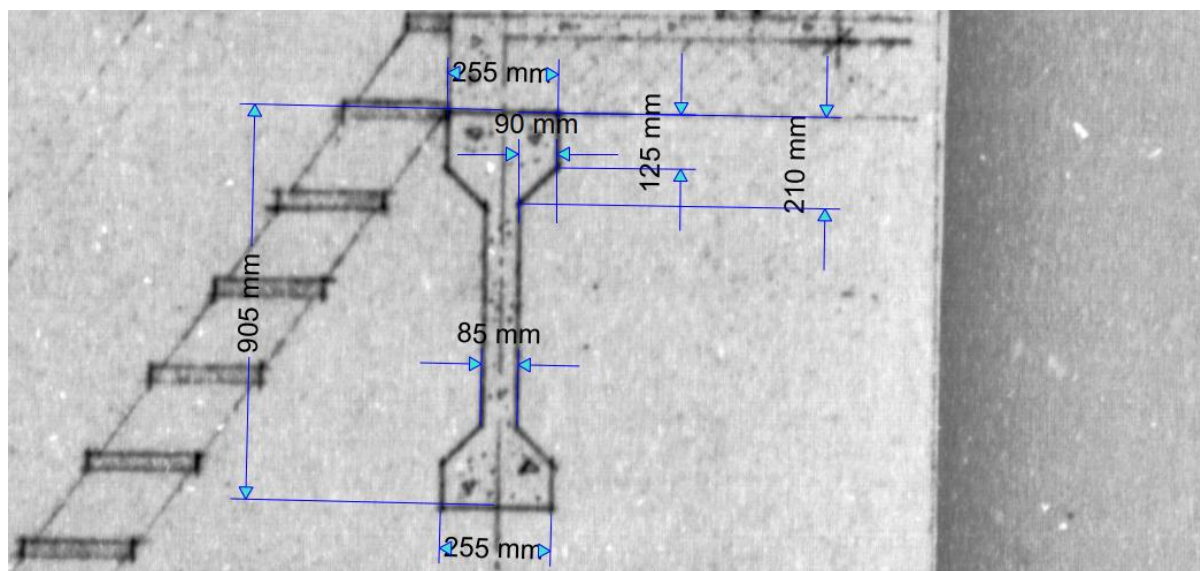


Figure 3-2. Approximated dimensions of the prestressed beam considered.

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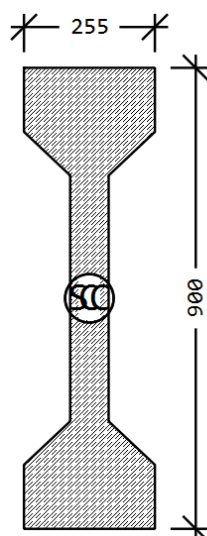
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4 LOADS CONSIDERED

4.1 EXISTING PRESTRESSED BEAM CHECK

4.1.1 PRESTRESSED BEAM WEIGHT

The self-weight of the prestressed beam in accordance with the cross section assumed is estimated at **319,50 kg/m**.



Cross-sections static properties

SNo	Mat	A[m ²]	Ay[m ²]	Iy[m ⁴]	yc[mm]	ysc[mm]	E[N/mm ²]	g[kg/m]	I-1[m ⁴]
	MRf	It[m ⁴]	Az[m ²]	Iz[m ⁴]	zc[mm]	zsc[mm]	G[N/mm ²]		I-2[m ⁴]
			Ayz[m ²]	Iyz[m ⁴]					α[°]
1	1	1.2780E-01	8.437E-02	1.272E-02	0.0	0.0	34077	319.5	1.272E-02

Figure 4-1. Estimated self-weight for the prestressed beam cross section considered.

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4.1.2 EXISTING TERRACE ROOF SLAB AND FINISHES

The total weight of the terrace elements of the building has been estimated in accordance with document 471.031 Egenlaster for bygningsmaterialer (Byggforskserien) [1].

According to the available information, the terrace slab consists of 18 cm thick lightweight concrete of the SIPOREX type. Based on the reference document, a unit weight of 5,80 kN/m³ has been adopted [1].

As the evaluation procedure for the prestressed beam is based on comparing the additional load with respect to the existing dead load currently acting on the beam, a conservative approach has been adopted. Therefore, the load associated with the insulation layers located above the SIPOREX slab has not been considered. This insulation begins at approximately 600 mm above the façade edge and follows a downward slope of 1:40.

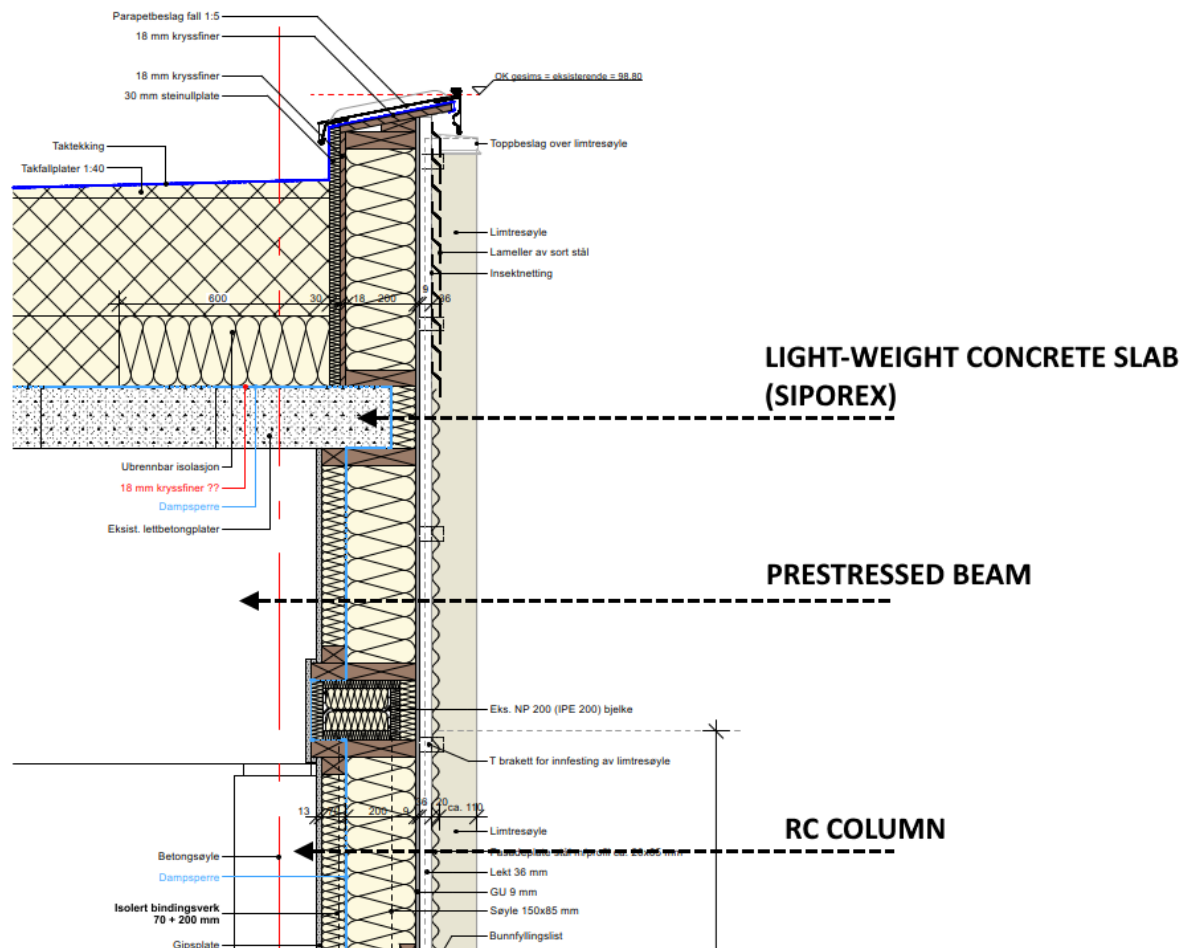


Figure 4-2. New building façade section where the terrace build-up above the prestressed beam is defined.

Then, the SIPOREX dead load transferred to the beams is $5,80 \text{ kN/m}^3 \cdot 0,18 \text{ m} \cdot 5 \text{ m} = 5,22 \text{ kN/m} = 522 \text{ kg/m}$

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4.1.3 GRAVEL LAYER TO BE REMOVED

As previously defined in this document, the load subtraction from the prestressed beams due to the gravel layer removal is estimated at **300 kg/m**.

4.1.4 NEW EQUIPMENT UNITS

The loads associated with the weight of the new equipment to be installed on the terrace are indicated in the drawing provided by ARK, whose loads are confirmed on reference document [4]. In addition, the weight of the steel profiles supporting two of these units, highlighted in the attached image, must also be considered. For these 5 meters long support frames, HEA 160 profiles have been assumed, with an estimated weight of $30,50 \text{ kg/m} \cdot 5\text{m} = 153 \text{ kg}$ each and UPE 160 profiles on the extremes to provide lateral restraint, with an estimated weight of $17 \text{ kg/m} \cdot 5 = 85 \text{ kg}$.

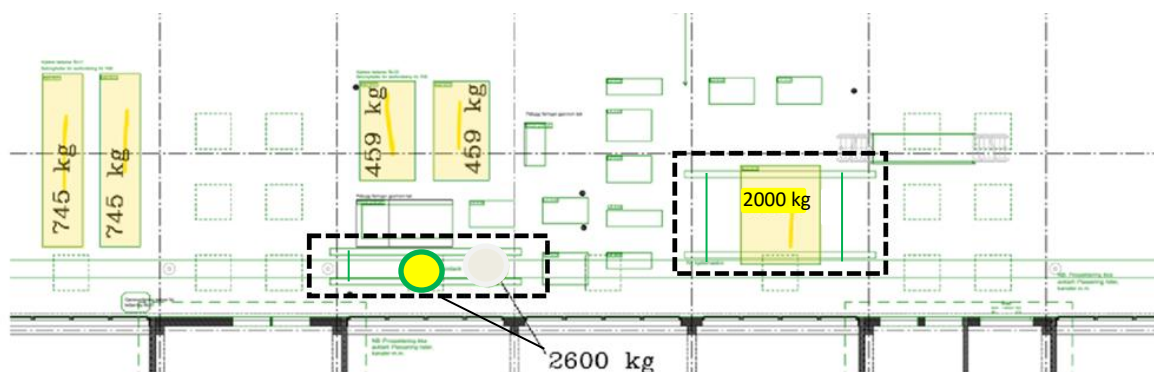


Figure 4-3. Location and weight of the new units at the terrace

4.2 NEW BEAMS ON THE ROOF TO SUPPORT THE NEW MACHINES

4.2.1 WIND LOAD

On the safety side, it is considered the wind on all the faces of the machines although some of them may be protected by other obstacles. The most unfavourable wind load obtained on the 25086_R01 report is followed, increasing from 0.84 kN/m² to 1 kN/m² to have into account the increase of height in which the wind acts due to the height of the machines.

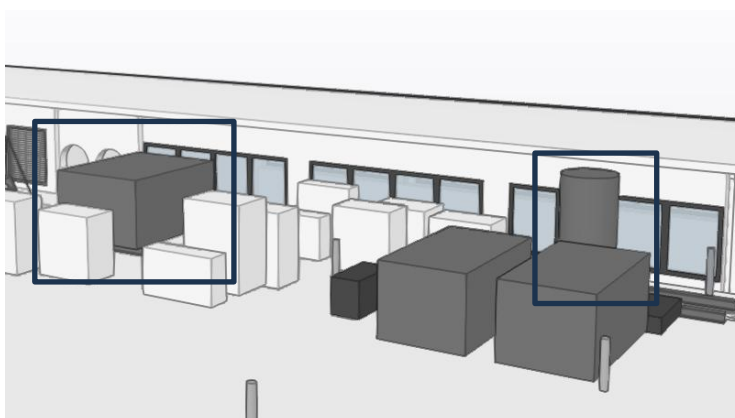


Figure 4-4. Situation of the machines around other obstacles

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4.2.2 SNOW LOADS

It is also considered that amount of snow can be retained on the top face of the machines.

For the persistent/transient design situations, the snow load on roofs (s) shall be determined as recommended in NS EN 1991-1-3, §5.2(3):

$$s = \mu_i \cdot C_e \cdot C_t \cdot s_k$$

Where:

μ_i : snow load shape coefficient.

C_e : exposure coefficient.

C_t : thermal coefficient.

s_k : characteristic value of snow load on ground.

For accidental design situations where exceptional snow load/drift is the accidental action, see NS-EN 1991-3, §5.2(3).

For this project, a normal topography category is assumed, where there is no significant removal of snow by wind on construction work. Then, $C_e = 1$.

Additionally, no snow load reduction on roofs due melting caused by heat loss has been considered, then $C_t = 1$.

The snow load shape coefficients (μ_1 , μ_2) used to estimate the load on each roof are defined in Table 5.2 of the NS-EN 1991-1-3:2003, which is attached below along a graphically representation of the coefficient variation according to the angle of pitch of roof.

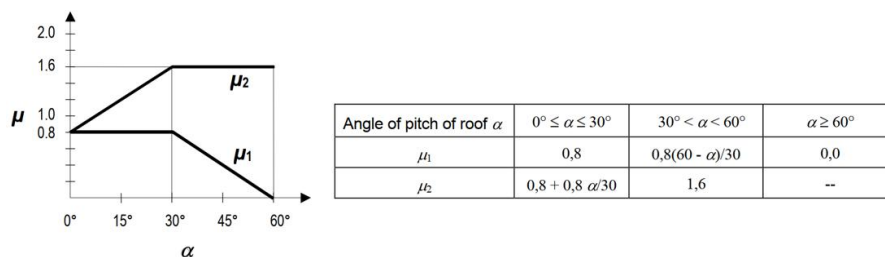


Figure 4-5. Snow load on Oslo 89.9 m

Therefore, $\mu_1 = 0.8$ with an angle of roof of 1.6°

As a result, the design snow load is $s = 0.8 \cdot 1 \cdot 1 \cdot 3.5 = 2.8 \text{ kN/m}^2$

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5 STRUCTURAL EVALUATION

Considering the information previously stated in this document, the superposition of the original and proposed equipment layouts identifies four relevant areas where the impact on the prestressed beams should be evaluated.

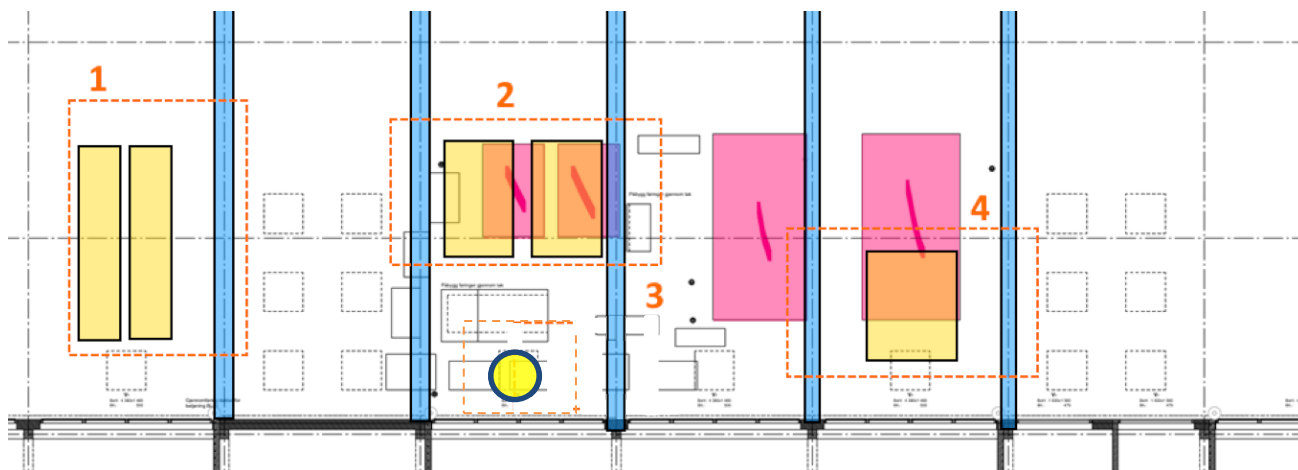


Figure 5-1. Superposition of the removed (pink) and new (yellow) equipment locations at the terrace.

For the evaluation of Areas 1 and 2, a conservative approach has been adopted, considering only the net load variation resulting from the removal of gravel and existing equipment and the installation of the new units within the tributary area of the 15 m span beam affected by these interventions. The overall load reduction along the full span due to gravel removal has been disregarded.

For Areas 3 and 4, where the heaviest new equipment is located, this approach is considered overly conservative. Therefore, the analysis has been performed on a more global basis.

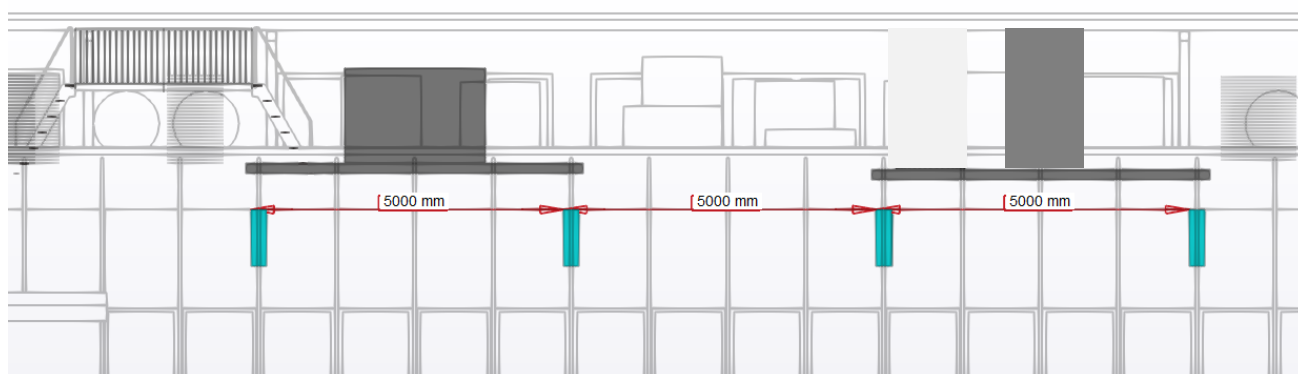


Figure 5-2. Elevation view of the heaviest new units and the affected prestressed beams.

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5.1 AREA 1

Based on the drawings provided by ARK, the new equipment located in Area 1 is considered to have plan dimensions of 5×1,15 m and a weight of 750 kg each. For the prestressed beam under consideration, within its tributary area there is one complete unit and an additional 300 mm portion of the adjacent unit. Therefore, the total additional load associated with this equipment is estimated proportionally as $(750 \text{ kg} + (0,30/1,15) \cdot 750 \text{ kg})/5\text{m} = \mathbf{190 \text{ kg/m}}$.

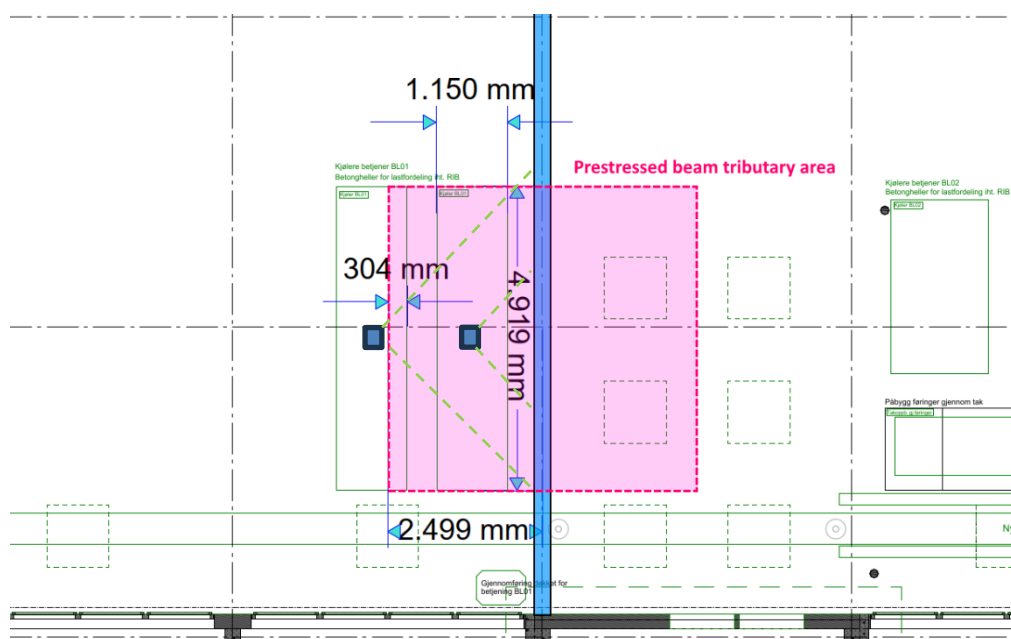


Figure 5-3. Loading situation at terrace in study Area 1.

The reduction in load associated with the pebble gravel layer removal within the tributary area of the prestressed beam at the location of the new unit, as previously justified, is estimated at **300 kg/m**.

Therefore, the difference between the removed and the added loads results in a **net reduction of approximately 110 kg/m** acting on the beam within the studied span segment following this methodology.

On the other hand, another methodology is studied:

- Each equipment weights 750 kg represented by the blue boxes
- This weight is transmitted to the existing prestressed beam (45° to the beam, dotted green lines), whose value is the reaction obtained on the 5m slab span.
- Considering the position of these loads, the reaction of these equipments on the right-hand side is 9 kN, transmitted by 5.4 m long on the prestressed beams. As a result, the weight transmitted on the prestressed beam is $9 / 5.4 = 1.7 \text{ kN/m}$, in comparison to the 3 kN/m due to the removal of gravel.

Consequently, the proposed configuration leads to a favourable loading condition for the beam.

The equipment must be longitudinally distributed along all the perimeters. In the case that this is not possible, further information regarding the status, reinforcement and compressive strength of the lightweight concrete slab must be reported in order to provide a minimum area to transmit these loads.

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5.2 AREA 2

Although equipment previously existed at this location and has been replaced by new units which, according to RIV, are lighter than the original ones, a conservative approach has been adopted and this circumstance has not been considered. Accounting for this difference would already result in a straight reduction of the load acting on the beam due to the installation of lighter equipment. Therefore, the weight of the new equipment has been treated entirely as an additional load.

Based on the drawings provided by ARK, the new equipment located in Area 2 is considered to have plan dimensions of 2,80x1,60 m and a weight of 459 kg each. For the prestressed beam under consideration, within its tributary area there is one complete unit. Therefore, the total additional load associated with this equipment is estimated as

$$q = 459 \text{ kg}/2,80\text{m} = \mathbf{165 \text{ kg/m.}}$$

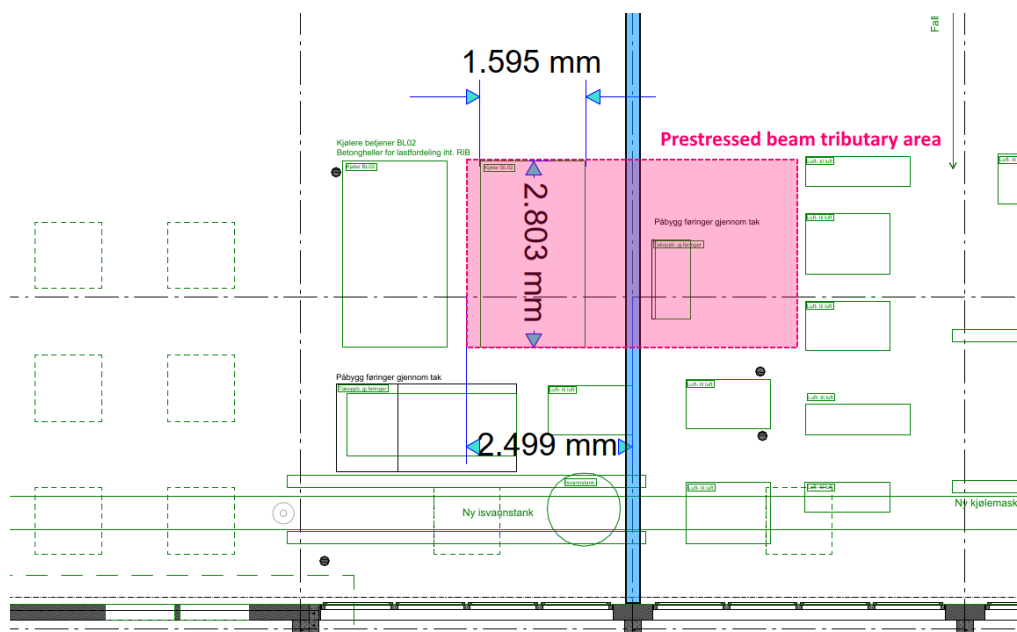


Figure 5-4. Loading situation at terrace in study Area 2.

The reduction in load associated with the pebble gravel layer removal within the tributary area of the prestressed beam at the location of the new unit, as previously justified, is estimated at **300 kg/m**.

Therefore, the difference between the removed and the added loads results in a **net reduction of approximately 135 kg/m** acting on the beam within the studied span segment. Consequently, the proposed configuration leads to a favourable loading condition for the beam.

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5.3 AREA 3

Based on the drawings provided by ARK, the new cylindrical tank located in Area 3 has a weight of 2600 kg.



Figure 5-5. Location of the new cylindrical tank at the terrace area.

The HEA 160 support profiles of the frame carrying the tank are spaced at 850 mm. Due to the centric position of the tank on the support frame, it is assumed that the load is evenly distributed between the prestressed beams located beneath, each corresponding to the combined weight of the tank and the support profiles (30,40 kg/m, HEA 160; 17 kg/m, UPE 160 on the extremes to provide lateral restraint) equal to:

$$q = 2600\text{kg}/4 + 2 \cdot (30,40\text{kg}/\text{m} \cdot 5,40\text{ m})/4 + 2 \cdot (17\text{kg}/\text{m} \cdot 1\text{m})/2 = \mathbf{750\text{ kg (red arrows)}}.$$

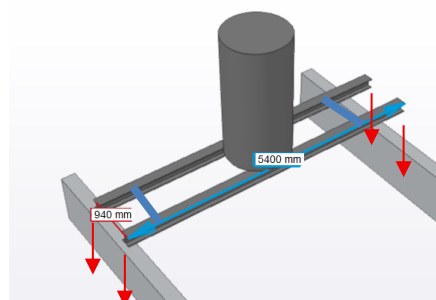


Figure 5-6. Plan and detailed view of the new cylindrical tank in Area 3 of the terrace.

The reduction in load associated with the pebble gravel layer removal within the tributary area of the prestressed beam at the location of the new unit, as previously justified, is estimated at **300 kg/m**.

A preliminary assessment has been carried out based on the net variation of permanent load acting on the existing 900 mm deep prestressed beam, since no reliable information is currently available regarding the prestressing layout, reinforcement, material properties, or detailed section capacity of the element.

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The new tank and its supporting steel frame introduce a total permanent load of approximately 29,30 kN, assumed that the entire load is transferred to the nearest prestressed beam. Accordingly, the additional load applied to the beam under consideration is transmitted through two point-loads of about 14,65 kN each.

At the same time, the existing gravel ballast layer is removed over the full roof area. Based on the adopted value of 300 kg/m acting on each beam, this corresponds to a permanent load reduction of approximately 2,94 kN/m. For a beam span of 15 m, the total removed load is therefore about 44 kN.

It follows that the total permanent load removed from the beam is significantly greater than the permanent load introduced by the new tank arrangement. On a global basis, the beam is therefore subject to a net reduction in permanent loading. A simplified comparison of structural effects also indicates that the reduction in uniformly distributed load produces a larger decrease in global bending moment and support reactions than the increase generated by the new concentrated loads:

- Permanent loads influence:
 - o Existing permanent loads (SW+DL) = 840 kg/m
 - o Load reduction due gravel removal = 300 kg/m

So, the gravel removal means a $300/840 = 36\%$ permanent load reduction, which is a high relevant value.

- Bending influence (assuming the formulation for a simply supported beam):
 - o Bending moment due existing permanent load = $qL^2/8 = 8,24 \cdot 15^2/8 = 232 \text{ mkN}$
 - o Bending moment reduction due gravel removal = $qL^2/8 = 3 \cdot 15^2/8 = 83 \text{ mkN}$

Assuming a resulting force of the new unit weight acting at approximately 2 m from the beam support, the resulting maximum bending moment would be:

- o Bending moment due to new equipment = $F \cdot a \cdot b/L = 29,30 \text{ kN} \cdot 2 \text{ m} \cdot 13 \text{ m}/15 \text{ m} = 51 \text{ mkN}$

Therefore, the reduction in load resulting from the gravel removal is significantly greater than the increase generated by the installation of the new equipment. Consequently, from a global bending perspective, the new loading condition of the beam may be considered favorable.

- Shear influence:
 - o Global reduction from the gravel removal = $2,94 \text{ kN/m} \cdot 15 \text{ m}/2 = 22 \text{ kN}$
 - o New vertical force due to new equipment = 29,30 kN

The increase in shear exceeds the load reduction resulting from the removal of the gravel layer ($0.84 \cdot 15/2 = 6.3 \text{ kN}$ vs $29.3 - 22 = 7 \text{ kN} \rightarrow 10\%$). Therefore, a more detailed analysis should be carried out to assess whether the reserve capacity considered in the original beam design can accommodate this increase.

- Wind. Regarding the possible wind impact, a rough calculation is shown showing that it is negligible:
 - o $H_{\text{tank}} = 2.2 \text{ m}$
 - o $B_{\text{tank}} = 1.1 \text{ m}$
 - o $F_{\text{wind}} = 2.2 \cdot 1.1 \cdot 1 = 2.4 \text{ kN} \rightarrow M_{\text{wind}} = 3 \cdot 2.2/2 = 2.6 \text{ kNm}$
 - o Reaction = $M_{\text{wind}} / \text{span} = 2.6/5 = 0.5 \text{ kN} \rightarrow \text{negligible.}$
- Snow: snow accumulation besides the vertical walls of machinery is considered as not relevant as the biggest accumulation will be determined by the obstacles which are in front of the equipment. Same happens in Area 4.

