EUROCODESTOOLS

Calculer facilement, construire durablement

SYNTHÈSE

STRUCTURAL ANALYSIS DESIGN REPORT

Example Project - Client Name

Project defined by :	My Name - My Company
E-mail :	myemail@mycompany.com
Last update :	2026-01-23 14:06 (utc)
Link for inspection agency :	

EUROCODESTOOLS
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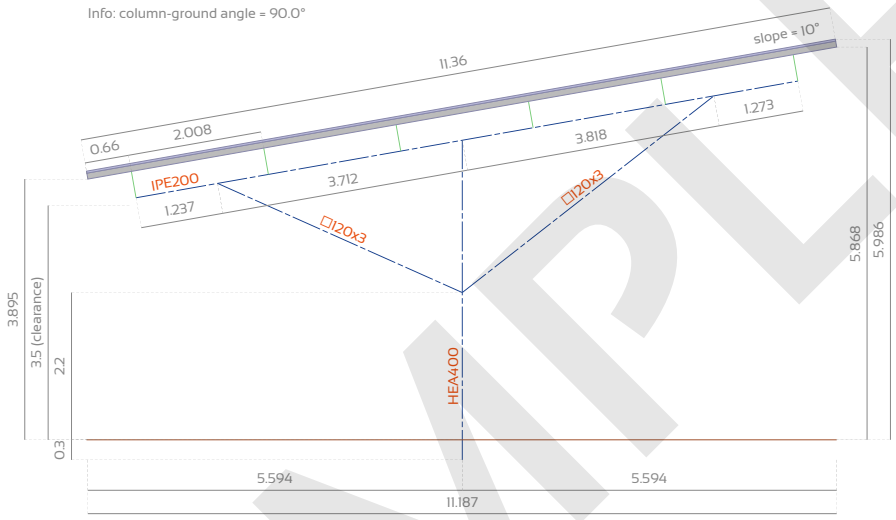
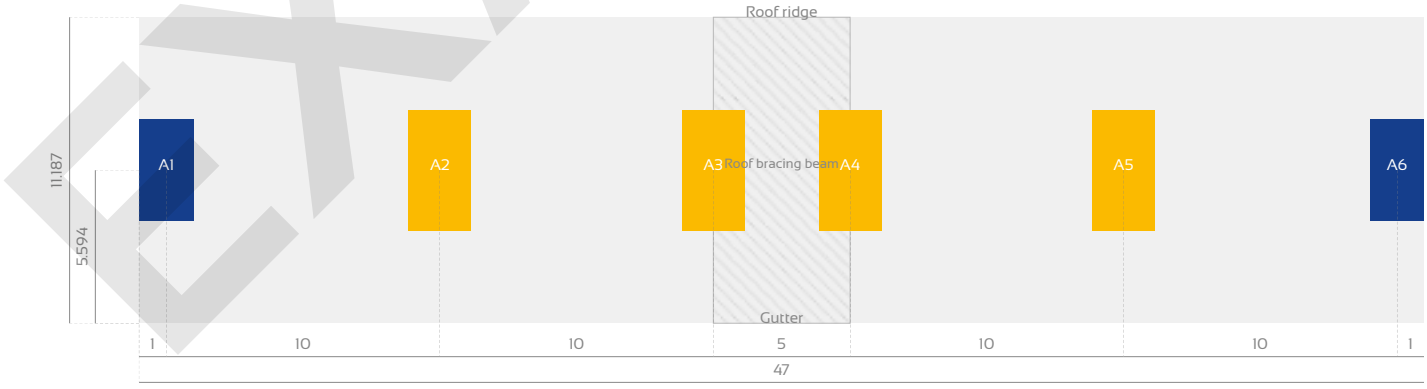
A - GENERAL INFORMATION

Project title : Example Project
Customer name : Client Name
Last update : 2026-01-23 14:06 (utc) Software Version : 04-0918

B - DATA AND SUMMARY OF RESULTS

B 1 - Sketches and dimensions of the photovoltaic shelter





B 2 - Summary of checkings according to Eurocodes

Element		Checking (It's okay if the rate is less than 100%)
Column	HEA400 - S275	OK (82.6 %)
Rafter	IPE200 - S275	OK (95.9 %)
Left diagonal brace	□120x3 - S235	OK (71.7 %)
Right diagonal brace	□120x3 - S235	OK (96.5 %)

Execution class according to EN 1090-2: EXC 2

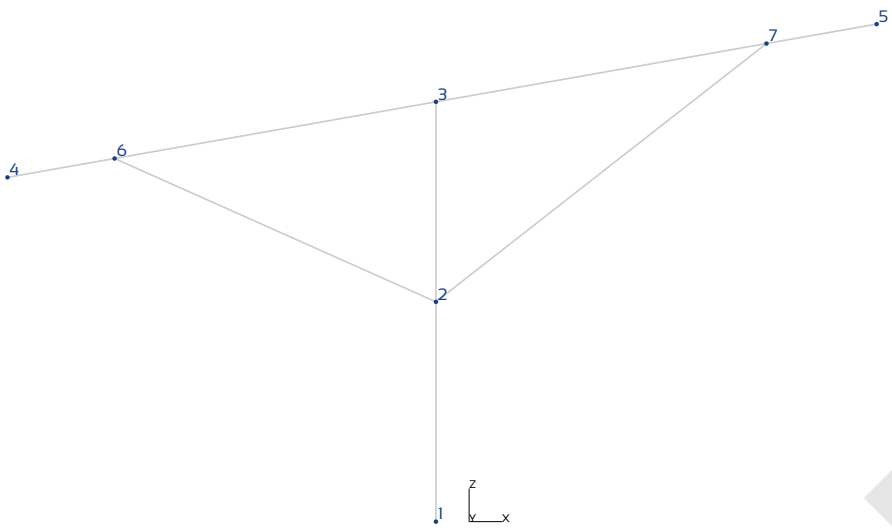
It is recommended that hot-dip galvanization protection be applied to the buried structural components.
The main structure shall receive an anti-corrosion protection system whose selection will be adapted to the specified atmospheric corrosivity category, in reference to the requirements of the EN ISO 12944 standard series.

Purlin laying system:unknown (with or without sleeve)

C - LOADS DISTRIBUTION REPORT

Snow zone: A1 *(s_n = 0.45 kN/m²)*

Wind zone: 2 *(455.8 N/m² ≤ $q_{p(z)}$ ≤ 475.1 N/m²)*



Transverse axes

Node 1 is corresponding to axis A

Longitudinal axes

Axis	Loading width	Continuity factor
1	6.0 m	1.008
2	10.0 m	1.17
3	7.5 m	1.0
4	7.5 m	1.0
5	10.0 m	1.17
6	6.0 m	1.008

Axis 1 and 6

(Loading width: 6.0m, continuity factor: 1.008)

Node	F_X (daN)	F_Y (daN)	F_Z (daN)	M_X (m.daN)	M_Y (m.daN)	M_Z (m.daN)
Permanent loads						
1	0.0	-	-3224.9	-	-302.3	-
Normal snow						
1	0.0	-	-2436.6	-	-0.0	-
Accidental snow						
1	-0.0	-	-0.0	-	-0.0	-
Left wind sagging						
1	362.8	-	-1347.5	-	-2428.4	-
Left wind in uplift						
1	-389.0	-	2916.5	-	6008.1	-
Right wind sagging						
1	107.8	-	-1292.8	-	4692.0	-
Right wind in uplift						
1	-613.5	-	2798.0	-	-10876.7	-
Front wind sagging						
1	113.4	618.1	-643.1	-2604.3	587.6	-0.0
Front wind in uplift						
1	-413.7	618.1	2346.5	-2604.3	-2143.8	-0.0
Rear wind sagging						
1	113.4	-618.1	-643.1	2604.3	587.6	0.0
Rear wind in uplift						
1	-413.7	-618.1	2346.5	2604.3	-2143.8	0.0

Axis 2 , 3 , 4 and 5

(Loading width: 10.0m, continuity factor: 1.17)

Node	F_X (daN)	F_Y (daN)	F_Z (daN)	M_X (m.daN)	M_Y (m.daN)	M_Z (m.daN)
Permanent loads						
1	0.0	-	-5043.1	-	-618.2	-
Normal snow						
1	0.0	-	-4711.3	-	-0.0	-
Accidental snow						
1	-0.0	-	-0.0	-	-0.0	-
Left wind sagging						
1	584.7	-	-2605.5	-	-4974.6	-
Left wind in uplift						
1	-869.1	-	5639.3	-	11337.9	-
Right wind sagging						
1	320.6	-	-2499.7	-	9339.9	-
Right wind in uplift						
1	-1074.1	-	5410.2	-	-20762.8	-
Front wind sagging						
1	219.3	618.1	-1243.5	-2604.3	1136.1	-0.0
Front wind in uplift						
1	-800.0	618.1	4537.0	-2604.3	-4145.1	-0.0
Rear wind sagging						
1	219.3	-618.1	-1243.5	2604.3	1136.1	0.0
Rear wind in uplift						
1	-800.0	-618.1	4537.0	2604.3	-4145.1	0.0

Additional actions to consider for columns adjoining span containing the stability system (roof bracing beam) :

Longitudinal positions (axes)	Node	F_X (daN)	F_Y (daN)	F_Z (daN)	M_X (m.daN)	M_Y (m.daN)	M_Z (m.daN)
Front wind sagging and Front wind in uplift							
Axis 4	1	52.3	-	9.2	-	249.8	-
Axis 3	1	-52.3	-	-9.2	-	-249.8	-
Rear wind sagging and Rear wind in uplift							
Axis 3	1	52.3	-	9.2	-	249.8	-
Axis 4	1	-52.3	-	-9.2	-	-249.8	-

D - STRUCTURAL BEHAVIOR AND CONSTRUCTION PRINCIPLES

The most stressed portal frame is used in the design calculations (axis 2).

D 1 - Purlins

D 1.1 - Recommended minimum thickness

The photovoltaic panels are fixed on an integration system.
The minimum purlins thickness is recommended by the supplier of the integration system (usually 2.5mm min thickness).

D 1.2 - Normal forces required for the design of cold-formed purlins

The cross-sections of the purlins must be sufficient to take up the normal forces crossing the roof cross-bracing, in particular compression (in red on the diagrams).

Diagram of the normal forces circulating in the roof plane during a front wind (Simple unweighted load case - rounded in daN)

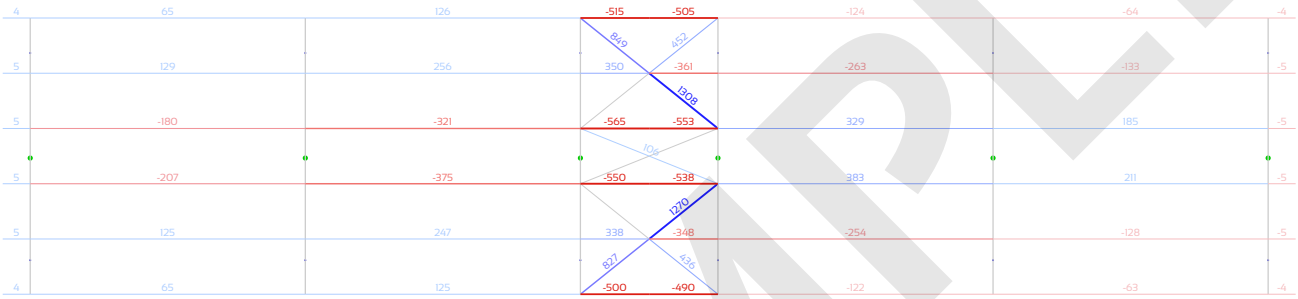
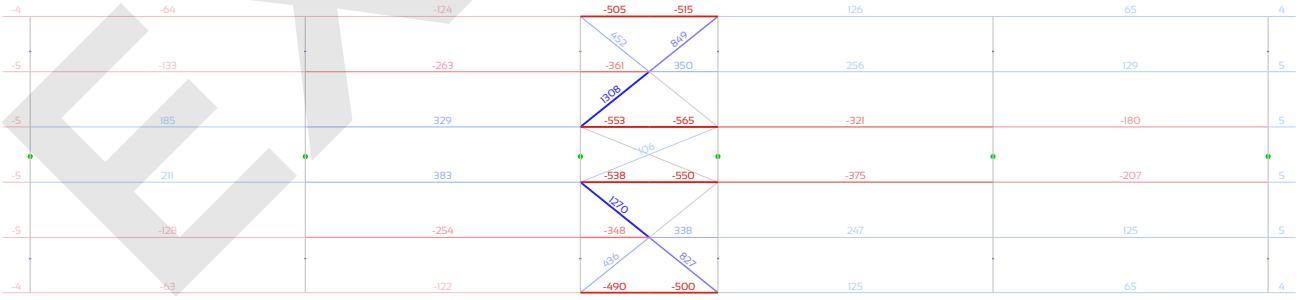


Diagram of the normal forces circulating in the roof plane during a rear wind (Simple unweighted load case - rounded in daN)



D 2 - Rafter

The top flange is restrained by the purlins. The purlins will be linked to the nodes of the roof cross-bracing. So the lateral-buckling length of the top flange is the distance between purlins.

The lower flange is restrained plumb with the column (torsional restraint) and the diagonal braces (torsion spring), so lateral-buckling is checked between these points without considering the influence of warping restraint at the supports. Lateral-buckling of the lower flange is checked for a double length in the cantilevered parts located after the diagonal braces.

D 3 - Column

No vehicle impact on the columns is taken into account in this analysis.
If the risk is acceptable, it is not necessary to take special measures. Otherwise, risk mitigation measures are to be planned (signage / protection / additional structural analysis in an accident situation).

D 4 - Assemblies

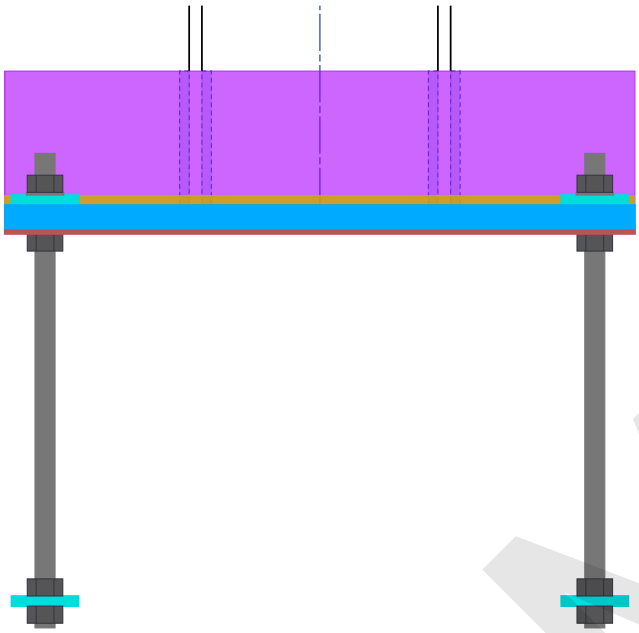
The connecting bolts of the steel parts will be of the SB type (Structural Bolt) and class 8.8 minimum.
Drillings will comply with standard EN 1090-2 §6.6.1 « Dimensions of holes ».

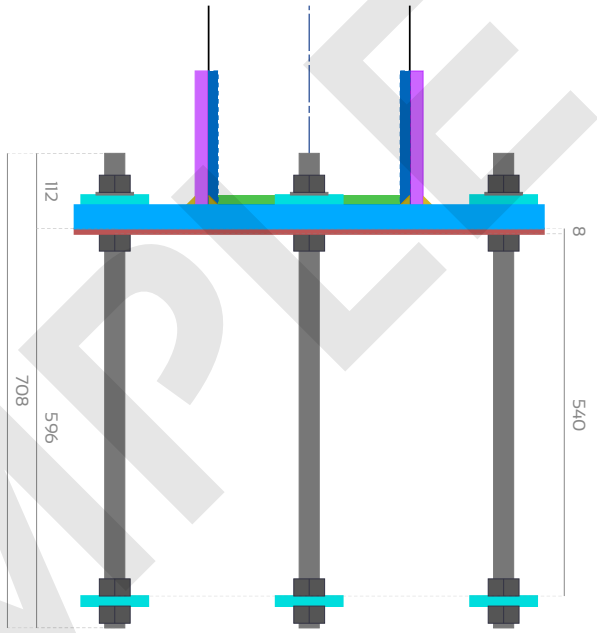
D 4.1 - Column base and anchorages

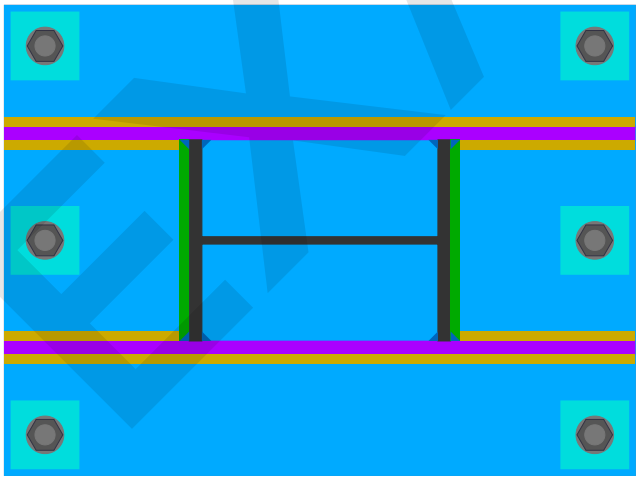
The anchorages consist of threaded rods each fitted with an anchor pad bolted to its end embedded in the concrete.
The positioning jig plate is useful for positioning anchors when pouring concrete and for obtaining a flat contact surface. A central hole 50 mm in diameter will be provided to serve as a vent during the pouring of the concrete.

The rotation of the column base is blocked (calculated as semi-rigid) about the X and Y axes at -0.3m level on C25/30 concrete foundation blocks.

Working rate: 0.817







Positioning jig plate : 940x700x8 (S235)
Column base plate : 940x700x35 (S235)
Stiffeners : 940x200x20 (S235)
Anchor pad and support pad : 100x100x15 (S235)
Anchor bolts: M30 8.8

Transverse spacing p_2	Edge distance e_2	Longitudinal spacing p_1	End distance e_1
290 mm > 79.2 mm	60.0 mm > 39.6 mm	820 mm > 79.2 mm	60.0 mm > 39.6 mm

Weld throats		
On the internal flanges a_f	Horizontal on the stiffeners a_s	Vertical on the column a_c
10 mm	10 mm	10 mm

Minimum required dimensions of the C25/30 concrete foundation blocks for local failure modes analysis: see attached file ('Detailed quantities.xlsx' - Foundation tab).
The minimum cross-section of concrete reinforcement to avoid splitting failure should be greater than 5.5 cm^2.

Additional provisions:
The column base plate can be lengthened and widened to eventually make oversized holes (the distance from the axis of the hole to the edge of the column base plate must be at least 1.5 times the diameter of the hole).
In this case, to allow the transfer of the shear force from the column base plate to the anchor bolts, it will be necessary to (several solutions to choose from):

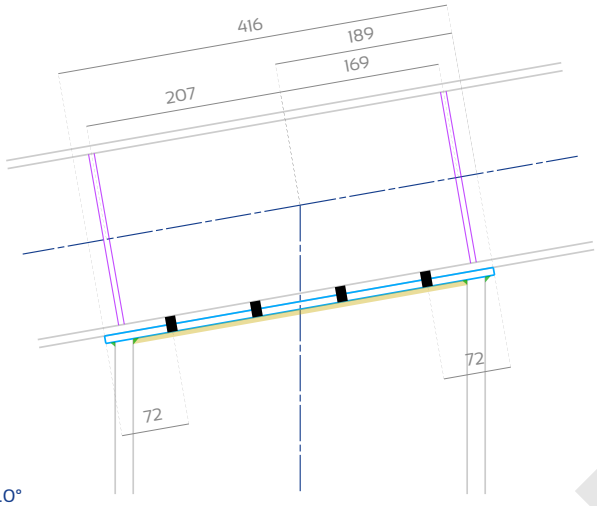
- Weld the top pads to the column base plate.
- Fill the annular space (with a suitable anchoring resin for example).
- Add 1 anchor peg on either side of the column in normal holes (direct take-up of shear by the anchor pegs).

If normal holes are provided, these additional provisions are not necessary.

D 4.2 - Column top end plate

The rafter is bolted to the column via an end plate made of S235 steel.
This connection is calculated as a pin.

Working rate: 0.773



Angle between elements = 80.0°

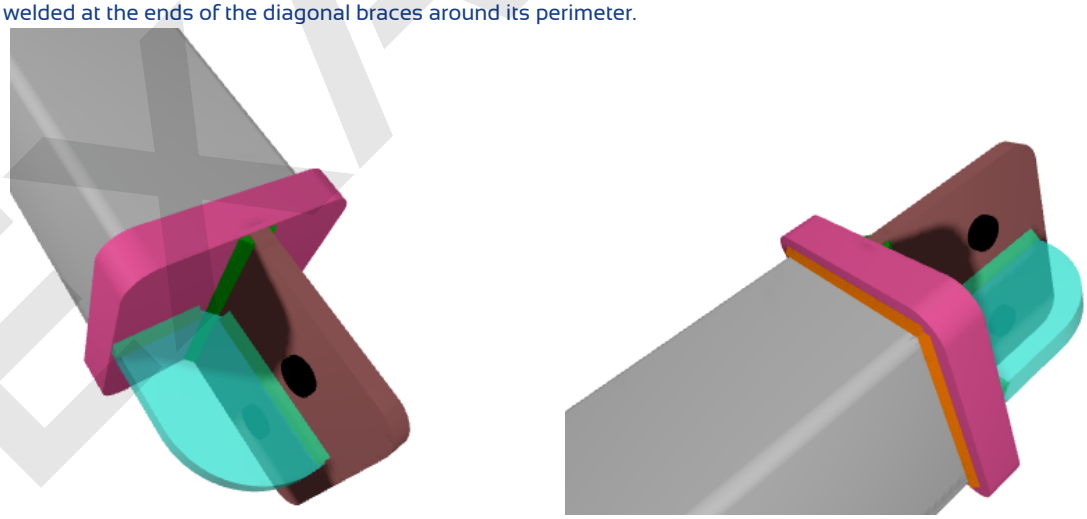
End plate	Thickness t_p	Width	Length	Drillings d_0	Weld throat on the flanges a_f	Weld throat on the web a_w
	8.0 mm	300.0 mm	*(See sketch)*	11 mm	4 mm	4 mm
Bolts	Designation	Screw diameter d	Washer diameter	Transverse spacing p_2	Edge distance (rafter) e_2	Longitudinal spacing p_1
	M10 8.8 SB	10 mm	20 mm	58 mm > 26.4 mm	21.0 mm > 13.2 mm	91 mm > 24.2 mm
Stiffeners (on both faces of the web)	Thickness t_s	Width b_s	Position			
	6 mm	40 mm	*(See sketch)*			

D 4.3 - Diagonal braces gussets

The diagonal braces gussets will be made of minimum S235 steel.

On the rafter/column side, the connection consists of a single gussets welded to the flange on both sides along its length (2 welding fillets per gusset) and centered on the web.

T-shaped gusset
On the brace side, the connection consists of a single centered gusset welded on an end plate and forming a T.
This T are welded at the ends of the diagonal braces around its perimeter.

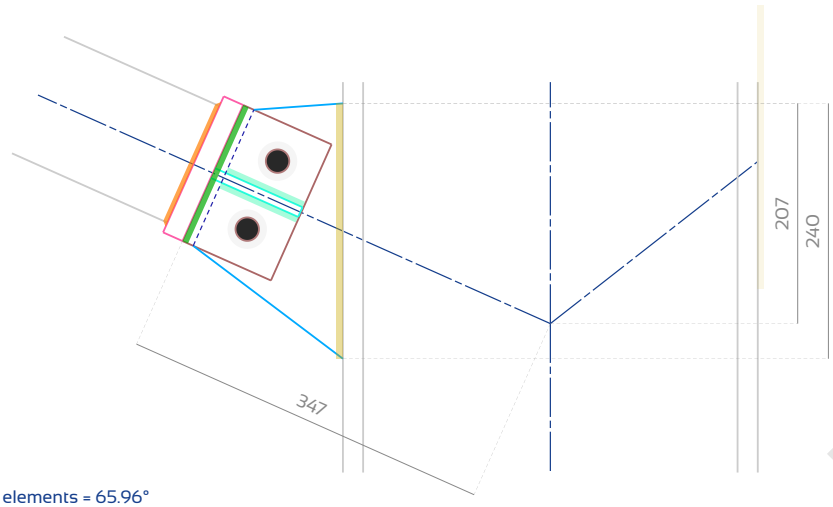


The gussets are connected to each other by two bolts (and hardened washers) functionning in simple shearing.

This connection system causes an eccentricity of the forces which pass through the diagonal brace from the other elements and, consequently, creates an out-of-plane moment in the diagonal brace. A lateral stiffener is therefore provided to prevent the the gussets centered on the diagonal braces and their welds from being stressed by out-of-plane bending.

Left diagonal brace - Column side (T-shaped gusset)

Working rate: 0.807

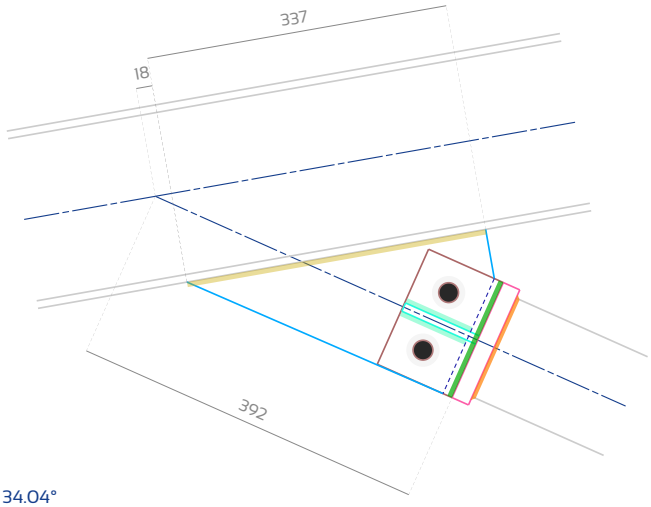


Angle between elements = 65.96°

Gusset attached to diagonal brace	Thickness $t_{b,g}$	Width	Length	Drillings d_0	Weld throat $a_{b,g}$	
	10 mm	140 mm	91 mm	22 mm	4 mm	
End plate attached to diagonal brace	Thickness $t_{b,p}$	Width	Length	Drillings d_0	Weld throat $a_{b,p}$	
	20 mm	140 mm	140 mm	20 mm (galvanizing)	3 mm	
Gusset attached to the other element	Thickness t_i	Dimensions and position	Drillings d_0	Clearance with end plate	Weld throat $a_{o,s,g}$	
	10 mm	*(See sketch)*	22 mm	11 mm	4 mm	
Bolts	Designation	Screw diameter d	Hardened washer diameter	Spacing p_2	Edge distance e_2	End distance e_1
	M20 8.8 SB	20 mm	37 mm	70 mm > 52.8 mm	35.0 mm > 26.4 mm	40 mm > 26.4 mm
Web stiffeners	none	Gusset lateral stiffener	Thickness $t_{s,g}$	Width $b_{s,g}$	Height $h_{s,g}$	Weld throat $a_{s,g}$
			10 mm	65 mm	90 mm	4 mm

Left diagonal brace - Rafter side (T-shaped gusset)

Working rate: 0.805

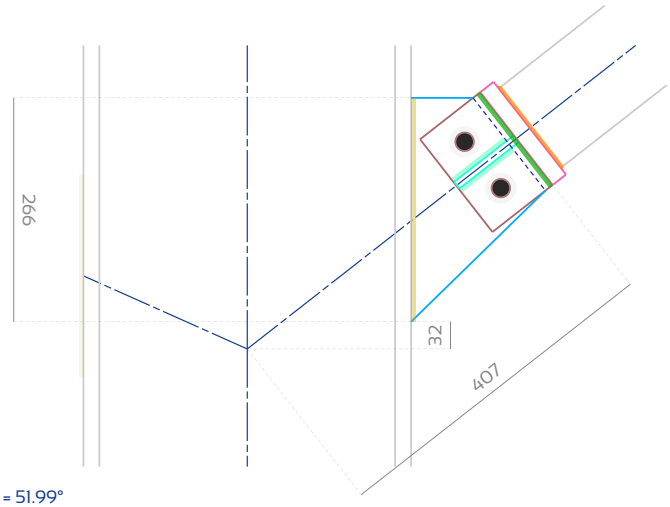


Angle between elements = 34.04°

Gusset attached to diagonal brace	Thickness $t_{b,g}$	Width	Length	Drillings d_0	Weld throat $a_{b,g}$	
	10 mm	140 mm	91 mm	22 mm	4 mm	
End plate attached to diagonal brace	Thickness $t_{b,p}$	Width	Length	Drillings d_0	Weld throat $a_{b,p}$	
	20 mm	140 mm	140 mm	20 mm (galvanizing)	3 mm	
Gusset attached to the other element	Thickness t_i	Dimensions and position	Drillings d_0	Clearance with end plate	Weld throat $a_{o,s,g}$	
	10 mm	*(See sketch)*	22 mm	11 mm	4 mm	
Bolts	Designation	Screw diameter d	Hardened washer diameter	Spacing p_2	Edge distance e_2	End distance e_1
	M20 8.8 SB	20 mm	37 mm	70 mm > 52.8 mm	35.0 mm > 26.4 mm	40 mm > 26.4 mm
Web stiffeners	none	Gusset lateral stiffener	Thickness $t_{ls,g}$	Width $b_{ls,g}$	Height $h_{ls,g}$	Weld throat $a_{ls,g}$
			10 mm	65 mm	90 mm	4 mm

Right diagonal brace - Column side (T-shaped gusset)

Working rate: 0.902

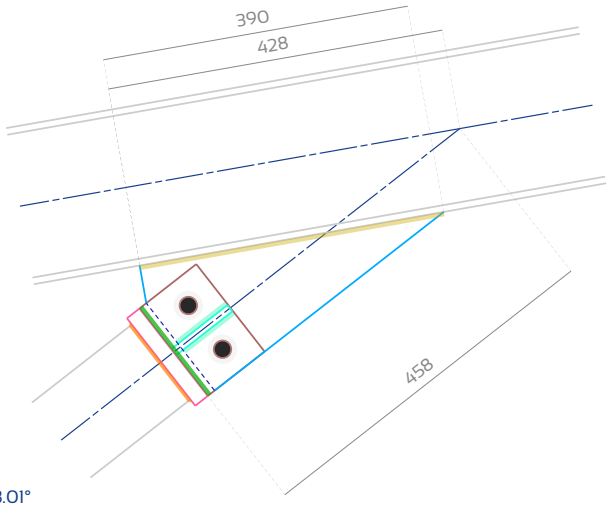


Angle between elements = 51.99°

Gusset attached to diagonal brace	Thickness $t_{b,g}$	Width	Length	Drillings d_0	Weld throat $a_{b,g}$	
	10 mm	140 mm	91 mm	22 mm	4 mm	
End plate attached to diagonal brace	Thickness $t_{b,p}$	Width	Length	Drillings d_0	Weld throat $a_{b,p}$	
	20 mm	140 mm	140 mm	20 mm (galvanizing)	3 mm	
Gusset attached to the other element	Thickness t_i	Dimensions and position	Drillings d_0	Clearance with end plate	Weld throat $a_{o,s,g}$	
	10 mm	*(See sketch)*	22 mm	11 mm	4 mm	
Bolts	Designation	Screw diameter d	Hardened washer diameter	Spacing p_2	Edge distance e_2	End distance e_1
	M20 8.8 SB	20 mm	37 mm	70 mm > 52.8 mm	35.0 mm > 26.4 mm	40 mm > 26.4 mm
Web stiffeners	none	Gusset lateral stiffener	Thickness $t_{ls,g}$	Width $b_{ls,g}$	Height $h_{ls,g}$	Weld throat $a_{ls,g}$
			10 mm	65 mm	90 mm	4 mm

Right diagonal brace - Rafter side (T-shaped gusset)

Working rate: 0.899



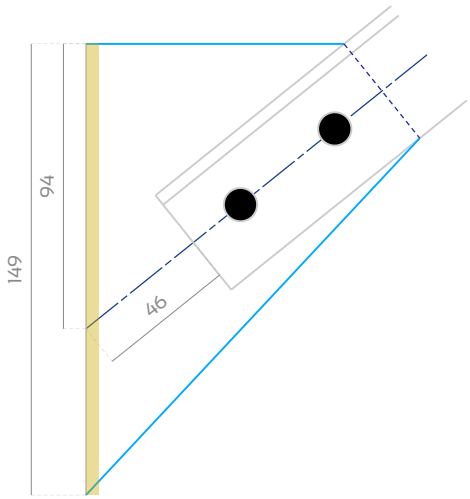
Angle between elements = 28.01°

Gusset attached to diagonal brace	Thickness $t_{b,g}$	Width	Length	Drillings d_0	Weld throat $a_{b,g}$	
	10 mm	140 mm	91 mm	22 mm	4 mm	
End plate attached to diagonal brace	Thickness $t_{b,p}$	Width	Length	Drillings d_0	Weld throat $a_{b,p}$	
	20 mm	140 mm	140 mm	20 mm (galvanizing)	3 mm	
Gusset attached to the other element	Thickness t_i	Dimensions and position	Drillings d_0	Clearance with end plate	Weld throat $a_{o,s,g}$	
	10 mm	*(See sketch)*	22 mm	11 mm	4 mm	
Bolts	Designation	Screw diameter d	Hardened washer diameter	Spacing p_2	Edge distance e_2	End distance e_1
	M20 8.8 SB	20 mm	37 mm	70 mm > 52.8 mm	35.0 mm > 26.4 mm	40 mm > 26.4 mm
Web stiffeners	none	Gusset lateral stiffener	Thickness $t_{ls,g}$	Width $b_{ls,g}$	Height $h_{ls,g}$	Weld throat $a_{ls,g}$
			10 mm	65 mm	90 mm	4 mm

D 4.4 - Roof cross-bracing gussets

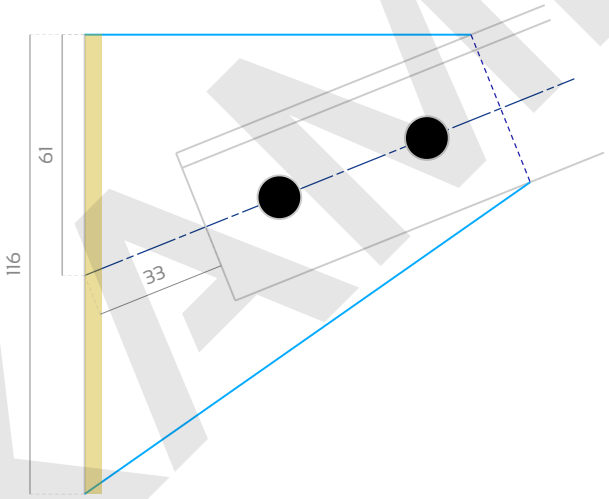
The roof plane is stiffened by installing an angle (cross) truss in the plane of the slope.
The angles are linked together and on the rafters by gussets.
The central gusset of each cross is fixed on the intermediate purlins.
These gussets are connected to the braces by several class 8.8 bolts functionning in simple shearing.