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On this basis, the proposed arrangement appears reasonable from a preliminary structural standpoint. However, as the assessment is based solely on load variation and not on a full resistance verification of the existing prestressed member, it should be regarded as an initial screening exercise rather than a definitive capacity check.

5.4 AREA 4

Based on the drawings provided by ARK, the new cylindrical tank located in Area 4 has a weight of 2000 kg.

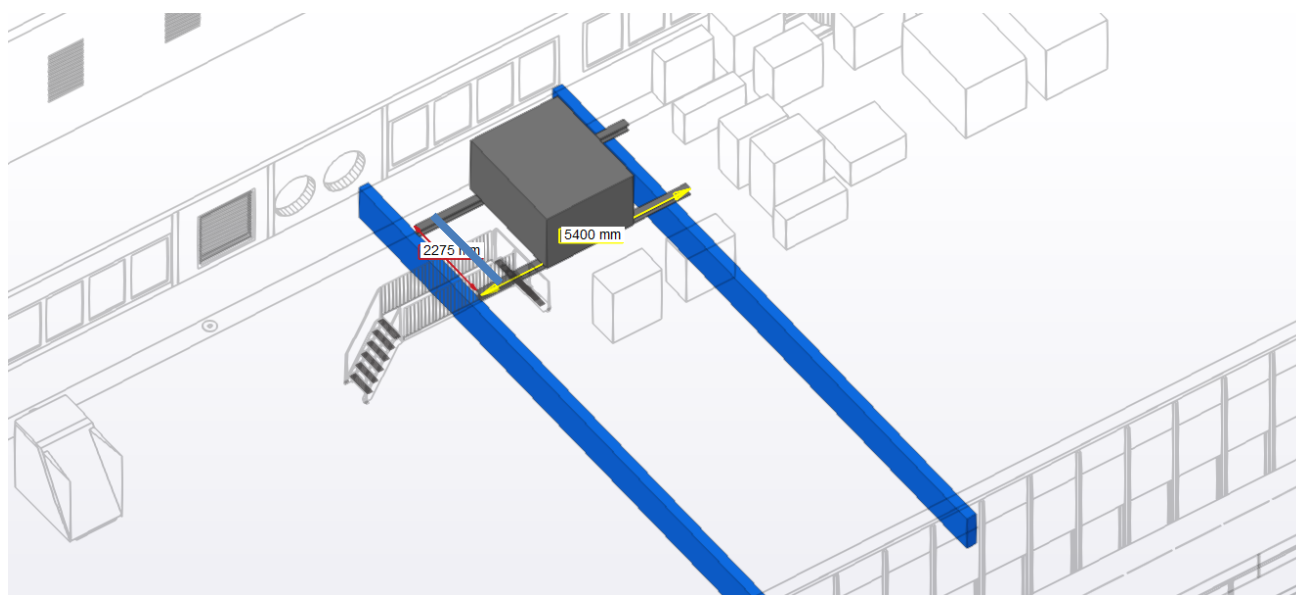


Figure 5-7. Location of the new cubic tank at the terrace area.

The support profiles of the frame carrying the tank are spaced at 2275 mm. Due to the centric position of the tank on the support frame, it is assumed that the load is evenly distributed between the prestressed beams located beneath it, through four point loads whose magnitude corresponds to the combined weight of the tank and the support profiles

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(30,40 kg/m, HEA 160; 17 kg/m, UPE 160) equal to $q = 2000\text{kg}/4 + 2 \cdot (30,40\text{kg}/\text{m} \cdot 5,40\text{m} + 17\text{kg}/\text{m} \cdot 2,3\text{m})/4 = 777\text{ kg}$ (pink arrows).

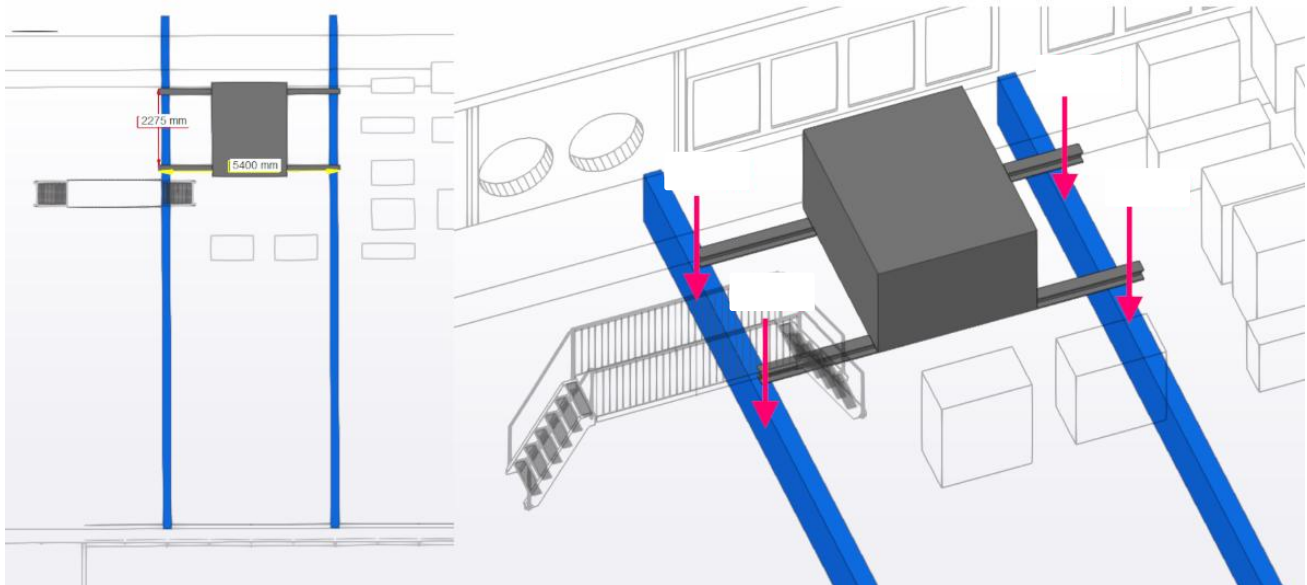


Figure 5-8. Plan and detailed view of the new cubic tank in Area 4 of the terrace.

A preliminary assessment has been carried out based on the net variation of permanent load acting on the existing 900 mm deep prestressed beam, since no reliable information is currently available regarding the prestressing layout, reinforcement, material properties, or detailed section capacity of the element.

The new tank and its supporting steel frame introduce a total permanent load of approximately 22,20 kN, assumed to be equally distributed between the two existing prestressed beams. Accordingly, the additional load applied to the beam under consideration is approximately 11,10 kN, transmitted through two point loads of about 5,57 kN each.

At the same time, the existing gravel ballast layer is removed over the full roof area. Based on the adopted value of 300 kg/m acting on each beam, this corresponds to a permanent load reduction of approximately 2,94 kN/m. For a beam span of 15 m, the total removed load is therefore about 44 kN.

It follows that the total permanent load removed from the beam is significantly greater than the permanent load introduced by the new tank arrangement. On a global basis, the beam is therefore subject to a net reduction in permanent loading. A simplified comparison of structural effects also indicates that the reduction in uniformly distributed load produces a larger decrease in global bending moment and support reactions than the increase generated by the new concentrated loads:

- Permanent loads influence:
 - Existing permanent loads (SW+DL) = 840 kg/m
 - Load reduction due gravel removal = 300 kg/m

So, the gravel removal means a $300/840 = 36\%$ permanent load reduction, which is a high relevant value.

- Bending influence (assuming the formulation for a simply supported beam):
 - Bending moment due existing permanent load = $qL^2/8 = 8,24 \cdot 15^2/8 = 232\text{ mkN}$

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- Bending moment reduction due gravel removal $= qL^2/8 = 3*15/8 = 83 \text{ mkN}$

Assuming an unrealistically conservative scenario in which the point loads from the new equipment are applied at the midspan of the beam, the resulting maximum bending moment would be:

- Bending moment due to new equipment (unrealistic value) $= pL/4 = (5,57*2)*15/4 = 42 \text{ mkN}$

Therefore, the reduction in load resulting from the gravel removal is significantly greater than the increase generated by the installation of the new equipment. Consequently, from a global bending perspective, the new loading condition of the beam may be considered favorable.

- Shear influence:

- Global reduction from the gravel removal $= 2,94\text{kN/m} * 15\text{m}/2 = 22 \text{ kN}$
- New vertical force due to new equipment $= 11,10 \text{ kN}$

Therefore, both effects are of a similar order of magnitude and do not appear to be significant at first assessment. Overall, the proposed configuration could be considered as favorable.

- Wind. Regarding the possible wind impact, a rough calculation is shown showing that it is negligible:

- $H_{\text{tank}} = 1.5 \text{ m}$
- $B_{\text{tank}} = 2.8 \text{ m}$
- $F_{\text{wind}} = 2.8 * 1.5 * 1 = 4.2 \text{ kN} \rightarrow M_{\text{wind}} = 4.2 * 1.5/2 = 3.2 \text{ kNm}$
- $\text{Reaction} = M_{\text{wind}} / \text{span} = 3.2/5 = 0.6 \text{ kN} \rightarrow \text{negligible.}$

On this basis, the proposed arrangement appears reasonable from a preliminary structural standpoint. However, as the assessment is based solely on load variation and not on a full resistance verification of the existing prestressed member, it should be regarded as an initial screening exercise rather than a definitive capacity check.

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6 BEAMS FOR MACHINES CALCULATION

As it was shown previously, the new beams placed on the roof are supporting the new machines. These new beams will be supported on the existing light-weight concrete slab (SIPOREX) matching the ends of the beams with the existing prestressed beams.

Hereafter it is shown a detail provided by architects on 13.05.2026. Final detail will be shown on sketches.

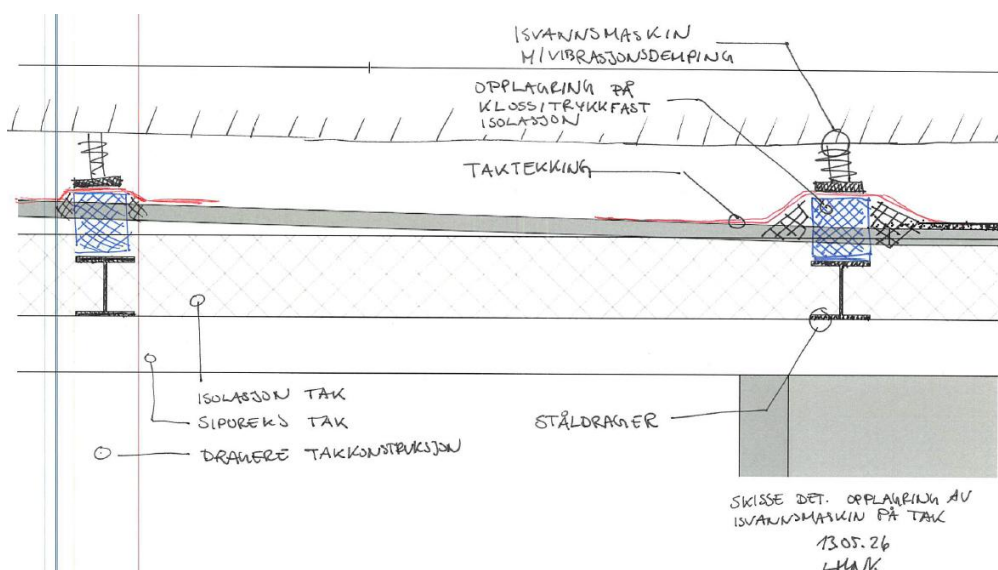


Figure 6-1. Detail received by ARK [3]

6.1 CALCULATION PROGRAM

The structure was modelled with Cype 3D v26, using bar elements to represent each beam and the overall shape of the machines over the beams.

Figure 6-2. General data Cype3D

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6.2 INPUT DATA

6.2.1 PRELIMINARY CONSIDERATIONS

Although the beams are supported by the light-weight concrete slab, they are modelled as simply supported at the edges. The punctual load which is transmitted by the beams will be distributed with steel plates, whose thickness will be higher than the total deflection of the beams, in such a way that the beams do not transmit additional loads along its length to the existing light-weight concrete slab.

6.2.2 GEOMETRY AND SECTIONS

- Black sections: HEA 160, 5 m span
- Brown sections: HEA 100, to provide lateral restraint.
 - o 2.3 m span for the cubic machine
 - o 0.9 m span for the cylindric case
- Red sections: SHS 60x60x8.0, 0.5 m high

The grey bars represent the edges of the machines, to create the area where the wind load will be applied. It is worth mentioning that the geometry of the cylindric machine is modelled as rectangular faces, with more tributary area on the safety side.

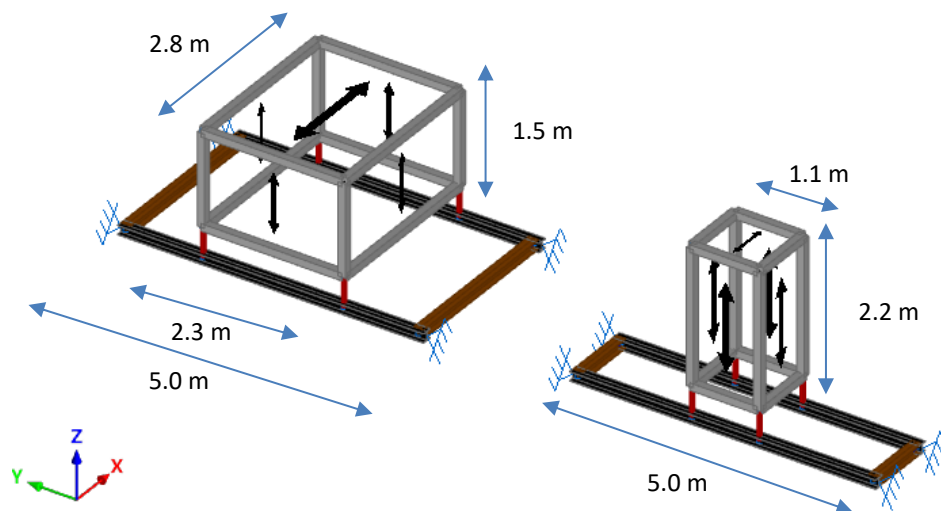


Figure 6-3. Dimensions

The dimensions of the machines are taken from the IFC model.

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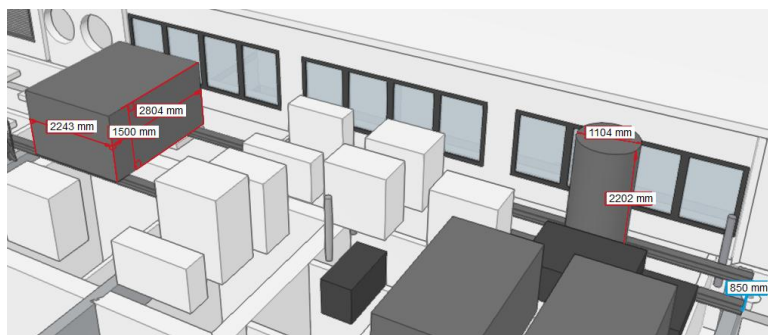


Figure 6-4. Dimensions of machines

6.3 BUCKLING

Automatically set by the software.

6.4 LOADS APPLIED

- Self-weight of machines:
 - Machine on area 3 (cylindrical): 2600 kg → each beam: 1300 kg along 1.1 m each side → 12 kN/m
 - Machine on area 4: 2000 kg → each beam: 1000 kg along 2.3 m each side → 4.4 kN/m

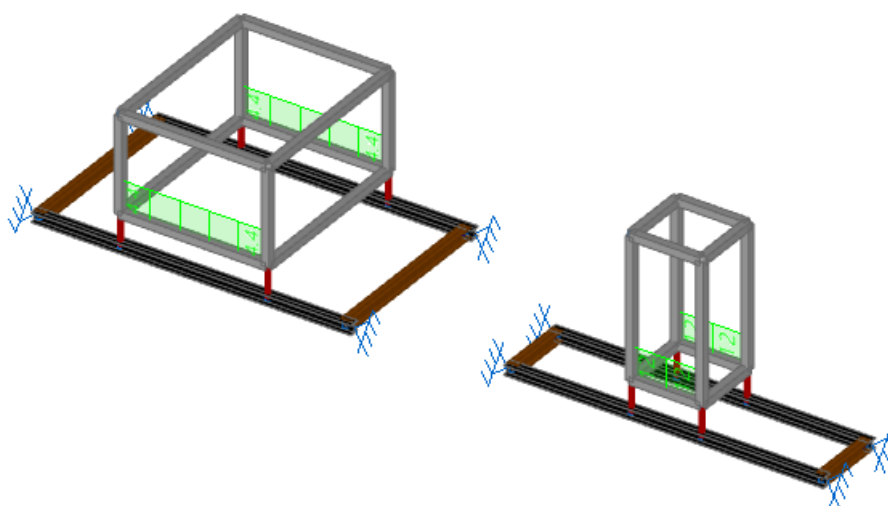


Figure 6-5. DL from machines

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- Wind, direction “x” (1 kN/m²)

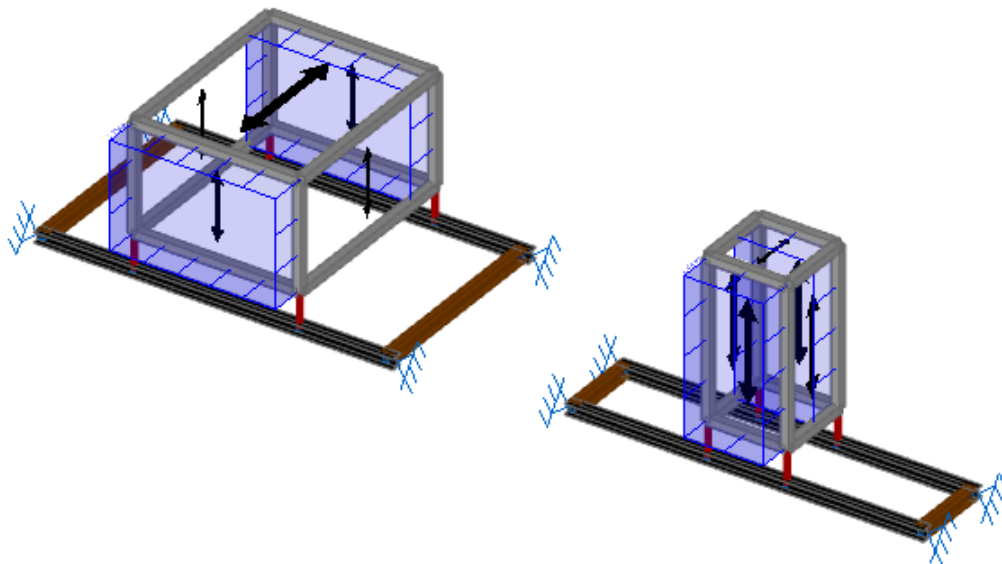


Figure 6-6. Wind, dir. X

- Wind, direction “y” (1 kN/m²)

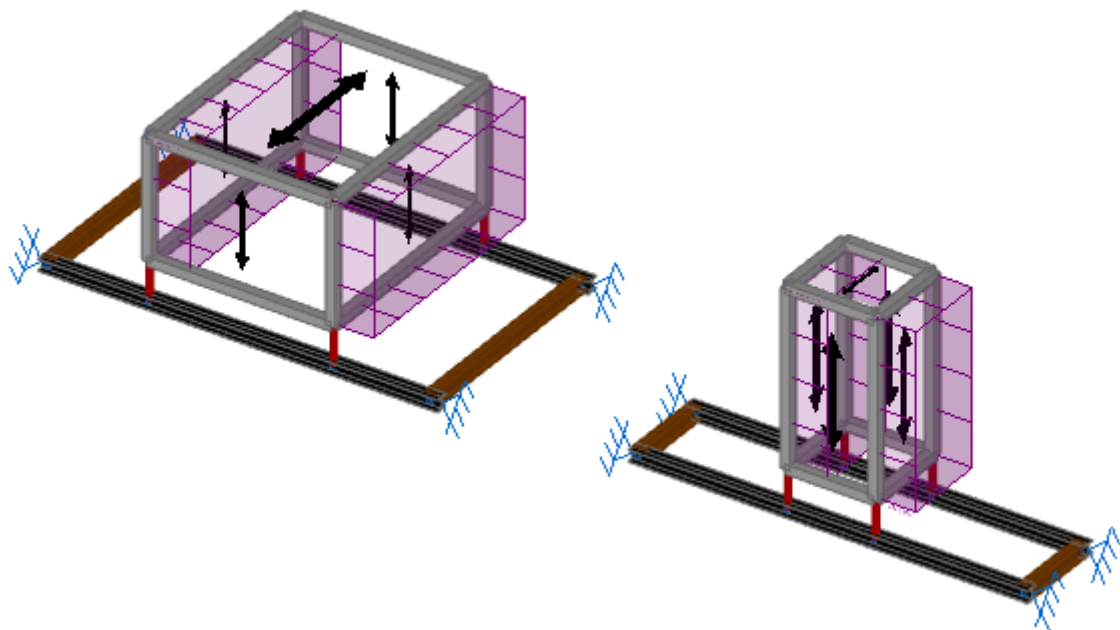


Figure 6-7. Wind, dir. Y

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- Snow (2.8 kN/m²)

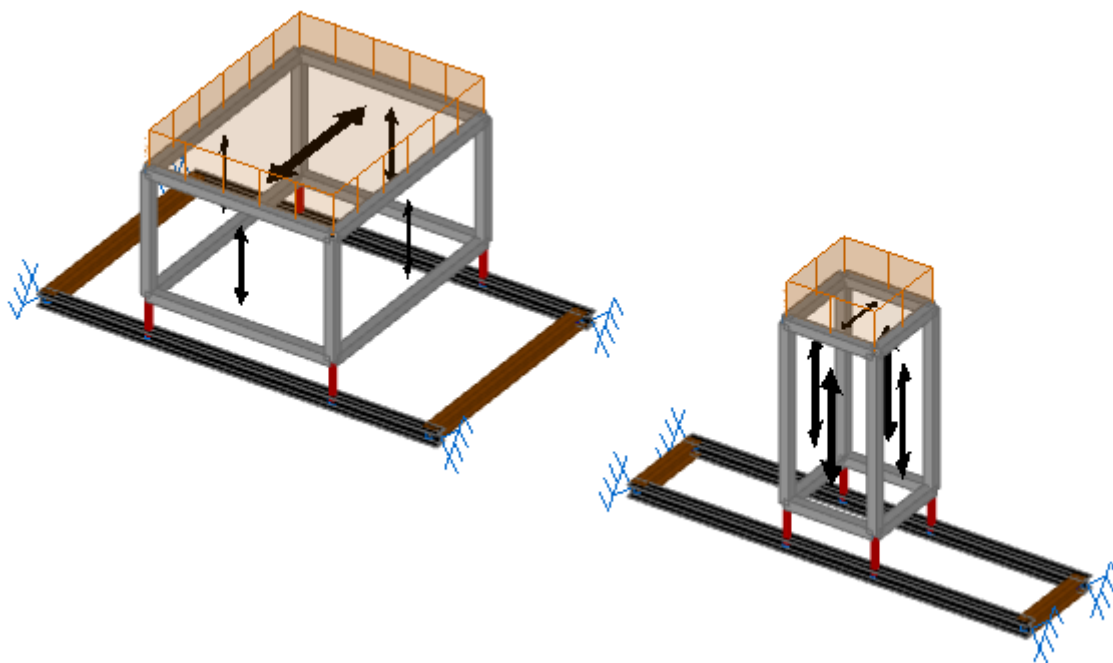


Figure 6-8. Snow loads

6.5 RESULTS

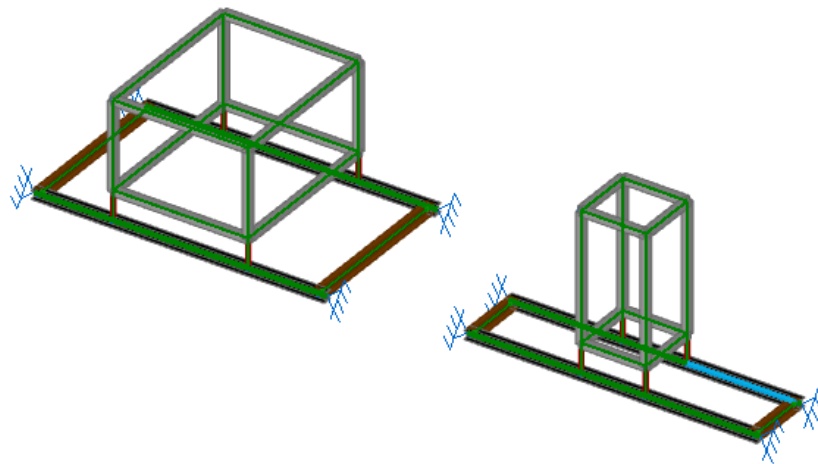
6.5.1 ULS VERIFICATION

Regarding the most unfavourable ratio of the beams (HEA 160), it is checked that they work with a ratio resistance of 44%.

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Bar N73/N45: L. 1.865 m
Level : With no associated level
Layer : Beams
HE 160 A (S355 (EN 1993-1-1))
✓ D/C ratio - resistance : 43.14 %
✓ D/C ratio - deflection : 25.65 %
Fire situation
⚠ It has been selected not to carry out the fire resistance check
📄 Click to obtain a table displaying the demand capacity ratio for each of the sections of the series.

Figure 6-9. Resistance ratios – 44%

6.5.2 SLS VERIFICATION

Following a restriction of deflection of $L/300$, it is obtained:

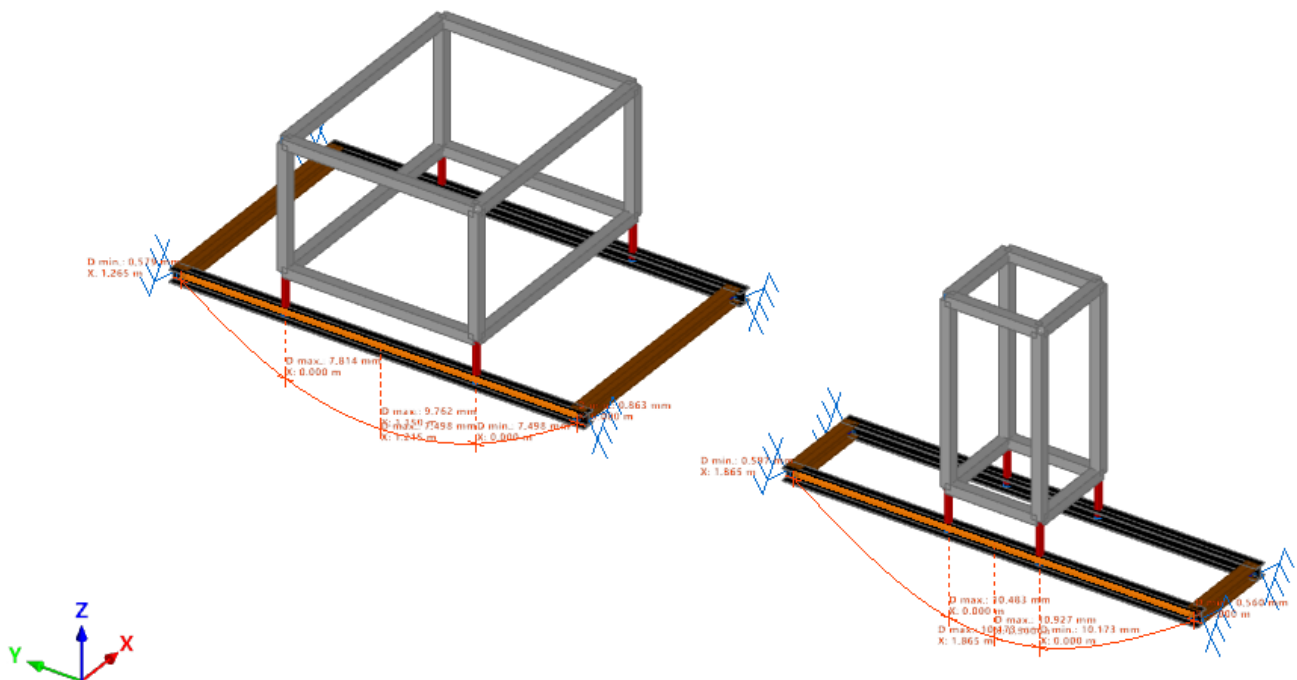


Figure 6-10. Total deflection

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$L / 300 = 5000 / 300 = 16.67 \text{ mm} > 11 \text{ mm}$. OK

6.5.3 REACTIONS

Maximum reaction: 18 kN

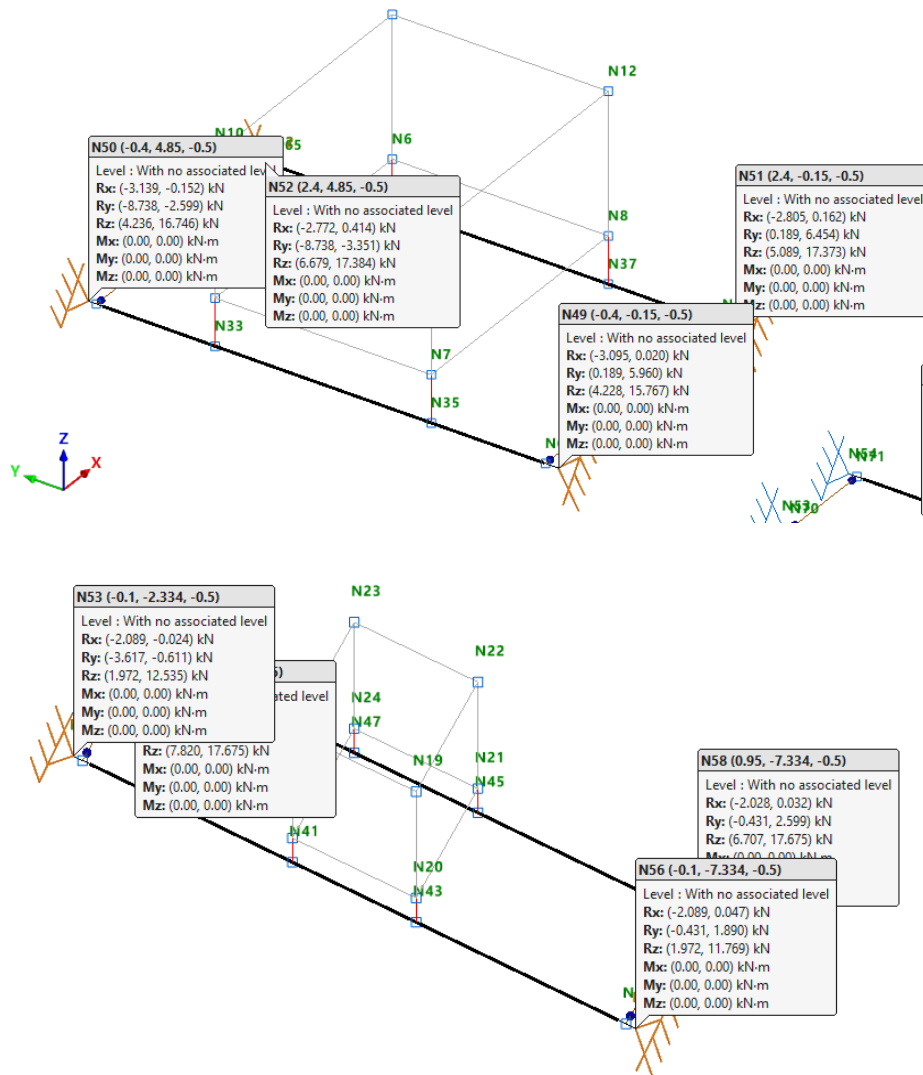


Figure 6-11. Maximum reactions

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Minimum reactions in some ends, where the wind is mostly factored and the weight is not factored, to prevent any potential uplift:

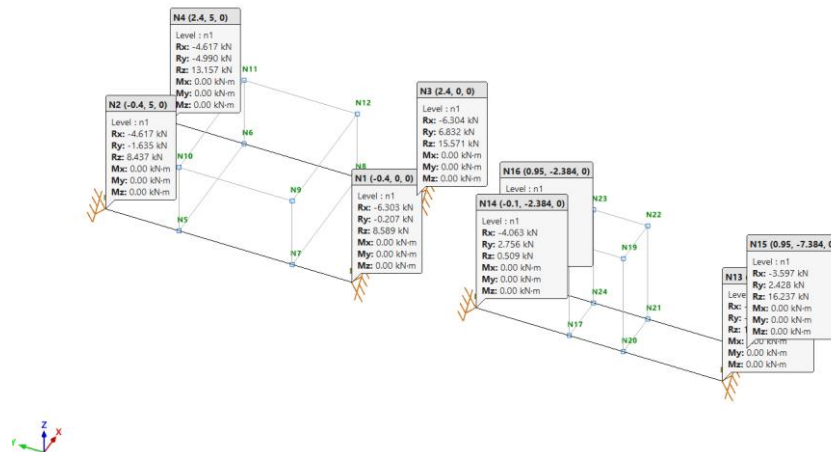


Figure 6-12. Minimum reactions

It is confirmed that any uplift is produced.

6.5.3.1 BEARING STEEL PLATES

Bearing steel plates on each end of the beams need to be placed to distribute the punctual load on the light-weight concrete slab. The maximum compressive strength of this concrete slab is not known. Therefore, it is considered about 10 MPa on the safety side.

Considering that the width of top flanges of the prestressed beams below is 250 mm, it is designed a 250x250x15dp steel plate to resist the maximum reaction of 18 kN:

The stress obtained on the concrete slab is $\frac{18000 \text{ N}}{250 \times 250 \text{ mm}^2} = 0.3 \text{ MPa}$

Hereafter, the resistance of the plate is shown:

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DESIGN RESISTANCE OF PLATES			
CODE		NS-EN 1993-1	
	γ_{a1}	1,05	
	γ_{a2}	1,25	
PLATE PROPERTIES	leff (effective length)	250	mm
	t (thickness)	15	mm
	steel	S 355	
	f_y	355	N/mm ²
	f_u	470	N/mm ²
	Model	ELASTIC	
	I	70313	mm ⁴
	W _{el}	9375	mm ³
	A	3750	mm ²
POINT LOAD	F _{dpoint}	18	kN
CONT LOAD	F _{dcont}	0	kN/m
	end conditions	Simply supported	
	Span	250	mm
	Working mode	BEAM	
	Moment M	1,13	kNm
	Shear V	9,00	kN
STRESS	σ_d	120,07	N/mm ²
		36%	
DEFLECTION	Reduction for security factor	1,35	
	δ_y	0,3	mm
	L/	851	

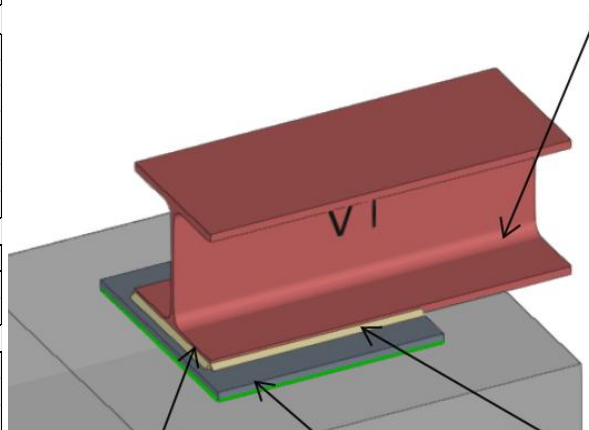


Figure 6-13. Resistance of the plate

6.5.3.2 CONNECTION BETWEEN STEEL PLATES AND LIGHT-WEIGHT CONCRETE SLAB

Regarding the existing light-weight concrete slab, it is worth mentioning that it is wanted to avoid bolts through it. Therefore, it is checked if the total vertical reaction with the friction between the steel and the concrete is enough to resist the horizontal reactions due to the wind. The fact that the 2 HEA beams are connected implies that the sliding can be considered as unique check for all the supports.

The maximum horizontal reaction is 7 kN according to the Figure 6-11. The vertical reaction pair of this horizontal reaction is 16 kN. In order to guarantee the sliding check, the minimum friction coefficient should be

$$\mu > \frac{H_{max}}{N} = \frac{7}{16} = 0.44$$

Although this friction value is between the normal values of steel-concrete following the Table B 18.1 of B18 TRYKKOVERFØRING I FORBINDELSER, this coefficient friction must be checked on site.

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Tabell B 18.1. Friksjonskoeffisienter.

Materialer i kontakt	Friksjonskoeffisient μ før glidning	
	Øvre verdi	Nedre verdi
Syntetisk gummi / betong eller stål	0,4	0,2
Stål / stål	0,5	0,2
Stål / betong	0,6	0,2
Glatt, hard trefiber / betong	0,7	0,2
To lag papp / betong	0,8	0,25
Presset polyetylen / presset polyetylen	0,2	0,08

Figure 6-14. Table B.18.1 B18 TRYKKOVERFØRING I FORBINDELSER

6.5.3.3 WELDING BETWEEN THE BEAM AND BEARING STEEL PLATE

Taking into account the most unfavourable vertical and horizontal reactions for the most critical welding (indicated on Figure 6-15)

ULS VERIFICATION FOR FILLET WELDS DIRECTIONAL METHOD AS PER §4.5.3.2 - EN 1993-1-8				
CODE	NS-EN 1993-1			
	γ_{a1}	1,05		§NA.6.1 NS-EN 1993-1-1
	γ_{a2}	1,25		§NA.6.1 NS-EN 1993-1-1
PLATE	Plate thickness (t)	15	mm	
	steel	S 355		
	f_y	355	N/mm ²	Table 3.1 EN 1993-1-1
	f_u	470	N/mm ²	Table 3.1 EN 1993-1-1
WELD	Throat thickness a	4,0	mm	§4.5.2 (2)
	Weld length L_w	150	mm	
	L_{eff}	142	mm	§4.5.1 (1)
	L_{min}	24	mm	§4.5.1 (2)
	A_w	568	mm ²	§4.5.3.2 (2)
ACTIONS ON 1 WELD	F1	0,0	kN	
	F2	7,0	kN	
	F3	18,0	kN	
RESULTS	σ_T	-13,7	N/mm ²	
	τ_T	31,1	N/mm ²	
	τ_{II}	0,0	N/mm ²	
	β_w	0,9		
	Long Lap Joint	YES		
	β_{Lw1}	1,00		Table 4.1
	ultimate weld stress	417,8	N/mm ²	§4.11
	max σ_T	338,4	N/mm ²	(4.1)
	weld stress	55,6	N/mm ²	(4.1)
	factor	13%		§4.5.3.2 (6)

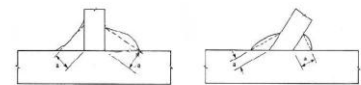


Figure 4.3: Throat thickness of a fillet weld

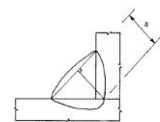


Figure 4.4: Throat thickness of a deep penetration fillet weld

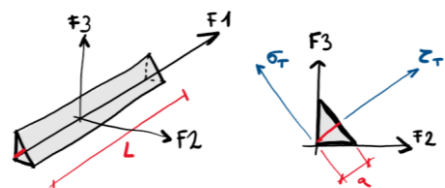


Figure 4.5: Stresses on the throat section of a fillet weld

Figure 6-15. Table B.18.1 B18 TRYKKOVERFØRING I FORBINDELSER

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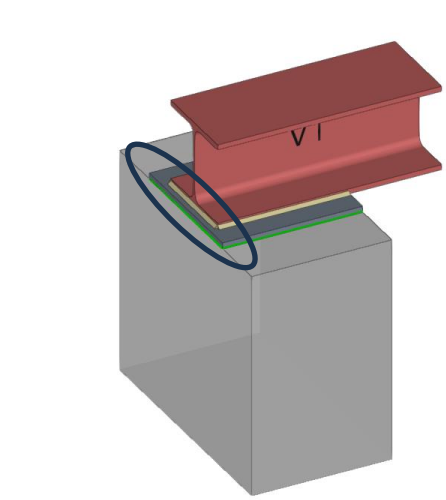


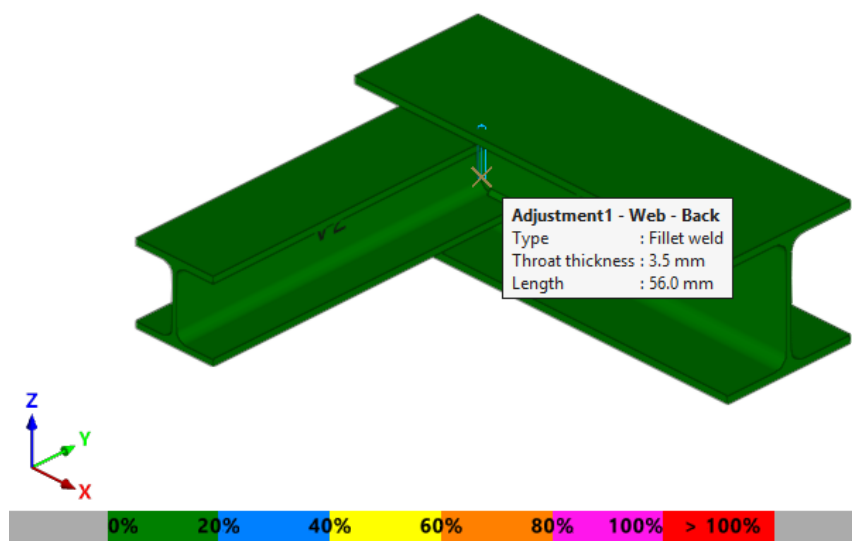
Figure 6-16. Most critical welding – 15mm plate thickness

7 CONNECTIONS

Program used CypeConnect 2026.c

7.1 HEA 100 TO HEA 160

Use 3.5 mm throat thickness all weld around



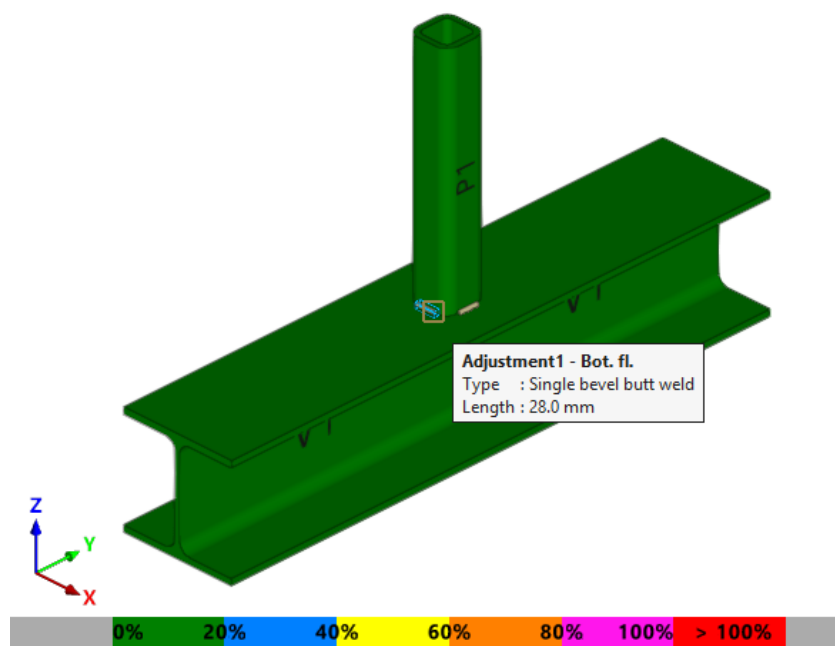
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7.2 SHS 60x60x8.0 TO HEA 160

Use single bevel butt weld around the SHS profile



8 CONCLUSION

Based on the considerations presented in this report, the preliminary evaluation of the prestressed roof beams under the new arrangement of the ventilation equipment appears reasonable, taking into account the load reduction associated with the removal of the gravel layer and the old equipment.

However, this assessment cannot be regarded as definitive, as the lack of available data prevents it from being considered a reliable structural analysis of the beam. It should instead be understood as a preliminary, order of magnitude evaluation.

On the other hand, the structure needed to support the machines is the following:

- 4 No. HEA 160 S355 beams with 5 m span
- 2 No. HEA 100 S355 beams with 2.3 m span
- 2 No. HEA 100 S355 beams with 0.9 m span
- 8 No. SHS 60x60x8.0 posts with 0.5 m high
- 8 No. 250x250x15dp steel plates S355
- Bottom flanges of the edges of the beams welded to the bearing steel plates:
 - o 4 mm throat thickness
 - o Full length filled welds all around the edges

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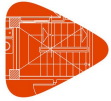
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9 ANNEX I – BEAMS CALCULATION

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1. JOB DATA

1.1. Codes considered

Rolled and welded steel: Eurocodes 3 and 4

Timber: Eurocode 5

Use category: A. Domésticos y residenciales

1.2. Limit states

Fracture U.L.S. Rolled steel	Noruega
Fracture U.L.S. Timber	EC Snow: Finland, Iceland, Norway, Sweden
Displacements	Characteristic loads

1.2.1. Project situations

The load combinations will be defined according to the following criteria for the different project situations:

- With combination coefficients

$$\sum_{j \geq 1} \gamma_{Gj} G_{kj} + \gamma_P P_k + \gamma_{Q1} \Psi_{p1} Q_{k1} + \sum_{i > 1} \gamma_{Qi} \Psi_{ai} Q_{ki}$$

- Without combination coefficients

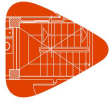
$$\sum_{j \geq 1} \gamma_{Gj} G_{kj} + \gamma_P P_k + \sum_{i \geq 1} \gamma_{Qi} Q_{ki}$$

- Where:

- G_k Permanent load
- P_k Prestressing action
- Q_k Variable load
- γ_G Permanent load partial safety factor
- γ_P Partial safety coefficient for prestressing action
- $\gamma_{Q,1}$ Main variable load partial safety factor
- $\gamma_{Q,i}$ Accompanying variable load partial safety factor
- $\Psi_{p,1}$ Main variable load combination coefficient
- $\Psi_{a,i}$ Accompanying variable load combination coefficient

For each project situation and limit state, the loading coefficients will be determined by:

Fracture U.L.S. Rolled steel: Eurocodes 3 and 4



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6.10a (Cat A)				
	Partial safety factors (γ)		Combination coefficients (ψ)	
	Favourable	Unfavourable	Main (ψ_p)	Accompanying (ψ_s)
Dead load (G)	1.000	1.350	-	-
Live load (Q)	0.000	1.500	0.700	0.700
Wind (Q)	0.000	1.500	0.600	0.600
Snow (Q)	0.000	1.500	0.700	0.700

6.10b (Cat A)				
	Partial safety factors (γ)		Combination coefficients (ψ)	
	Favourable	Unfavourable	Main (ψ_p)	Accompanying (ψ_s)
Dead load (G)	1.000	1.200	-	-
Live load (Q)	0.000	1.500	1.000	0.700
Wind (Q)	0.000	1.500	1.000	0.600
Snow (Q)	0.000	1.500	1.000	0.700

Fracture U.L.S. Timber: Eurocode 5

Persistent or transient				
	Partial safety factors (γ)		Combination coefficients (ψ)	
	Favourable	Unfavourable	Main (ψ_p)	Accompanying (ψ_s)
Dead load (G)	1.000	1.350	-	-
Live load (Q)	0.000	1.500	1.000	0.700
Wind (Q)	0.000	1.500	1.000	0.600
Snow (Q)	0.000	1.500	1.000	0.700

Displacements

Variable loads without seismic loading		
	Partial safety factors (γ)	
	Favourable	Unfavourable
Dead load (G)	1.000	1.000
Live load (Q)	0.000	1.000
Wind (Q)	0.000	1.000
Snow (Q)	0.000	1.000

2. STRUCTURE

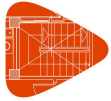
2.1. Geometry

2.1.1. Nodes

References:

$\Delta_x, \Delta_y, \Delta_z$: Prescribed displacements in global axes.

$\theta_x, \theta_y, \theta_z$: Prescribed rotations in global axes.



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Each degree of freedom is marked with 'X' if it has external restrictions and, in the opposite case, with '-'.
.

Nodes										
Reference	Coordinates			External fixity						Internal fixity
	X (m)	Y (m)	Z (m)	Δ_x	Δ_y	Δ_z	θ_x	θ_y	θ_z	
N5	-0.400	3.500	0.000	-	-	-	-	-	-	Fixed
N6	2.400	3.500	0.000	-	-	-	-	-	-	Fixed
N7	-0.400	1.200	0.000	-	-	-	-	-	-	Fixed
N8	2.400	1.200	0.000	-	-	-	-	-	-	Fixed
N9	-0.400	1.200	1.500	-	-	-	-	-	-	Fixed
N10	-0.400	3.500	1.500	-	-	-	-	-	-	Fixed
N11	2.400	3.500	1.500	-	-	-	-	-	-	Fixed
N12	2.400	1.200	1.500	-	-	-	-	-	-	Fixed
N17	-0.100	-4.284	0.000	-	-	-	-	-	-	Fixed
N18	-0.100	-4.284	2.200	-	-	-	-	-	-	Fixed
N19	-0.100	-5.384	2.200	-	-	-	-	-	-	Fixed
N20	-0.100	-5.384	0.000	-	-	-	-	-	-	Fixed
N21	0.950	-5.384	0.000	-	-	-	-	-	-	Fixed
N22	0.950	-5.384	2.200	-	-	-	-	-	-	Fixed
N23	0.950	-4.284	2.200	-	-	-	-	-	-	Fixed
N24	0.950	-4.284	0.000	-	-	-	-	-	-	Fixed
N33	-0.400	3.500	-0.500	-	-	-	-	-	-	Fixed
N35	-0.400	1.200	-0.500	-	-	-	-	-	-	Fixed
N37	2.400	1.200	-0.500	-	-	-	-	-	-	Fixed
N39	2.400	3.500	-0.500	-	-	-	-	-	-	Fixed
N41	-0.100	-4.284	-0.500	-	-	-	-	-	-	Fixed
N43	-0.100	-5.384	-0.500	-	-	-	-	-	-	Fixed
N45	0.950	-5.384	-0.500	-	-	-	-	-	-	Fixed
N47	0.950	-4.284	-0.500	-	-	-	-	-	-	Fixed
N49	-0.400	-0.150	-0.500	X	X	X	-	-	-	Fixed
N50	-0.400	4.850	-0.500	X	X	X	-	-	-	Fixed
N51	2.400	-0.150	-0.500	X	X	X	-	-	-	Fixed
N52	2.400	4.850	-0.500	X	X	X	-	-	-	Fixed
N53	-0.100	-2.334	-0.500	X	X	X	-	-	-	Fixed
N54	0.950	-2.334	-0.500	X	X	X	-	-	-	Fixed
N56	-0.100	-7.334	-0.500	X	X	X	-	-	-	Fixed
N58	0.950	-7.334	-0.500	X	X	X	-	-	-	Fixed
N64	-0.400	4.765	-0.500	-	-	-	-	-	-	Fixed
N65	2.400	4.765	-0.500	-	-	-	-	-	-	Fixed
N66	-0.400	-0.015	-0.500	-	-	-	-	-	-	Fixed
N67	2.400	-0.015	-0.500	-	-	-	-	-	-	Fixed
N70	-0.100	-2.419	-0.500	-	-	-	-	-	-	Fixed
N71	0.950	-2.419	-0.500	-	-	-	-	-	-	Fixed
N72	-0.100	-7.249	-0.500	-	-	-	-	-	-	Fixed
N73	0.950	-7.249	-0.500	-	-	-	-	-	-	Fixed

2.1.2. Bars



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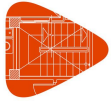
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2.1.2.1. Materials used

Materials used							
Material		E (MPa)	ν	G (MPa)	f_y (MPa)	α_t (m/m°C)	γ (kN/m ³)
Type	Designation						
Rolled steel	S355 (EN 1993-1-1)	210000.00	0.300	81000.00	355.00	0.000012	77.01
Timber	C24	11000.00	-	690.00	-	0.000005	4.12
Notes: E: Modulus of Elasticity ν : Poisson's ratio G: Shear Modulus f_y : Yield strength α_t : Coefficient of thermal expansion γ : Unit weight							

2.1.2.2. Description

Description									
Material		Bar (Ni/Nf)	Element (Ni/Nf)	Section(Series)	Length (m)	β_{xy}	β_{xz}	Lb _{Top} (m)	Lb _{Bot.} (m)
Type	Designation								
Rolled steel	S355 (EN 1993-1-1)	N33/N5	N33/N5	SHS 60x8.0 (Hot Finished SHS)	0.500	1.00	1.00	0.500	0.500
		N35/N7	N35/N7	SHS 60x8.0 (Hot Finished SHS)	0.500	1.00	1.00	0.500	0.500
		N37/N8	N37/N8	SHS 60x8.0 (Hot Finished SHS)	0.500	1.00	1.00	0.500	0.500
		N39/N6	N39/N6	SHS 60x8.0 (Hot Finished SHS)	0.500	1.00	1.00	0.500	0.500
		N41/N17	N41/N17	SHS 60x8.0 (Hot Finished SHS)	0.500	1.00	1.00	0.500	0.500
		N43/N20	N43/N20	SHS 60x8.0 (Hot Finished SHS)	0.500	1.00	1.00	0.500	0.500
		N45/N21	N45/N21	SHS 60x8.0 (Hot Finished SHS)	0.500	1.00	1.00	0.500	0.500
		N47/N24	N47/N24	SHS 60x8.0 (Hot Finished SHS)	0.500	1.00	1.00	0.500	0.500
		N51/N67	N51/N52	HE 160 A (HEA)	0.135	1.00	1.00	0.135	0.135
		N67/N37	N51/N52	HE 160 A (HEA)	1.215	1.00	1.00	1.215	1.215
		N37/N39	N51/N52	HE 160 A (HEA)	2.300	1.00	1.00	2.300	2.300
		N39/N65	N51/N52	HE 160 A (HEA)	1.265	1.00	1.00	1.265	1.265
		N65/N52	N51/N52	HE 160 A (HEA)	0.085	1.00	1.00	0.085	0.085
		N49/N66	N49/N50	HE 160 A (HEA)	0.135	1.00	1.00	0.135	0.135
		N66/N35	N49/N50	HE 160 A (HEA)	1.215	1.00	1.00	1.215	1.215
		N35/N33	N49/N50	HE 160 A (HEA)	2.300	1.00	1.00	2.300	2.300
		N33/N64	N49/N50	HE 160 A (HEA)	1.265	1.00	1.00	1.265	1.265
		N64/N50	N49/N50	HE 160 A (HEA)	0.085	1.00	1.00	0.085	0.085
		N56/N72	N56/N53	HE 160 A (HEA)	0.085	1.00	1.00	0.085	0.085
		N72/N43	N56/N53	HE 160 A (HEA)	1.865	1.00	1.00	1.865	1.865
		N43/N41	N56/N53	HE 160 A (HEA)	1.100	1.00	1.00	1.100	1.100
		N41/N70	N56/N53	HE 160 A (HEA)	1.865	1.00	1.00	1.865	1.865
		N70/N53	N56/N53	HE 160 A (HEA)	0.085	1.00	1.00	0.085	0.085
		N58/N73	N58/N54	HE 160 A (HEA)	0.085	1.00	1.00	0.085	0.085
		N73/N45	N58/N54	HE 160 A (HEA)	1.865	1.00	1.00	1.865	1.865
		N45/N47	N58/N54	HE 160 A (HEA)	1.100	1.00	1.00	1.100	1.100



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Description									
Material		Bar (Ni/Nf)	Element (Ni/Nf)	Section(Series)	Length (m)	β_{xy}	β_{xz}	Lb _{Top} (m)	Lb _{Bot.} (m)
Type	Designation								
		N47/N71	N58/N54	HE 160 A (HEA)	1.865	1.00	1.00	1.865	1.865
		N71/N54	N58/N54	HE 160 A (HEA)	0.085	1.00	1.00	0.085	0.085
		N64/N65	N64/N65	HE 100 A (HEA)	2.800	1.00	1.00	2.800	2.800
		N66/N67	N66/N67	HE 100 A (HEA)	2.800	1.00	1.00	2.800	2.800
		N70/N71	N70/N71	HE 100 A (HEA)	1.050	1.00	1.00	1.050	1.050
		N72/N73	N72/N73	HE 100 A (HEA)	1.050	1.00	1.00	1.050	1.050
Timber	C24	N5/N6	N5/N6	S-120x120 (Maciza)	2.800	1.00	1.00	2.800	2.800
		N7/N8	N7/N8	S-120x120 (Maciza)	2.800	1.00	1.00	2.800	2.800
		N9/N10	N9/N10	S-120x120 (Maciza)	2.300	1.00	1.00	2.300	2.300
		N7/N9	N7/N9	S-120x120 (Maciza)	1.500	1.00	1.00	1.500	1.500
		N5/N10	N5/N10	S-120x120 (Maciza)	1.500	1.00	1.00	1.500	1.500
		N10/N11	N10/N11	S-120x120 (Maciza)	2.800	1.00	1.00	2.800	2.800
		N6/N11	N6/N11	S-120x120 (Maciza)	1.500	1.00	1.00	1.500	1.500
		N9/N12	N9/N12	S-120x120 (Maciza)	2.800	1.00	1.00	2.800	2.800
		N8/N12	N8/N12	S-120x120 (Maciza)	1.500	1.00	1.00	1.500	1.500
		N12/N11	N12/N11	S-120x120 (Maciza)	2.300	1.00	1.00	2.300	2.300
		N17/N18	N17/N18	S-120x120 (Maciza)	2.200	1.00	1.00	2.200	2.200
		N19/N18	N19/N18	S-120x120 (Maciza)	1.100	1.00	1.00	1.100	1.100
		N20/N19	N20/N19	S-120x120 (Maciza)	2.200	1.00	1.00	2.200	2.200
		N20/N21	N20/N21	S-120x120 (Maciza)	1.050	1.00	1.00	1.050	1.050
		N21/N22	N21/N22	S-120x120 (Maciza)	2.200	1.00	1.00	2.200	2.200
		N22/N23	N22/N23	S-120x120 (Maciza)	1.100	1.00	1.00	1.100	1.100
		N18/N23	N18/N23	S-120x120 (Maciza)	1.050	1.00	1.00	1.050	1.050
		N19/N22	N19/N22	S-120x120 (Maciza)	1.050	1.00	1.00	1.050	1.050
		N24/N23	N24/N23	S-120x120 (Maciza)	2.200	1.00	1.00	2.200	2.200
		N17/N24	N17/N24	S-120x120 (Maciza)	1.050	1.00	1.00	1.050	1.050
		N7/N5	N7/N5	S-120x120 (Maciza)	2.300	1.00	1.00	2.300	2.300
		N8/N6	N8/N6	S-120x120 (Maciza)	2.300	1.00	1.00	2.300	2.300



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Description									
Material		Bar (Ni/Nf)	Element (Ni/Nf)	Section(Series)	Length (m)	β_{xy}	β_{xz}	Lb _{Top} (m)	Lb _{Bot.} (m)
Type	Designation								
		N20/N17	N20/N17	S-120x120 (Maciza)	1.100	1.00	1.00	1.100	1.100
		N21/N24	N21/N24	S-120x120 (Maciza)	1.100	1.00	1.00	1.100	1.100

Notes:
Ni: Initial node
Nf: Final node
 β_{xy} : Buckling coefficient in the 'XY' plane
 β_{xz} : Buckling coefficient in the 'XZ' plane
Lb_{Top}: Separation between bracings of the top flange
Lb_{Bot.}: Separation between bracings of the bottom flange

2.1.2.3. Mechanical characteristics

Element types	
Ref.	Elements
1	N33/N5, N35/N7, N37/N8, N39/N6, N41/N17, N43/N20, N45/N21 and N47/N24
2	N51/N52, N49/N50, N56/N53 and N58/N54
3	N64/N65, N66/N67, N70/N71 and N72/N73
4	N5/N6, N7/N8, N9/N10, N7/N9, N5/N10, N10/N11, N6/N11, N9/N12, N8/N12, N12/N11, N17/N18, N19/N18, N20/N19, N20/N21, N21/N22, N22/N23, N18/N23, N19/N22, N24/N23, N17/N24, N7/N5, N8/N6, N20/N17 and N21/N24

Mechanical characteristics									
Material		Ref.	Description	A (cm ²)	A _{vy} (cm ²)	A _{vz} (cm ²)	I _{yy} (cm ⁴)	I _{zz} (cm ⁴)	It (cm ⁴)
Type	Designation								
Rolled steel	S355 (EN 1993-1-1)	1	SHS 60x8.0, (Hot Finished SHS)	14.95	6.93	6.93	61.82	61.82	115.37
		2	HE 160 A, (HEA)	38.80	21.60	7.24	1673.00	615.60	12.10
		3	HE 100 A, (HEA)	21.20	12.00	3.60	349.20	133.80	5.28
Timber	C24	4	S-120x120, (Maciza)	144.00	120.00	120.00	1728.00	1728.00	2903.04

Notes:
Ref.: Reference
A: Area of the transverse section
A_{vy}: Shear area of the section in the local 'Y' axis
A_{vz}: Shear area of the section in the local 'Z' axis
I_{yy}: Inertia of the section about the local 'Y' axis
I_{zz}: Inertia of the section about the local 'Z' axis
It: Torsional inertia
The mechanical characteristics of the elements correspond to those of their cross section at their mid-point.