Working rate: 0.614



Angle = 38.77°

Element	Cross section	Gusset	Thickness t	Dimensions and position	Drillings d_0	Weld throat a_w
	L40x40x4		5 mm	*(See sketch)*	11 mm	3 mm
Bolts	Designation	Screw diameter d	Washer diameter	Edge distance e_2	Spacing p_1	End distance e_1
	M10 8.8 SB	10 mm	20 mm	20 mm > 13.2 mm	40 mm > 24.2 mm	20 mm > 13.2 mm



Angle = 21.88°

Element	Cross section	Gusset	Thickness t	Dimensions and position	Drillings d_0	Weld throat a_w
	L40x40x4		5 mm	*(See sketch)*	11 mm	3 mm
Bolts	Designation	Screw diameter d	Washer diameter	Edge distance e_2	Spacing p_1	End distance e_1
	M10 8.8 SB	10 mm	20 mm	20 mm > 13.2 mm	40 mm > 24.2 mm	20 mm > 13.2 mm

EUROCODES TOOLS

Calculer facilement, construire durablement

ANNEXES

STRUCTURAL ANALYSIS DESIGN REPORT

Example Project - Client Name

Project defined by :	My Name - My Company
E-mail :	myemail@mycompany.com
Last update :	2026-01-23 14:06 (utc)
Link for inspection agency :	

ANNEX 1 - MODEL FEATURES

Annex 1.1 - Nodes

Node Id	Coordinates		Restrained degrees of freedom
	X	Z	
1	5.594 m	-0.3 m	U_X U_Z R_Y (252646.5 m.kN/rad)
2	5.594 m	2.2 m	
3	5.594 m	4.475 m	
4	0.719 m	3.616 m	
5	10.607 m	5.359 m	
6	1.938 m	3.831 m	
7	9.354 m	5.138 m	

Annex 1.2 - Elements

Element Id	Start node	End node	Length	Cross section	Boundary conditions
1	1	2	2.5 m	HEA400	
2	2	3	2.275 m	HEA400	Pinned at end node
3	4	6	1.237 m	IPE200	
4	6	3	3.712 m	IPE200	
5	3	7	3.818 m	IPE200	
6	7	5	1.273 m	IPE200	
7	6	2	4.003 m	☐ 120x3	Pinned at start node and end node
8	2	7	4.772 m	☐ 120x3	Pinned at start node and end node

Annex 1.3 - Cross sections and materials

Cross section	Gross area A	Shear areas		Second moments of area		Polar moment of inertia I_O	Torsional constant I_t	Warping constant I_w
		on y-y A_{vy}	on z-z A_{vz}	about y-y I_Y	about z-z I_Z			
HEA400	159.0 cm²	126.2 cm²	57.3 cm²	45069.4 cm⁴	8563.8 cm⁴	53633.2 cm⁴	189.04 cm⁴	2942.08 x 10³ cm⁶
IPE200	28.5 cm²	19.6 cm²	14.0 cm²	1943.2 cm⁴	142.4 cm⁴	2085.5 cm⁴	6.98 cm⁴	12.99 x 10³ cm⁶
☐ 120x3	13.8 cm²	6.9 cm²	6.9 cm²	312.3 cm⁴	312.3 cm⁴	624.7 cm⁴	487.72 cm⁴	-

Cross section	Material	Yield strength f_y	Young modulus E	Shear modulus G
HEA400	S275	275 MPa	210000.0 MPa	80769.2 MPa
IPE200	S275	275 MPa	210000.0 MPa	80769.2 MPa
☐ 120x3	S235	235 MPa	210000.0 MPa	80769.2 MPa

ANNEX 2 - LOADINGS

Annex 2.1 - Dead loads

Name	Type	Intensity
Self-weight of steel structures	density	7698 daN/m³
Solar panels	uniformly distributed load	20.0 kg/m²
Purlins	uniformly distributed load	8.0 kg/m²
Gutter	linear load at the bottom edge	10.0 kg/m

Annex 2.2 - Maintenance imposed loads

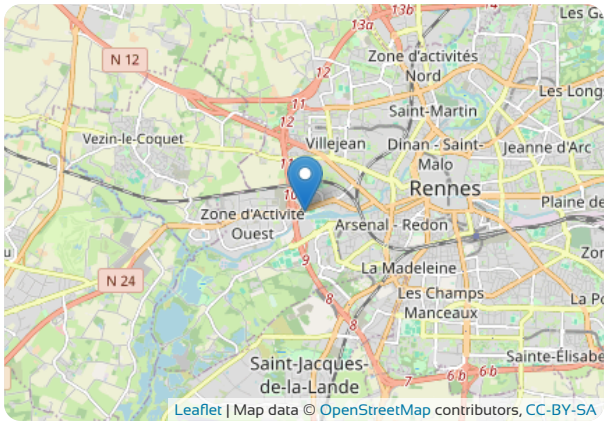
No maintenance loads is to be taken into account because it is not recommended to move on the solar panels.

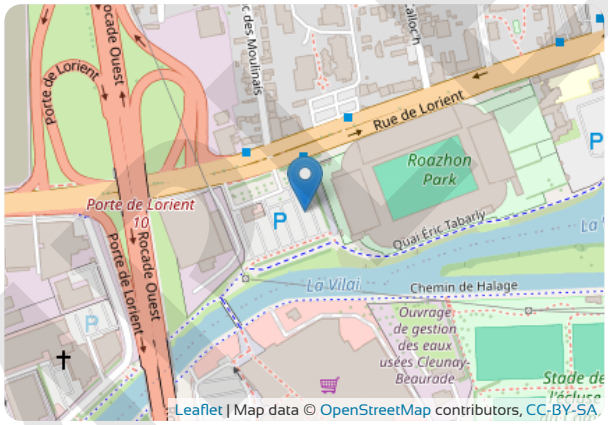
Annex 2.3 - Climatic loads

Annex 2.3.1 - Location

Coordinates in World Geodetic System 1984 (WGS84) :

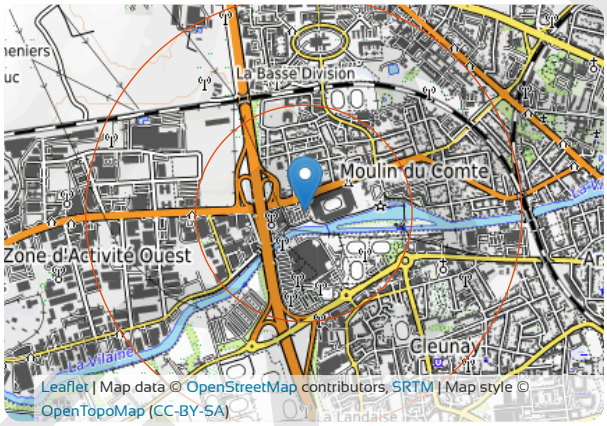
48.10712 ° , -1.71474 °





Address : Rue de Lorient, 35000 Rennes, Bretagne

Annex 2.3.2 - Elevations



Distances / Direction	At the place of construction	500 m	1000 m
North	25 m	30 m	38 m
Northeast		32 m	42 m
East		23 m	24 m
Southeast		23 m	29 m
South		24 m	30 m
Southwest		21 m	23 m
West		24 m	25 m
Northwest		29 m	38 m

source : European digital elevation model Copernicus 25m

Annex 2.3.3 - Building

Type of building : common structure
Design working life category : 50 years
Max height : 5.986 m
Orientation from North : 70 °

Annex 2.3.4 - Terrain categories

Sectors	s1	s2	s3	s4
Categories	IV	IIIb	IIIb	IIIb

Radius R of the angular sector : 300 m

Annex 2.3.5 - Snow (NF EN 1991-1-3/NA (05/2007) + A1 (07/2011) + A2 (07/2022))

Annex 2.3.5.1 - On the ground

Zone : A1 ($s_{k,0}$ = 0.45 kN/m²) Criteria for zoning :ILLE-ET-VILAINE (35)

Characteristic value of snow on the ground at the relevant site :$s_{k,25\ m}$ = 0.45 kN/m²

Ground snow load with a return period of 50 years :$s_{50\ years}$ = 0.45 kN/m²

Annex 2.3.5.2 - On the roof

Name	Type	Characteristic value	Roof form factor	Design value (horizontal projection)
Normal snow	uniformly distributed load	45.0 daN/m²	0.8	35.45 daN/m²

Annex 2.3.6 - Wind (NF EN 1991-1-4/NA (03/2008) + A1 (07/2011) + A2 (09/2012) + A3 (04/2019))

Annex 2.3.6.1 - Wind - Peak velocity pressure

Zone : 2 ($v_{b,0}$ = 24.0 m/s) Criteria for zoning :ILLE-ET-VILAINE (35) Zone c_{dir} : 2

Sectors	s1	s2	s3	s4
Sector definition	from 25 ° to 115 °	from 115 ° to 205 °	from 205 ° to 295 °	from 295 ° to 25 °
Fundamental value of the basic wind velocity $v_{b,0}$	24.0 m/s			
Shape parameter K	0.2			
Exponent n	0.5			
Annual probability of exceedence p	0.02			
Probability factor c_{prob}	1.0			
Directional factor c_{dir}	1.0	1.0	1.0	1.0
Basic wind velocity v_b	24.0 m/s	24.0 m/s	24.0 m/s	24.0 m/s
Reference roughness length $z_{0,II}$	0.05 m			
Roughness length z_0	1.0 m	0.5 m	0.5 m	0.5 m
Terrain factor k_r	0.234	0.223	0.223	0.223
Height above ground z	5.986 m			
Minimum height z_{min}	15.0 m	9.0 m	9.0 m	9.0 m
Roughness factor $c_{r(z)}$	0.635	0.645	0.645	0.645
Orography factor* $c_{o(z)}$	1.0	1.0	1.0	1.0
Mean wind velocity $v_{m(z)}$	15.2 m/s	15.5 m/s	15.5 m/s	15.5 m/s
Turbulence factor k_I	0.854	0.923	0.923	0.923
Standard deviation of the turbulence σ_v	4.804 m/s	4.943 m/s	4.943 m/s	4.943 m/s
Turbulence intensity $I_{v(z)}$	0.315	0.319	0.319	0.319
Air density ρ	1.225 kg/m³			
Exposure factor $c_{e(z)}$	1.292	1.347	1.347	1.347
Peak velocity pressure $q_{p(z)}$	455.8 N/m²	475.1 N/m²	475.1 N/m²	475.1 N/m²
Peak wind velocity for Serviceability Limit States $v_{p(z),SLS}$	98.2 km/h	100.3 km/h	100.3 km/h	100.3 km/h
Peak wind velocity for Ultimate Limit States $v_{p(z),ULS}$	120.3 km/h	122.8 km/h	122.8 km/h	122.8 km/h

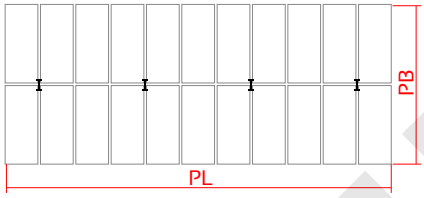
* Here, the orography factor is calculated according to Procedure 1, for an orography consisting of obstacles of various heights and shapes. This type of orography is the most frequently encountered.However, if the building is in a case of orography consisting of well individualized obstacle (isolated hills and ridges or cliffs and escarpments) the orography factor must be calculated according to the procedure 2.According to EN 1991-1-4 §4.3.3(1), the calculated orography factor (1.0) is not taken into account because it does not increase wind velocities by more than 5%.

Low edge oriented towards the sector : s3

Low edge orientation relative to North : 250 °

Wind from left X+ (gutter to ridge) $q_{p,s3}$	Wind from right X- (ridge to gutter) $q_{p,s1}$	Wind from front Y+ (the last axis to axis 1) $q_{p,s2}$	Wind from rear Y- (axis 1 to last axis) $q_{p,s4}$
47.51 daN/m²	45.58 daN/m²	47.51 daN/m²	47.51 daN/m²

Annex 2.3.6.2 - Degree of blockage under the roof



Parking	Vehicle type	Number over length P_L	Face area	Total blockage area
		18	3.36 m²/vehicle	60.48 m²
	medium utility vehicle (Renault Trafic L1H1)	Number over width P_B	Profile area	Total blockage area
		2	7.84 m²/vehicle	15.68 m²

Position	Blockage area	Cross sectional area under the canopy	Blockage ratio φ
At left	60.48 m²	183.06 m²	0.33
At right	60.48 m²	275.78 m²	0.219
Profile	15.68 m²	54.61 m²	0.287

Annex 2.3.6.3 - Surface pressures on the roof

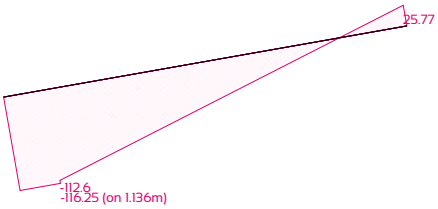
(EN 1991-1-4 §7.3 + cf distribution from BNCM/CNC2M N0380 / REC EC1-CM : July 2017 Figure 22)

Left wind - sag *(in daN/m2)*

Force coefficient c_f : 0.5
Table 7.6

Location of c_f : 2.84 m
Figure 7.16

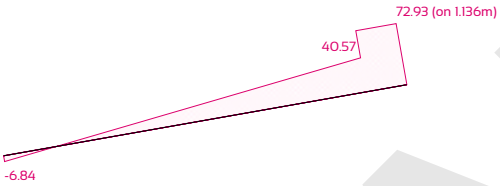
Left wind - uplift *(in daN/m2)*



Force coefficient c_f : -1.065
Table 7.6

Location of c_f : 2.84 m
Figure 7.16

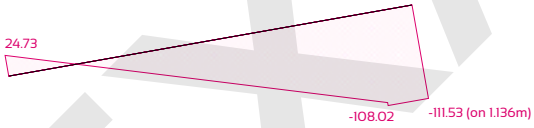
Right wind - sag *(in daN/m2)*



Force coefficient c_f : 0.5
Table 7.6

Location of c_f : 8.52 m
Figure 7.16

Right wind - uplift *(in daN/m2)*



Force coefficient c_f : -1.065
Table 7.6

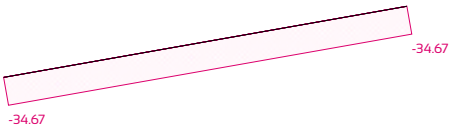
Location of c_f : 8.52 m
Figure 7.16

Front wind - sag *(in daN/m2)*

Force coefficient c_f : 0.2
for roof slope angle α = 0° - BNCM/CNC2M N0380 / REC EC1-CM : July 2017 Table 3

Location of c_f : 5.68 m
cf is uniform on the whole roof - BNCM/CNC2M N0380 / REC EC1-CM : July 2017 §5.3

Front wind - uplift *(in daN/m2)*



Force coefficient c_f : -0.73

for roof slope angle α = 0° - BNCM/CNC2M N0380 / REC ECI-CM : July 2017 Table 3

Location of c_f : 5.68 m

cf is uniform on the whole roof - BNCM/CNC2M N0380 / REC ECI-CM : July 2017 §5.3

Rear wind - sag *(in daN/m2)*

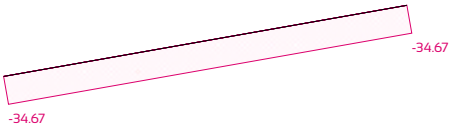
Force coefficient c_f : 0.2

for roof slope angle α = 0° - BNCM/CNC2M N0380 / REC ECI-CM : July 2017 Table 3

Location of c_f : 5.68 m

cf is uniform on the whole roof - BNCM/CNC2M N0380 / REC ECI-CM : July 2017 §5.3

Rear wind - uplift *(in daN/m2)*



Force coefficient c_f : -0.73

for roof slope angle α = 0° - BNCM/CNC2M N0380 / REC ECI-CM : July 2017 Table 3

Location of c_f : 5.68 m

cf is uniform on the whole roof - BNCM/CNC2M N0380 / REC ECI-CM : July 2017 §5.3

Annex 2.3.6.4 - Friction on the elements

	Column		Rafter		Left diagonal brace		Right diagonal brace		Roof surface	
Load case	c_f	q	c_f	q	c_f	q	c_f	q	c_{fr}	q
Left wind - sag	1.415	26.2 daN/m	-	-	-	-	-	-	-	-
Left wind - uplift	1.415	26.2 daN/m	-	-	-	-	-	-	-	-
Right wind - sag	1.415	-25.2 daN/m	-	-	-	-	-	-	-	-
Right wind - uplift	1.415	-25.2 daN/m	-	-	-	-	-	-	-	-
Front wind - sag	1.785	33.1 daN/m	1.749	16.6 daN/m	1.84	10.5 daN/m	1.84	10.5 daN/m	0.05	18.6 daN/m
Front wind - uplift	1.785	33.1 daN/m	1.749	16.6 daN/m	1.84	10.5 daN/m	1.84	10.5 daN/m	0.05	18.6 daN/m
Rear wind - sag	1.785	-33.1 daN/m	1.749	-16.6 daN/m	1.84	10.5 daN/m	1.84	10.5 daN/m	0.05	-18.6 daN/m
Rear wind - uplift	1.785	-33.1 daN/m	1.749	-16.6 daN/m	1.84	10.5 daN/m	1.84	10.5 daN/m	0.05	-18.6 daN/m

Annex 2.3.6.5 - Structural factor c_sc_d (NF EN 1991-1-4/NA (03/2008) §6)

The structural factor c_sc_d should take into account the effect on wind actions from the non-simultaneous occurrence of peak wind pressures on the surface (c_s) together with the effect of the vibrations of the structure due to turbulence (c_d).

Load case	Left wind - sag	Left wind - uplift	Right wind - sag	Right wind - uplift	Reference standard
Turbulent length scale $L(z_s)$	41.83 m	41.83 m	52.89 m	52.89 m	§B.1(1)
Background factor B^2	0.488	0.488	0.525	0.525	§B.2(2)
Natural frequency of the structure $n_{1,x}$	3.44 Hz				-
Non-dimensional frequency $f_{L(zs,n1x)}$	9.284	9.284	11.973	11.973	§B.1(2)
Non-dimensional power spectral density function $S_{L(zs,n1x)}$	0.032	0.032	0.027	0.027	
η_h	6.418	6.418	6.545	6.545	§B.2(6)
Aerodynamic admittance function R_h	0.144	0.144	0.141	0.141	
η_b	47.989	47.989	48.936	48.936	
Aerodynamic admittance function R_b	0.021	0.021	0.02	0.02	
Logarithmic decrement of structural damping δ_s	0.05				table F.2
Mass per unit area of the structure μ	38.5 kg/m²				-
Equivalent mass per unit of frontal area ($H_s.L$) μ_e	218.2 kg/m²				§F.5(3)
Air density ρ	1.225 kg/m³				§4.5
Logarithmic decrement of aerodynamic damping δ_a	0.006	0.013	0.006	0.013	§F.5(4)
Logarithmic decrement of damping δ	0.056	0.063	0.056	0.063	§F.5(1)
Resonance response factor R^2	0.008	0.007	0.007	0.006	§B.2(5)
Up-crossing frequency ν	0.442 Hz	0.417 Hz	0.386 Hz	0.364 Hz	§B.2(4)
Peak factor k_p	3.52	3.504	3.482	3.465	§B.2(3)
Structural factor c_sc_d	0.85	0.85	0.85	0.85	§6.3.1(1)

The structural factor c_sc_d is equal to 1.0 for the other wind directions.

Annex 2.4 - Thermal actions (NF EN 1991-1-5/NA (02/2008))

Annex 2.4.1 - Temperatures

Seasons	Shade air §6.1.3.2	Inner environment T_{in} §5.3	Outer environment T_{out} table 5.2	Environments averages §5.3(1) note 2	Initial temperature T_0 Annex A.1	Uniform temperature components of purlins ΔT_u equation 5.1
Winter	-15 °C	-15 °C	-15 °C	-15.0 °C	10 °C	-25.0 °C
Summer	35 °C	35 °C	45 °C (dark surface: + 10°C)	40.0 °C		+30.0 °C

Annex 2.4.2 - Expansion

Coefficient of linear expansion α_T Table C.1	12 x10⁻⁶/°C	Purlin drilling clearance	Cleat web drilling clearance	Strain capacity by span
		+/-1 mm	+/-1 mm	+/-4 mm
		Cleat flange drilling clearance	Rafter flange drilling clearance	Jointless overall strain capacity
		+/-1 mm	+/-1 mm	+/-4 mm

Span	Longitudinal strain of purlins	Longitudinal strain less clearances by span	Axis	Cumulative sums of longitudinal strains	Expansion joints	Cumulated sums with expansion joints
1	-3.0 mm / +3.6 mm	0.0 mm / +0.0 mm	2	0.0 mm / +0.0 mm	-	0.0 mm / +0.0 mm
2	-3.0 mm / +3.6 mm	0.0 mm / +0.0 mm	3	0.0 mm / +0.0 mm	-	0.0 mm / +0.0 mm
3	-1.5 mm / +1.8 mm	0.0 mm / +0.0 mm	4	0.0 mm / +0.0 mm	-	0.0 mm / +0.0 mm
4	-3.0 mm / +3.6 mm	0.0 mm / +0.0 mm	5	0.0 mm / +0.0 mm	-	0.0 mm / +0.0 mm
5	-3.0 mm / +3.6 mm	0.0 mm / +0.0 mm	6	0.0 mm / +0.0 mm	-	0.0 mm / +0.0 mm

Annex 2.5 - Earthquake (Code of the Environment - Article D563-8-1 (09/01/2015) + JORF n°0248 of 24/10/2010 text N°5)

Annex 2.5.1 - Construction data

Zone : 2 (a_{gR} = 0.7 m/s²) Criteria for zoning :ILLE-ET-VILAINE (35)

Importance class defined by the contracting authority: I - Buildings of minor importance for public safety, agricultural buildings, etc.

Design ground acceleration on type « unknown » ground : a_g.S = 1.008 m/s²

Annex 2.5.2 - Seismic verification condition

In France, no seismic analysis is required for buildings in importance class I.

Annex 2.6 - Loads tables

Annex 2.6.1 - Loads due to self-weight *(G)*

Element Id	Distributed loads (including a 10% increase to take assembly parts into account)				
	System	Abscissa	q_X	q_Y	q_Z
1	global	0.0 m	0.0 daN/m	0 daN/m	-134.6 daN/m
		2.5 m	0.0 daN/m	0 daN/m	-134.6 daN/m
2	global	0.0 m	0.0 daN/m	0 daN/m	-134.6 daN/m
		2.275 m	0.0 daN/m	0 daN/m	-134.6 daN/m
3	global	0.0 m	0.0 daN/m	0 daN/m	-24.1 daN/m
		1.237 m	0.0 daN/m	0 daN/m	-24.1 daN/m
4	global	0.0 m	0.0 daN/m	0 daN/m	-24.1 daN/m
		3.712 m	0.0 daN/m	0 daN/m	-24.1 daN/m
5	global	0.0 m	0.0 daN/m	0 daN/m	-24.1 daN/m
		3.818 m	0.0 daN/m	0 daN/m	-24.1 daN/m
6	global	0.0 m	0.0 daN/m	0 daN/m	-24.1 daN/m
		1.273 m	0.0 daN/m	0 daN/m	-24.1 daN/m
7	global	0.0 m	0.0 daN/m	0 daN/m	-11.7 daN/m
		4.003 m	0.0 daN/m	0 daN/m	-11.7 daN/m
8	global	0.0 m	0.0 daN/m	0 daN/m	-11.7 daN/m
		4.772 m	0.0 daN/m	0 daN/m	-11.7 daN/m

Annex 2.6.2 - Concentrated loads

Element Id	Loads				
	System	Abscissa	F_X	F_Z	C_Y
Permanent loads (G)					
1	global	0.025 m	0.0 daN	-289.6 daN	0.0 m.daN
3	global	0.0 m	4.3 daN	-675.6 daN	-45.3 m.daN
4	global	0.771 m	-5.5 daN	-614.0 daN	-44.8 m.daN
	global	2.779 m	1.8 daN	-655.3 daN	-44.8 m.daN
5	global	1.075 m	-1.8 daN	-634.9 daN	-44.8 m.daN
	global	3.083 m	5.3 daN	-675.0 daN	-44.8 m.daN
6	global	1.273 m	-4.1 daN	-511.2 daN	-37.1 m.daN
Normal snow (Sn)					
3	global	0.0 m	-5.3 daN	-660.2 daN	-47.9 m.daN
4	global	0.771 m	6.6 daN	-870.2 daN	-57.8 m.daN
	global	2.779 m	-1.3 daN	-825.3 daN	-57.8 m.daN
5	global	1.075 m	-1.3 daN	-825.3 daN	-57.8 m.daN
	global	3.083 m	6.6 daN	-870.2 daN	-57.8 m.daN
6	global	1.273 m	-5.3 daN	-660.2 daN	-47.9 m.daN
Accidental snow (Sa)					
Left wind sagging (Wl-)					
3	global	0.0 m	185.6 daN	-1052.4 daN	0.0 m.daN
4	global	0.771 m	123.9 daN	-702.5 daN	0.0 m.daN
	global	2.779 m	86.5 daN	-490.7 daN	0.0 m.daN
5	global	1.075 m	53.8 daN	-305.4 daN	0.0 m.daN
	global	3.083 m	19.9 daN	-113.1 daN	0.0 m.daN
6	global	1.273 m	-10.3 daN	58.5 daN	0.0 m.daN
Left wind in uplift (Wl+)					
3	global	0.0 m	-315.2 daN	1787.3 daN	-0.0 m.daN
4	global	0.771 m	-339.0 daN	1922.7 daN	-0.0 m.daN
	global	2.779 m	-218.7 daN	1240.3 daN	-0.0 m.daN
5	global	1.075 m	-131.8 daN	747.3 daN	-0.0 m.daN
	global	3.083 m	-34.5 daN	195.7 daN	-0.0 m.daN
6	global	1.273 m	44.8 daN	-254.1 daN	-0.0 m.daN
Right wind sagging (Wr-)					
3	global	0.0 m	-9.9 daN	56.1 daN	0.0 m.daN
4	global	0.771 m	19.1 daN	-108.5 daN	0.0 m.daN
	global	2.779 m	51.7 daN	-293.0 daN	0.0 m.daN
5	global	1.075 m	83.0 daN	-470.8 daN	0.0 m.daN

Element Id	Loads				
	System	Abscissa	F_X	F_Z	C_Y
	global	3.083 m	118.8 daN	-673.9 daN	0.0 m.daN
6	global	1.273 m	178.0 daN	-1009.6 daN	0.0 m.daN
Right wind in uplift (Wr+)					
3	global	0.0 m	43.0 daN	-243.8 daN	-0.0 m.daN
4	global	0.771 m	-33.1 daN	187.7 daN	-0.0 m.daN
	global	2.779 m	-126.4 daN	717.0 daN	-0.0 m.daN
5	global	1.075 m	-209.8 daN	1190.0 daN	-0.0 m.daN
	global	3.083 m	-325.3 daN	1844.6 daN	-0.0 m.daN
6	global	1.273 m	-302.3 daN	1714.7 daN	-0.0 m.daN
Front wind sagging (Wf-)					
3	global	0.0 m	30.7 daN	-174.0 daN	0.0 m.daN
4	global	0.771 m	40.6 daN	-230.0 daN	0.0 m.daN
	global	2.779 m	38.4 daN	-217.8 daN	0.0 m.daN
5	global	1.075 m	38.4 daN	-217.8 daN	0.0 m.daN
	global	3.083 m	40.6 daN	-230.0 daN	0.0 m.daN
6	global	1.273 m	30.7 daN	-174.0 daN	0.0 m.daN
Front wind in uplift (Wf+)					
3	global	0.0 m	-111.9 daN	634.9 daN	-0.0 m.daN
4	global	0.771 m	-148.0 daN	839.1 daN	-0.0 m.daN
	global	2.779 m	-140.1 daN	794.5 daN	-0.0 m.daN
5	global	1.075 m	-140.1 daN	794.5 daN	-0.0 m.daN
	global	3.083 m	-148.0 daN	839.1 daN	-0.0 m.daN
6	global	1.273 m	-111.9 daN	634.9 daN	-0.0 m.daN
Rear wind sagging (Wb-)					
3	global	0.0 m	30.7 daN	-174.0 daN	0.0 m.daN
4	global	0.771 m	40.6 daN	-230.0 daN	0.0 m.daN
	global	2.779 m	38.4 daN	-217.8 daN	0.0 m.daN
5	global	1.075 m	38.4 daN	-217.8 daN	0.0 m.daN
	global	3.083 m	40.6 daN	-230.0 daN	0.0 m.daN
6	global	1.273 m	30.7 daN	-174.0 daN	0.0 m.daN
Rear wind in uplift (Wb+)					
3	global	0.0 m	-111.9 daN	634.9 daN	-0.0 m.daN
4	global	0.771 m	-148.0 daN	839.1 daN	-0.0 m.daN
	global	2.779 m	-140.1 daN	794.5 daN	-0.0 m.daN
5	global	1.075 m	-140.1 daN	794.5 daN	-0.0 m.daN
	global	3.083 m	-148.0 daN	839.1 daN	-0.0 m.daN
6	global	1.273 m	-111.9 daN	634.9 daN	-0.0 m.daN
Earthquake on X+ (EX+)					
Earthquake on X- (EX-)					
Earthquake on Y+ (EY+)					
Earthquake on Y- (EY-)					

Annex 2.7 - Loadings combinations (NF EN 1990/NA (12/2011))