2.1.2.4. Quantities table

Quantities table						
Material		Element (Ni/Nf)	Section(Series)	Length (m)	Volume (m ³)	Weight (kg)
Type	Designation					
Rolled steel	S355 (EN 1993-1-1)	N33/N5	SHS 60x8.0 (Hot Finished SHS)	0.500	0.001	5.87
		N35/N7	SHS 60x8.0 (Hot Finished SHS)	0.500	0.001	5.87
		N37/N8	SHS 60x8.0 (Hot Finished SHS)	0.500	0.001	5.87
		N39/N6	SHS 60x8.0 (Hot Finished SHS)	0.500	0.001	5.87
		N41/N17	SHS 60x8.0 (Hot Finished SHS)	0.500	0.001	5.87



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Quantities table						
Material		Element (Ni/Nf)	Section(Series)	Length (m)	Volume (m³)	Weight (kg)
Type	Designation					
		N43/N20	SHS 60x8.0 (Hot Finished SHS)	0.500	0.001	5.87
		N45/N21	SHS 60x8.0 (Hot Finished SHS)	0.500	0.001	5.87
		N47/N24	SHS 60x8.0 (Hot Finished SHS)	0.500	0.001	5.87
		N51/N52	HE 160 A (HEA)	5.000	0.019	152.29
		N49/N50	HE 160 A (HEA)	5.000	0.019	152.29
		N56/N53	HE 160 A (HEA)	5.000	0.019	152.29
		N58/N54	HE 160 A (HEA)	5.000	0.019	152.29
		N64/N65	HE 100 A (HEA)	2.800	0.006	46.60
		N66/N67	HE 100 A (HEA)	2.800	0.006	46.60
		N70/N71	HE 100 A (HEA)	1.050	0.002	17.47
		N72/N73	HE 100 A (HEA)	1.050	0.002	17.47
Timber	C24	N5/N6	S-120x120 (Maciza)	2.800	0.040	16.93
		N7/N8	S-120x120 (Maciza)	2.800	0.040	16.93
		N9/N10	S-120x120 (Maciza)	2.300	0.033	13.91
		N7/N9	S-120x120 (Maciza)	1.500	0.022	9.07
		N5/N10	S-120x120 (Maciza)	1.500	0.022	9.07
		N10/N11	S-120x120 (Maciza)	2.800	0.040	16.93
		N6/N11	S-120x120 (Maciza)	1.500	0.022	9.07
		N9/N12	S-120x120 (Maciza)	2.800	0.040	16.93
		N8/N12	S-120x120 (Maciza)	1.500	0.022	9.07
		N12/N11	S-120x120 (Maciza)	2.300	0.033	13.91
		N17/N18	S-120x120 (Maciza)	2.200	0.032	13.31
		N19/N18	S-120x120 (Maciza)	1.100	0.016	6.65
		N20/N19	S-120x120 (Maciza)	2.200	0.032	13.31
		N20/N21	S-120x120 (Maciza)	1.050	0.015	6.35
		N21/N22	S-120x120 (Maciza)	2.200	0.032	13.31
		N22/N23	S-120x120 (Maciza)	1.100	0.016	6.65
		N18/N23	S-120x120 (Maciza)	1.050	0.015	6.35
		N19/N22	S-120x120 (Maciza)	1.050	0.015	6.35
		N24/N23	S-120x120 (Maciza)	2.200	0.032	13.31
		N17/N24	S-120x120 (Maciza)	1.050	0.015	6.35
		N7/N5	S-120x120 (Maciza)	2.300	0.033	13.91
		N8/N6	S-120x120 (Maciza)	2.300	0.033	13.91
		N20/N17	S-120x120 (Maciza)	1.100	0.016	6.65
		N21/N24	S-120x120 (Maciza)	1.100	0.016	6.65
Notes: Ni: Initial node Nf: Final node						

2.1.2.5. Quantities summary



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Quantities summary												
Material		Series	Section	Length			Volume			Weight		
Type	Designation			Section (m)	Series (m)	Material (m)	Section (m³)	Series (m³)	Material (m³)	Section (kg)	Series (kg)	Material (kg)
Rolled steel	S355 (EN 1993-1-1)	Hot Finished SHS	SHS 60x8.0	4.000	4.000		0.006	0.006		46.95	46.95	
			HE 160 A	20.000			0.078			609.16		
		HEA	HE 100 A	7.700	27.700	31.700	0.016	0.094	0.100	128.14	737.30	784.26
Timber	C24	Maciza	S-120x120	43.800	43.800	43.800	0.631	0.631	0.631	264.90	264.90	264.90

2.1.2.6. Surface area quantities

Rolled steel: Quantities of the surface areas to paint				
Series	Section	Unit surface area (m²/m)	Length (m)	Surface (m²)
Hot Finished SHS	SHS 60x8.0	0.212	4.000	0.847
HEA	HE 160 A	0.932	20.000	18.640
	HE 100 A	0.582	7.700	4.481
Total				23.969

Timber: Quantities of the surface areas to paint				
Series	Section	Unit surface area (m²/m)	Length (m)	Surface (m²)
Maciza	S-120x120	0.480	43.800	21.024
Total				21.024

2.2. Loads

2.2.1. Bars

References:

'P1', 'P2':

- Point moments, point, uniform and strip loads: 'P1' is the load value. 'P2' is not used.
- Trapezoidal loads: 'P1' is the value of the load at the point where it begins (L1) and 'P2' is the value of the load where it ends (L2).
- Triangular loads: 'P1' is the maximum value of the load. 'P2' is not used.
- Temperature increments: 'P1' and 'P2' are the temperature values on the external faces or surfaces of the element. The position of the temperature increment over the transverse section will depend on the selected direction.

'L1', 'L2':

- Point loads and moments: 'L1' is the distance between the initial node of the bar and the position where the load is applied. 'L2' is not used.
- Trapezoidal, strip and triangular loads: 'L1' is the distance between the initial node of the bar and the position where the load begins, 'L2' is the distance between the initial node of the bar and the position where the load ends.

Units:

- Point loads: kN
- Point moments: kN·m.
- Uniform, strip, triangular and trapezoidal loads: kN/m.
- Temperature increments: °C.



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Loads on bars										
Bar	Loadcase	Type	Values		Position		Direction			
			P1	P2	L1 (m)	L2 (m)	Centre axis	X	Y	Z
N5/N6	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N5/N6	W 1 (Vy)	Uniform	0.750	-	-	-	Global	-0.000	1.000	0.000
N7/N8	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N7/N8	W 1 (Vy)	Uniform	0.750	-	-	-	Global	-0.000	1.000	0.000
N9/N10	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N9/N10	W 1 (Vx)	Uniform	0.750	-	-	-	Global	1.000	0.000	0.000
N9/N10	N 1	Uniform	3.920	-	-	-	Global	0.000	0.000	-1.000
N7/N9	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N5/N10	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N10/N11	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N10/N11	W 1 (Vy)	Uniform	0.750	-	-	-	Global	-0.000	1.000	0.000
N6/N11	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N9/N12	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N9/N12	W 1 (Vy)	Uniform	0.750	-	-	-	Global	-0.000	1.000	0.000
N8/N12	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N12/N11	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N12/N11	W 1 (Vx)	Uniform	0.750	-	-	-	Global	1.000	0.000	0.000
N12/N11	N 1	Uniform	3.920	-	-	-	Global	0.000	0.000	-1.000
N17/N18	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N19/N18	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N19/N18	W 1 (Vx)	Uniform	1.100	-	-	-	Global	1.000	0.000	0.000
N19/N18	N 1	Uniform	1.470	-	-	-	Global	0.000	0.000	-1.000
N20/N19	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N20/N21	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N20/N21	W 1 (Vy)	Uniform	1.100	-	-	-	Global	0.000	1.000	0.000
N21/N22	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N22/N23	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N22/N23	W 1 (Vx)	Uniform	1.100	-	-	-	Global	1.000	0.000	0.000
N22/N23	N 1	Uniform	1.470	-	-	-	Global	0.000	0.000	-1.000
N18/N23	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N18/N23	W 1 (Vy)	Uniform	1.100	-	-	-	Global	-0.000	1.000	0.000
N19/N22	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N19/N22	W 1 (Vy)	Uniform	1.100	-	-	-	Global	0.000	1.000	0.000
N24/N23	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N17/N24	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N17/N24	W 1 (Vy)	Uniform	1.100	-	-	-	Global	-0.000	1.000	0.000
N7/N5	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N7/N5	CM 1	Uniform	4.400	-	-	-	Global	0.000	0.000	-1.000
N7/N5	W 1 (Vx)	Uniform	0.750	-	-	-	Global	1.000	0.000	0.000
N8/N6	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N8/N6	CM 1	Uniform	4.400	-	-	-	Global	0.000	0.000	-1.000
N8/N6	W 1 (Vx)	Uniform	0.750	-	-	-	Global	1.000	0.000	0.000
N20/N17	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N20/N17	CM 1	Uniform	12.000	-	-	-	Global	0.000	0.000	-1.000
N20/N17	W 1 (Vx)	Uniform	1.100	-	-	-	Global	1.000	0.000	0.000



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Loads on bars										
Bar	Loadcase	Type	Values		Position		Direction			
			P1	P2	L1 (m)	L2 (m)	Centre axis	X	Y	Z
N21/N24	Self weight	Uniform	0.059	-	-	-	Global	0.000	0.000	-1.000
N21/N24	CM 1	Uniform	12.000	-	-	-	Global	0.000	0.000	-1.000
N21/N24	W 1 (Vx)	Uniform	1.100	-	-	-	Global	1.000	0.000	0.000
N33/N5	Self weight	Uniform	0.115	-	-	-	Global	0.000	0.000	-1.000
N35/N7	Self weight	Uniform	0.115	-	-	-	Global	0.000	0.000	-1.000
N37/N8	Self weight	Uniform	0.115	-	-	-	Global	0.000	0.000	-1.000
N39/N6	Self weight	Uniform	0.115	-	-	-	Global	0.000	0.000	-1.000
N41/N17	Self weight	Uniform	0.115	-	-	-	Global	0.000	0.000	-1.000
N43/N20	Self weight	Uniform	0.115	-	-	-	Global	0.000	0.000	-1.000
N45/N21	Self weight	Uniform	0.115	-	-	-	Global	0.000	0.000	-1.000
N47/N24	Self weight	Uniform	0.115	-	-	-	Global	0.000	0.000	-1.000
N51/N67	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N67/N37	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N37/N39	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N39/N65	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N65/N52	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N49/N66	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N66/N35	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N35/N33	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N33/N64	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N64/N50	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N56/N72	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N72/N43	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N43/N41	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N41/N70	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N70/N53	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N58/N73	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N73/N45	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N45/N47	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N47/N71	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N71/N54	Self weight	Uniform	0.299	-	-	-	Global	0.000	0.000	-1.000
N64/N65	Self weight	Uniform	0.163	-	-	-	Global	0.000	0.000	-1.000
N66/N67	Self weight	Uniform	0.163	-	-	-	Global	0.000	0.000	-1.000
N70/N71	Self weight	Uniform	0.163	-	-	-	Global	0.000	0.000	-1.000
N72/N73	Self weight	Uniform	0.163	-	-	-	Global	0.000	0.000	-1.000

2.3. Results

2.3.1. Nodes

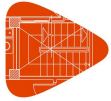
2.3.1.1. Displacements

References:

Dx, Dy, Dz: Node displacements in global axes.

Gx, Gy, Gz: Node rotations in global axes.

2.3.1.1.1. Envelope



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Node displacement envelope								
Reference	Combination		Displacements in global axes					
	Type	Description	Dx (mm)	Dy (mm)	Dz (mm)	Rx (mRad)	Ry (mRad)	Rz (mRad)
N5	Displacements	Minimum envelope value	-0.002	-0.059	-7.819	-1.973	0.031	-0.003
		Maximum envelope value	7.036	0.640	-3.128	0.946	4.693	1.008
N6	Displacements	Minimum envelope value	0.000	-0.066	-8.903	-1.973	-0.032	-0.633
		Maximum envelope value	7.036	0.640	-4.316	0.794	4.629	1.013
N7	Displacements	Minimum envelope value	0.000	0.044	-7.659	-2.702	0.031	-1.008
		Maximum envelope value	7.036	0.757	-3.129	0.040	4.692	0.639
N8	Displacements	Minimum envelope value	-0.002	0.051	-8.904	-2.702	-0.035	-1.013
		Maximum envelope value	7.036	0.757	-4.158	0.199	4.630	-0.003
N9	Displacements	Minimum envelope value	0.000	0.001	-7.704	-4.622	0.053	-0.664
		Maximum envelope value	14.508	5.327	-3.125	0.305	3.242	0.819
N10	Displacements	Minimum envelope value	-0.003	-0.012	-7.871	-2.100	0.054	0.000
		Maximum envelope value	14.508	5.309	-3.124	2.760	3.241	0.818
N11	Displacements	Minimum envelope value	0.000	-0.010	-8.953	-2.100	-0.054	-0.818
		Maximum envelope value	14.508	5.309	-4.318	2.806	3.134	0.664
N12	Displacements	Minimum envelope value	-0.003	-0.001	-8.955	-4.622	-0.054	-0.819
		Maximum envelope value	14.508	5.327	-4.153	0.261	3.134	0.000
N17	Displacements	Minimum envelope value	0.000	-0.022	-10.494	-0.939	0.005	0.000
		Maximum envelope value	10.755	0.416	-4.376	0.531	11.402	0.218
N18	Displacements	Minimum envelope value	0.000	-0.001	-10.524	-1.132	0.007	0.000
		Maximum envelope value	38.463	5.759	-4.358	0.179	10.794	0.103
N19	Displacements	Minimum envelope value	0.000	0.000	-10.348	-1.266	0.007	-0.103
		Maximum envelope value	38.463	5.760	-4.358	0.117	10.794	0.086
N20	Displacements	Minimum envelope value	0.000	0.014	-10.335	-1.363	0.004	-0.218
		Maximum envelope value	10.755	0.460	-4.376	-0.179	11.402	0.075
N21	Displacements	Minimum envelope value	0.000	0.020	-15.501	-1.363	-0.005	-0.218
		Maximum envelope value	10.755	0.460	-9.152	0.105	11.392	0.000
N22	Displacements	Minimum envelope value	0.000	-0.001	-15.535	-1.266	-0.007	-0.103
		Maximum envelope value	38.463	5.760	-9.138	0.059	10.781	0.000
N23	Displacements	Minimum envelope value	0.000	0.000	-15.535	-1.132	-0.007	-0.086
		Maximum envelope value	38.463	5.759	-9.311	0.240	10.781	0.103
N24	Displacements	Minimum envelope value	0.000	-0.028	-15.501	-0.939	-0.006	-0.074
		Maximum envelope value	10.755	0.416	-9.309	0.259	11.392	0.218
N33	Displacements	Minimum envelope value	-0.012	0.005	-7.801	1.458	0.013	-0.007
		Maximum envelope value	4.065	0.011	-3.121	3.641	6.516	2.104
N35	Displacements	Minimum envelope value	-0.011	-0.007	-7.644	-3.725	0.013	-2.103
		Maximum envelope value	4.066	-0.002	-3.123	-1.457	6.513	0.025
N37	Displacements	Minimum envelope value	0.010	-0.008	-8.885	-4.236	-0.022	-2.118
		Maximum envelope value	4.085	-0.002	-4.152	-2.026	6.486	-0.007
N39	Displacements	Minimum envelope value	0.011	0.006	-8.884	1.943	-0.016	-0.010
		Maximum envelope value	4.087	0.011	-4.307	4.237	6.483	2.118
N41	Displacements	Minimum envelope value	-0.003	0.002	-10.478	0.901	0.003	-0.001
		Maximum envelope value	4.613	0.006	-4.372	2.175	12.690	1.045
N43	Displacements	Minimum envelope value	-0.002	-0.003	-10.323	-2.379	0.001	-1.045
		Maximum envelope value	4.613	0.000	-4.372	-0.901	12.690	0.004
N45	Displacements	Minimum envelope value	0.001	-0.004	-15.482	-3.278	-0.003	-1.046
		Maximum envelope value	4.617	0.000	-9.145	-1.955	12.684	-0.001
N47	Displacements	Minimum envelope value	0.002	0.003	-15.482	1.753	-0.005	-0.002
		Maximum envelope value	4.617	0.006	-9.299	3.278	12.684	1.046
N49	Displacements	Minimum envelope value	0.000	0.000	0.000	-6.408	0.013	-3.453



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Node displacement envelope								
Reference	Combination		Displacements in global axes					
	Type	Description	Dx (mm)	Dy (mm)	Dz (mm)	Rx (mRad)	Ry (mRad)	Rz (mRad)
N50	Displacements	Maximum envelope value	0.000	0.000	0.000	-2.634	6.513	0.003
		Minimum envelope value	0.000	0.000	0.000	2.631	0.013	-0.012
		Maximum envelope value	0.000	0.000	0.000	6.597	6.516	3.451
N51	Displacements	Minimum envelope value	0.000	0.000	0.000	-7.446	-0.022	-3.460
		Maximum envelope value	0.000	0.000	0.000	-3.436	6.486	0.000
N52	Displacements	Minimum envelope value	0.000	0.000	0.000	3.623	-0.016	0.006
		Maximum envelope value	0.000	0.000	0.000	7.444	6.483	3.463
N53	Displacements	Minimum envelope value	0.000	0.000	0.000	2.837	0.003	-0.001
		Maximum envelope value	0.000	0.000	0.000	6.860	12.690	3.015
N54	Displacements	Minimum envelope value	0.000	0.000	0.000	6.000	-0.005	0.000
		Maximum envelope value	0.000	0.000	0.000	9.970	12.684	3.016
N56	Displacements	Minimum envelope value	0.000	0.000	0.000	-6.658	0.001	-3.015
		Maximum envelope value	0.000	0.000	0.000	-2.837	12.690	0.000
N58	Displacements	Minimum envelope value	0.000	0.000	0.000	-9.970	-0.003	-3.016
		Maximum envelope value	0.000	0.000	0.000	-5.800	12.684	0.000
N64	Displacements	Minimum envelope value	-0.001	0.000	-0.578	-	-	-
		Maximum envelope value	0.294	0.001	-0.231	-	-	-
N65	Displacements	Minimum envelope value	0.000	0.000	-0.651	-	-	-
		Maximum envelope value	0.295	0.001	-0.317	-	-	-
N66	Displacements	Minimum envelope value	0.000	-0.001	-0.889	-	-	-
		Maximum envelope value	0.467	0.000	-0.366	-	-	-
N67	Displacements	Minimum envelope value	0.000	-0.001	-1.033	-	-	-
		Maximum envelope value	0.468	0.000	-0.476	-	-	-
N70	Displacements	Minimum envelope value	0.000	0.000	-0.596	-	-	-
		Maximum envelope value	0.257	0.000	-0.247	-	-	-
N71	Displacements	Minimum envelope value	0.000	0.000	-0.865	-	-	-
		Maximum envelope value	0.257	0.000	-0.521	-	-	-
N72	Displacements	Minimum envelope value	0.000	0.000	-0.578	-	-	-
		Maximum envelope value	0.257	0.000	-0.247	-	-	-
N73	Displacements	Minimum envelope value	0.000	0.000	-0.865	-	-	-
		Maximum envelope value	0.257	0.000	-0.503	-	-	-

2.3.1.2. Reactions

References:

Rx, Ry, Rz: Node reactions with displacements with external fixity (forces).

Mx, My, Mz: Node reactions with rotations with external fixity (moments).

2.3.1.2.1. Envelope

Node reaction envelopes								
Reference	Combination		Reactions in global axes					
	Type	Description	Rx (kN)	Ry (kN)	Rz (kN)	Mx (kN·m)	My (kN·m)	Mz (kN·m)
N49	Foundation concrete	Minimum envelope value	-3.080	0.185	4.040	0.00	0.00	0.00
		Maximum envelope value	0.006	5.954	15.513	0.00	0.00	0.00
	Ground bearing pressures	Minimum envelope value	-2.581	0.606	4.366	0.00	0.00	0.00
		Maximum envelope value	-0.009	4.591	12.343	0.00	0.00	0.00
N50	Foundation concrete	Minimum envelope value	-3.102	-8.731	4.045	0.00	0.00	0.00
		Maximum envelope value	-0.125	-2.595	16.488	0.00	0.00	0.00
	Ground bearing pressures	Minimum envelope value	-2.597	-6.990	4.370	0.00	0.00	0.00
		Maximum envelope value	-0.125	-2.695	13.183	0.00	0.00	0.00



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Node reaction envelopes								
Reference	Combination		Reactions in global axes					
	Type	Description	Rx (kN)	Ry (kN)	Rz (kN)	Mx (kN·m)	My (kN·m)	Mz (kN·m)
N51	Foundation concrete	Minimum envelope value	-2.815	0.185	4.902	0.00	0.00	0.00
		Maximum envelope value	0.148	6.448	17.119	0.00	0.00	0.00
	Ground bearing pressures	Minimum envelope value	-2.362	0.606	5.112	0.00	0.00	0.00
		Maximum envelope value	0.109	5.006	13.692	0.00	0.00	0.00
N52	Foundation concrete	Minimum envelope value	-2.799	-8.731	6.487	0.00	0.00	0.00
		Maximum envelope value	0.325	-3.346	17.125	0.00	0.00	0.00
	Ground bearing pressures	Minimum envelope value	-2.347	-6.990	6.487	0.00	0.00	0.00
		Maximum envelope value	0.260	-3.346	13.696	0.00	0.00	0.00
N53	Foundation concrete	Minimum envelope value	-2.086	-3.616	1.901	0.00	0.00	0.00
		Maximum envelope value	-0.022	-0.611	12.439	0.00	0.00	0.00
	Ground bearing pressures	Minimum envelope value	-1.756	-2.907	2.681	0.00	0.00	0.00
		Maximum envelope value	-0.022	-0.704	9.460	0.00	0.00	0.00
N54	Foundation concrete	Minimum envelope value	-2.030	-3.616	7.748	0.00	0.00	0.00
		Maximum envelope value	0.093	-1.307	17.578	0.00	0.00	0.00
	Ground bearing pressures	Minimum envelope value	-1.712	-2.907	7.748	0.00	0.00	0.00
		Maximum envelope value	0.077	-1.307	13.768	0.00	0.00	0.00
N56	Foundation concrete	Minimum envelope value	-2.086	-0.432	1.901	0.00	0.00	0.00
		Maximum envelope value	0.042	1.889	11.673	0.00	0.00	0.00
	Ground bearing pressures	Minimum envelope value	-1.756	-0.200	2.681	0.00	0.00	0.00
		Maximum envelope value	0.033	1.415	8.799	0.00	0.00	0.00
N58	Foundation concrete	Minimum envelope value	-2.030	-0.432	6.635	0.00	0.00	0.00
		Maximum envelope value	0.029	2.598	17.578	0.00	0.00	0.00
	Ground bearing pressures	Minimum envelope value	-1.712	-0.200	6.784	0.00	0.00	0.00
		Maximum envelope value	0.022	2.012	13.768	0.00	0.00	0.00

Note: The indicated concrete combinations are the same as those used to check the equilibrium limit state of the foundations.

2.3.2. Bars

2.3.2.1. Forces

References:

N: Axial force (kN)

Vy: Shear force in the local Y axis of the bar. (kN)

Vz: Shear force in the local Z axis of the bar. (kN)

Mt: Torsional moment (kN·m)

My: Bending moment in the 'XZ' plane (section rotation with respect to the local 'Y' axis of the bar). (kN·m)

Mz: Bending moment in the 'XY' plane (section rotation with respect to the local 'Z' axis of the bar). (kN·m)

2.3.2.1.1. Envelope

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.400 m	0.600 m	1.000 m	1.400 m	1.800 m	2.200 m	2.400 m	2.800 m
N5/N6	Timber	N _{min}	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
		N _{max}	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417	0.417
		Vy _{min}	-0.438	-0.438	-0.438	-0.438	-0.438	-0.458	-0.917	-1.146	-1.604
		Vy _{max}	1.604	1.146	0.917	0.458	0.000	0.000	0.000	0.000	0.000
		Vz _{min}	-0.112	-0.080	-0.064	-0.032	0.000	0.024	0.047	0.059	0.083
		Vz _{max}	1.541	1.564	1.576	1.600	1.628	1.660	1.692	1.708	1.740
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-0.05	-0.01	0.00	0.02	0.02	-0.63	-1.30	-1.64	-2.33
		My _{max}	2.24	1.62	1.31	0.68	0.03	0.03	0.01	-0.01	-0.03



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Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.400 m	0.600 m	1.000 m	1.400 m	1.800 m	2.200 m	2.400 m	2.800 m
		Mz _{min}	-0.61	-0.44	-0.35	-0.41	-0.50	-0.41	-0.14	0.00	0.00
		Mz _{max}	0.62	0.07	0.00	0.00	0.00	0.18	0.35	0.44	0.62

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.400 m	0.600 m	1.000 m	1.400 m	1.800 m	2.200 m	2.400 m	2.800 m
N7/N8	Timber	N _{min}	-0.362	-0.362	-0.362	-0.362	-0.362	-0.362	-0.362	-0.362	-0.362
		N _{max}	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
		Vy _{min}	0.000	0.000	0.000	0.000	0.000	-0.458	-0.917	-1.146	-1.604
		Vy _{max}	1.604	1.146	0.917	0.458	0.438	0.438	0.438	0.438	0.438
		Vz _{min}	-0.112	-0.080	-0.064	-0.032	0.000	0.024	0.047	0.059	0.083
		Vz _{max}	1.541	1.564	1.576	1.600	1.628	1.660	1.692	1.708	1.740
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-0.05	-0.01	0.00	0.02	0.02	-0.63	-1.30	-1.64	-2.33
		My _{max}	2.24	1.62	1.31	0.68	0.03	0.03	0.01	-0.01	-0.03
		Mz _{min}	0.00	0.00	-0.14	-0.41	-0.50	-0.41	-0.35	-0.44	-0.61
		Mz _{max}	0.62	0.44	0.35	0.18	0.00	0.00	0.00	0.07	0.62

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.383 m	0.575 m	0.767 m	1.150 m	1.533 m	1.725 m	2.108 m	2.300 m
N9/N10	Timber	N _{min}	-2.067	-2.067	-2.067	-2.067	-2.067	-2.067	-2.067	-2.067	-2.067
		N _{max}	-0.268	-0.268	-0.268	-0.268	-0.268	-0.268	-0.268	-0.268	-0.268
		Vy _{min}	-1.466	-0.978	-0.733	-0.503	-0.503	-0.503	-0.503	-0.503	-0.503
		Vy _{max}	0.000	0.000	0.000	0.000	0.000	0.489	0.733	1.222	1.466
		Vz _{min}	-6.854	-4.569	-3.427	-2.285	0.000	0.023	0.034	0.057	0.068
		Vz _{max}	0.975	0.998	1.009	1.021	1.058	2.923	4.065	6.350	7.493
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-1.94	-0.08	-0.07	-0.06	-0.06	-0.45	-0.66	-1.55	-2.67
		My _{max}	1.13	0.99	1.40	1.83	2.02	1.59	1.04	-0.06	-0.07
		Mz _{min}	-0.58	-0.39	-0.29	-0.19	0.00	0.00	0.00	-0.14	-0.39
		Mz _{max}	0.00	0.07	0.24	0.36	0.45	0.36	0.29	0.48	0.58

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.188 m	0.375 m	0.563 m	0.750 m	0.938 m	1.125 m	1.313 m	1.500 m
N7/N9	Timber	N _{min}	-7.086	-7.071	-7.056	-7.041	-7.026	-7.011	-6.996	-6.981	-6.966
		N _{max}	0.803	0.814	0.825	0.837	0.848	0.859	0.870	0.881	0.892
		Vy _{min}	-0.053	-0.053	-0.053	-0.053	-0.053	-0.053	-0.053	-0.053	-0.053
		Vy _{max}	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.424
		Vz _{min}	-1.892	-1.892	-1.892	-1.892	-1.892	-1.892	-1.892	-1.892	-1.892
		Vz _{max}	1.314	1.314	1.314	1.314	1.314	1.314	1.314	1.314	1.314
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		My _{min}	-0.90	-0.54	-0.39	-0.31	-0.23	-0.43	-0.66	-0.88	-1.13
		My _{max}	0.85	0.60	0.48	0.45	0.61	0.93	1.26	1.59	1.94
		Mz _{min}	-0.04	-0.03	-0.02	-0.02	-0.28	-0.55	-0.82	-1.08	-1.35
		Mz _{max}	0.79	0.52	0.25	0.00	0.00	0.01	0.02	0.03	0.04

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.188 m	0.375 m	0.563 m	0.750 m	0.938 m	1.125 m	1.313 m	1.500 m
N5/N10	Timber	N _{min}	-7.725	-7.710	-7.695	-7.680	-7.665	-7.650	-7.635	-7.620	-7.605
		N _{max}	0.700	0.711	0.722	0.733	0.744	0.755	0.766	0.778	0.789



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Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.188 m	0.375 m	0.563 m	0.750 m	0.938 m	1.125 m	1.313 m	1.500 m
		Vy _{min}	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052
		Vy _{max}	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.424	1.424
		Vz _{min}	0.268	0.268	0.268	0.268	0.268	0.268	0.268	0.268	0.268
		Vz _{max}	3.008	3.008	3.008	3.008	3.008	3.008	3.008	3.008	3.008
		Mt _{min}	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	0.33	0.28	0.05	-0.28	-0.61	-1.12	-1.63	-2.14	-2.67
		My _{max}	1.92	1.35	0.91	0.54	0.23	0.14	0.06	-0.02	-0.07
		Mz _{min}	-0.04	-0.03	-0.02	-0.02	-0.28	-0.55	-0.82	-1.08	-1.35
		Mz _{max}	0.78	0.52	0.25	0.00	0.00	0.01	0.02	0.03	0.04

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.400 m	0.600 m	1.000 m	1.400 m	1.800 m	2.200 m	2.400 m	2.800 m
N10/N11	Timber	N _{min}	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052	-0.052
		N _{max}	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464	0.464
		Vy _{min}	-0.286	-0.286	-0.286	-0.286	-0.286	-0.458	-0.917	-1.146	-1.604
		Vy _{max}	1.604	1.146	0.917	0.458	0.000	0.000	0.000	0.000	0.000
		Vz _{min}	-0.112	-0.080	-0.064	-0.032	0.000	0.024	0.047	0.059	0.083
		Vz _{max}	0.905	0.928	0.940	0.964	0.990	1.022	1.054	1.070	1.102
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-0.04	0.00	0.01	0.02	0.03	-0.37	-0.78	-0.99	-1.43
		My _{max}	1.35	0.99	0.80	0.43	0.04	0.03	0.01	0.00	-0.03
		Mz _{min}	-0.40	-0.29	-0.23	-0.45	-0.54	-0.45	-0.17	0.00	0.00
		Mz _{max}	0.58	0.03	0.00	0.00	0.00	0.11	0.23	0.29	0.58

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.188 m	0.375 m	0.563 m	0.750 m	0.938 m	1.125 m	1.313 m	1.500 m
N6/N11	Timber	N _{min}	-7.725	-7.710	-7.695	-7.680	-7.665	-7.650	-7.635	-7.620	-7.605
		N _{max}	-0.240	-0.229	-0.218	-0.207	-0.196	-0.185	-0.174	-0.162	-0.151
		Vy _{min}	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038
		Vy _{max}	1.518	1.518	1.518	1.518	1.518	1.518	1.518	1.518	1.518
		Vz _{min}	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202
		Vz _{max}	3.008	3.008	3.008	3.008	3.008	3.008	3.008	3.008	3.008
		Mt _{min}	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	0.24	0.20	0.01	-0.31	-0.63	-1.12	-1.63	-2.14	-2.67
		My _{max}	1.92	1.35	0.91	0.54	0.19	0.12	0.05	-0.02	-0.06
		Mz _{min}	0.03	0.02	0.01	-0.01	-0.29	-0.58	-0.86	-1.14	-1.43
		Mz _{max}	0.85	0.56	0.28	0.01	0.00	-0.01	-0.02	-0.02	-0.03

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.400 m	0.600 m	1.000 m	1.400 m	1.800 m	2.200 m	2.400 m	2.800 m
N9/N12	Timber	N _{min}	-0.556	-0.556	-0.556	-0.556	-0.556	-0.556	-0.556	-0.556	-0.556
		N _{max}	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038	-0.038
		Vy _{min}	0.000	0.000	0.000	0.000	0.000	-0.458	-0.917	-1.146	-1.604
		Vy _{max}	1.604	1.146	0.917	0.458	0.286	0.286	0.286	0.286	0.286
		Vz _{min}	-0.112	-0.080	-0.064	-0.032	0.000	0.024	0.047	0.059	0.083
		Vz _{max}	0.905	0.928	0.940	0.964	0.990	1.022	1.054	1.070	1.102
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-0.04	0.00	0.01	0.02	0.03	-0.37	-0.78	-0.99	-1.43
		My _{max}	1.35	0.99	0.80	0.43	0.04	0.03	0.01	0.00	-0.03
		Mz _{min}	0.00	0.00	-0.17	-0.45	-0.54	-0.45	-0.23	-0.29	-0.40
		Mz _{max}	0.58	0.29	0.23	0.11	0.00	0.00	0.00	0.03	0.58



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Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.188 m	0.375 m	0.563 m	0.750 m	0.938 m	1.125 m	1.313 m	1.500 m
N8/N12	Timber	N _{min}	-7.694	-7.679	-7.664	-7.649	-7.634	-7.619	-7.604	-7.589	-7.574
		N _{max}	0.803	0.814	0.825	0.837	0.848	0.859	0.870	0.881	0.892
		Vy _{min}	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038
		Vy _{max}	1.518	1.518	1.518	1.518	1.518	1.518	1.518	1.518	1.518
		Vz _{min}	-1.849	-1.849	-1.849	-1.849	-1.849	-1.849	-1.849	-1.849	-1.849
		Vz _{max}	1.314	1.314	1.314	1.314	1.314	1.314	1.314	1.314	1.314
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		My _{min}	-0.84	-0.50	-0.33	-0.26	-0.20	-0.43	-0.66	-0.88	-1.13
		My _{max}	0.85	0.60	0.48	0.45	0.63	0.95	1.27	1.59	1.94
		Mz _{min}	0.03	0.02	0.01	-0.01	-0.29	-0.58	-0.86	-1.14	-1.43
		Mz _{max}	0.85	0.56	0.28	0.01	0.00	-0.01	-0.02	-0.02	-0.03

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.383 m	0.575 m	0.767 m	1.150 m	1.533 m	1.725 m	2.108 m	2.300 m
N12/N11	Timber	N _{min}	-1.849	-1.849	-1.849	-1.849	-1.849	-1.849	-1.849	-1.849	-1.849
		N _{max}	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
		Vy _{min}	-1.466	-0.978	-0.733	-0.489	0.000	0.000	0.000	0.000	0.000
		Vy _{max}	0.503	0.503	0.503	0.503	0.503	0.503	0.733	1.222	1.466
		Vz _{min}	-6.854	-4.569	-3.427	-2.285	0.000	0.023	0.034	0.057	0.068
		Vz _{max}	0.975	0.998	1.009	1.021	1.058	2.923	4.065	6.350	7.493
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-1.94	-0.07	-0.06	-0.05	-0.05	-0.45	-0.66	-1.55	-2.67
		My _{max}	1.13	0.99	1.40	1.83	2.03	1.59	1.05	-0.05	-0.06
		Mz _{min}	-0.39	0.00	0.00	0.00	0.00	-0.19	-0.29	-0.48	-0.58
		Mz _{max}	0.58	0.39	0.29	0.36	0.45	0.36	0.24	0.00	0.00

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.220 m	0.440 m	0.880 m	1.100 m	1.320 m	1.760 m	1.980 m	2.200 m
N17/N18	Timber	N _{min}	-2.883	-2.866	-2.848	-2.813	-2.795	-2.777	-2.742	-2.725	-2.707
		N _{max}	1.998	2.011	2.024	2.050	2.063	2.076	2.102	2.115	2.128
		Vy _{min}	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
		Vy _{max}	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025
		Vz _{min}	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
		Vz _{max}	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	0.08	0.07	0.05	0.01	-0.02	-0.22	-0.65	-0.86	-1.08
		My _{max}	1.09	0.88	0.66	0.24	0.08	0.05	0.00	-0.02	-0.03
		Mz _{min}	0.00	0.00	0.00	0.00	-0.08	-0.31	-0.76	-0.98	-1.21
		Mz _{max}	1.05	0.82	0.60	0.15	0.00	0.00	0.00	0.00	0.00

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.183 m	0.367 m	0.550 m	0.733 m	0.917 m	1.100 m
N19/N18	Timber	N _{min}	-0.437	-0.437	-0.437	-0.437	-0.437	-0.437	-0.437
		N _{max}	-0.046	-0.046	-0.046	-0.046	-0.046	-0.046	-0.046
		Vy _{min}	-1.029	-0.686	-0.343	-0.196	-0.196	-0.196	-0.196
		Vy _{max}	0.000	0.000	0.000	0.000	0.343	0.686	1.029
		Vz _{min}	-1.257	-0.838	-0.419	0.000	0.011	0.022	0.033
		Vz _{max}	1.715	1.726	1.737	1.772	2.070	2.367	2.665
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00



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Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.183 m	0.367 m	0.550 m	0.733 m	0.917 m	1.100 m
		$M_{y_{min}}$	-0.15	-0.06	-0.06	-0.06	-0.35	-0.67	-1.08
		$M_{y_{max}}$	0.93	0.69	0.45	0.22	0.18	0.07	-0.03
		$M_{z_{min}}$	-0.13	-0.07	-0.04	0.00	0.00	0.00	-0.13
		$M_{z_{max}}$	0.00	0.02	0.12	0.15	0.12	0.07	0.11

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.220 m	0.440 m	0.880 m	1.100 m	1.320 m	1.760 m	1.980 m	2.200 m
N20/N19	Timber	N_{min}	-1.475	-1.457	-1.440	-1.405	-1.387	-1.369	-1.334	-1.316	-1.299
		N_{max}	1.998	2.011	2.024	2.050	2.063	2.076	2.102	2.115	2.128
		$V_{y_{min}}$	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
		$V_{y_{max}}$	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025	1.025
		$V_{z_{min}}$	-0.179	-0.179	-0.179	-0.179	-0.179	-0.179	-0.179	-0.179	-0.179
		$V_{z_{max}}$	0.823	0.823	0.823	0.823	0.823	0.823	0.823	0.823	0.823
		$M_{t_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{y_{min}}$	-0.25	-0.21	-0.17	-0.11	-0.08	-0.22	-0.57	-0.75	-0.93
		$M_{y_{max}}$	0.88	0.70	0.53	0.18	0.02	0.04	0.08	0.12	0.16
		$M_{z_{min}}$	0.00	0.00	0.00	0.00	-0.08	-0.31	-0.76	-0.98	-1.21
		$M_{z_{max}}$	1.05	0.82	0.60	0.15	0.00	0.00	0.00	0.00	0.00

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.175 m	0.350 m	0.525 m	0.700 m	0.875 m	1.050 m
N20/N21	Timber	N_{min}	-0.173	-0.173	-0.173	-0.173	-0.173	-0.173	-0.173
		N_{max}	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		$V_{y_{min}}$	0.000	0.000	0.000	0.000	-0.294	-0.588	-0.882
		$V_{y_{max}}$	0.882	0.588	0.586	0.586	0.586	0.586	0.586
		$V_{z_{min}}$	-0.042	-0.028	-0.014	0.000	0.010	0.021	0.031
		$V_{z_{max}}$	3.918	3.932	3.946	3.960	3.974	3.988	4.002
		$M_{t_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{t_{max}}$	0.02	0.02	0.02	0.02	0.02	0.02	0.02
		$M_{y_{min}}$	0.00	0.00	0.00	0.00	-0.69	-1.39	-2.08
		$M_{y_{max}}$	2.07	1.39	0.70	0.01	0.00	0.00	0.00
		$M_{z_{min}}$	0.00	-0.01	-0.09	-0.12	-0.10	-0.21	-0.31
		$M_{z_{max}}$	0.31	0.21	0.10	0.00	0.00	0.00	0.11

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.220 m	0.440 m	0.880 m	1.100 m	1.320 m	1.760 m	1.980 m	2.200 m
N21/N22	Timber	N_{min}	-3.420	-3.403	-3.385	-3.350	-3.332	-3.315	-3.279	-3.262	-3.244
		N_{max}	1.554	1.567	1.580	1.606	1.619	1.632	1.658	1.671	1.684
		$V_{y_{min}}$	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
		$V_{y_{max}}$	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032
		$V_{z_{min}}$	-0.121	-0.121	-0.121	-0.121	-0.121	-0.121	-0.121	-0.121	-0.121
		$V_{z_{max}}$	0.823	0.823	0.823	0.823	0.823	0.823	0.823	0.823	0.823
		$M_{t_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{y_{min}}$	-0.13	-0.10	-0.08	-0.05	-0.04	-0.22	-0.57	-0.75	-0.93
		$M_{y_{max}}$	0.88	0.70	0.53	0.18	0.05	0.06	0.08	0.11	0.14
		$M_{z_{min}}$	0.00	0.00	0.00	0.00	-0.08	-0.31	-0.76	-0.99	-1.22
		$M_{z_{max}}$	1.05	0.83	0.60	0.15	0.00	0.00	0.00	0.00	0.00



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Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.183 m	0.367 m	0.550 m	0.733 m	0.917 m	1.100 m
N22/N23	Timber	N_{min}	-0.121	-0.121	-0.121	-0.121	-0.121	-0.121	-0.121
		N_{max}	0.264	0.264	0.264	0.264	0.264	0.264	0.264
		Vy_{min}	-1.029	-0.686	-0.343	0.000	0.000	0.000	0.000
		Vy_{max}	0.196	0.196	0.196	0.196	0.343	0.686	1.029
		Vz_{min}	-1.257	-0.838	-0.419	0.000	0.011	0.022	0.033
		Vz_{max}	1.715	1.726	1.737	1.772	2.070	2.367	2.665
		Mt_{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt_{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My_{min}	-0.14	-0.03	-0.03	-0.03	-0.35	-0.67	-1.08
		My_{max}	0.93	0.69	0.45	0.24	0.20	0.09	0.00
		Mz_{min}	-0.13	0.00	0.00	0.00	-0.04	-0.07	-0.13
		Mz_{max}	0.11	0.07	0.12	0.15	0.12	0.02	0.00

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.175 m	0.350 m	0.525 m	0.700 m	0.875 m	1.050 m
N18/N23	Timber	N_{min}	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004
		N_{max}	0.193	0.193	0.193	0.193	0.193	0.193	0.193
		Vy_{min}	-0.258	-0.258	-0.258	-0.258	-0.294	-0.588	-0.882
		Vy_{max}	0.882	0.588	0.294	0.000	0.000	0.000	0.000
		Vz_{min}	-0.042	-0.028	-0.014	0.000	0.010	0.021	0.031
		Vz_{max}	2.272	2.282	2.295	2.309	2.323	2.337	2.351
		Mt_{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt_{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My_{min}	0.00	0.00	0.00	0.01	-0.40	-0.81	-1.22
		My_{max}	1.21	0.81	0.41	0.01	0.01	0.00	0.00
		Mz_{min}	-0.14	-0.09	-0.10	-0.12	-0.10	-0.02	0.00
		Mz_{max}	0.11	0.00	0.00	0.00	0.05	0.09	0.14

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.175 m	0.350 m	0.525 m	0.700 m	0.875 m	1.050 m
N19/N22	Timber	N_{min}	-0.199	-0.199	-0.199	-0.199	-0.199	-0.199	-0.199
		N_{max}	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003	-0.003
		Vy_{min}	0.000	0.000	0.000	0.000	-0.294	-0.588	-0.882
		Vy_{max}	0.882	0.588	0.294	0.258	0.258	0.258	0.258
		Vz_{min}	-0.042	-0.028	-0.014	0.000	0.010	0.021	0.031
		Vz_{max}	2.272	2.282	2.295	2.309	2.323	2.337	2.351
		Mt_{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt_{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My_{min}	0.00	0.00	0.00	0.01	-0.40	-0.81	-1.22
		My_{max}	1.21	0.81	0.41	0.01	0.01	0.00	0.00
		Mz_{min}	0.00	-0.02	-0.10	-0.12	-0.10	-0.09	-0.14
		Mz_{max}	0.14	0.09	0.05	0.00	0.00	0.00	0.11



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Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.220 m	0.440 m	0.880 m	1.100 m	1.320 m	1.760 m	1.980 m	2.200 m
N24/N23	Timber	N _{min}	-3.420	-3.403	-3.385	-3.350	-3.332	-3.315	-3.279	-3.262	-3.244
		N _{max}	-0.194	-0.181	-0.168	-0.142	-0.129	-0.116	-0.090	-0.077	-0.064
		Vy _{min}	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
		Vy _{max}	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032	1.032
		Vz _{min}	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023	-0.023
		Vz _{max}	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987	0.987
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-0.04	-0.04	-0.04	-0.05	-0.05	-0.22	-0.65	-0.86	-1.08
		My _{max}	1.09	0.88	0.66	0.24	0.04	0.02	0.00	0.00	0.01
		Mz _{min}	0.00	0.00	0.00	0.00	-0.08	-0.31	-0.76	-0.99	-1.22
		Mz _{max}	1.05	0.83	0.60	0.15	0.00	0.00	0.00	0.00	0.00

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.175 m	0.350 m	0.525 m	0.700 m	0.875 m	1.050 m
N17/N24	Timber	N _{min}	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		N _{max}	0.173	0.173	0.173	0.173	0.173	0.173	0.173
		Vy _{min}	-0.586	-0.586	-0.586	-0.586	-0.586	-0.588	-0.882
		Vy _{max}	0.882	0.588	0.294	0.000	0.000	0.000	0.000
		Vz _{min}	-0.042	-0.028	-0.014	0.000	0.010	0.021	0.031
		Vz _{max}	3.918	3.932	3.946	3.960	3.974	3.988	4.002
		Mt _{min}	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	0.00	0.00	0.00	0.00	-0.69	-1.39	-2.08
		My _{max}	2.07	1.39	0.70	0.01	0.00	0.00	0.00
		Mz _{min}	-0.31	-0.21	-0.10	-0.12	-0.09	-0.01	0.00
		Mz _{max}	0.11	0.00	0.00	0.00	0.10	0.21	0.31

Bar force envelopes										
Bar	Combination type	Force	Positions on the bar							
			0.000 m	0.383 m	0.575 m	0.767 m	1.150 m	1.533 m	1.725 m	2.108 m
N7/N5	Timber	N _{min}	-11.097	-11.097	-11.097	-11.097	-11.097	-11.097	-11.097	-11.097
		N _{max}	-5.713	-5.713	-5.713	-5.713	-5.713	-5.713	-5.713	-5.713
		Vy _{min}	-1.466	-0.978	-0.733	-0.489	-0.391	-0.391	-0.391	-0.391
		Vy _{max}	0.000	0.000	0.000	0.000	0.000	0.489	0.733	1.222
		Vz _{min}	-6.923	-4.615	-3.462	-2.308	0.000	1.709	2.564	4.274
		Vz _{max}	-4.025	-2.315	-1.461	-0.606	1.105	3.413	4.566	6.874
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-2.68	-0.47	0.17	0.58	0.91	0.22	-0.41	-2.46
		My _{max}	-0.58	0.64	1.14	1.48	1.54	1.10	0.55	-0.90
		Mz _{min}	-0.45	-0.30	-0.22	-0.15	0.00	0.00	0.00	-0.05
		Mz _{max}	0.00	0.16	0.33	0.44	0.54	0.44	0.33	0.45

Bar force envelopes										
Bar	Combination type	Force	Positions on the bar							
			0.000 m	0.383 m	0.575 m	0.767 m	1.150 m	1.533 m	1.725 m	2.108 m
N8/N6	Timber	N _{min}	-11.989	-11.989	-11.989	-11.989	-11.989	-11.989	-11.989	-11.989
		N _{max}	-7.004	-7.004	-7.004	-7.004	-7.004	-7.004	-7.004	-7.004
		Vy _{min}	-1.466	-0.978	-0.733	-0.489	0.000	0.000	0.000	0.000
		Vy _{max}	0.391	0.391	0.391	0.391	0.391	0.489	0.733	1.222
		Vz _{min}	-6.923	-4.615	-3.462	-2.308	0.000	1.709	2.564	4.274
		Vz _{max}	-4.025	-2.315	-1.461	-0.606	1.105	3.413	4.566	6.874



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Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.383 m	0.575 m	0.767 m	1.150 m	1.533 m	1.725 m	2.108 m	2.300 m
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-2.71	-0.50	0.14	0.55	0.88	0.22	-0.41	-2.46	-3.89
		My _{max}	-0.58	0.64	1.14	1.48	1.50	1.06	0.51	-0.93	-1.83
		Mz _{min}	-0.31	0.00	0.00	0.00	0.00	-0.15	-0.22	-0.37	-0.45
		Mz _{max}	0.45	0.30	0.33	0.44	0.54	0.44	0.33	0.00	0.00

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.183 m	0.367 m	0.550 m	0.733 m	0.917 m	1.100 m
N20/N17	Timber	N _{min}	-8.468	-8.468	-8.468	-8.468	-8.468	-8.468	-8.468
		N _{max}	-3.206	-3.206	-3.206	-3.206	-3.206	-3.206	-3.206
		Vy _{min}	-1.029	-0.686	-0.343	-0.171	-0.171	-0.171	-0.171
		Vy _{max}	0.000	0.000	0.000	0.000	0.343	0.686	1.029
		Vz _{min}	-8.954	-5.969	-2.985	0.000	2.211	4.422	6.633
		Vz _{max}	-4.724	-2.513	-0.302	1.912	4.896	7.881	10.866
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-1.56	-0.19	0.45	0.65	0.11	-0.88	-2.60
		My _{max}	-0.09	0.58	1.02	1.09	0.82	0.03	-0.99
		Mz _{min}	-0.09	-0.06	-0.03	0.00	0.00	0.00	-0.07
		Mz _{max}	0.00	0.08	0.18	0.21	0.18	0.08	0.09

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.183 m	0.367 m	0.550 m	0.733 m	0.917 m	1.100 m
N21/N24	Timber	N _{min}	-11.196	-11.196	-11.196	-11.196	-11.196	-11.196	-11.196
		N _{max}	-5.893	-5.893	-5.893	-5.893	-5.893	-5.893	-5.893
		Vy _{min}	-1.029	-0.686	-0.343	0.000	0.000	0.000	0.000
		Vy _{max}	0.171	0.171	0.171	0.171	0.343	0.686	1.029
		Vz _{min}	-8.954	-5.969	-2.985	0.000	2.211	4.422	6.633
		Vz _{max}	-4.724	-2.513	-0.302	1.912	4.896	7.881	10.866
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	-1.70	-0.33	0.31	0.51	0.11	-0.88	-2.60
		My _{max}	-0.09	0.58	1.02	0.95	0.67	-0.11	-1.13
		Mz _{min}	-0.07	0.00	0.00	0.00	-0.03	-0.06	-0.09
		Mz _{max}	0.09	0.08	0.18	0.21	0.18	0.08	0.00

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
N33/N5	Rolled steel	N _{min}	-14.677	-14.643	-14.608
		N _{max}	-3.067	-3.038	-3.009
		Vy _{min}	-0.024	-0.024	-0.024
		Vy _{max}	2.886	2.886	2.886
		Vz _{min}	5.640	5.640	5.640
		Vz _{max}	14.122	14.122	14.122
		Mt _{min}	-0.31	-0.31	-0.31



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Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
		$M_{t,max}$	0.17	0.17	0.17
		$M_{y,min}$	1.45	0.04	-2.07
		$M_{y,max}$	5.30	1.77	-1.24
		$M_{z,min}$	0.00	-0.72	-1.44
		$M_{z,max}$	0.00	0.01	0.01

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
N35/N7	Rolled steel	N_{min}	-13.373	-13.338	-13.304
		N_{max}	-3.067	-3.038	-3.009
		$V_{y,min}$	-0.024	-0.024	-0.024
		$V_{y,max}$	2.884	2.884	2.884
		$V_{z,min}$	-12.006	-12.006	-12.006
		$V_{z,max}$	-4.113	-4.113	-4.113
		$M_{t,min}$	0.00	0.00	0.00
		$M_{t,max}$	0.31	0.31	0.31
		$M_{y,min}$	-4.30	-1.34	1.24
		$M_{y,max}$	-0.64	0.39	2.02
		$M_{z,min}$	0.00	-0.72	-1.44
		$M_{z,max}$	0.00	0.01	0.01

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
N37/N8	Rolled steel	N_{min}	-14.964	-14.929	-14.895
		N_{max}	-3.378	-3.349	-3.320
		$V_{y,min}$	0.012	0.012	0.012
		$V_{y,max}$	2.928	2.928	2.928
		$V_{z,min}$	-13.057	-13.057	-13.057
		$V_{z,max}$	-4.113	-4.113	-4.113
		$M_{t,min}$	-0.17	-0.17	-0.17
		$M_{t,max}$	0.31	0.31	0.31
		$M_{y,min}$	-4.75	-1.52	1.28
		$M_{y,max}$	-0.64	0.39	2.10
		$M_{z,min}$	0.00	-0.73	-1.46
		$M_{z,max}$	0.00	0.00	-0.01

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
N39/N6	Rolled steel	N_{min}	-14.964	-14.929	-14.895
		N_{max}	-5.509	-5.480	-5.452
		$V_{y,min}$	0.017	0.017	0.017
		$V_{y,max}$	2.926	2.926	2.926



Reports

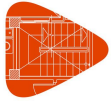
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Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
		$V_{z_{min}}$	7.274	7.274	7.274
		$V_{z_{max}}$	14.122	14.122	14.122
		$M_{t_{min}}$	-0.31	-0.31	-0.31
		$M_{t_{max}}$	0.00	0.00	0.00
		$M_{y_{min}}$	2.14	0.32	-2.10
		$M_{y_{max}}$	5.30	1.77	-1.33
		$M_{z_{min}}$	0.00	-0.73	-1.46
		$M_{z_{max}}$	0.00	0.00	-0.01

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
N41/N17	Rolled steel	N_{min}	-12.829	-12.795	-12.760
		N_{max}	-1.068	-1.040	-1.011
		$V_{y_{min}}$	-0.003	-0.003	-0.003
		$V_{y_{max}}$	2.036	2.036	2.036
		$V_{z_{min}}$	2.777	2.777	2.777
		$V_{z_{max}}$	9.476	9.476	9.476
		$M_{t_{min}}$	-0.23	-0.23	-0.23
		$M_{t_{max}}$	0.02	0.02	0.02
		$M_{y_{min}}$	0.62	-0.08	-1.48
		$M_{y_{max}}$	3.29	0.97	-0.77
		$M_{z_{min}}$	0.00	-0.51	-1.02
		$M_{z_{max}}$	0.00	0.00	0.00

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
N43/N20	Rolled steel	N_{min}	-10.185	-10.146	-10.107
		N_{max}	-1.068	-1.040	-1.011
		$V_{y_{min}}$	-0.004	-0.004	-0.004
		$V_{y_{max}}$	2.036	2.036	2.036
		$V_{z_{min}}$	-8.417	-8.417	-8.417
		$V_{z_{max}}$	-2.777	-2.777	-2.777
		$M_{t_{min}}$	0.00	0.00	0.00
		$M_{t_{max}}$	0.23	0.23	0.23
		$M_{y_{min}}$	-2.78	-0.68	0.77
		$M_{y_{max}}$	-0.62	0.08	1.43
		$M_{z_{min}}$	0.00	-0.51	-1.02
		$M_{z_{max}}$	0.00	0.00	0.00



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Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
N45/N21	Rolled steel	N _{min}	-15.360	-15.325	-15.291
		N _{max}	-3.286	-3.257	-3.228
		Vy _{min}	0.002	0.002	0.002
		Vy _{max}	2.041	2.041	2.041
		Vz _{min}	-10.889	-10.889	-10.889
		Vz _{max}	-4.203	-4.203	-4.203
		Mt _{min}	-0.02	-0.02	-0.02
		Mt _{max}	0.23	0.23	0.23
		My _{min}	-3.88	-1.16	0.96
		My _{max}	-1.14	-0.09	1.61
		Mz _{min}	0.00	-0.51	-1.02
		Mz _{max}	0.00	0.00	0.00

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.250 m	0.500 m
N47/N24	Rolled steel	N _{min}	-15.360	-15.325	-15.291
		N _{max}	-6.916	-6.887	-6.858
		Vy _{min}	0.000	0.000	0.000
		Vy _{max}	2.041	2.041	2.041
		Vz _{min}	5.942	5.942	5.942
		Vz _{max}	10.889	10.889	10.889
		Mt _{min}	-0.23	-0.23	-0.23
		Mt _{max}	0.00	0.00	0.00
		My _{min}	1.93	0.44	-1.61
		My _{max}	3.88	1.16	-1.05
		Mz _{min}	0.00	-0.51	-1.02
		Mz _{max}	0.00	0.00	0.00

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.068 m	0.135 m
N51/N67	Rolled steel	N _{min}	-6.006	-6.006	-6.006
		N _{max}	-0.185	-0.185	-0.185
		Vy _{min}	-2.792	-2.792	-2.792
		Vy _{max}	0.148	0.148	0.148
		Vz _{min}	-16.132	-16.108	-16.083
		Vz _{max}	-4.902	-4.881	-4.861
		Mt _{min}	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00
		My _{min}	0.00	0.33	0.66
		My _{max}	0.00	1.09	2.17
		Mz _{min}	0.00	-0.01	-0.02
		Mz _{max}	0.00	0.19	0.38



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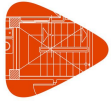
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Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.202 m	0.405 m	0.607 m	0.810 m	1.012 m	1.215 m
N67/N37	Rolled steel	N _{min}	-6.006	-6.006	-6.006	-6.006	-6.006	-6.006	-6.006
		N _{max}	-0.185	-0.185	-0.185	-0.185	-0.185	-0.185	-0.185
		Vy _{min}	-2.928	-2.928	-2.928	-2.928	-2.928	-2.928	-2.928
		Vy _{max}	0.064	0.064	0.064	0.064	0.064	0.064	0.064
		Vz _{min}	-15.809	-15.737	-15.664	-15.591	-15.519	-15.446	-15.374
		Vz _{max}	-4.633	-4.572	-4.512	-4.451	-4.391	-4.330	-4.270
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	0.66	1.59	2.51	3.42	4.31	5.20	6.07
		My _{max}	2.17	5.37	8.55	11.71	14.86	18.00	21.12
		Mz _{min}	-0.02	-0.01	-0.03	-0.04	-0.05	-0.06	-0.08
		Mz _{max}	0.38	0.97	1.56	2.15	2.75	3.34	3.93