Annex 2.7.1 - Ultimate Limit States

Id	Combination	γ_{M0}	γ_{M1}	γ_{M2}
ULS 1	G	1.0	1.0	1.25
ULS 2	1.35 G	1.0	1.0	1.25
ULS 3	G + 1.5 S	1.0	1.0	1.25
ULS 4	1.35 G + 1.5 S	1.0	1.0	1.25
ULS 5	G + 1.5 (S + 0.6 Wl-)	1.0	1.0	1.25
ULS 6	1.35 G + 1.5 (S + 0.6 Wl-)	1.0	1.0	1.25
ULS 7	G + 1.5 (S + 0.6 Wl+)	1.0	1.0	1.25
ULS 8	1.35 G + 1.5 (S + 0.6 Wl+)	1.0	1.0	1.25
ULS 9	G + 1.5 (S + 0.6 Wr-)	1.0	1.0	1.25
ULS 10	1.35 G + 1.5 (S + 0.6 Wr-)	1.0	1.0	1.25
ULS 11	G + 1.5 (S + 0.6 Wr+)	1.0	1.0	1.25
ULS 12	1.35 G + 1.5 (S + 0.6 Wr+)	1.0	1.0	1.25
ULS 13	G + 1.5 (S + 0.6 Wf-)	1.0	1.0	1.25
ULS 14	1.35 G + 1.5 (S + 0.6 Wf-)	1.0	1.0	1.25
ULS 15	G + 1.5 (S + 0.6 Wf+)	1.0	1.0	1.25
ULS 16	1.35 G + 1.5 (S + 0.6 Wf+)	1.0	1.0	1.25
ULS 17	G + 1.5 (S + 0.6 Wb-)	1.0	1.0	1.25
ULS 18	1.35 G + 1.5 (S + 0.6 Wb-)	1.0	1.0	1.25
ULS 19	G + 1.5 (S + 0.6 Wb+)	1.0	1.0	1.25
ULS 20	1.35 G + 1.5 (S + 0.6 Wb+)	1.0	1.0	1.25
ULS 21	G + 1.5 Wl-	1.0	1.0	1.25
ULS 22	1.35 G + 1.5 Wl-	1.0	1.0	1.25
ULS 23	G + 1.5 (Wl- + 0.5 * S)	1.0	1.0	1.25
ULS 24	1.35 G + 1.5 (Wl- + 0.5 * S)	1.0	1.0	1.25
ULS 25	G + 1.5 Wl+	1.0	1.0	1.25
ULS 26	1.35 G + 1.5 Wl+	1.0	1.0	1.25
ULS 27	G + 1.5 (Wl+ + 0.5 * S)	1.0	1.0	1.25
ULS 28	1.35 G + 1.5 (Wl+ + 0.5 * S)	1.0	1.0	1.25
ULS 29	G + 1.5 Wr-	1.0	1.0	1.25
ULS 30	1.35 G + 1.5 Wr-	1.0	1.0	1.25
ULS 31	G + 1.5 (Wr- + 0.5 * S)	1.0	1.0	1.25
ULS 32	1.35 G + 1.5 (Wr- + 0.5 * S)	1.0	1.0	1.25
ULS 33	G + 1.5 Wr+	1.0	1.0	1.25
ULS 34	1.35 G + 1.5 Wr+	1.0	1.0	1.25
ULS 35	G + 1.5 (Wr+ + 0.5 * S)	1.0	1.0	1.25
ULS 36	1.35 G + 1.5 (Wr+ + 0.5 * S)	1.0	1.0	1.25
ULS 37	G + 1.5 Wf-	1.0	1.0	1.25
ULS 38	1.35 G + 1.5 Wf-	1.0	1.0	1.25
ULS 39	G + 1.5 (Wf- + 0.5 * S)	1.0	1.0	1.25
ULS 40	1.35 G + 1.5 (Wf- + 0.5 * S)	1.0	1.0	1.25
ULS 41	G + 1.5 Wf+	1.0	1.0	1.25
ULS 42	1.35 G + 1.5 Wf+	1.0	1.0	1.25
ULS 43	G + 1.5 (Wf+ + 0.5 * S)	1.0	1.0	1.25
ULS 44	1.35 G + 1.5 (Wf+ + 0.5 * S)	1.0	1.0	1.25
ULS 45	G + 1.5 Wb-	1.0	1.0	1.25
ULS 46	1.35 G + 1.5 Wb-	1.0	1.0	1.25
ULS 47	G + 1.5 (Wb- + 0.5 * S)	1.0	1.0	1.25
ULS 48	1.35 G + 1.5 (Wb- + 0.5 * S)	1.0	1.0	1.25
ULS 49	G + 1.5 Wb+	1.0	1.0	1.25
ULS 50	1.35 G + 1.5 Wb+	1.0	1.0	1.25
ULS 51	G + 1.5 (Wb+ + 0.5 * S)	1.0	1.0	1.25
ULS 52	1.35 G + 1.5 (Wb+ + 0.5 * S)	1.0	1.0	1.25
ULS 53	G + Sa	1.0	1.0	1.25

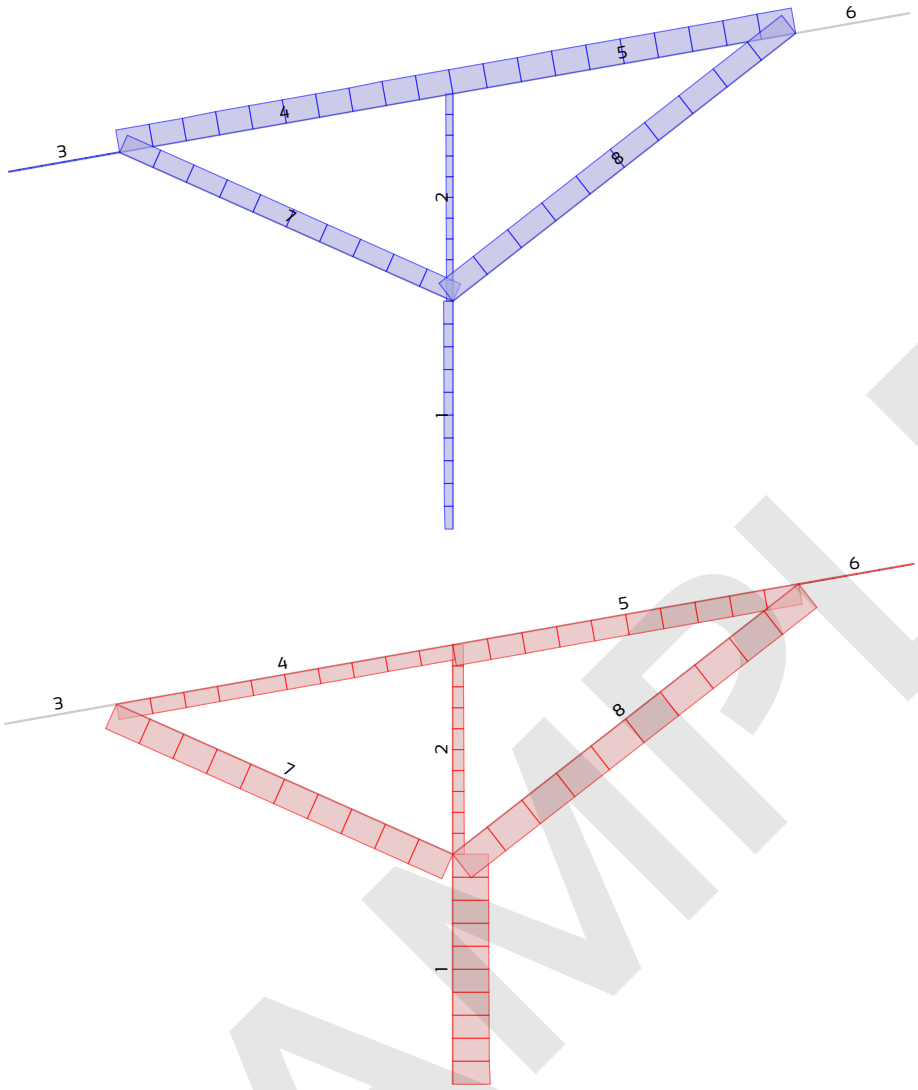
Annex 2.7.2 - Serviceability Limit States

Id	Combination
SLS 1	G
SLS 2	G + S
SLS 3	G + S + 0.6 Wl-
SLS 4	G + S + 0.6 Wl+
SLS 5	G + S + 0.6 Wr-
SLS 6	G + S + 0.6 Wr+
SLS 7	G + S + 0.6 Wf-
SLS 8	G + S + 0.6 Wf+
SLS 9	G + S + 0.6 Wb-
SLS 10	G + S + 0.6 Wb+
SLS 11	G + Wl-
SLS 12	G + Wl- + 0.5 * S
SLS 13	G + Wl+
SLS 14	G + Wl+ + 0.5 * S
SLS 15	G + Wr-
SLS 16	G + Wr- + 0.5 * S
SLS 17	G + Wr+
SLS 18	G + Wr+ + 0.5 * S
SLS 19	G + Wf-
SLS 20	G + Wf- + 0.5 * S
SLS 21	G + Wf+
SLS 22	G + Wf+ + 0.5 * S
SLS 23	G + Wb-
SLS 24	G + Wb- + 0.5 * S
SLS 25	G + Wb+
SLS 26	G + Wb+ + 0.5 * S

ANNEX 3 - MECHANICAL CALCULATION RESULTS

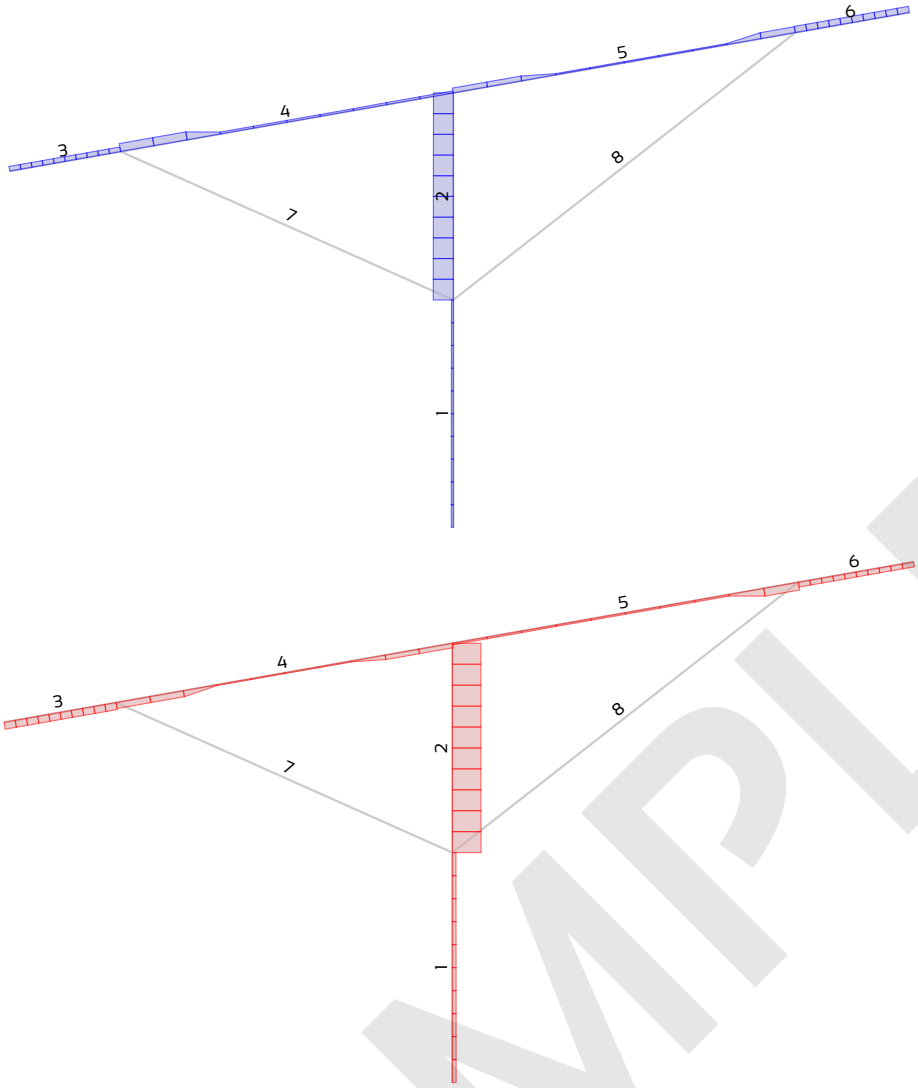
When calculating, items are sub divided by 10.

Annex 3.1 - Normal forces N_X



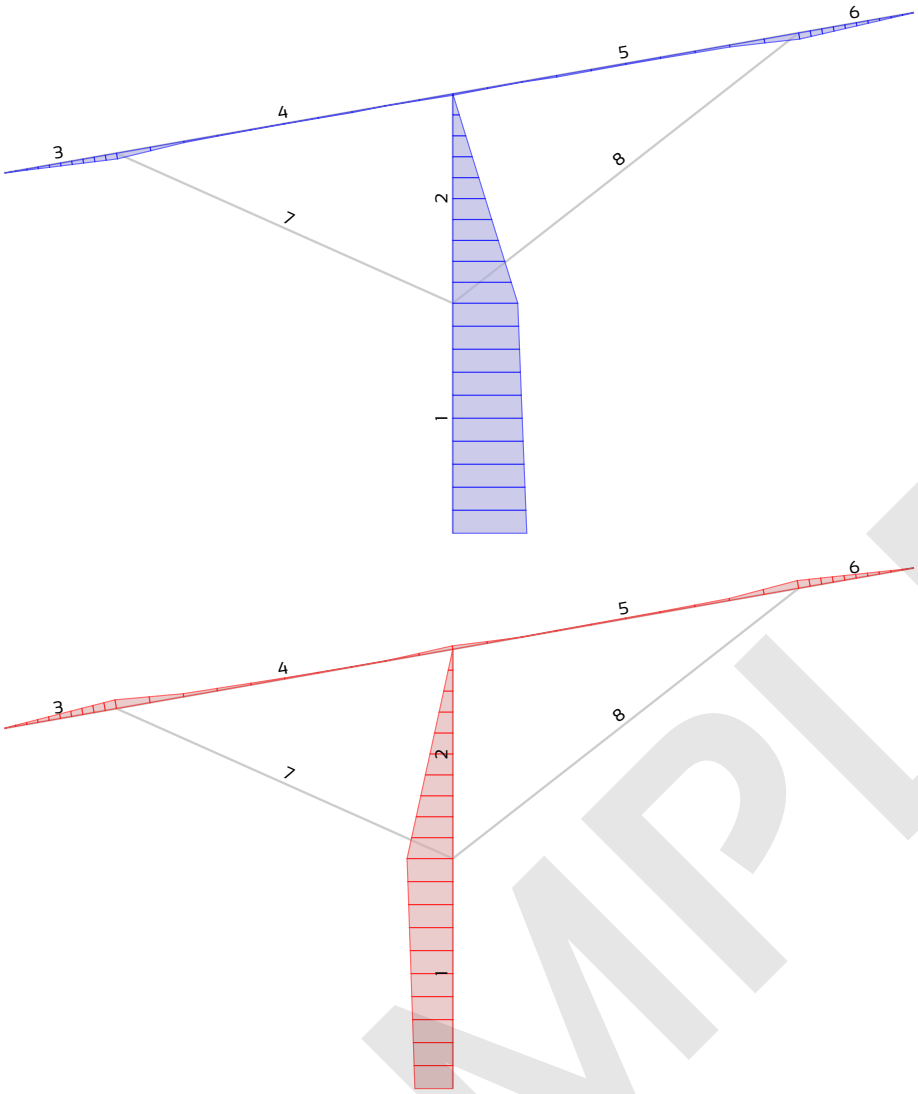
Element (Id)	$N_{X,max}$(tension)	$N_{X,min}$(compression)
Column - lower part (1)	4041.9 daN (ULS 25)	-16220.2 daN (ULS 6)
Column - upper part (2)	3103.3 daN (ULS 25)	-4983.8 daN (ULS 6)
Rafter - cantilever (3)	339.5 daN (ULS 8)	-
Rafter - span (4)	10650.4 daN (ULS 6)	-6691.2 daN (ULS 25)
Rafter - span (5)	11145.9 daN (ULS 32)	-9072.1 daN (ULS 33)
Rafter - cantilever (6)	-	-312.2 daN (ULS 6)
Left diagonal brace (7)	8231.9 daN (ULS 25)	-11546.3 daN (ULS 24)
Right diagonal brace (8)	9904.0 daN (ULS 33)	-12906.7 daN (ULS 32)

Annex 3.2 - Shear forces V_Z



Element (Id)	$V_{Z,max}$	$V_{Z,min}$
Column - lower part (1)	877.0 daN (ULS 24)	-1611.2 daN (ULS 33)
Column - upper part (2)	8734.6 daN (ULS 25)	-12380.1 daN (ULS 36)
Rafter - cantilever (3)	2056.3 daN (ULS 25)	-3028.7 daN (ULS 24)
Rafter - span (4)	3544.0 daN (ULS 6)	-2616.3 daN (ULS 25)
Rafter - span (5)	2600.1 daN (ULS 33)	-3394.0 daN (ULS 10)
Rafter - cantilever (6)	2744.1 daN (ULS 32)	-2109.1 daN (ULS 33)
Left diagonal brace (7)	28.9 daN (ULS 42)	-28.9 daN (ULS 42)
Right diagonal brace (8)	29.7 daN (ULS 2)	-29.7 daN (ULS 2)

Annex 3.3 - Bending moments M_Y



Element (Id)	$M_{Y,max}$	$M_{Y,min}$
Column - lower part (1)	31978.8 m.daN (ULS 36)	-19770.7 m.daN (ULS 25)
Column - upper part (2)	28068.9 m.daN (ULS 36)	-19770.7 m.daN (ULS 25)
Rafter - cantilever (3)	2480.9 m.daN (ULS 25)	-3820.1 m.daN (ULS 24)
Rafter - span (4)	2480.9 m.daN (ULS 25)	-3820.1 m.daN (ULS 24)
Rafter - span (5)	2702.0 m.daN (ULS 33)	-3380.2 m.daN (ULS 32)
Rafter - cantilever (6)	2702.0 m.daN (ULS 33)	-3380.2 m.daN (ULS 32)
Left diagonal brace (7)	28.9 m.daN (ULS 2)	-0.0 m.daN
Right diagonal brace (8)	35.4 m.daN (ULS 2)	-0.0 m.daN

Annex 3.4 - Shear forces V_Y

Element (Id)	$V_{Y,max}$	$V_{Y,min}$
Column - lower part (1)	927.2 daN (ULS 45)	-927.2 daN (ULS 37)
Column - upper part (2)	749.1 daN (ULS 45)	-749.1 daN (ULS 37)
Rafter - cantilever (3)	31.4 daN (ULS 45)	-33.2 daN (ULS 37)
Rafter - span (4)	335.4 daN (ULS 37)	-338.6 daN (ULS 45)
Rafter - span (5)	299.3 daN (ULS 45)	-296.4 daN (ULS 37)
Rafter - cantilever (6)	34.4 daN (ULS 37)	-32.5 daN (ULS 45)
Left diagonal brace (7)	31.5 daN (ULS 45)	-31.5 daN (ULS 37)
Right diagonal brace (8)	37.5 daN (ULS 45)	-37.5 daN (ULS 37)

Annex 3.5 - Bending moments M_Z

Element (Id)	$M_{Z,max}$	$M_{Z,min}$
Column - lower part (1)	3906.5 m.daN (ULS 45)	-3906.5 m.daN (ULS 37)
Column - upper part (2)	1708.6 m.daN (ULS 45)	-1708.6 m.daN (ULS 37)
Rafter - cantilever (3)	19.8 m.daN (ULS 45)	-22.0 m.daN (ULS 37)
Rafter - span (4)	238.7 m.daN (ULS 37)	-238.9 m.daN (ULS 45)
Rafter - span (5)	238.7 m.daN (ULS 37)	-238.9 m.daN (ULS 45)
Rafter - cantilever (6)	21.1 m.daN (ULS 45)	-23.5 m.daN (ULS 37)
Left diagonal brace (7)	115.5 m.daN (ULS 24)	-107.8 m.daN (ULS 18)
Right diagonal brace (8)	129.1 m.daN (ULS 32)	-125.7 m.daN (ULS 18)

Annex 3.6 - Nodes displacements

Annex 3.6.1 - Horizontal translations U_X

Node		1	2	3	4	5	6	7
Combination Id	1	0.0 mm	-0.3 mm	-0.8 mm	-0.1 mm	-0.4 mm	-0.6 mm	-0.6 mm
	2	0.0 mm	-0.3 mm	-0.8 mm	0.4 mm	0.4 mm	-0.6 mm	-0.2 mm
	3	0.0 mm	-1.6 mm	-5.2 mm	-2.3 mm	-5.2 mm	-4.2 mm	-5.4 mm
	4	0.0 mm	2.8 mm	8.8 mm	6.8 mm	12.9 mm	7.1 mm	11.4 mm
	5	0.0 mm	2.1 mm	6.2 mm	5.5 mm	10.2 mm	5.0 mm	8.5 mm
	6	0.0 mm	-5.4 mm	-16.1 mm	-10.9 mm	-20.3 mm	-13.1 mm	-19.1 mm
	7	0.0 mm	-0.0 mm	-0.1 mm	1.0 mm	1.5 mm	-0.1 mm	0.7 mm
	8	0.0 mm	-1.2 mm	-3.3 mm	-1.8 mm	-3.2 mm	-2.7 mm	-3.4 mm
	9	0.0 mm	-0.0 mm	-0.1 mm	1.0 mm	1.5 mm	-0.1 mm	0.7 mm
	10	0.0 mm	-1.2 mm	-3.3 mm	-1.8 mm	-3.2 mm	-2.7 mm	-3.4 mm
	11	0.0 mm	-2.6 mm	-8.1 mm	-4.6 mm	-9.8 mm	-6.5 mm	-9.4 mm
	12	0.0 mm	-2.6 mm	-8.1 mm	-4.4 mm	-9.4 mm	-6.5 mm	-9.1 mm
	13	0.0 mm	4.8 mm	15.3 mm	10.6 mm	20.5 mm	12.3 mm	18.7 mm
	14	0.0 mm	4.8 mm	15.3 mm	10.8 mm	20.9 mm	12.3 mm	19.0 mm
	15	0.0 mm	3.7 mm	10.9 mm	8.5 mm	15.8 mm	8.8 mm	13.9 mm
	16	0.0 mm	3.7 mm	10.9 mm	8.8 mm	16.2 mm	8.8 mm	14.1 mm
	17	0.0 mm	-8.9 mm	-26.3 mm	-18.8 mm	-34.9 mm	-21.4 mm	-32.1 mm
	18	0.0 mm	-8.9 mm	-26.3 mm	-18.6 mm	-34.5 mm	-21.4 mm	-31.9 mm
	19	0.0 mm	0.2 mm	0.3 mm	0.9 mm	1.3 mm	0.3 mm	0.9 mm
	20	0.0 mm	0.2 mm	0.3 mm	1.1 mm	1.7 mm	0.3 mm	1.1 mm
	21	0.0 mm	-1.8 mm	-5.0 mm	-3.7 mm	-6.5 mm	-4.1 mm	-6.0 mm
	22	0.0 mm	-1.8 mm	-5.0 mm	-3.5 mm	-6.1 mm	-4.1 mm	-5.8 mm
	23	0.0 mm	0.2 mm	0.3 mm	0.9 mm	1.3 mm	0.3 mm	0.9 mm
	24	0.0 mm	0.2 mm	0.3 mm	1.1 mm	1.7 mm	0.3 mm	1.1 mm
	25	0.0 mm	-1.8 mm	-5.0 mm	-3.7 mm	-6.5 mm	-4.1 mm	-6.0 mm
	26	0.0 mm	-1.8 mm	-5.0 mm	-3.5 mm	-6.1 mm	-4.1 mm	-5.8 mm

Annex 3.6.2 - Horizontal translations U_Y

Node		1	2	3	4	5	6	7
Combination Id	7	0.0 mm	2.3 mm	6.7 mm	8.2 mm	9.0 mm	8.3 mm	9.0 mm
	8	0.0 mm	2.3 mm	6.7 mm	8.2 mm	9.0 mm	8.3 mm	9.0 mm
	9	0.0 mm	-2.3 mm	-6.7 mm	-8.2 mm	-9.0 mm	-8.3 mm	-9.0 mm
	10	0.0 mm	-2.3 mm	-6.7 mm	-8.2 mm	-9.0 mm	-8.3 mm	-9.0 mm
	19	0.0 mm	3.9 mm	11.1 mm	13.6 mm	15.0 mm	13.9 mm	15.0 mm
	20	0.0 mm	3.9 mm	11.1 mm	13.6 mm	15.0 mm	13.9 mm	15.0 mm
	21	0.0 mm	3.9 mm	11.1 mm	13.6 mm	15.0 mm	13.9 mm	15.0 mm
	22	0.0 mm	3.9 mm	11.1 mm	13.6 mm	15.0 mm	13.9 mm	15.0 mm
	23	0.0 mm	-3.9 mm	-11.1 mm	-13.6 mm	-15.0 mm	-13.8 mm	-14.9 mm
	24	0.0 mm	-3.9 mm	-11.1 mm	-13.6 mm	-15.0 mm	-13.8 mm	-14.9 mm
	25	0.0 mm	-3.9 mm	-11.1 mm	-13.6 mm	-15.0 mm	-13.8 mm	-14.9 mm
	26	0.0 mm	-3.9 mm	-11.1 mm	-13.6 mm	-15.0 mm	-13.8 mm	-14.9 mm

Annex 3.6.3 - Vertical translations U_Z

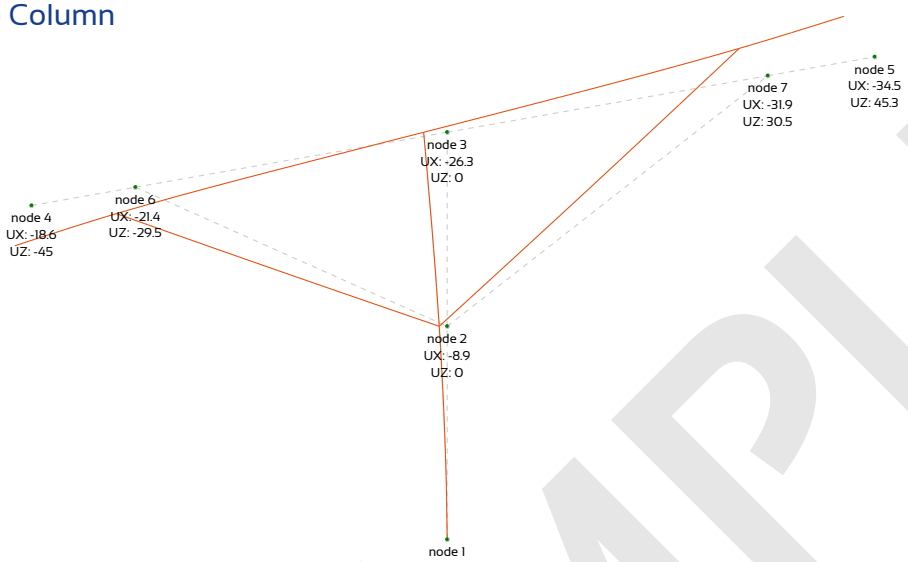
Node		1	2	3	4	5	6	7
Combination Id	1	0.0 mm	-0.0 mm	-0.0 mm	-5.1 mm	-1.7 mm	-1.8 mm	-0.4 mm

Node		1	2	3	4	5	6	7
	2	0.0 mm	-0.1 mm	-0.1 mm	-8.7 mm	-5.4 mm	-2.9 mm	-1.9 mm
	3	0.0 mm	-0.1 mm	-0.1 mm	-18.8 mm	1.8 mm	-8.5 mm	3.0 mm
	4	0.0 mm	-0.0 mm	-0.1 mm	11.2 mm	-21.4 mm	9.2 mm	-12.8 mm
	5	0.0 mm	-0.1 mm	-0.1 mm	1.7 mm	-20.0 mm	4.6 mm	-10.7 mm
	6	0.0 mm	-0.0 mm	-0.1 mm	-31.5 mm	23.9 mm	-19.2 mm	17.1 mm
	7	0.0 mm	-0.1 mm	-0.1 mm	-8.2 mm	-7.0 mm	-2.3 mm	-2.9 mm
	8	0.0 mm	-0.0 mm	-0.1 mm	-10.2 mm	0.6 mm	-4.8 mm	1.7 mm
	9	0.0 mm	-0.1 mm	-0.1 mm	-8.2 mm	-7.0 mm	-2.3 mm	-2.9 mm
	10	0.0 mm	-0.0 mm	-0.1 mm	-10.2 mm	0.6 mm	-4.8 mm	1.7 mm
	11	0.0 mm	-0.1 mm	-0.1 mm	-22.1 mm	10.2 mm	-11.1 mm	7.8 mm
	12	0.0 mm	-0.1 mm	-0.1 mm	-23.8 mm	8.4 mm	-11.7 mm	7.1 mm
	13	0.0 mm	0.0 mm	0.0 mm	27.9 mm	-28.4 mm	18.2 mm	-18.6 mm
	14	0.0 mm	-0.0 mm	-0.0 mm	26.1 mm	-30.2 mm	17.7 mm	-19.4 mm
	15	0.0 mm	-0.1 mm	-0.1 mm	12.1 mm	-26.1 mm	10.6 mm	-15.1 mm
	16	0.0 mm	-0.1 mm	-0.1 mm	10.4 mm	-27.9 mm	10.0 mm	-15.8 mm
	17	0.0 mm	0.0 mm	-0.0 mm	-43.2 mm	47.1 mm	-29.0 mm	31.3 mm
	18	0.0 mm	-0.0 mm	-0.0 mm	-45.0 mm	45.3 mm	-29.5 mm	30.5 mm
	19	0.0 mm	-0.0 mm	-0.1 mm	-4.5 mm	-4.4 mm	-0.9 mm	-2.0 mm
	20	0.0 mm	-0.1 mm	-0.1 mm	-6.2 mm	-6.2 mm	-1.5 mm	-2.8 mm
	21	0.0 mm	-0.0 mm	-0.0 mm	-7.7 mm	8.2 mm	-5.1 mm	5.6 mm
	22	0.0 mm	-0.0 mm	-0.0 mm	-9.4 mm	6.4 mm	-5.7 mm	4.8 mm
	23	0.0 mm	-0.0 mm	-0.1 mm	-4.5 mm	-4.4 mm	-0.9 mm	-2.0 mm
	24	0.0 mm	-0.1 mm	-0.1 mm	-6.2 mm	-6.2 mm	-1.5 mm	-2.8 mm
	25	0.0 mm	-0.0 mm	-0.0 mm	-7.7 mm	8.2 mm	-5.1 mm	5.6 mm
	26	0.0 mm	-0.0 mm	-0.0 mm	-9.4 mm	6.4 mm	-5.7 mm	4.8 mm

ANNEX 4 - DETAILED CHECKINGS OF THE ELEMENTS (NF EN 1993-1-1/NA (08/2013))

Element (Id)	Cross section	Material	ULS ratio	ULS combination	SLS ratio	SLS combination
Column - lower part (1)	HEA400	S275	0.481	ULS 36	0.826	SLS 18
Column - upper part (2)	HEA400	S275	0.424	ULS 36		
Rafter - cantilever (3)	IPE200	S275	0.731	ULS 24	0.325	SLS 12
Rafter - span (4)	IPE200	S275	0.959	ULS 24		
Rafter - span (5)	IPE200	S275	0.779	ULS 32	0.287	SLS 17
Rafter - cantilever (6)	IPE200	S275	0.651	ULS 32		
Left diagonal brace (7)	☐ 120x3	S235	0.717	ULS 24	-	-
Right diagonal brace (8)	☐ 120x3	S235	0.965	ULS 32	-	-

Annex 4.1 - Column



Maximum displacement at the top of the column on X-axis : U_X = -26.3 mm (SLS 18) < H/150 = 31.8 mm

Maximum displacement at the top of the column on Y-axis : U_Y = 11.1 mm (SLS 19) < H/150 = 31.8 mm

Element 1

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations	Abscissa on the element
Compression (buckling) (§6.3.1)	0.063	ULS 6	0.0 m
Shear on z-z axis (§6.2.6)	0.018	ULS 33	0.0 m
Shear on y-y axis (§6.2.6)	0.005	ULS 37	0.0 m
Bending about y-y axis (§6.2.5)	0.454	ULS 36	0.0 m
Bending about z-z axis (§6.2.5)	0.163	ULS 37	0.0 m
Lateral-torsional buckling (§6.3.2)	0.472	ULS 36	0.0 m
Bending about y-y and shear on z-z (§6.2.8)	0.454	ULS 36	0.0 m
Bending about z-z and shear on y-y (§6.2.8)	0.163	ULS 37	0.0 m
Bending about y-y and axial force (§6.2.9)	0.454	ULS 36	0.0 m
Bending about z-z and axial force (§6.2.9)	0.163	ULS 37	0.0 m
Bi-axial bending (§6.2.9)	0.173	ULS 44	0.0 m
Lateral-torsional buckling, bending about z-z and flexural buckling about y-y (eq. 6.61)	**0.481**	**ULS 36**	**0.0 m**
Lateral-torsional buckling, bending about z-z and flexural buckling about z-z (eq. 6.62)	0.26	ULS 36	0.0 m

Slenderness $\lambda_{y,max}$	Slenderness $\lambda_{z,max}$	Critical factor $\alpha_{cr,y,min}$	Critical factor $\alpha_{cr,z,min}$
53.9	130.1	170.66	27.97