Bar force envelopes										
Bar	Combination type	Force	Positions on the bar							
			0.000 m	0.383 m	0.575 m	0.767 m	1.150 m	1.533 m	1.725 m	2.108 m
N37/N39	Rolled steel	N _{min}	3.928	3.928	3.928	3.928	3.928	3.928	3.928	3.928
		N _{max}	7.051	7.051	7.051	7.051	7.051	7.051	7.051	7.051
		Vy _{min}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Vy _{max}	0.076	0.076	0.076	0.076	0.076	0.076	0.076	0.076
		Vz _{min}	-0.968	-0.830	-0.762	-0.693	-0.556	-0.441	-0.384	-0.269
		Vz _{max}	-0.341	-0.227	-0.170	-0.112	0.003	0.158	0.235	0.390
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	5.43	5.75	5.89	6.03	6.26	6.23	6.21	6.12
		My _{max}	16.37	16.50	16.55	16.58	16.60	16.58	16.54	16.44
		Mz _{min}	0.01	0.01	0.01	0.01	0.01	-0.02	-0.04	-0.06
		Mz _{max}	3.62	3.62	3.62	3.62	3.62	3.62	3.62	3.62

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.211 m	0.422 m	0.633 m	0.843 m	1.054 m	1.265 m
N39/N65	Rolled steel	N _{min}	-8.228	-8.228	-8.228	-8.228	-8.228	-8.228	-8.228
		N _{max}	-3.346	-3.346	-3.346	-3.346	-3.346	-3.346	-3.346
		Vy _{min}	0.016	0.016	0.016	0.016	0.016	0.016	0.016
		Vy _{max}	2.925	2.925	2.925	2.925	2.925	2.925	2.925
		Vz _{min}	5.855	5.918	5.981	6.044	6.107	6.170	6.233
		Vz _{max}	15.379	15.455	15.530	15.606	15.681	15.757	15.833
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	8.20	6.95	5.70	4.43	3.15	1.86	0.55
		My _{max}	21.11	17.86	14.60	11.31	8.01	4.70	1.37
		Mz _{min}	0.01	0.01	0.00	0.00	-0.01	-0.01	-0.03
		Mz _{max}	3.93	3.32	2.70	2.08	1.47	0.85	0.24

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.042 m	0.085 m
N65/N52	Rolled steel	N _{min}	-8.228	-8.228	-8.228
		N _{max}	-3.346	-3.346	-3.346



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Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.042 m	0.085 m
		$V_{y_{min}}$	-0.306	-0.306	-0.306
		$V_{y_{max}}$	2.776	2.776	2.776
		$V_{z_{min}}$	6.462	6.474	6.487
		$V_{z_{max}}$	16.107	16.122	16.137
		$M_{t_{min}}$	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00
		$M_{y_{min}}$	0.55	0.28	0.00
		$M_{y_{max}}$	1.37	0.69	0.00
		$M_{z_{min}}$	-0.03	-0.01	0.00
		$M_{z_{max}}$	0.24	0.12	0.00

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.068 m	0.135 m
N49/N66	Rolled steel	N_{min}	-5.523	-5.523	-5.523
		N_{max}	-0.185	-0.185	-0.185
		$V_{y_{min}}$	-3.037	-3.037	-3.037
		$V_{y_{max}}$	0.006	0.006	0.006
		$V_{z_{min}}$	-14.541	-14.517	-14.492
		$V_{z_{max}}$	-4.040	-4.020	-4.000
		$M_{t_{min}}$	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00
		$M_{y_{min}}$	0.00	0.27	0.54
		$M_{y_{max}}$	0.00	0.98	1.96
		$M_{z_{min}}$	0.00	0.00	0.00
		$M_{z_{max}}$	0.00	0.21	0.41

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.202 m	0.405 m	0.607 m	0.810 m	1.012 m	1.215 m
N66/N35	Rolled steel	N_{min}	-5.523	-5.523	-5.523	-5.523	-5.523	-5.523	-5.523
		N_{max}	-0.185	-0.185	-0.185	-0.185	-0.185	-0.185	-0.185
		$V_{y_{min}}$	-2.883	-2.883	-2.883	-2.883	-2.883	-2.883	-2.883
		$V_{y_{max}}$	0.025	0.025	0.025	0.025	0.025	0.025	0.025
		$V_{z_{min}}$	-14.218	-14.146	-14.073	-14.000	-13.928	-13.855	-13.783
		$V_{z_{max}}$	-3.771	-3.711	-3.650	-3.590	-3.529	-3.469	-3.408
		$M_{t_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{y_{min}}$	0.54	1.30	2.05	2.78	3.50	4.21	4.90
		$M_{y_{max}}$	1.96	4.83	7.69	10.53	13.36	16.17	18.97
		$M_{z_{min}}$	0.00	0.01	0.01	0.00	0.00	-0.01	-0.01
		$M_{z_{max}}$	0.41	0.99	1.58	2.16	2.75	3.33	3.91



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Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.383 m	0.575 m	0.767 m	1.150 m	1.533 m	1.725 m	2.108 m	2.300 m
N35/N33	Rolled steel	N _{min}	3.046	3.046	3.046	3.046	3.046	3.046	3.046	3.046	3.046
		N _{max}	6.483	6.483	6.483	6.483	6.483	6.483	6.483	6.483	6.483
		Vy _{min}	-0.076	-0.076	-0.076	-0.076	-0.076	-0.076	-0.076	-0.076	-0.076
		Vy _{max}	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Vz _{min}	-0.968	-0.830	-0.762	-0.693	-0.556	-0.441	-0.384	-0.269	-0.212
		Vz _{max}	-0.341	-0.227	-0.170	-0.112	0.003	0.158	0.235	0.390	0.467
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	3.45	3.56	3.60	3.63	3.65	3.63	3.60	3.51	3.45
		My _{max}	14.67	14.80	14.85	14.88	14.90	15.01	15.04	15.06	15.05
		Mz _{min}	-0.10	-0.07	-0.05	-0.04	-0.01	-0.01	-0.01	-0.01	-0.01
		Mz _{max}	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60	3.60

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.211 m	0.422 m	0.633 m	0.843 m	1.054 m	1.265 m
N33/N64	Rolled steel	N _{min}	-8.228	-8.228	-8.228	-8.228	-8.228	-8.228	-8.228
		N _{max}	-2.595	-2.595	-2.595	-2.595	-2.595	-2.595	-2.595
		Vy _{min}	-0.098	-0.098	-0.098	-0.098	-0.098	-0.098	-0.098
		Vy _{max}	2.887	2.887	2.887	2.887	2.887	2.887	2.887
		Vz _{min}	3.413	3.476	3.539	3.602	3.665	3.728	3.791
		Vz _{max}	14.756	14.831	14.907	14.982	15.058	15.134	15.209
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	4.90	4.17	3.43	2.68	1.91	1.14	0.34
		My _{max}	20.27	17.15	14.02	10.87	7.70	4.52	1.32
		Mz _{min}	-0.10	-0.08	-0.06	-0.04	-0.02	0.00	0.01
		Mz _{max}	3.91	3.30	2.69	2.08	1.48	0.87	0.26

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.042 m	0.085 m
N64/N50	Rolled steel	N _{min}	-8.228	-8.228	-8.228
		N _{max}	-2.595	-2.595	-2.595
		Vy _{min}	0.125	0.125	0.125
		Vy _{max}	3.056	3.056	3.056
		Vz _{min}	4.019	4.032	4.045
		Vz _{max}	15.484	15.499	15.514
		Mt _{min}	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00
		My _{min}	0.34	0.17	0.00
		My _{max}	1.32	0.66	0.00
		Mz _{min}	0.01	0.01	0.00
		Mz _{max}	0.26	0.13	0.00



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Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.042 m	0.085 m
N56/N72	Rolled steel	N _{min}	-1.852	-1.852	-1.852
		N _{max}	0.432	0.432	0.432
		Vy _{min}	-2.064	-2.064	-2.064
		Vy _{max}	0.042	0.042	0.042
		Vz _{min}	-11.309	-11.292	-11.275
		Vz _{max}	-1.901	-1.888	-1.876
		Mt _{min}	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00
		My _{min}	0.00	0.08	0.16
		My _{max}	0.00	0.48	0.96
		Mz _{min}	0.00	0.00	0.00
		Mz _{max}	0.00	0.09	0.18

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.187 m	0.373 m	0.746 m	0.933 m	1.119 m	1.492 m	1.679 m	1.865 m
N72/N43	Rolled steel	N _{min}	-1.852	-1.852	-1.852	-1.852	-1.852	-1.852	-1.852	-1.852	-1.852
		N _{max}	0.432	0.432	0.432	0.432	0.432	0.432	0.432	0.432	0.432
		Vy _{min}	-2.036	-2.036	-2.036	-2.036	-2.036	-2.036	-2.036	-2.036	-2.036
		Vy _{max}	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
		Vz _{min}	-11.159	-11.084	-11.009	-10.858	-10.783	-10.708	-10.557	-10.482	-10.407
		Vz _{max}	-1.790	-1.734	-1.678	-1.567	-1.511	-1.456	-1.344	-1.288	-1.233
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	0.16	0.49	0.81	1.41	1.70	1.98	2.50	2.74	2.98
		My _{max}	0.96	3.03	5.09	9.17	11.19	13.19	17.16	19.12	21.07
		Mz _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mz _{max}	0.18	0.56	0.93	1.69	2.07	2.45	3.21	3.59	3.97

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.183 m	0.367 m	0.550 m	0.733 m	0.917 m	1.100 m
N43/N41	Rolled steel	N _{min}	2.166	2.166	2.166	2.166	2.166	2.166	2.166
		N _{max}	6.565	6.565	6.565	6.565	6.565	6.565	6.565
		Vy _{min}	-0.012	-0.012	-0.012	-0.012	-0.012	-0.012	-0.012
		Vy _{max}	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Vz _{min}	-2.750	-2.684	-2.618	-2.553	-2.497	-2.443	-2.388
		Vz _{max}	-0.164	-0.110	-0.055	0.000	0.074	0.148	0.222
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	2.36	2.39	2.40	2.41	2.40	2.39	2.36
		My _{max}	18.29	18.32	18.34	18.35	18.63	18.89	19.13
		Mz _{min}	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
		Mz _{max}	3.74	3.74	3.74	3.74	3.74	3.74	3.74

Bar force envelopes										
Bar	Combination type	Force	Positions on the bar							
			0.000 m	0.187 m	0.373 m	0.746 m	0.933 m	1.119 m	1.492 m	1.679 m
N41/N70	Rolled steel	N _{min}	-3.419	-3.419	-3.419	-3.419	-3.419	-3.419	-3.419	-3.419
		N _{max}	-0.611	-0.611	-0.611	-0.611	-0.611	-0.611	-0.611	-0.611



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Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.187 m	0.373 m	0.746 m	0.933 m	1.119 m	1.492 m	1.679 m	1.865 m
		Vy _{min}	-0.012	-0.012	-0.012	-0.012	-0.012	-0.012	-0.012	-0.012	-0.012
		Vy _{max}	2.036	2.036	2.036	2.036	2.036	2.036	2.036	2.036	2.036
		Vz _{min}	1.233	1.288	1.344	1.456	1.511	1.567	1.678	1.734	1.790
		Vz _{max}	11.085	11.160	11.235	11.385	11.461	11.536	11.686	11.762	11.837
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	2.98	2.74	2.50	1.98	1.70	1.41	0.81	0.49	0.16
		My _{max}	22.39	20.32	18.23	14.01	11.88	9.74	5.40	3.22	1.02
		Mz _{min}	-0.02	-0.01	-0.01	-0.01	0.00	0.00	0.00	0.00	0.00
		Mz _{max}	3.97	3.59	3.21	2.45	2.07	1.69	0.93	0.56	0.18

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.042 m	0.085 m
N70/N53	Rolled steel	N _{min}	-3.419	-3.419	-3.419
		N _{max}	-0.611	-0.611	-0.611
		Vy _{min}	0.022	0.022	0.022
		Vy _{max}	2.064	2.064	2.064
		Vz _{min}	1.876	1.888	1.901
		Vz _{max}	11.953	11.970	11.987
		Mt _{min}	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00
		My _{min}	0.16	0.08	0.00
		My _{max}	1.02	0.51	0.00
		Mz _{min}	0.00	0.00	0.00
		Mz _{max}	0.18	0.09	0.00

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.042 m	0.085 m
N58/N73	Rolled steel	N _{min}	-2.395	-2.395	-2.395
		N _{max}	0.432	0.432	0.432
		Vy _{min}	-2.014	-2.014	-2.014
		Vy _{max}	0.029	0.029	0.029
		Vz _{min}	-16.359	-16.344	-16.329
		Vz _{max}	-6.635	-6.623	-6.610
		Mt _{min}	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00
		My _{min}	0.00	0.28	0.56
		My _{max}	0.00	0.69	1.39
		Mz _{min}	0.00	0.00	0.00
		Mz _{max}	0.00	0.09	0.17

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.187 m	0.373 m	0.746 m	0.933 m	1.119 m	1.492 m	1.679 m	1.865 m
N73/N45	Rolled steel	N _{min}	-2.395	-2.395	-2.395	-2.395	-2.395	-2.395	-2.395	-2.395	-2.395
		N _{max}	0.432	0.432	0.432	0.432	0.432	0.432	0.432	0.432	0.432



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Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.187 m	0.373 m	0.746 m	0.933 m	1.119 m	1.492 m	1.679 m	1.865 m
		Vy _{min}	-2.041	-2.041	-2.041	-2.041	-2.041	-2.041	-2.041	-2.041	-2.041
		Vy _{max}	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
		Vz _{min}	-16.226	-16.159	-16.092	-15.958	-15.891	-15.825	-15.691	-15.624	-15.557
		Vz _{max}	-6.524	-6.469	-6.413	-6.301	-6.246	-6.190	-6.079	-6.023	-5.967
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	0.56	1.77	2.98	5.35	6.52	7.68	9.96	11.09	12.21
		My _{max}	1.39	4.41	7.42	13.39	16.36	19.32	25.20	28.12	31.03
		Mz _{min}	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	-0.01
		Mz _{max}	0.17	0.55	0.93	1.69	2.07	2.45	3.21	3.60	3.98

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.183 m	0.367 m	0.550 m	0.733 m	0.917 m	1.100 m
N45/N47	Rolled steel	N _{min}	4.635	4.635	4.635	4.635	4.635	4.635	4.635
		N _{max}	8.493	8.493	8.493	8.493	8.493	8.493	8.493
		Vy _{min}	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Vy _{max}	0.012	0.012	0.012	0.012	0.012	0.012	0.012
		Vz _{min}	-2.750	-2.684	-2.618	-2.553	-2.497	-2.443	-2.388
		Vz _{max}	-0.164	-0.110	-0.055	0.000	0.074	0.148	0.222
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	11.07	11.56	12.03	12.50	12.50	12.48	12.46
		My _{max}	27.15	27.18	27.19	27.20	27.19	27.18	27.15
		Mz _{min}	0.00	0.00	0.00	0.00	0.00	0.00	-0.01
		Mz _{max}	3.74	3.74	3.74	3.74	3.74	3.74	3.74

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.187 m	0.373 m	0.746 m	0.933 m	1.119 m	1.492 m	1.679 m	1.865 m
N47/N71	Rolled steel	N _{min}	-3.419	-3.419	-3.419	-3.419	-3.419	-3.419	-3.419	-3.419	-3.419
		N _{max}	-1.307	-1.307	-1.307	-1.307	-1.307	-1.307	-1.307	-1.307	-1.307
		Vy _{min}	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
		Vy _{max}	2.041	2.041	2.041	2.041	2.041	2.041	2.041	2.041	2.041
		Vz _{min}	7.080	7.136	7.191	7.303	7.359	7.414	7.526	7.582	7.637
		Vz _{max}	15.557	15.624	15.691	15.825	15.891	15.958	16.092	16.159	16.226
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	14.38	13.06	11.72	9.02	7.65	6.27	3.49	2.08	0.66
		My _{max}	31.03	28.12	25.20	19.32	16.36	13.39	7.42	4.41	1.39
		Mz _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01
		Mz _{max}	3.98	3.60	3.21	2.45	2.07	1.69	0.93	0.55	0.17

Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.042 m	0.085 m
N71/N54	Rolled steel	N _{min}	-3.419	-3.419	-3.419
		N _{max}	-1.307	-1.307	-1.307
		Vy _{min}	-0.090	-0.090	-0.090
		Vy _{max}	2.014	2.014	2.014
		Vz _{min}	7.723	7.736	7.748
		Vz _{max}	16.329	16.344	16.359



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Bar force envelopes					
Bar	Combination type	Force	Positions on the bar		
			0.000 m	0.042 m	0.085 m
		$M_{t_{min}}$	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00
		$M_{y_{min}}$	0.66	0.33	0.00
		$M_{y_{max}}$	1.39	0.69	0.00
		$M_{z_{min}}$	-0.01	0.00	0.00
		$M_{z_{max}}$	0.17	0.09	0.00

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.400 m	0.600 m	1.000 m	1.400 m	1.800 m	2.200 m	2.400 m	2.800 m
N64/N65	Rolled steel	N_{min}	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141	0.141
		N_{max}	0.404	0.404	0.404	0.404	0.404	0.404	0.404	0.404	0.404
		$V_{y_{min}}$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		$V_{y_{max}}$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		$V_{z_{min}}$	-0.309	-0.220	-0.176	-0.088	0.000	0.065	0.131	0.163	0.229
		$V_{z_{max}}$	-0.229	-0.163	-0.131	-0.065	0.000	0.088	0.176	0.220	0.309
		$M_{t_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{y_{min}}$	0.00	0.08	0.11	0.15	0.16	0.15	0.11	0.08	0.00
		$M_{y_{max}}$	0.00	0.11	0.15	0.20	0.22	0.20	0.15	0.11	0.00
		$M_{z_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{z_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Bar force envelopes											
Bar	Combination type	Force	Positions on the bar								
			0.000 m	0.400 m	0.600 m	1.000 m	1.400 m	1.800 m	2.200 m	2.400 m	2.800 m
N66/N67	Rolled steel	N_{min}	-0.070	-0.070	-0.070	-0.070	-0.070	-0.070	-0.070	-0.070	-0.070
		N_{max}	0.173	0.173	0.173	0.173	0.173	0.173	0.173	0.173	0.173
		$V_{y_{min}}$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		$V_{y_{max}}$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		$V_{z_{min}}$	-0.309	-0.220	-0.176	-0.088	0.000	0.065	0.131	0.163	0.229
		$V_{z_{max}}$	-0.229	-0.163	-0.131	-0.065	0.000	0.088	0.176	0.220	0.309
		$M_{t_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{y_{min}}$	0.00	0.08	0.11	0.15	0.16	0.15	0.11	0.08	0.00
		$M_{y_{max}}$	0.00	0.11	0.15	0.20	0.22	0.20	0.15	0.11	0.00
		$M_{z_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{z_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.175 m	0.350 m	0.525 m	0.700 m	0.875 m	1.050 m
N70/N71	Rolled steel	N_{min}	0.023	0.023	0.023	0.023	0.023	0.023	0.023
		N_{max}	0.102	0.102	0.102	0.102	0.102	0.102	0.102
		$V_{y_{min}}$	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		$V_{y_{max}}$	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		$V_{z_{min}}$	-0.116	-0.077	-0.039	0.000	0.029	0.057	0.086
		$V_{z_{max}}$	-0.086	-0.057	-0.029	0.000	0.039	0.077	0.116
		$M_{t_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{t_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{y_{min}}$	0.00	0.01	0.02	0.02	0.02	0.01	0.00
		$M_{y_{max}}$	0.00	0.02	0.03	0.03	0.03	0.02	0.00
		$M_{z_{min}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		$M_{z_{max}}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00



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Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.175 m	0.350 m	0.525 m	0.700 m	0.875 m	1.050 m
		Mz _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Bar force envelopes									
Bar	Combination type	Force	Positions on the bar						
			0.000 m	0.175 m	0.350 m	0.525 m	0.700 m	0.875 m	1.050 m
N72/N73	Rolled steel	N _{min}	-0.050	-0.050	-0.050	-0.050	-0.050	-0.050	-0.050
		N _{max}	0.032	0.032	0.032	0.032	0.032	0.032	0.032
		Vy _{min}	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Vy _{max}	0.000	0.000	0.000	0.000	0.000	0.000	0.000
		Vz _{min}	-0.116	-0.077	-0.039	0.000	0.029	0.057	0.086
		Vz _{max}	-0.086	-0.057	-0.029	0.000	0.039	0.077	0.116
		Mt _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mt _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		My _{min}	0.00	0.01	0.02	0.02	0.02	0.01	0.00
		My _{max}	0.00	0.02	0.03	0.03	0.03	0.02	0.00
		Mz _{min}	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Mz _{max}	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2.3.2.2. Resistance

References:

N: Axial force (kN)

Vy: Shear force in the local Y axis of the bar. (kN)

Vz: Shear force in the local Z axis of the bar. (kN)

Mt: Torsional moment (kN·m)

My: Bending moment in the 'XZ' plane (section rotation with respect to the local 'Y' axis of the bar). (kN·m)

Mz: Bending moment in the 'XY' plane (section rotation with respect to the local 'Z' axis of the bar). (kN·m)

The indicated forces are those corresponding to the worst case combination, in other words, that requiring the maximum resistance of the section.

Origin of worst case loads:

- G: Only gravity loads
- GW: Gravity loads + wind
- GE: Gravity loads + earthquake
- GWE: Gravity loads + wind + earthquake

η : Demand capacity ratio - resistance. The bar complies with the code resistance conditions if $\eta \leq 100$ %.

Steel sections										
Bar	η (%)	Position (m)	Worst case forces						Origin	Status
			N (kN)	Vy (kN)	Vz (kN)	Mt (kN·m)	My (kN·m)	Mz (kN·m)		
N33/N5	55.92	0.000	-13.506	-0.022	14.122	0.17	5.30	0.00	GW	Verified
N35/N7	45.81	0.000	-13.373	-0.022	-11.852	0.00	-4.30	0.00	G	Verified
N37/N8	50.58	0.000	-14.964	1.804	-12.916	0.19	-4.75	0.00	GW	Verified
N39/N6	55.92	0.000	-13.506	0.022	14.122	-0.17	5.30	0.00	GW	Verified
N41/N17	35.54	0.000	-12.829	0.000	9.290	0.02	3.29	0.00	GW	Verified



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Steel sections										
Bar	η (%)	Position (m)	Worst case forces						Origin	Status
			N (kN)	Vy (kN)	Vz (kN)	Mt (kN·m)	My (kN·m)	Mz (kN·m)		
N43/N20	29.98	0.000	-10.185	-0.003	-8.417	0.00	-2.78	0.00	G	Verified
N45/N21	41.90	0.000	-15.360	2.041	-10.889	0.23	-3.88	0.00	GW	Verified
N47/N24	41.90	0.000	-15.360	2.041	10.889	-0.23	3.88	0.00	GW	Verified
N51/N67	5.94	0.000	-5.942	-1.651	-16.132	0.00	0.00	0.00	GW	Verified
N67/N37	29.82	1.215	-5.820	-2.928	-14.349	0.00	19.73	3.93	GW	Verified
N37/N39	26.93	1.150	6.832	0.000	0.003	0.00	15.46	3.62	GW	Verified
N39/N65	29.83	0.000	-5.820	2.925	14.354	0.00	19.73	3.93	GW	Verified
N65/N52	5.95	0.085	-5.942	1.632	16.137	0.00	0.00	0.00	GW	Verified
N49/N66	5.36	0.000	-5.452	-0.131	-14.541	0.00	0.00	0.00	G	Verified
N66/N35	23.77	1.215	-4.962	-1.759	-12.192	0.00	16.82	2.40	GW	Verified
N35/N33	20.88	1.150	5.825	0.000	0.003	0.00	13.21	2.20	GW	Verified
N33/N64	23.93	0.000	-7.387	-0.066	14.756	0.00	20.27	-0.06	GW	Verified
N64/N50	5.72	0.085	-7.387	0.245	15.514	0.00	0.00	0.00	GW	Verified
N56/N72	4.17	0.000	-1.852	-0.029	-11.309	0.00	0.00	0.00	G	Verified
N72/N43	24.36	1.865	-1.852	0.003	-10.407	0.00	21.07	0.00	G	Verified
N43/N41	22.47	1.100	6.565	-0.007	-1.311	0.00	19.13	0.00	GW	Verified
N41/N70	25.97	0.000	-2.911	-0.009	11.085	0.00	22.39	-0.01	GW	Verified
N70/N53	4.42	0.085	-2.911	0.067	11.987	0.00	0.00	0.00	GW	Verified
N58/N73	6.03	0.000	-2.395	-2.012	-16.359	0.00	0.00	0.00	GW	Verified
N73/N45	43.13	1.865	-2.395	-2.041	-15.557	0.00	31.03	3.98	GW	Verified
N45/N47	40.84	0.550	8.493	0.000	0.000	0.00	27.20	3.74	GW	Verified
N47/N71	43.13	0.000	-2.395	2.041	15.557	0.00	31.03	3.98	GW	Verified
N71/N54	6.03	0.085	-2.395	2.012	16.359	0.00	0.00	0.00	GW	Verified
N64/N65	0.78	1.400	0.331	0.000	0.000	0.00	0.22	0.00	GW	Verified
N66/N67	0.76	1.400	0.173	0.000	0.000	0.00	0.22	0.00	G	Verified
N70/N71	0.11	0.525	0.076	0.000	0.000	0.00	0.03	0.00	GW	Verified
N72/N73	0.11	0.525	0.032	0.000	0.000	0.00	0.03	0.00	G	Verified

Timber sections										
Bar	η (%)	Position (m)	Worst case forces						Origin	Status
			N (kN)	Vy (kN)	Vz (kN)	Mt (kN·m)	My (kN·m)	Mz (kN·m)		
N5/N6	55.06	2.800	0.030	-0.438	1.740	0.00	-2.33	0.61	GW	Verified
N7/N8	55.07	2.800	0.027	0.438	1.740	0.00	-2.33	-0.61	GW	Verified
N9/N10	61.18	2.300	-1.402	-0.503	5.883	0.00	-2.60	0.58	GW	Verified
N7/N9	53.70	1.500	-6.359	0.848	-1.890	0.00	1.94	-0.81	GW	Verified
N5/N10	58.20	1.500	-7.605	-0.052	2.815	0.00	-2.67	0.04	GW	Verified
N10/N11	34.22	2.800	-0.052	-0.286	1.102	0.00	-1.43	0.40	GW	Verified
N6/N11	58.20	1.500	-7.605	0.052	2.815	0.00	-2.67	-0.04	GW	Verified
N9/N12	34.22	2.800	-0.051	0.286	1.102	0.00	-1.43	-0.40	GW	Verified
N8/N12	55.25	1.500	-7.574	0.951	-1.803	0.00	1.93	-0.89	GW	Verified
N12/N11	61.18	2.300	-1.402	0.503	5.883	0.00	-2.60	-0.58	GW	Verified
N17/N18	26.12	2.200	1.374	1.025	0.177	0.00	-0.14	-1.21	GW	Verified
N19/N18	23.14	1.100	-0.105	-0.196	2.653	0.00	-1.08	0.11	GW	Verified
N20/N19	27.06	2.200	1.374	1.025	-0.177	0.00	0.14	-1.21	GW	Verified



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Timber sections										
Bar	η (%)	Position (m)	Worst case forces						Origin	Status
			N (kN)	V _y (kN)	V _z (kN)	M _t (kN·m)	M _y (kN·m)	M _z (kN·m)		
N20/N21	45.96	1.050	0.000	0.586	4.002	0.02	-2.08	-0.31	GW	Verified
N21/N22	27.73	2.200	-3.244	1.032	-0.029	0.00	0.07	-1.22	GW	Verified
N22/N23	23.14	1.100	-0.105	0.196	2.653	0.00	-1.08	-0.11	GW	Verified
N18/N23	26.21	1.050	-0.004	-0.258	2.351	0.00	-1.22	0.14	GW	Verified
N19/N22	26.21	1.050	-0.004	0.258	2.351	0.00	-1.22	-0.14	GW	Verified
N24/N23	27.73	2.200	-3.244	1.032	0.029	0.00	-0.07	-1.22	GW	Verified
N17/N24	45.96	1.050	0.000	-0.586	4.002	-0.02	-2.08	0.31	GW	Verified
N7/N5	92.56	2.300	-10.604	-0.391	8.028	0.00	-3.89	0.45	GW	Verified
N8/N6	92.56	2.300	-10.604	0.391	8.028	0.00	-3.89	-0.45	GW	Verified
N20/N17	75.41	0.000	-7.956	0.000	-8.954	0.00	-1.52	0.00	G	Verified
N21/N24	75.41	0.000	-7.956	0.000	-8.954	0.00	-1.52	0.00	G	Verified

2.3.2.3. Deflections

References:

Pos.: Local 'X' coordinate value of the deflection group at the point at which the worst case deflection value occurs.

L.: Distance between two consecutive cut-off points of the deformed shape on the straight line that joins the end nodes of the deflection group.