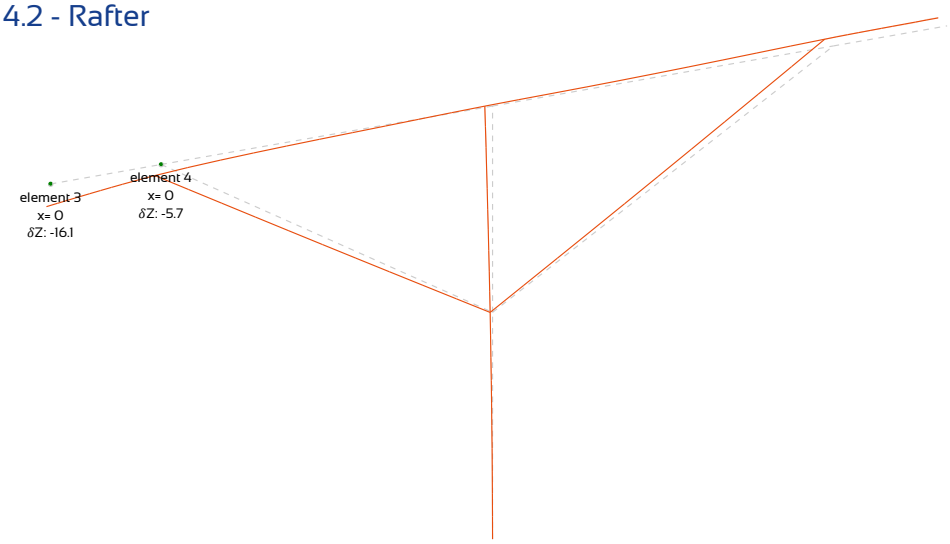
Element 2

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations	Abscissa on the element
Compression (buckling) (§6.3.1)	0.019	ULS 6	0.0 m
Shear on z-z axis (§6.2.6)	0.136	ULS 36	0.0 m
Shear on y-y axis (§6.2.6)	0.004	ULS 37	0.0 m
Bending about y-y axis (§6.2.5)	0.398	ULS 36	0.0 m
Bending about z-z axis (§6.2.5)	0.071	ULS 37	0.0 m
Lateral-torsional buckling (§6.3.2)	0.414	ULS 36	0.0 m
Bending about y-y and shear on z-z (§6.2.8)	0.398	ULS 36	0.0 m
Bending about z-z and shear on y-y (§6.2.8)	0.071	ULS 37	0.0 m
Bending about y-y and axial force (§6.2.9)	0.398	ULS 36	0.0 m
Bending about z-z and axial force (§6.2.9)	0.071	ULS 37	0.0 m
Bi-axial bending (§6.2.9)	0.074	ULS 44	0.0 m
Lateral-torsional buckling, bending about z-z and flexural buckling about y-y (eq. 6.61)	**0.424**	**ULS 36**	**0.0 m**
Lateral-torsional buckling, bending about z-z and flexural buckling about z-z (eq. 6.62)	0.232	ULS 36	0.0 m

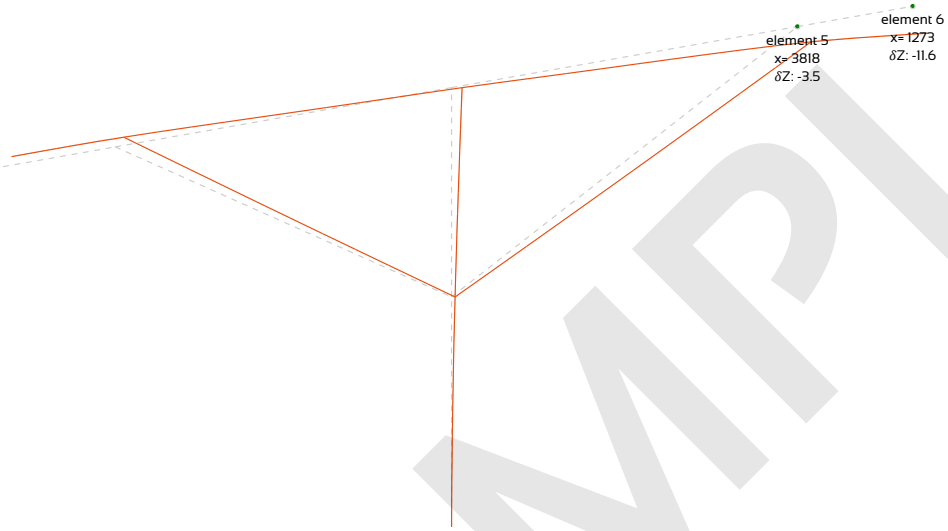
Slenderness $\lambda_{y,max}$	Slenderness $\lambda_{z,max}$	Critical factor $\alpha_{cr,y,min}$	Critical factor $\alpha_{cr,z,min}$
53.9	130.1	170.66	27.97

Annex 4.2 - Rafter



Maximum total deflection on the left side : δ_Z = -16.1 mm(SLS 12) < L/100 = 49.5 mm

Maximum variable deflection on the left side : $\delta_{var,Z}$ = 10.7 mm(SLS 13 - SLS 1) < L/125 = 39.6 mm



Maximum total deflection on the right side : δ_Z = -11.6 mm(SLS 16) < L/100 = 50.9 mm

Maximum variable deflection on the right side : $\delta_{var,Z}$ = 11.7 mm(SLS 17 - SLS 1) < L/125 = 40.7 mm

Element 3

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations	Abscissa on the element
Tension (§6.2.3)	0.004	ULS 8	1.237 m
Shear on z-z axis (§6.2.6)	0.136	ULS 24	1.237 m
Shear on y-y axis (§6.2.6)	0.001	ULS 37	0.0 m
Bending about y-y axis (§6.2.5)	0.63	ULS 24	1.237 m
Bending about z-z axis (§6.2.5)	0.018	ULS 37	1.237 m
Lateral-torsional buckling (§6.3.2)	**0.731**	**ULS 24**	**1.237 m**
Bending about y-y and shear on z-z (§6.2.8)	0.63	ULS 24	1.237 m
Bending about z-z and shear on y-y (§6.2.8)	0.018	ULS 37	1.237 m
Bending about y-y and axial force (§6.2.9)	0.63	ULS 24	1.237 m
Bending about z-z and axial force (§6.2.9)	0.018	ULS 37	1.237 m
Bi-axial bending (§6.2.9)	0.205	ULS 14	1.237 m

Slenderness $\lambda_{y,max}$	Slenderness $\lambda_{z,max}$
30.0	89.8

Element 4

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations	Abscissa on the element
Compression (buckling) (§6.3.1)	0.148	ULS 25	0.0 m
Shear on z-z axis (§6.2.6)	0.159	ULS 6	0.0 m
Shear on y-y axis (§6.2.6)	0.011	ULS 45	3.712 m
Bending about y-y axis (§6.2.5)	0.63	ULS 24	0.0 m
Bending about z-z axis (§6.2.5)	0.195	ULS 45	3.712 m
Lateral-torsional buckling (§6.3.2)	**0.959**	**ULS 24**	**0.0 m**
Bending about y-y and shear on z-z (§6.2.8)	0.63	ULS 24	0.0 m
Bending about z-z and shear on y-y (§6.2.8)	0.195	ULS 45	3.712 m
Bending about y-y and axial force (§6.2.9)	0.63	ULS 24	0.0 m
Bending about z-z and axial force (§6.2.9)	0.195	ULS 45	3.712 m
Bi-axial bending (§6.2.9)	0.23	ULS 48	3.712 m
Lateral-torsional buckling, bending about z-z and flexural bucking about y-y (eq. 6.61)	0.553	ULS 25	0.0 m
Lateral-torsional buckling, bending about z-z and flexural bucking about z-z (eq. 6.62)	0.395	ULS 25	0.0 m

Slenderness $\lambda_{y,max}$	Slenderness $\lambda_{z,max}$
31.5	89.8

Element 5

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations	Abscissa on the element
Compression (buckling) (§6.3.1)	0.201	ULS 33	0.0 m
Shear on z-z axis (§6.2.6)	0.153	ULS 10	3.818 m
Shear on y-y axis (§6.2.6)	0.01	ULS 45	0.0 m
Bending about y-y axis (§6.2.5)	0.557	ULS 32	3.818 m
Bending about z-z axis (§6.2.5)	0.195	ULS 45	0.0 m
Lateral-torsional buckling (§6.3.2)	**0.779**	**ULS 32**	**3.818 m**
Bending about y-y and shear on z-z (§6.2.8)	0.557	ULS 32	3.818 m
Bending about z-z and shear on y-y (§6.2.8)	0.195	ULS 45	0.0 m
Bending about y-y and axial force (§6.2.9)	0.557	ULS 32	3.818 m
Bending about z-z and axial force (§6.2.9)	0.195	ULS 45	0.0 m
Bi-axial bending (§6.2.9)	0.23	ULS 48	0.0 m
Lateral-torsional buckling, bending about z-z and flexural bucking about y-y (eq. 6.61)	0.648	ULS 33	3.818 m
Lateral-torsional buckling, bending about z-z and flexural bucking about z-z (eq. 6.62)	0.48	ULS 33	3.818 m

Slenderness $\lambda_{y,max}$	Slenderness $\lambda_{z,max}$
32.4	89.8

Element 6

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations	Abscissa on the element
Compression (buckling) (§6.3.1)	0.007	ULS 6	0.0 m
Shear on z-z axis (§6.2.6)	0.123	ULS 32	0.0 m
Shear on y-y axis (§6.2.6)	0.001	ULS 37	1.273 m
Bending about y-y axis (§6.2.5)	0.557	ULS 32	0.0 m
Bending about z-z axis (§6.2.5)	0.019	ULS 37	0.0 m
Lateral-torsional buckling (§6.3.2)	**0.651**	**ULS 32**	**0.0 m**
Bending about y-y and shear on z-z (§6.2.8)	0.557	ULS 32	0.0 m
Bending about z-z and shear on y-y (§6.2.8)	0.019	ULS 37	0.0 m
Bending about y-y and axial force (§6.2.9)	0.557	ULS 32	0.0 m
Bending about z-z and axial force (§6.2.9)	0.019	ULS 37	0.0 m
Bi-axial bending (§6.2.9)	0.144	ULS 14	0.0 m
Lateral-torsional buckling, bending about z-z and flexural bucking about y-y (eq. 6.61)	0.646	ULS 32	0.0 m
Lateral-torsional buckling, bending about z-z and flexural bucking about z-z (eq. 6.62)	0.341	ULS 32	0.0 m

Slenderness $\lambda_{y,max}$	Slenderness $\lambda_{z,max}$
30.8	89.8

Annex 4.3 - Diagonal braces

Element 7

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations	Abscissa on the element
Compression (buckling) (§6.3.1)	0.591	ULS 24	4.003 m
Shear on z-z axis (§6.2.6)	0.003	ULS 42	0.0 m
Shear on y-y axis (§6.2.6)	0.003	ULS 37	0.0 m
Bending about y-y axis (§6.2.5)	0.02	ULS 2	2.001 m
Bending about z-z axis (§6.2.5)	0.082	ULS 24	4.003 m
Bending about y-y and shear on z-z (§6.2.8)	0.02	ULS 2	2.001 m
Bending about z-z and shear on y-y (§6.2.8)	0.082	ULS 24	4.003 m
Bending about y-y and axial force (§6.2.9)	0.024	ULS 24	2.001 m
Bending about z-z and axial force (§6.2.9)	0.082	ULS 24	4.003 m
Bi-axial bending (§6.2.9)	0.011	ULS 40	2.001 m
Lateral-torsional buckling, bending about z-z and flexural buckling about y-y (eq. 6.61)	0.651	ULS 24	2.001 m
Lateral-torsional buckling, bending about z-z and flexural buckling about z-z (eq. 6.62)	**0.717**	**ULS 24**	**2.001 m**

Slenderness $\lambda_{y,max}$	Slenderness $\lambda_{z,max}$
75.7	84.2

Element 8

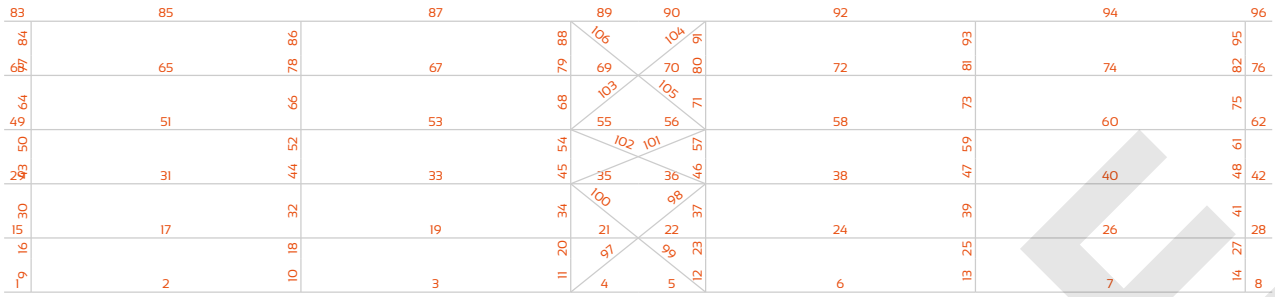
Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations	Abscissa on the element
Compression (buckling) (§6.3.1)	0.793	ULS 32	0.0 m
Shear on z-z axis (§6.2.6)	0.003	ULS 2	0.0 m
Shear on y-y axis (§6.2.6)	0.004	ULS 37	0.0 m
Bending about y-y axis (§6.2.5)	0.025	ULS 2	2.386 m
Bending about z-z axis (§6.2.5)	0.091	ULS 32	0.0 m
Bending about y-y and shear on z-z (§6.2.8)	0.025	ULS 2	2.386 m
Bending about z-z and shear on y-y (§6.2.8)	0.091	ULS 32	0.0 m
Bending about y-y and axial force (§6.2.9)	0.032	ULS 32	2.386 m
Bending about z-z and axial force (§6.2.9)	0.091	ULS 32	0.0 m
Bi-axial bending (§6.2.9)	0.015	ULS 40	2.386 m
Lateral-torsional buckling, bending about z-z and flexural buckling about y-y (eq. 6.61)	0.906	ULS 32	2.386 m
Lateral-torsional buckling, bending about z-z and flexural buckling about z-z (eq. 6.62)	**0.965**	**ULS 32**	**2.386 m**

Slenderness $\lambda_{y,max}$	Slenderness $\lambda_{z,max}$
90.3	100.3

ANNEX 5 - LONGITUDINAL STABILITY SYSTEM (NF EN 1993-1-1/NA (08/2013))

Annex 5.1 - Roof cross-bracing



Maximum working rates per element and associated combinations

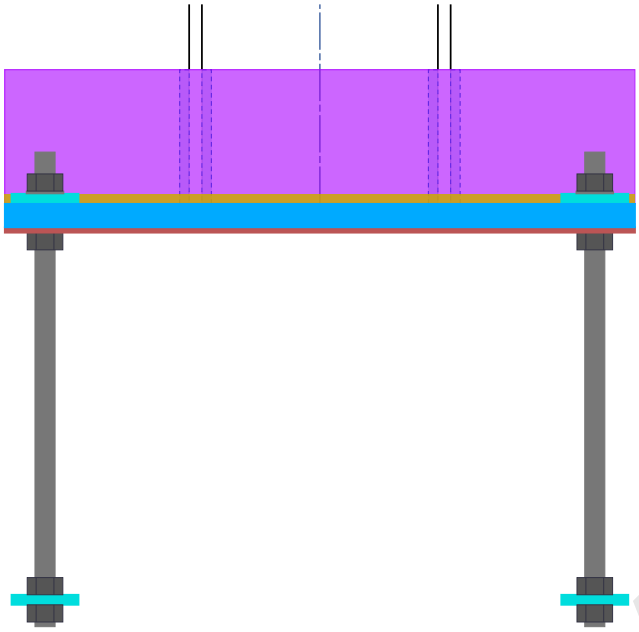
Element (Id)	Cross section	Material	ULS ratio	ULS combination
Roof bracing (97)	L40x40x4	S235	0.367	1.5 x Wf-
Roof bracing (98)	L40x40x4	S235	0.563	1.5 x Wf-
Roof bracing (99)	L40x40x4	S235	0.367	1.5 x Wb-
Roof bracing (100)	L40x40x4	S235	0.563	1.5 x Wb-
Roof bracing (101)	L40x40x4	S235	0.047	1.5 x Wb-
Roof bracing (102)	L40x40x4	S235	0.047	1.5 x Wf-
Roof bracing (103)	**L40x40x4**	**S235**	**0.58**	**1.5 x Wb-**
Roof bracing (104)	L40x40x4	S235	0.376	1.5 x Wb-
Roof bracing (105)	L40x40x4	S235	0.58	1.5 x Wf-
Roof bracing (106)	L40x40x4	S235	0.376	1.5 x Wf-