Deflections								
Group	Absolute maximum deflection xy Relative maximum deflection xy		Absolute maximum deflection xz Relative maximum deflection xz		Absolute active deflection xy Relative active deflection xy		Absolute active deflection xz Relative active deflection xz	
	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)
N5/N6	1.400	1.18	0.600	1.02	1.600	1.24	0.600	0.98
	1.400	L/(>1000)	0.600	L/(>1000)	1.400	L/(>1000)	0.600	L/(>1000)
N7/N8	1.400	1.18	0.600	1.02	1.200	1.24	2.200	0.98
	1.400	L/(>1000)	0.600	L/(>1000)	1.400	L/(>1000)	0.600	L/(>1000)
N9/N10	1.150	0.77	0.958	3.45	0.958	0.81	0.958	3.59
	1.150	L/(>1000)	0.958	L/667.5	1.150	L/(>1000)	0.958	L/681.6
N7/N9	0.938	0.33	0.938	0.60	0.938	0.34	0.938	0.87
	0.938	L/(>1000)	0.938	L/(>1000)	0.938	L/(>1000)	1.125	L/(>1000)
N5/N10	0.938	0.33	1.125	0.73	0.938	0.34	0.938	0.90
	0.938	L/(>1000)	1.125	L/(>1000)	0.938	L/(>1000)	0.938	L/(>1000)
N10/N11	1.400	1.31	0.600	0.65	1.600	1.33	2.200	0.60
	1.400	L/(>1000)	0.600	L/(>1000)	1.400	L/(>1000)	0.600	L/(>1000)
N6/N11	0.938	0.35	1.125	0.73	0.938	0.34	0.938	0.87
	0.938	L/(>1000)	1.125	L/(>1000)	0.938	L/(>1000)	1.125	L/(>1000)
N9/N12	1.400	1.31	0.600	0.65	1.200	1.33	0.600	0.60
	1.400	L/(>1000)	0.600	L/(>1000)	1.400	L/(>1000)	0.600	L/(>1000)
N8/N12	0.938	0.35	0.938	0.63	0.938	0.34	0.938	0.90
	0.938	L/(>1000)	0.938	L/(>1000)	0.938	L/(>1000)	0.938	L/(>1000)
N12/N11	1.150	0.77	1.150	3.46	1.342	0.81	1.342	3.59
	1.150	L/(>1000)	1.150	L/665.4	1.150	L/(>1000)	0.958	L/681.6
N17/N18	1.760	0.41	0.440	0.33	1.760	0.41	1.540	0.38
	1.760	L/(>1000)	1.760	L/(>1000)	1.760	L/(>1000)	1.760	L/(>1000)
N19/N18	0.550	0.07	0.367	0.14	0.550	0.07	0.367	0.17
	0.550	L/(>1000)	0.367	L/(>1000)	0.550	L/(>1000)	0.367	L/(>1000)
N20/N19	1.760	0.41	1.760	0.30	1.760	0.41	0.660	0.38
	1.760	L/(>1000)	1.760	L/(>1000)	1.760	L/(>1000)	1.760	L/(>1000)
N20/N21	0.525	0.06	0.175	0.12	0.350	0.06	0.175	0.12
	0.525	L/(>1000)	0.175	L/(>1000)	0.525	L/(>1000)	0.175	L/(>1000)
N21/N22	1.760	0.41	1.760	0.30	1.760	0.41	1.540	0.38
	1.760	L/(>1000)	1.760	L/(>1000)	1.760	L/(>1000)	1.760	L/(>1000)
N22/N23	0.550	0.07	0.367	0.14	0.550	0.07	0.733	0.17
	0.550	L/(>1000)	0.367	L/(>1000)	0.550	L/(>1000)	0.367	L/(>1000)

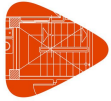


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Deflections								
Group	Absolute maximum deflection xy Relative maximum deflection xy		Absolute maximum deflection xz Relative maximum deflection xz		Absolute active deflection xy Relative active deflection xy		Absolute active deflection xz Relative active deflection xz	
	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)
N18/N23	0.525	0.06	0.175	0.07	0.525	0.06	0.175	0.07
	0.525	L/(> 1000)	0.175	L/(> 1000)	0.525	L/(> 1000)	0.175	L/(> 1000)
N19/N22	0.525	0.06	0.175	0.07	0.525	0.06	0.875	0.07
	0.525	L/(> 1000)	0.175	L/(> 1000)	0.525	L/(> 1000)	0.175	L/(> 1000)
N24/N23	1.760	0.41	0.440	0.33	1.760	0.41	0.660	0.38
	1.760	L/(> 1000)	1.760	L/(> 1000)	1.760	L/(> 1000)	1.760	L/(> 1000)
N17/N24	0.525	0.06	0.175	0.12	0.700	0.06	0.875	0.12
	0.525	L/(> 1000)	0.175	L/(> 1000)	0.525	L/(> 1000)	0.175	L/(> 1000)
N7/N5	1.150	0.96	1.150	2.61	0.958	0.99	1.533	0.79
	1.150	L/(> 1000)	1.150	L/881.4	1.150	L/(> 1000)	1.533	L/(> 1000)
N8/N6	1.150	0.97	0.958	2.56	1.342	0.99	0.767	0.79
	1.150	L/(> 1000)	0.958	L/897.5	1.150	L/(> 1000)	0.767	L/(> 1000)
N20/N17	0.550	0.11	0.550	0.61	0.550	0.11	0.733	0.14
	0.550	L/(> 1000)	0.550	L/(> 1000)	0.550	L/(> 1000)	0.733	L/(> 1000)
N21/N24	0.550	0.11	0.550	0.53	0.550	0.11	0.367	0.14
	0.550	L/(> 1000)	0.550	L/(> 1000)	0.550	L/(> 1000)	0.367	L/(> 1000)
N33/N5	0.250	0.11	0.250	0.35	0.250	0.11	0.250	0.31
	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)
N35/N7	0.250	0.11	0.250	0.23	0.250	0.11	0.250	0.27
	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)
N37/N8	0.250	0.12	0.250	0.28	0.250	0.12	0.250	0.31
	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)
N39/N6	0.250	0.12	0.250	0.35	0.250	0.11	0.250	0.27
	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)
N41/N17	0.250	0.08	0.250	0.18	0.250	0.08	0.250	0.16
	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)
N43/N20	0.250	0.08	0.250	0.12	0.250	0.08	0.250	0.10
	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)
N45/N21	0.250	0.08	0.250	0.21	0.250	0.08	0.250	0.16
	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)
N47/N24	0.250	0.08	0.250	0.21	0.250	0.08	0.250	0.11
	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)	0.250	L/(> 1000)
N49/N35	0.743	0.23	0.743	0.48	0.743	0.23	0.743	0.27
	0.743	L/(> 1000)	0.743	L/(> 1000)	0.743	L/(> 1000)	0.743	L/(> 1000)
N35/N33	1.150	1.21	1.150	2.10	1.150	1.21	1.150	1.26
	1.150	L/(> 1000)	1.150	L/(> 1000)	1.150	L/(> 1000)	1.150	L/(> 1000)
N33/N50	0.633	0.23	0.633	0.52	0.633	0.23	0.633	0.32
	0.633	L/(> 1000)	0.633	L/(> 1000)	0.633	L/(> 1000)	0.633	L/(> 1000)
N51/N37	0.743	0.23	0.743	0.56	0.743	0.24	0.743	0.33
	0.743	L/(> 1000)	0.743	L/(> 1000)	0.743	L/(> 1000)	0.743	L/(> 1000)
N37/N39	1.150	1.22	1.150	2.45	1.150	1.21	1.150	1.27
	1.150	L/(> 1000)	1.150	L/940.5	1.150	L/(> 1000)	1.150	L/(> 1000)
N39/N52	0.633	0.23	0.633	0.55	0.633	0.23	0.633	0.28
	0.633	L/(> 1000)	0.633	L/(> 1000)	0.633	L/(> 1000)	0.633	L/(> 1000)
N41/N53	0.746	0.49	0.746	1.22	0.746	0.49	0.746	0.73
	0.746	L/(> 1000)	0.746	L/(> 1000)	0.746	L/(> 1000)	0.746	L/(> 1000)
N47/N54	0.746	0.49	0.746	1.67	0.746	0.49	0.746	0.66
	0.746	L/(> 1000)	0.746	L/(> 1000)	0.746	L/(> 1000)	0.746	L/(> 1000)
N56/N43	1.204	0.49	1.204	1.12	1.204	0.49	1.204	0.63
	1.204	L/(> 1000)	1.204	L/(> 1000)	1.204	L/(> 1000)	1.204	L/(> 1000)
N58/N45	1.204	0.49	1.204	1.67	1.204	0.49	1.204	0.76
	1.204	L/(> 1000)	1.204	L/(> 1000)	1.204	L/(> 1000)	1.204	L/(> 1000)
N43/N41	0.550	0.29	0.550	0.60	0.550	0.29	0.550	0.35
	0.550	L/(> 1000)	0.550	L/(> 1000)	0.550	L/(> 1000)	0.550	L/(> 1000)
N45/N47	0.550	0.29	0.550	0.90	0.550	0.29	0.550	0.36
	0.550	L/(> 1000)	0.550	L/(> 1000)	0.550	L/(> 1000)	0.550	L/(> 1000)
N64/N65	1.400	0.00	1.400	0.18	2.400	0.00	1.400	0.00
	-	L/(> 1000)	1.400	L/(> 1000)	-	L/(> 1000)	-	L/(> 1000)
N66/N67	1.600	0.00	1.400	0.18	2.200	0.00	0.200	0.00
	-	L/(> 1000)	1.400	L/(> 1000)	-	L/(> 1000)	-	L/(> 1000)
N70/N71	0.525	0.00	0.525	0.00	0.525	0.00	0.525	0.00
	-	L/(> 1000)	0.525	L/(> 1000)	-	L/(> 1000)	-	L/(> 1000)



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Deflections								
Group	Absolute maximum deflection xy Relative maximum deflection xy		Absolute maximum deflection xz Relative maximum deflection xz		Absolute active deflection xy Relative active deflection xy		Absolute active deflection xz Relative active deflection xz	
	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)	Pos. (m)	Deflection (mm)
N72/N73	0.875 -	0.00 L/(> 1000)	0.525 0.525	0.00 L/(> 1000)	0.875 -	0.00 L/(> 1000)	0.875 -	0.00 L/(> 1000)



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2.3.2.4. U.L.S. Checks (Summarised)

Bars	CHECKS (EUROCODE 5 EN 1995-1-1: 2004 + A1:2008)											Status
	$N_{t,0,d}$	$N_{c,0,d}$	$M_{y,d}$	$M_{z,d}$	$V_{y,d}$	$V_{z,d}$	$M_{x,d}$	$M_{y,d}M_{z,d}$	$N_{t,0,d}M_{y,d}M_{z,d}$	$N_{c,0,d}M_{y,d}M_{z,d}$	$M_{x,d}V_{y,d}V_{z,d}$	
N5/N6	$\eta = 0.3$	D.N.P. ⁽¹⁾	x: 2.8 m $\eta = 46.5$	x: 0 m $\eta = 12.4$	x: 0 m $\eta = 9.0$	x: 2.8 m $\eta = 9.8$	$\eta = 0.3$	x: 2.8 m $\eta = 55.1$	x: 0 m $\eta = 53.3$	D.N.P. ⁽²⁾	x: 2.8 m $\eta = 10.1$	VERIFIED $\eta = 55.1$
N7/N8	$\eta < 0.1$	$\eta = 0.4$	x: 2.8 m $\eta = 46.5$	x: 0 m $\eta = 12.4$	x: 0 m $\eta = 9.0$	x: 2.8 m $\eta = 9.8$	$\eta = 0.3$	x: 2.8 m $\eta = 55.1$	x: 0 m $\eta = 53.3$	x: 0 m $\eta = 13.4$	x: 2.8 m $\eta = 10.1$	VERIFIED $\eta = 55.1$
N9/N10	D.N.P. ⁽³⁾	$\eta = 1.7$	x: 2.3 m $\eta = 53.4$	x: 0 m $\eta = 11.6$	x: 0 m $\eta = 8.2$	x: 2.3 m $\eta = 43.3$	D.N.P. ⁽⁴⁾	x: 2.3 m $\eta = 60.1$	D.N.P. ⁽⁵⁾	x: 2.3 m $\eta = 61.2$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 61.2$
N7/N9	x: 1.5 m $\eta = 0.6$	x: 0 m $\eta = 4.4$	x: 1.5 m $\eta = 43.5$	x: 1.5 m $\eta = 27.0$	$\eta = 8.0$	$\eta = 11.7$	$\eta = 0.6$	x: 1.5 m $\eta = 50.2$	x: 1.5 m $\eta = 27.6$	x: 1.5 m $\eta = 53.7$	$\eta = 11.0$	VERIFIED $\eta = 53.7$
N5/N10	x: 1.5 m $\eta = 0.5$	x: 0 m $\eta = 4.4$	x: 1.5 m $\eta = 53.4$	x: 1.5 m $\eta = 27.0$	$\eta = 8.0$	$\eta = 16.9$	$\eta = 0.6$	x: 1.5 m $\eta = 54.0$	x: 1.5 m $\eta = 24.8$	x: 1.5 m $\eta = 58.2$	$\eta = 17.2$	VERIFIED $\eta = 58.2$
N10/N11	$\eta = 0.3$	$\eta = 0.1$	x: 2.8 m $\eta = 28.6$	x: 0 m $\eta = 11.6$	x: 0 m $\eta = 9.0$	x: 2.8 m $\eta = 6.2$	D.N.P. ⁽⁴⁾	x: 2.8 m $\eta = 34.2$	x: 1.4 m $\eta = 11.6$	x: 2.8 m $\eta = 34.2$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 34.2$
N6/N11	D.N.P. ⁽³⁾	x: 0 m $\eta = 4.4$	x: 1.5 m $\eta = 53.4$	x: 1.5 m $\eta = 28.6$	$\eta = 8.5$	$\eta = 16.9$	$\eta = 0.6$	x: 1.5 m $\eta = 54.0$	D.N.P. ⁽⁵⁾	x: 1.5 m $\eta = 58.2$	$\eta = 17.2$	VERIFIED $\eta = 58.2$
N9/N12	D.N.P. ⁽³⁾	$\eta = 0.6$	x: 2.8 m $\eta = 28.6$	x: 0 m $\eta = 11.6$	x: 0 m $\eta = 9.0$	x: 2.8 m $\eta = 6.2$	D.N.P. ⁽⁴⁾	x: 2.8 m $\eta = 34.2$	D.N.P. ⁽⁵⁾	x: 2.8 m $\eta = 34.2$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 34.2$
N8/N12	x: 1.5 m $\eta = 0.6$	x: 0 m $\eta = 4.4$	x: 1.5 m $\eta = 43.5$	x: 1.5 m $\eta = 28.6$	$\eta = 8.5$	$\eta = 11.7$	$\eta = 0.6$	x: 1.5 m $\eta = 51.0$	x: 0 m $\eta = 17.9$	x: 1.5 m $\eta = 55.2$	$\eta = 10.5$	VERIFIED $\eta = 55.2$
N12/N11	$\eta < 0.1$	$\eta = 1.7$	x: 2.3 m $\eta = 53.4$	x: 0 m $\eta = 11.6$	x: 0 m $\eta = 8.2$	x: 2.3 m $\eta = 43.3$	D.N.P. ⁽⁴⁾	x: 2.3 m $\eta = 60.1$	x: 1.15 m $\eta = 8.3$	x: 2.3 m $\eta = 61.2$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 61.2$
N17/N18	x: 2.2 m $\eta = 1.5$	x: 0 m $\eta = 2.2$	x: 0 m $\eta = 21.8$	x: 2.2 m $\eta = 24.1$	$\eta = 5.8$	$\eta = 5.5$	D.N.P. ⁽⁴⁾	x: 2.2 m $\eta = 26.1$	x: 0 m $\eta = 25.3$	x: 0 m $\eta = 24.0$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 26.1$
N19/N18	D.N.P. ⁽³⁾	$\eta = 0.2$	x: 1.1 m $\eta = 21.6$	x: 0.55 m $\eta = 3.0$	x: 0 m $\eta = 5.8$	x: 1.1 m $\eta = 15.0$	D.N.P. ⁽⁴⁾	x: 1.1 m $\eta = 23.1$	D.N.P. ⁽⁵⁾	x: 1.1 m $\eta = 23.1$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 23.1$
N20/N19	x: 2.2 m $\eta = 1.5$	x: 0 m $\eta = 1.3$	x: 2.2 m $\eta = 18.7$	x: 2.2 m $\eta = 24.1$	$\eta = 5.8$	$\eta = 4.6$	D.N.P. ⁽⁴⁾	x: 2.2 m $\eta = 26.1$	x: 2.2 m $\eta = 27.1$	x: 0 m $\eta = 15.7$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 27.1$
N20/N21	D.N.P. ⁽³⁾	$\eta = 0.1$	x: 1.05 m $\eta = 41.6$	x: 0 m $\eta = 6.2$	x: 0 m $\eta = 5.0$	x: 1.05 m $\eta = 22.5$	$\eta = 1.5$	x: 1.05 m $\eta = 46.0$	D.N.P. ⁽⁵⁾	x: 0.525 m $\eta = 2.5$	x: 1.05 m $\eta = 23.9$	VERIFIED $\eta = 46.0$
N21/N22	x: 2.2 m $\eta = 1.2$	x: 0 m $\eta = 2.6$	x: 2.2 m $\eta = 18.7$	x: 2.2 m $\eta = 24.3$	$\eta = 5.8$	$\eta = 4.6$	D.N.P. ⁽⁴⁾	x: 2.2 m $\eta = 25.3$	x: 0 m $\eta = 18.6$	x: 2.2 m $\eta = 27.7$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 27.7$
N22/N23	$\eta = 0.2$	$\eta = 0.1$	x: 1.1 m $\eta = 21.6$	x: 0.55 m $\eta = 3.0$	x: 0 m $\eta = 5.8$	x: 1.1 m $\eta = 15.0$	D.N.P. ⁽⁴⁾	x: 1.1 m $\eta = 23.1$	x: 0.55 m $\eta = 6.1$	x: 1.1 m $\eta = 23.1$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 23.1$
N18/N23	$\eta = 0.1$	$\eta < 0.1$	x: 1.05 m $\eta = 24.3$	x: 0 m $\eta = 2.7$	x: 0 m $\eta = 5.0$	x: 1.05 m $\eta = 13.2$	$\eta = 0.3$	x: 1.05 m $\eta = 26.2$	x: 0.525 m $\eta = 2.7$	x: 1.05 m $\eta = 26.2$	x: 1.05 m $\eta = 13.5$	VERIFIED $\eta = 26.2$
N19/N22	D.N.P. ⁽³⁾	$\eta = 0.1$	x: 1.05 m $\eta = 24.3$	x: 0 m $\eta = 2.7$	x: 0 m $\eta = 5.0$	x: 1.05 m $\eta = 13.2$	$\eta = 0.3$	x: 1.05 m $\eta = 26.2$	D.N.P. ⁽⁵⁾	x: 1.05 m $\eta = 26.2$	x: 1.05 m $\eta = 13.5$	VERIFIED $\eta = 26.2$
N24/N23	D.N.P. ⁽³⁾	x: 0 m $\eta = 2.6$	x: 0 m $\eta = 21.8$	x: 2.2 m $\eta = 24.3$	$\eta = 5.8$	$\eta = 5.5$	D.N.P. ⁽⁴⁾	x: 2.2 m $\eta = 25.3$	D.N.P. ⁽⁵⁾	x: 2.2 m $\eta = 27.7$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 27.7$
N17/N24	$\eta = 0.1$	D.N.P. ⁽¹⁾	x: 1.05 m $\eta = 41.6$	x: 0 m $\eta = 6.2$	x: 0 m $\eta = 5.0$	x: 1.05 m $\eta = 22.5$	$\eta = 1.5$	x: 1.05 m $\eta = 46.0$	x: 0.525 m $\eta = 2.6$	D.N.P. ⁽²⁾	x: 1.05 m $\eta = 23.9$	VERIFIED $\eta = 46.0$
N7/N5	D.N.P. ⁽³⁾	$\eta = 11.4$	x: 2.3 m $\eta = 77.8$	x: 1.15 m $\eta = 10.7$	x: 0 m $\eta = 8.2$	x: 2.3 m $\eta = 58.3$	D.N.P. ⁽⁴⁾	x: 2.3 m $\eta = 84.1$	D.N.P. ⁽⁵⁾	x: 2.3 m $\eta = 92.6$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 92.6$
N8/N6	D.N.P. ⁽³⁾	$\eta = 11.4$	x: 2.3 m $\eta = 77.8$	x: 1.15 m $\eta = 10.7$	x: 0 m $\eta = 8.2$	x: 2.3 m $\eta = 58.3$	D.N.P. ⁽⁴⁾	x: 2.3 m $\eta = 84.1$	D.N.P. ⁽⁵⁾	x: 2.3 m $\eta = 92.6$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 92.6$
N20/N17	D.N.P. ⁽³⁾	$\eta = 6.1$	x: 1.1 m $\eta = 52.0$	x: 0.55 m $\eta = 4.2$	x: 0 m $\eta = 5.8$	x: 0 m $\eta = 75.4$	D.N.P. ⁽⁴⁾	x: 1.1 m $\eta = 53.3$	D.N.P. ⁽⁵⁾	x: 1.1 m $\eta = 57.5$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 75.4$
N21/N24	D.N.P. ⁽³⁾	$\eta = 6.1$	x: 1.1 m $\eta = 52.0$	x: 0.55 m $\eta = 4.2$	x: 0 m $\eta = 5.8$	x: 0 m $\eta = 75.4$	D.N.P. ⁽⁴⁾	x: 1.1 m $\eta = 53.3$	D.N.P. ⁽⁵⁾	x: 1.1 m $\eta = 57.5$	D.N.P. ⁽⁶⁾	VERIFIED $\eta = 75.4$

Notes:

$N_{t,0,d}$: Uniform tension resistance parallel to the grain
 $N_{c,0,d}$: Uniform compression resistance parallel to the grain
 $M_{y,d}$: Bending resistance in the y axis
 $M_{z,d}$: Bending resistance in the z axis
 $V_{y,d}$: Shear resistance in the y axis
 $V_{z,d}$: Shear resistance in the z axis
 $M_{x,d}$: Torsional resistance
 $M_{y,d}M_{z,d}$: Biaxial bending resistance
 $N_{t,0,d}M_{y,d}M_{z,d}$: Combined bending and axial tensile resistance
 $N_{c,0,d}M_{y,d}M_{z,d}$: Combined bending and axial compression resistance
 $M_{x,d}V_{y,d}V_{z,d}$: Combined shear and torsion resistance
x: Distance to the origin of the bar
 η : Demand capacity ratio (%)
D.N.P.: Not applicable

Checks that do not proceed (D.N.P.):

- ⁽¹⁾ The check does not proceed as there is no axial compression.
⁽²⁾ The check does not proceed, as the bar is not submitted to combined bending and compression.
⁽³⁾ The check does not proceed as there is no axial tension.
⁽⁴⁾ The check does not proceed, as there is no torsional moment.
⁽⁵⁾ The check does not proceed, as there is no interaction between the axial tension and the bending moment for any combination.
⁽⁶⁾ The check does not proceed, as the bar is not submitted to a torsional moment or a shear force.

Bars	CHECKS (EUROCODE 3 EN 1993-1-1: 2005)														Status
	λ_w	N_t	N_c	M_x	M_y	V_z	V_y	$M_{y,z}$	M_xV_z	NM_xM_z	$NM_yV_zV_y$	M_t	M_yV_z	M_xV_y	
N33/N5	$\lambda_w \leq \lambda_{w,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	x: 0 m $\eta = 2.8$	x: 0 m $\eta = 53.9$	x: 0.5 m $\eta = 14.7$	$\eta = 9.8$	$\eta = 1.8$	$\eta < 0.1$	x: 0.25 m $\eta < 0.1$	x: 0 m $\eta = 55.9$	$\eta < 0.1$	$\eta = 3.5$	$\eta = 10.0$	$\eta = 1.8$	VERIFIED $\eta = 55.9$
N35/N7	$\lambda_w \leq \lambda_{w,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	x: 0 m $\eta = 2.5$	x: 0 m $\eta = 43.7$	x: 0.5 m $\eta = 14.7$	$\eta = 8.3$	$\eta = 1.8$	$\eta < 0.1$	x: 0.25 m $\eta < 0.1$	x: 0 m $\eta = 45.8$	$\eta < 0.1$	$\eta = 3.5$	$\eta = 7.8$	$\eta = 1.8$	VERIFIED $\eta = 45.8$
N37/N8	$\lambda_w \leq \lambda_{w,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	x: 0 m $\eta = 2.8$	x: 0 m $\eta = 48.3$	x: 0.5 m $\eta = 14.9$	$\eta = 9.0$	$\eta = 1.8$	$\eta < 0.1$	x: 0.25 m $\eta < 0.1$	x: 0 m $\eta = 50.6$	$\eta < 0.1$	$\eta = 3.5$	$\eta = 9.2$	$\eta = 1.9$	VERIFIED $\eta = 50.6$



Reports

25086 Beams for machines_v02

Date: 05/29/26

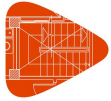
Bars	CHECKS (EUROCODE 3 EN 1993-1-1: 2005)													Status
	λ_{rel}	N_t	N_c	M_y	M_z	V_z	V_y	$M_y V_z$	$M_z V_y$	NM, M_z	$NM, M_y V, V_z$	M_t	$M_y V_z$	
N39/N6	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	x: 0 m $\eta = 2.8$	x: 0 m $\eta = 53.9$	x: 0.5 m $\eta = 14.9$	$\eta = 9.8$	$\eta = 1.8$	$\eta < 0.1$	x: 0.25 m $\eta < 0.1$	x: 0 m $\eta = 55.9$	$\eta < 0.1$	$\eta = 3.5$	$\eta = 10.0$	VERIFIED $\eta = 55.9$
N41/N17	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	x: 0 m $\eta = 2.4$	x: 0 m $\eta = 33.4$	x: 0.5 m $\eta = 10.4$	$\eta = 6.6$	$\eta = 1.3$	$\eta < 0.1$	x: 0.25 m $\eta < 0.1$	x: 0 m $\eta = 35.5$	$\eta < 0.1$	$\eta = 2.6$	$\eta = 6.6$	VERIFIED $\eta = 35.5$
N43/N20	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	x: 0 m $\eta = 1.9$	x: 0 m $\eta = 28.3$	x: 0.5 m $\eta = 10.4$	$\eta = 5.8$	$\eta = 1.3$	$\eta < 0.1$	x: 0.25 m $\eta < 0.1$	x: 0 m $\eta = 30.0$	$\eta < 0.1$	$\eta = 2.6$	$\eta = 5.1$	VERIFIED $\eta = 30.0$
N45/N21	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	x: 0 m $\eta = 2.9$	x: 0 m $\eta = 39.5$	x: 0.5 m $\eta = 10.4$	$\eta = 7.5$	$\eta = 1.3$	$\eta < 0.1$	x: 0.25 m $\eta < 0.1$	x: 0 m $\eta = 41.9$	$\eta < 0.1$	$\eta = 2.6$	$\eta = 7.8$	VERIFIED $\eta = 41.9$
N47/N24	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	x: 0 m $\eta = 2.9$	x: 0 m $\eta = 39.5$	x: 0.5 m $\eta = 10.4$	$\eta = 7.5$	$\eta = 1.3$	$\eta < 0.1$	x: 0.25 m $\eta < 0.1$	x: 0 m $\eta = 41.9$	$\eta < 0.1$	$\eta = 2.6$	$\eta = 7.8$	VERIFIED $\eta = 41.9$
N51/N67	x: 0.068 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.4$	x: 0.135 m $\eta = 2.5$	x: 0.135 m $\eta = 0.9$	x: 0 m $\eta = 5.9$	$\eta = 0.4$	x: 0.068 m $\eta < 0.1$	x: 0.068 m $\eta < 0.1$	x: 0.135 m $\eta = 3.4$	x: 0.068 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 5.9$
N67/N37	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.4$	x: 1.215 m $\eta = 24.3$	x: 1.215 m $\eta = 9.4$	x: 0 m $\eta = 5.8$	$\eta = 0.5$	$\eta < 0.1$	$\eta < 0.1$	x: 1.215 m $\eta = 29.8$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 29.8$
N37/N39	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta = 0.5$	$N_{Ed} = 0.00$ D.N.P. ⁽⁴⁾	x: 1.15 m $\eta = 19.1$	x: 2.3 m $\eta = 8.7$	x: 0 m $\eta = 0.4$	$\eta < 0.1$	$\eta < 0.1$	$\eta < 0.1$	x: 1.15 m $\eta = 26.9$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 26.9$
N39/N65	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.6$	x: 0 m $\eta = 24.3$	x: 0 m $\eta = 9.4$	x: 1.265 m $\eta = 5.8$	$\eta = 0.5$	$\eta < 0.1$	$\eta < 0.1$	x: 0 m $\eta = 29.8$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 29.8$
N65/N52	x: 0 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.6$	x: 0 m $\eta = 1.6$	x: 0 m $\eta = 0.6$	x: 0.085 m $\eta = 5.9$	$\eta = 0.4$	x: 0 m $\eta < 0.1$	x: 0 m $\eta < 0.1$	x: 0 m $\eta = 2.3$	x: 0 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 5.9$
N49/N66	x: 0.068 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.4$	x: 0.135 m $\eta = 2.3$	x: 0.135 m $\eta = 1.0$	x: 0 m $\eta = 5.4$	$\eta = 0.5$	x: 0.068 m $\eta < 0.1$	x: 0.068 m $\eta < 0.1$	x: 0.135 m $\eta = 2.8$	x: 0.068 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 5.4$
N66/N35	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.4$	x: 1.215 m $\eta = 21.8$	x: 1.215 m $\eta = 9.4$	x: 0 m $\eta = 5.2$	$\eta = 0.5$	$\eta < 0.1$	$\eta < 0.1$	x: 1.215 m $\eta = 23.8$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 23.8$
N35/N33	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta = 0.5$	$N_{Ed} = 0.00$ D.N.P. ⁽⁴⁾	x: 2.108 m $\eta = 17.3$	x: 0 m $\eta = 8.6$	x: 0 m $\eta = 0.4$	$\eta < 0.1$	$\eta < 0.1$	$\eta < 0.1$	x: 1.15 m $\eta = 20.9$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 20.9$
N33/N64	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.6$	x: 0 m $\eta = 23.3$	x: 0 m $\eta = 9.4$	x: 1.265 m $\eta = 5.6$	$\eta = 0.5$	$\eta < 0.1$	$\eta < 0.1$	x: 0 m $\eta = 23.9$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 23.9$
N64/N50	x: 0 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.6$	x: 0 m $\eta = 1.5$	x: 0 m $\eta = 0.6$	x: 0.085 m $\eta = 5.7$	$\eta = 0.5$	x: 0 m $\eta < 0.1$	x: 0 m $\eta < 0.1$	x: 0 m $\eta = 2.1$	x: 0 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 5.7$
N56/N72	x: 0.043 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta < 0.1$	$\eta = 0.1$	x: 0.085 m $\eta = 1.1$	x: 0.085 m $\eta = 0.4$	x: 0 m $\eta = 4.2$	$\eta = 0.3$	x: 0.043 m $\eta < 0.1$	x: 0.043 m $\eta < 0.1$	x: 0.085 m $\eta = 1.2$	x: 0.043 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 4.2$
N72/N43	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta < 0.1$	$\eta = 0.1$	x: 1.865 m $\eta = 24.2$	x: 1.865 m $\eta = 9.5$	x: 0 m $\eta = 4.1$	$\eta = 0.3$	$\eta < 0.1$	$\eta < 0.1$	x: 1.865 m $\eta = 24.4$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 24.4$
N43/N41	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta = 0.5$	$N_{Ed} = 0.00$ D.N.P. ⁽⁴⁾	x: 1.1 m $\eta = 22.0$	$\eta = 9.0$	x: 0 m $\eta = 1.0$	$\eta < 0.1$	$\eta < 0.1$	$\eta < 0.1$	x: 1.1 m $\eta = 22.5$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 22.5$
N41/N70	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.2$	x: 0 m $\eta = 25.7$	x: 0 m $\eta = 9.5$	x: 1.865 m $\eta = 4.4$	$\eta = 0.3$	$\eta < 0.1$	$\eta < 0.1$	x: 0 m $\eta = 26.0$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 26.0$
N70/N53	x: 0 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.2$	x: 0 m $\eta = 1.2$	x: 0 m $\eta = 0.4$	x: 0.085 m $\eta = 4.4$	$\eta = 0.3$	x: 0 m $\eta < 0.1$	x: 0 m $\eta < 0.1$	x: 0 m $\eta = 1.4$	x: 0 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 4.4$
N58/N73	x: 0.043 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta < 0.1$	$\eta = 0.2$	x: 0.085 m $\eta = 1.6$	x: 0.085 m $\eta = 0.4$	x: 0 m $\eta = 6.0$	$\eta = 0.3$	x: 0.043 m $\eta < 0.1$	x: 0.043 m $\eta < 0.1$	x: 0.085 m $\eta = 2.1$	x: 0.043 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 6.0$
N73/N45	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta < 0.1$	$\eta = 0.2$	x: 1.865 m $\eta = 35.7$	x: 1.865 m $\eta = 9.5$	x: 0 m $\eta = 6.0$	$\eta = 0.3$	$\eta < 0.1$	$\eta < 0.1$	x: 1.865 m $\eta = 43.1$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 43.1$
N45/N47	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta = 0.6$	$N_{Ed} = 0.00$ D.N.P. ⁽⁴⁾	x: 0.55 m $\eta = 31.3$	$\eta = 9.0$	x: 0 m $\eta = 1.0$	$\eta < 0.1$	$\eta < 0.1$	$\eta < 0.1$	x: 0.55 m $\eta = 40.8$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 40.8$
N47/N71	$\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.2$	x: 0 m $\eta = 35.7$	x: 0 m $\eta = 9.5$	x: 1.865 m $\eta = 6.0$	$\eta = 0.3$	$\eta < 0.1$	$\eta < 0.1$	x: 0 m $\eta = 43.1$	$\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 43.1$
N71/N54	x: 0 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$N_{Ed} = 0.00$ D.N.P. ⁽¹⁾	$\eta = 0.2$	x: 0 m $\eta = 1.6$	x: 0 m $\eta = 0.4$	x: 0.085 m $\eta = 6.0$	$\eta = 0.3$	x: 0 m $\eta < 0.1$	x: 0 m $\eta < 0.1$	x: 0 m $\eta = 2.1$	x: 0 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 6.0$
N64/N65	x: 0.2 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta = 0.1$	$N_{Ed} = 0.00$ D.N.P. ⁽⁴⁾	x: 1.4 m $\eta = 0.7$	$M_{Ed} = 0.00$ D.N.P. ⁽⁵⁾	x: 0 m $\eta = 0.2$	$V_{Ed} = 0.00$ D.N.P. ⁽⁶⁾	x: 0.2 m $\eta < 0.1$	D.N.P. ⁽⁷⁾	x: 1.4 m $\eta = 0.8$	x: 0.2 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 0.8$
N66/N67	x: 0.2 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta < 0.1$	$\eta < 0.1$	x: 1.4 m $\eta = 0.7$	$M_{Ed} = 0.00$ D.N.P. ⁽⁵⁾	x: 0 m $\eta = 0.2$	$V_{Ed} = 0.00$ D.N.P. ⁽⁶⁾	x: 0.2 m $\eta < 0.1$	D.N.P. ⁽⁷⁾	x: 1.4 m $\eta = 0.8$	x: 0.2 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 0.8$
N70/N71	x: 0.175 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta < 0.1$	$N_{Ed} = 0.00$ D.N.P. ⁽⁴⁾	x: 0.525 m $\eta = 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽⁵⁾	x: 0 m $\eta = 0.1$	$V_{Ed} = 0.00$ D.N.P. ⁽⁶⁾	x: 0.175 m $\eta < 0.1$	D.N.P. ⁽⁷⁾	x: 0.525 m $\eta = 0.1$	x: 0.175 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 0.1$
N72/N73	x: 0.175 m $\lambda_{rel} \leq \lambda_{rel,lim}$ Verified	$\eta < 0.1$	$\eta < 0.1$	x: 0.525 m $\eta = 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽⁵⁾	x: 0 m $\eta = 0.1$	$V_{Ed} = 0.00$ D.N.P. ⁽⁶⁾	x: 0.175 m $\eta < 0.1$	D.N.P. ⁽⁷⁾	x: 0.525 m $\eta = 0.1$	x: 0.175 m $\eta < 0.1$	$M_{Ed} = 0.00$ D.N.P. ⁽²⁾	D.N.P. ⁽³⁾	VERIFIED $\eta = 0.1$
Notes: λ _{rel} : Crushing of the web induced by the compressed flange N _t : Resistance to axial tension N _c : Resistance to axial compression M _y : Y - Axis bending resistance M _z : Z - Axis bending resistance V _z : Resistance to shear in the Z direction V _y : Resistance to shear in the Y direction M _y V _z : Combined bending moment Y and shear force Z resistance M _z V _y : Combined bending moment Z and shear force Y resistance NM, M _y : Combined bending and axial resistance NM, M _z V _y : Combined bending, axial and shear resistance M _t : Torsional resistance M _y V _z : Combined Z shear and torsional resistance M _z V _y : Combined Y shear and torsional resistance x: Distance to the origin of the bar η: Demand capacity ratio (%) D.N.P.: Not applicable														
Checks that do not proceed (D.N.P.): ⁽¹⁾ The check does not proceed, as there is no tensile axial force. ⁽²⁾ The check does not proceed, as there is no torsional moment. ⁽³⁾ There is no interaction between torsional moment and shear force for any combination. Therefore the check does not proceed. ⁽⁴⁾ The check does not proceed, as there is no compressive axial force. ⁽⁵⁾ The check does not proceed, as there is no bending moment. ⁽⁶⁾ The check does not proceed, as there is no shear force. ⁽⁷⁾ The check does not proceed, as there is no interaction between shear forces and bending moments for any loadcase combination.														

DEGREE OF FREEDOM

Beregning av stålbjelker for nye installasjoner på tak
Frederikke – Rehabilitering fasade og tekniske anlegg
25086-R02

Revision	Date	Done By	Controlled By	Approved By
00	01/06/2026	DP/JDO	FI	ER

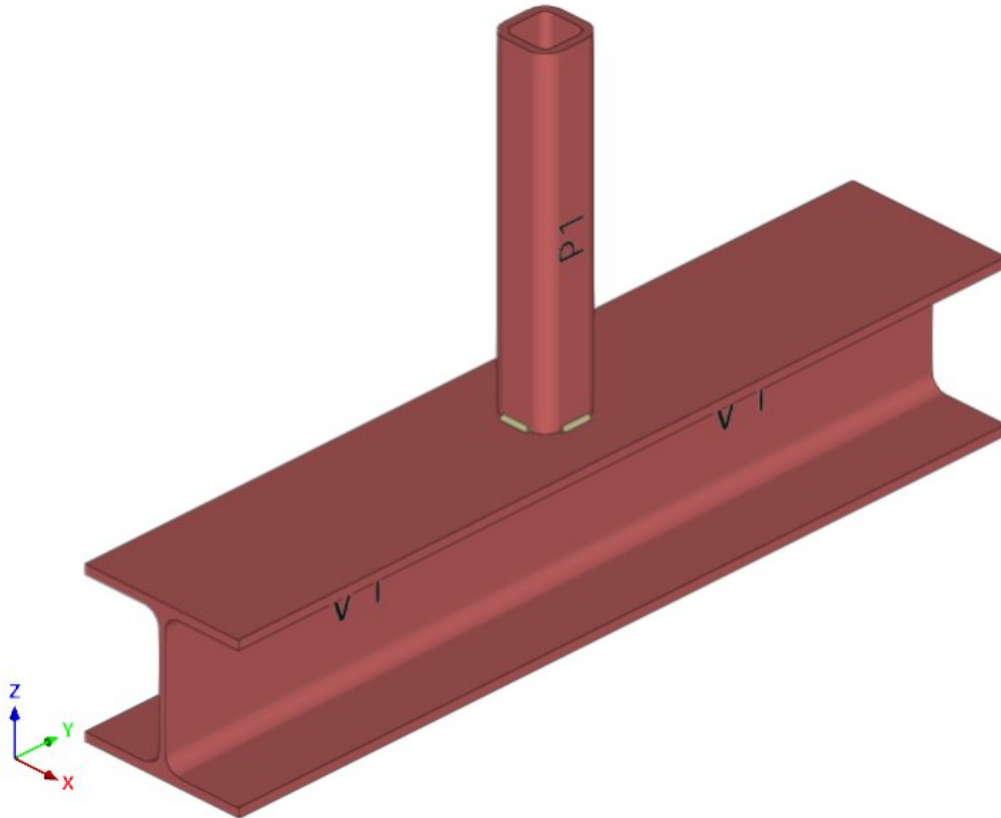
10 ANNEX II – CONNECTIONS



1. JOINTS

1.1. SHS to HEA

1.1.1. Connection components



3D View

Steel sections					
Element	Description	Geometry	Steel		
			Type	f_y (MPa)	f_u (MPa)
P1	SHS 60x8.0		S355 (EN 1993-1-1)	355.00	510.00
V1	HE 160 A		S355 (EN 1993-1-1)	355.00	510.00



Reports

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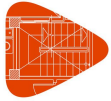
Welds					
Element	Type	Electrode	l (mm)	t (mm)	Angle (°)
Adjustment1 - Top flange Adjustment1 - Bot. fl. Adjustment1 - Left web Adjustment1 - Right web	Single bevel butt weld		28.0	8.0	45.0

l: Weld length
t: Thickness of the thinnest member to join

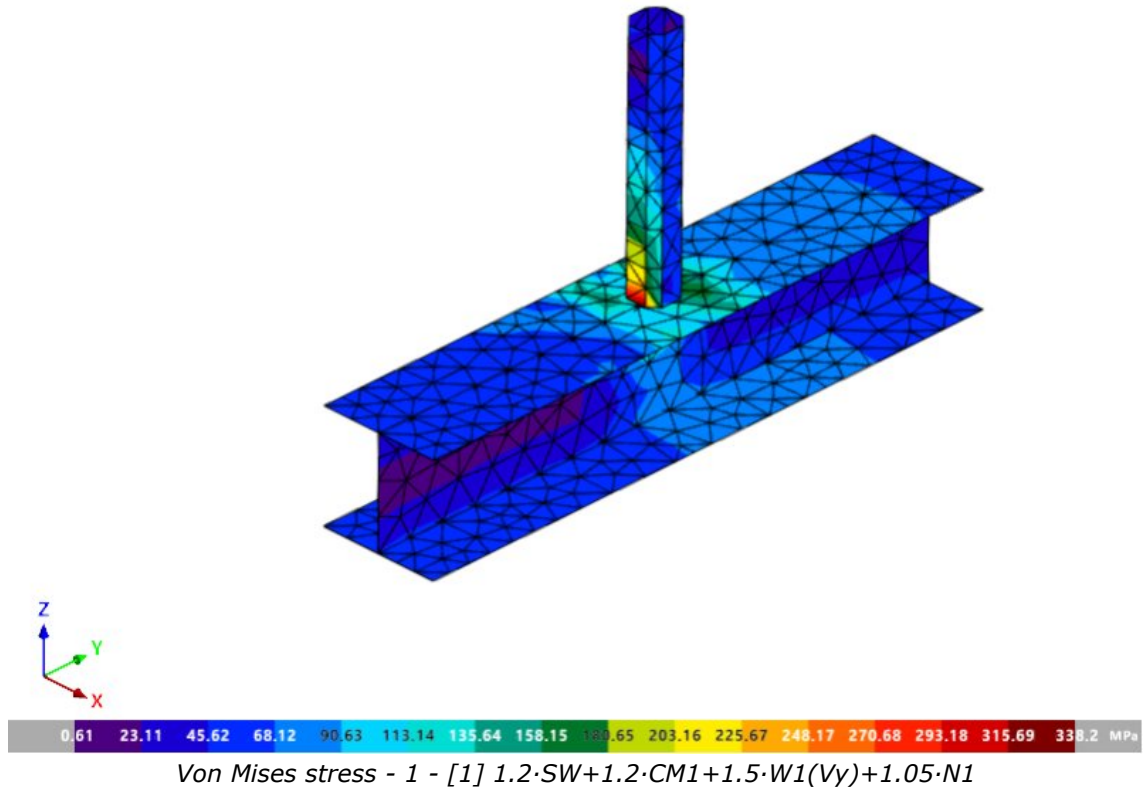
1.1.2. Loads

V1 (HE 160 A) - Forces towards the origin of the bar						
Load cases	N (kN)	Vy (kN)	Vz (kN)	Mx (kN·m)	My (kN·m)	Mz (kN·m)
1 - [1] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	5.89	-0.08	0.14	0.00	-13.09	-0.08
2 - [3] 1.35·SW+1.35·CM1+0.9·W1(Vx)+1.05·N1	-6.01	-1.78	14.20	0.00	-19.58	-2.39
3 - [3] 1.2·SW+1.2·CM1+0.9·W1(Vx)+1.5·N1	-5.94	-1.80	15.37	0.00	-21.12	-2.42
4 - [3] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	-5.82	-2.93	14.35	0.00	-19.73	-3.93
5 - [4] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	6.83	0.00	-0.42	0.00	-15.22	-3.62
6 - [4] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	5.89	0.08	0.14	0.00	-13.09	0.08
7 - [6] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.11	-0.01	8.22	0.00	-16.71	-0.01
8 - [7] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	-2.40	-2.04	15.56	0.00	-31.03	-3.98
9 - [7] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.11	0.01	8.22	0.00	-16.71	0.01
10 - [8] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	8.49	0.00	-0.20	0.00	-27.15	-3.74

V1 (HE 160 A) - Forces towards the end of the bar						
Load cases	N (kN)	Vy (kN)	Vz (kN)	Mx (kN·m)	My (kN·m)	Mz (kN·m)
1 - [1] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	-8.23	-0.10	13.36	0.00	-18.39	-0.10
2 - [3] 1.35·SW+1.35·CM1+0.9·W1(Vx)+1.05·N1	7.05	0.00	-0.46	0.00	-15.04	2.20
3 - [3] 1.2·SW+1.2·CM1+0.9·W1(Vx)+1.5·N1	6.97	0.00	-0.41	0.00	-16.37	2.22
4 - [3] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	6.83	0.00	-0.41	0.00	-15.22	3.62
5 - [4] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	-5.82	2.92	14.35	0.00	-19.73	3.93
6 - [4] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	-8.23	0.10	13.36	0.00	-18.39	0.10
7 - [6] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	5.87	-0.01	-2.75	0.00	-15.02	-0.01
8 - [7] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	8.49	0.00	-0.20	0.00	-27.15	3.74
9 - [7] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	5.87	0.01	-2.75	0.00	-15.02	0.01
10 - [8] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	-2.40	2.04	15.56	0.00	-31.03	3.98



1.1.3. Stress / Strain



1.1.4. Summary of code checks

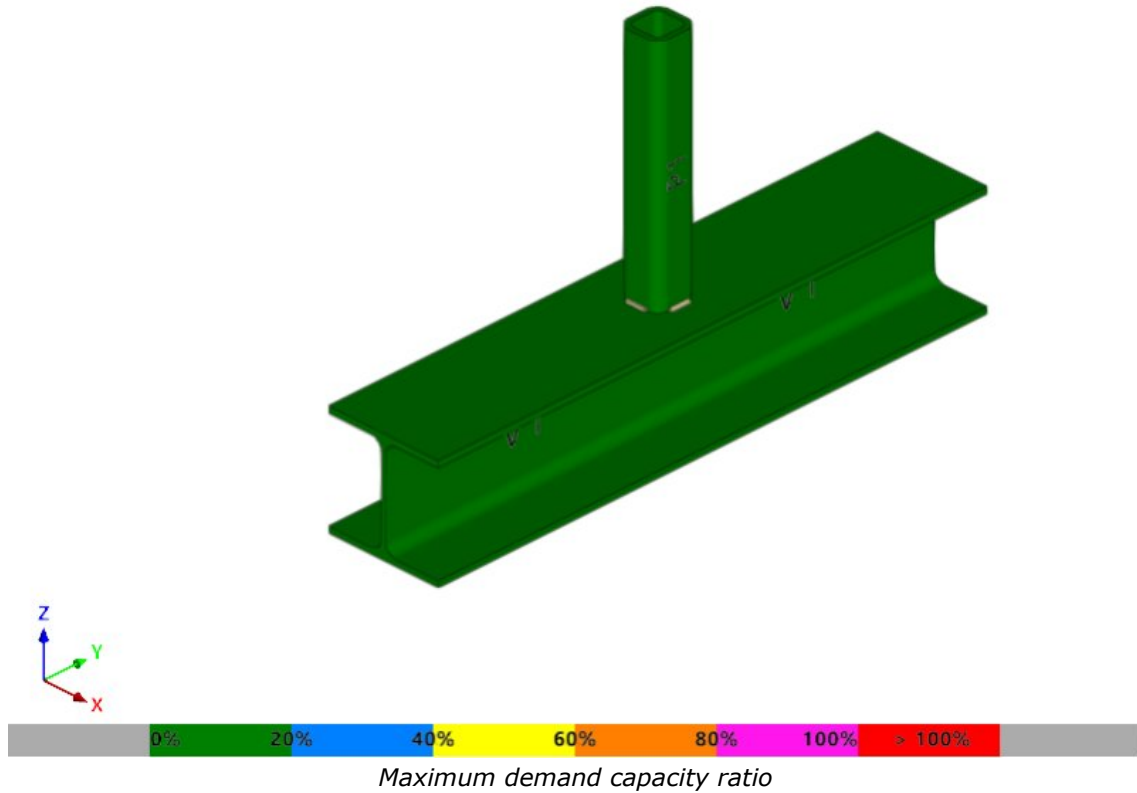


Reports

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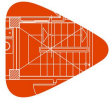
Date: 05/29/26

1.1.4.1. Stress / Strain

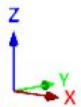
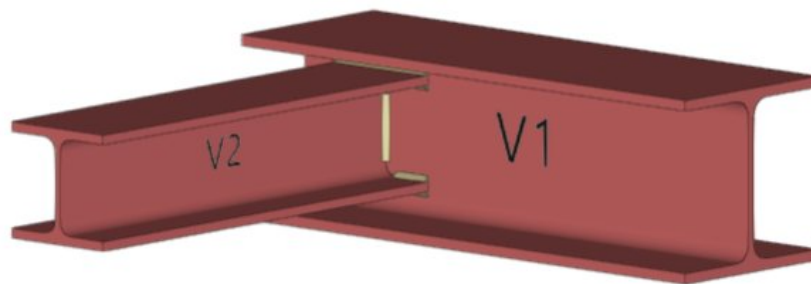


Elongation - Sections					
Element	Comb.	Plastic deformation (%)	Limit (%)	D/C ratio (%)	
P1 - Top flange	1 - [1] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.151	5.000	3.02	
P1 - Bot. fl.	3 - [3] 1.2·SW+1.2·CM1+0.9·W1(Vx)+1.5·N1	0.135	5.000	2.69	
P1 - Left web	8 - [7] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.054	5.000	1.08	
P1 - Right web	10 - [8] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.043	5.000	0.85	
P1 - Curved segment (Top Left) - 1	1 - [1] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.076	5.000	1.53	
P1 - Curved segment (Top Right) - 1	1 - [1] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.124	5.000	2.49	
P1 - Curved segment (Bot. Left) - 1	4 - [3] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.085	5.000	1.70	
P1 - Curved segment (Bot. Right) - 1	1 - [1] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.090	5.000	1.80	
V1 - Top flange	10 - [8] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.148	5.000	2.96	
V1 - Bot. fl.	8 - [7] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.122	5.000	2.45	
V1 - Web	10 - [8] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.124	5.000	2.48	

1.2. HEA 100 to HEA 160

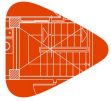


1.2.1. Connection components



3D View

Steel sections					
Element	Description	Geometry	Steel		
			Type	f_y (MPa)	f_u (MPa)
V1	HE 160 A		S355 (EN 1993-1-1)	355.00	510.00
V2	HE 100 A		S355 (EN 1993-1-1)	355.00	510.00



Reports

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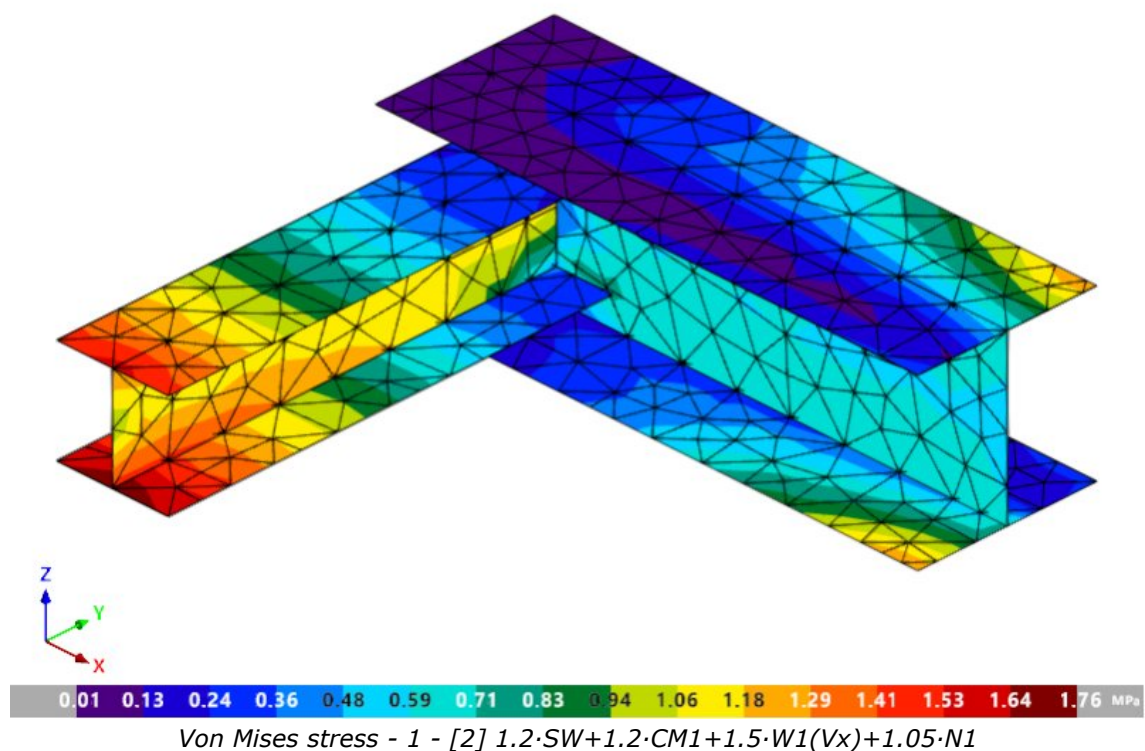
Welds							
Element	Type	Electrode	a (mm)	z (mm)	l (mm)	t (mm)	Angle (°)
Adjustment1 - Top flange - Front Adjustment1 - Bot. fl. - Front	Fillet weld		3.5	4.9	100.0	6.0	90.0
Adjustment1 - Top flange - Back 1 Adjustment1 - Top flange - Back 2 Adjustment1 - Bot. fl. - Back 1 Adjustment1 - Bot. fl. - Back 2	Fillet weld		3.5	4.9	35.5	6.0	90.0
Adjustment1 - Web - Front Adjustment1 - Web - Back	Fillet weld		3.5	4.9	56.0	5.0	90.0

a: Throat thickness
z: Leg length
l: Weld length
t: Thickness of the thinnest member to join

1.2.2. Loads

V2 (HE 100 A) - Forces at the end of the bar							
Load cases	N (kN)	Vy (kN)	Vz (kN)	Mx (kN·m)	My (kN·m)	Mz (kN·m)	
1 - [2] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.17	0.00	-0.27	0.00	0.00	0.00	
2 - [2] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.40	0.00	-0.27	0.00	0.00	0.00	
3 - [3] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.03	0.00	-0.10	0.00	0.00	0.00	

1.2.3. Stress / Strain



1.2.4. Summary of code checks

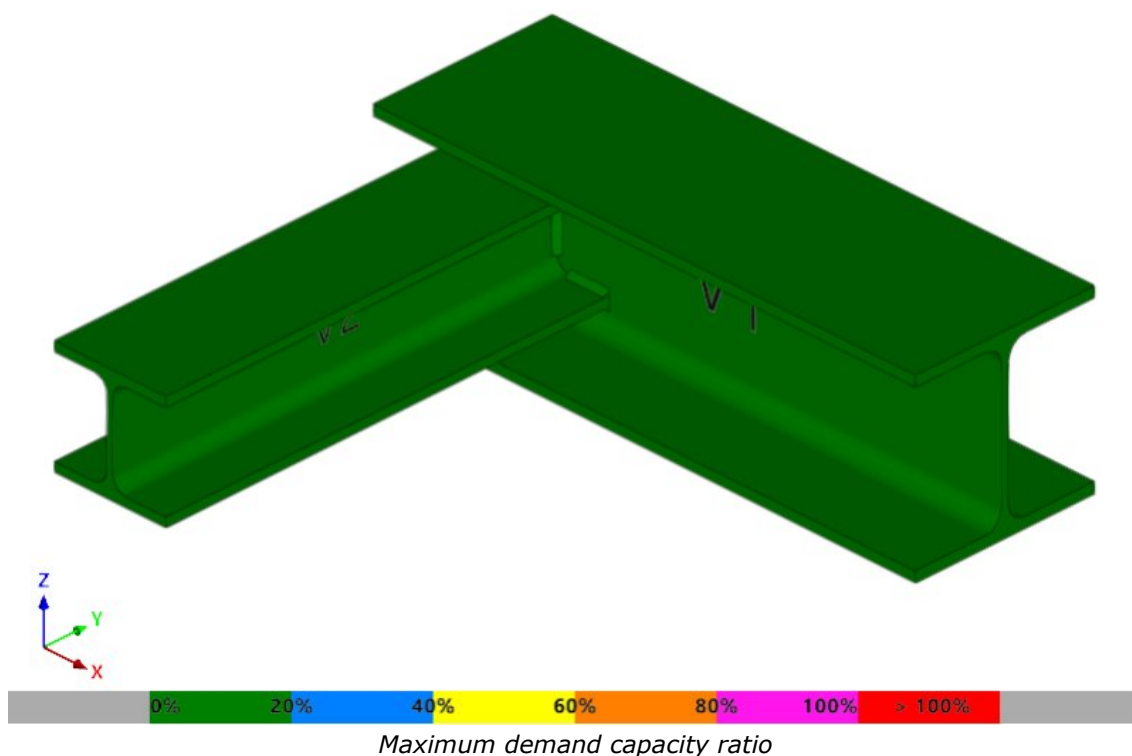


Reports

25086 Beams on the roof

Date: 05/29/26

1.2.4.1. Stress / Strain



Elongation - Sections				
Element	Comb.	Plastic deformation (%)	Limit (%)	D/C ratio (%)
V1 - Top flange	2 - [2] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.001	5.000	0.02
V1 - Bot. fl.	2 - [2] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.001	5.000	0.03
V1 - Web	2 - [2] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.001	5.000	0.01
V2 - Top flange	1 - [2] 1.2·SW+1.2·CM1+1.5·W1(Vx)+1.05·N1	0.001	5.000	0.02
V2 - Bot. fl.	2 - [2] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.001	5.000	0.03
V2 - Web	2 - [2] 1.2·SW+1.2·CM1+1.5·W1(Vy)+1.05·N1	0.001	5.000	0.02

Resistance - Welds									
Element	Von Mises stress					Normal stress		f_u (MPa)	β_w
	$\sigma_{\perp}$ (MPa)	$\tau_{\perp}$ (MPa)	$\tau_{//}$ (MPa)	Value (MPa)	D/C ratio (%)	$\sigma_{\perp}$ (MPa)	D/C ratio (%)		
Adjustment1 - Top flange - Front	1.41	0.42	0.15	1.61	0.36	1.41	0.38	510.00	0.90
Adjustment1 - Top flange - Back 1	0.03	0.16	0.17	0.41	0.09	0.04	0.01	510.00	0.90
Adjustment1 - Top flange - Back 2	0.47	0.71	0.09	1.32	0.29	0.47	0.13	510.00	0.90
Adjustment1 - Bot. fl. - Front	1.34	0.62	0.05	1.72	0.38	1.34	0.36	510.00	0.90
Adjustment1 - Bot. fl. - Back 1	0.57	0.69	0.01	1.32	0.29	0.57	0.15	510.00	0.90
Adjustment1 - Bot. fl. - Back 2	0.29	0.35	0.02	0.67	0.15	0.29	0.08	510.00	0.90
Adjustment1 - Web - Front	0.75	0.74	0.57	1.78	0.39	0.75	0.20	510.00	0.90



Reports

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Resistance - Welds									
Element	Von Mises stress					Normal stress		f_u (MPa)	β_w
	$\sigma_{\perp}$ (MPa)	$\tau_{\perp}$ (MPa)	$\tau_{//}$ (MPa)	Value (MPa)	D/C ratio (%)	$\sigma_{\perp}$ (MPa)	D/C ratio (%)		
Adjustment1 - Web - Back	0.74	0.75	0.57	1.79	0.39	0.74	0.20	510.00	0.90

Notes

$\sigma_{\perp}$: Normal stress perpendicular to the throat of the weld.

$\tau_{\perp}$: Shear stress (in the plane of the throat) perpendicular to the axis of the weld.

$\tau_{//}$: Shear stress (in the plane of the throat) parallel to the axis of the weld.

f_u : Ultimate nominal tensile resistance of the weakest part of the connection

β_w : Correlation coefficient for fillet welds.