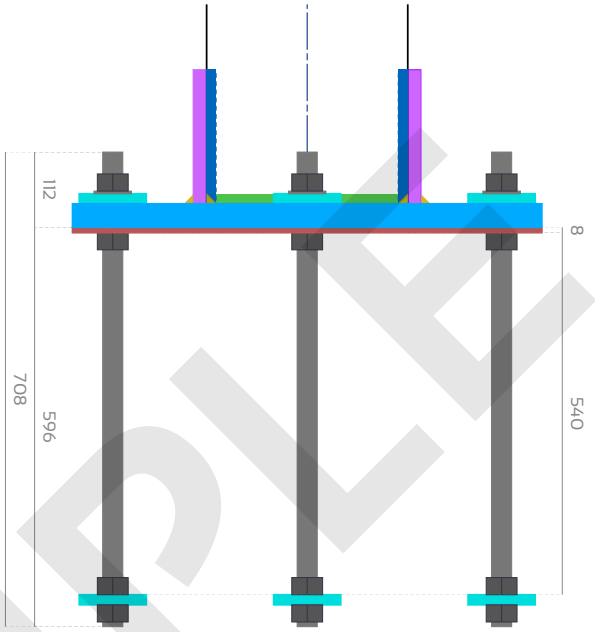
ANNEX 6 - DETAILED CHECKINGS OF THE CONNECTIONS (NF EN 1993-1-8/NA (07/2007))

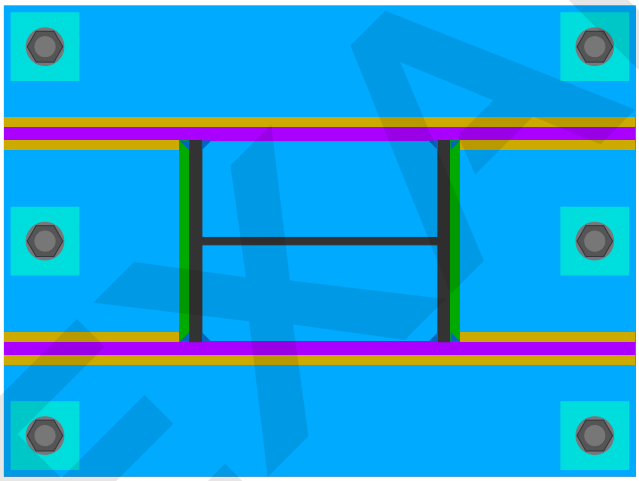
Annex 6.1 - Column base and anchorages

Element 1 (left-hand column)

Sketch and dimension table







Weld throats		
On the internal flanges a_f	Horizontal on the stiffeners a_s	Vertical on the column a_c
10 mm	10 mm	10 mm

Angle between elements = 90.0°

Anchor bolts	Designation	Threaded rod diameter d	Washer diameter	Transverse spacing p_2	Edge distance e_2	Longitudinal spacing p_1	End distance e_1
	M30 8.8	30 mm	56 mm	290 mm > 79.2 mm	60.0 mm > 39.6 mm	820 mm > 79.2 mm	60.0 mm > 39.6 mm
Positioning jig plate	Thickness t_{jp}	Width B_{jp}	Length L_{jp}	Anchor pad and support pad	Thickness t_{ap}	Width B_{ap}	Distance under positioning jig plate d_{ap}
	8 mm	700 mm	940 mm		15 mm	100 mm	540 mm
Column base plate	Thickness t_p	Width B_p	Length L_p	Drillings d_0	Stiffeners	Thickness t_s	Height h_s
	35 mm	700 mm	940 mm	33 mm		20 mm	200 mm

Rotational stiffnesses taken into account in the mechanical analysis

Parameter	Symbol	Value
Rotation about y-y	$S_{j,y}$	252646.5 m.kN/rad
Rotation about z-z	$S_{j,z}$	86064.7 m.kN/rad

Envelopes of maximum stresses in global coordinate system

Dominant stress	N_Z	V_X	M_Y	V_Y	M_X	T_Z	Combination
tension	**3415.8** daN	-1303.6 daN	16388.6 m.daN	0.0 daN	0.0 m.daN	0.0 m.daN	ULS 25
compression	**-16220.1** daN	526.2 daN	-5311.7 m.daN	0.0 daN	0.0 m.daN	0.0 m.daN	ULS 6
shear on x-x	3072.2 daN	**-1611.2** daN	-31762.4 m.daN	0.0 daN	0.0 m.daN	0.0 m.daN	ULS 33
bending moment about y-y	1307.1 daN	-1611.2 daN	**-31978.8** m.daN	0.0 daN	0.0 m.daN	0.0 m.daN	ULS 34
shear on y-y	1762.4 daN	-1200.0 daN	-6835.8 m.daN	**927.2** daN	-3906.4 m.daN	0.0 m.daN	ULS 41
bending moment about x-x	-2.7 daN	-1200.0 daN	-7052.2 m.daN	927.2 daN	**-3906.4** m.daN	0.0 m.daN	ULS 42
torsional moment about z-z	3415.8 daN	-1303.6 daN	16388.6 m.daN	0.0 daN	0.0 m.daN	**0.0** m.daN	ULS 25

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations
Assembly axial strength (EN 1993-1-8 equation 6.24)	0.029	ULS 25
Assembly compound bending strength around y-y (EN 1993-1-8 equation 6.23)	**0.817**	**ULS 33**
Assembly compound bending strength around z-z (EN 1993-1-8 equation 6.23)	0.201	ULS 41
Assembly compound bi-axial bending strength (EN 1993-1-8 equation 6.24)	0.394	ULS 41
Shear failure of the anchor bolts (EN 1993-1-8 §6.2.2(7))	0.03	ULS 33
Tension failure of the anchor bolts (BNCM / CNC2M – N0175 §6(9))	0.628	ULS 33
Combined tension and shear failure of the anchor bolts (BNCM / CNC2M – N0175 §6(9))	0.479	ULS 33
Stiffness of the anchor pads (CTICM 1982 Y.LESCOUARC'H §II.6.d)	0.382	ULS 33
Tensioned stiffeners - bending strength (EN 1993-1-1 §6.2.5)	0.74	ULS 33
Compressed stiffeners - bending strength (EN 1993-1-1 §6.2.5)	0.26	ULS 36
Tensioned stiffeners - shear strength (EN 1993-1-1 §6.2.6)	0.444	ULS 33
Compressed stiffeners - shear strength (EN 1993-1-1 §6.2.6)	0.443	ULS 36
Welds of the tensioned baseplate to column (EN 1993-1-8 §4.5.3.2)	0.333	ULS 33
Welds of the compressed baseplate to column (EN 1993-1-8 §4.5.3.2)	0.334	ULS 36
Welds of the tensioned stiffeners to column (EN 1993-1-8 §4.5.3.2)	0.322	ULS 33
Welds of the compressed stiffeners to column (EN 1993-1-8 §4.5.3.2)	0.321	ULS 36
Welds of the tensioned stiffeners to baseplate (EN 1993-1-8 §4.5.3.2)	0.444	ULS 33
Welds of the compressed stiffeners to baseplate (EN 1993-1-8 §4.5.3.2)	0.443	ULS 36

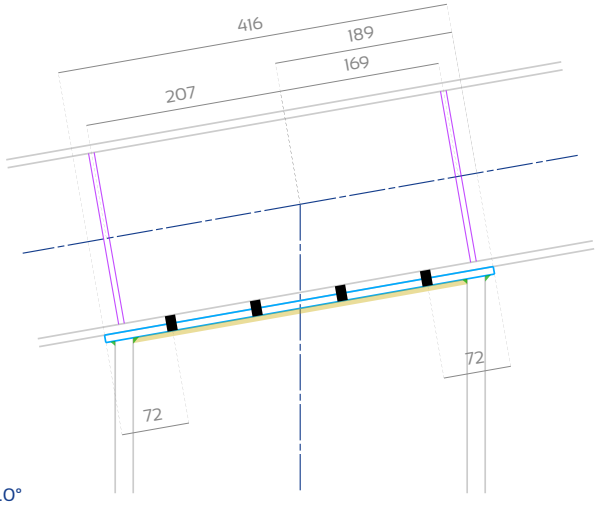
Checkings	Status	Information
Stiffness condition of the stiffener cantilever (CTICM 1988 Y.LESCOUARC'H §II.3-3.a)	OK	-
Plasticity condition of the stiffener cantilever (EN 1993-1-1 §5.6)	OK	Class 1
Plasticity condition of the stiffener part between the column flanges (EN 1993-1-1 §5.6)	OK	Class 1

The minimum cross-section of concrete reinforcement to avoid splitting failure should be greater than 5.5 cm^2.

Annex 6.2 - Column top end plate

Element 2 (left-hand column)

Sketch and dimension table



Angle between elements = 80.0°

End plate	Thickness t_p	Width	Length	Drillings d_0	Weld throat on the flanges a_f	Weld throat on the web a_w
	8.0 mm	300.0 mm	*(See sketch)*	11 mm	4 mm	4 mm
Bolts	Designation	Screw diameter d	Washer diameter	Transverse spacing p_2	Edge distance (rafter) e_2	Longitudinal spacing p_1
	M10 8.8 SB	10 mm	20 mm	58 mm > 26.4 mm	21.0 mm > 13.2 mm	91 mm > 24.2 mm
Stiffeners (on both faces of the web)	Thickness t_s	Width b_s	Position			
	6 mm	40 mm	*(See sketch)*			

Envelopes of maximum stresses in local coordinate system of the column top end plate

Dominant stress	$F_{N,Ed}$	$F_{Vx,Ed}$	$F_{Vy,Ed}$	Combination
tension	**1554.9** daN	9052.6 daN	0.0 daN	ULS 25
compression	**-3996.0** daN	-3656.7 daN	0.0 daN	ULS 6
shear on z-z	9.1 daN	**-12482.3** daN	0.0 daN	ULS 36
shear on y-y	977.6 daN	-1539.6 daN	**-636.2** daN	ULS 41

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations
Shear strength of bolts (EN 1993-1-8 table 3.4)	0.747	ULS 36
Tensile strength of bolts (EN 1993-1-8 table 3.4)	0.071	ULS 25
Combined shear and tensile strength of bolts (EN 1993-1-8 table 3.4)	**0.773**	**ULS 33**
Bearing strength of the bottom flange of the rafter (EN 1993-1-8 table 3.4)	0.747	ULS 36
Bearing strength of the column top end plate (EN 1993-1-8 table 3.4)	0.747	ULS 36
Punching shear strength of the bottom flange of the rafter (EN 1993-1-8 table 3.4)	0.024	ULS 25
Punching shear strength of the column top end plate (EN 1993-1-8 table 3.4)	0.03	ULS 25
Bending strength of the bottom flange of the rafter (EN 1993-1-8 §6.2)	0.063	ULS 25
Bending strength of the column top end plate (EN 1993-1-8 §6.2)	0.074	ULS 25
Compressive strength of web stiffeners (BNCM / CNC2M – N0175 table 18)	0.044	ULS 6
Weldings strength of plate to column web (EN 1993-1-8 §4.5.3.3)	0.255	ULS 36
Weldings strength of plate to column flanges (EN 1993-1-8 §4.5.3.3)	0.012	ULS 25

Annex 6.3 - Diagonal braces gussets

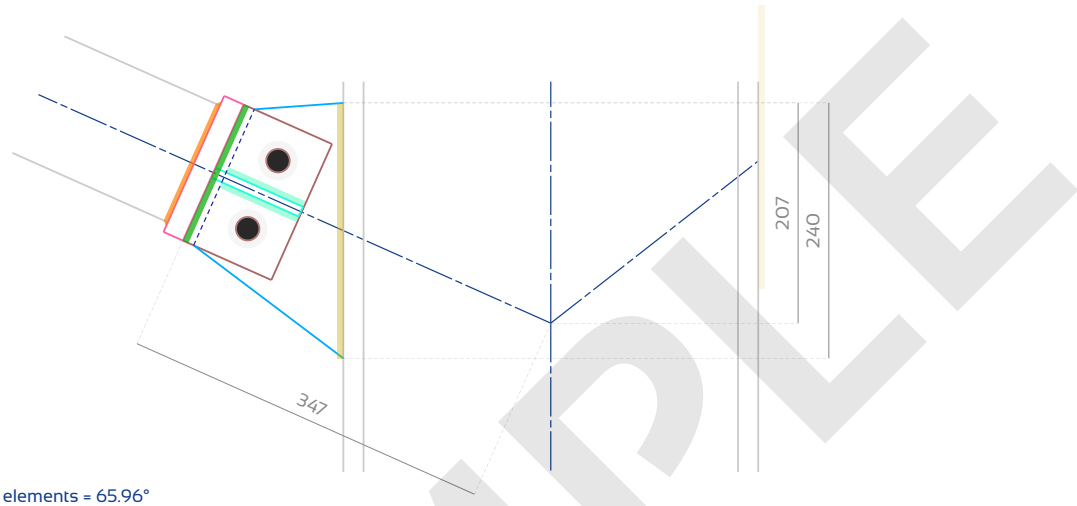
Element 7 (Left)

Envelopes of maximum stresses in the element

Gusset attached to	Column			Rafter		
Dominant stress	N_X	V_Z	Combination	N_X	V_Z	Combination
tension	8212.8 daN	-21.4 daN	ULS 25	8231.9 daN	21.4 daN	ULS 25
compression	-11546.3 daN	-28.9 daN	ULS 24	-11520.6 daN	28.9 daN	ULS 24

Column side

Sketch and dimension table



Angle between elements = 65.96°

Gusset attached to diagonal brace	Thickness $t_{b,g}$	Width	Length	Drillings d_0	Weld throat $a_{b,g}$	
	10 mm	140 mm	91 mm	22 mm	4 mm	
End plate attached to diagonal brace	Thickness $t_{b,p}$	Width	Length	Drillings d_0	Weld throat $a_{b,p}$	
	20 mm	140 mm	140 mm	20 mm (galvanizing)	3 mm	
Gusset attached to the other element	Thickness t_i	Dimensions and position	Drillings d_0	Clearance with end plate	Weld throat $a_{os,g}$	
	10 mm	*(See sketch)*	22 mm	11 mm	4 mm	
Bolts	Designation	Screw diameter d	Hardened washer diameter	Spacing p_2	Edge distance e_2	End distance e_1
	M20 8.8 SB	20 mm	37 mm	70 mm > 52.8 mm	35.0 mm > 26.4 mm	40 mm > 26.4 mm
Web stiffeners	none	Gusset lateral stiffener	Thickness $t_{ls,g}$	Width $b_{ls,g}$	Height $h_{ls,g}$	Weld throat $a_{ls,g}$
			10 mm	65 mm	90 mm	4 mm

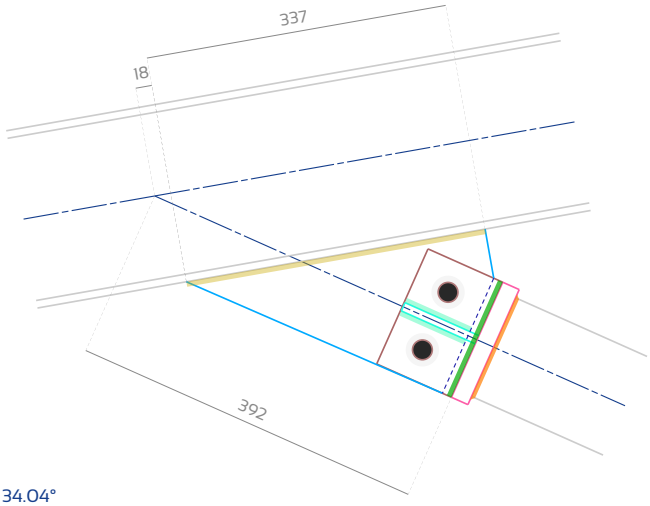
Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations
Shear strength of bolts (EN 1993-1-8 table 3.4)	0.614	ULS 24
Tensile strength of bolts (EN 1993-1-8 table 3.4)	0.102	ULS 24
Combined shear and tensile strength of bolts (EN 1993-1-8 table 3.4)	0.687	ULS 24
Bearing strength of the gussets (EN 1993-1-8 table 3.4)	0.668	ULS 24
Tension in the gussets (EN 1993-1-1 §6.2.3)	0.33	ULS 25
Block tearing of the gussets (EN 1993-1-8 §3.10.2)	0.379	ULS 25
Compressive strength of the web (BNCM / CNC2M – N0175 table 18)	0.11	ULS 24
Resistance of the lateral stiffener to bending (EN 1993-1-1 §6.2.5)	0.33	ULS 24
Local failure of the diagonal brace walls due to gusset pressure (CIDECT DG 1 - §7.4)	**0.807**	**ULS 24**
Local failure of the gusset due to diagonal brace pressure (CIDECT DG 1 - §7.4)	0.466	ULS 24
Local failure of the diagonal brace lateral wall due to stiffener pressure (CIDECT DG 1 - §7.4)	0.433	ULS 24
Weldings strength of the end plate on the diagonal brace (EN 1993-1-8 §4.5.3.3)	0.486	ULS 24
Weldings strength of the gusset to the end plate (EN 1993-1-8 §4.5.3.3)	0.629	ULS 24
Weldings strength of the gusset to the other element (EN 1993-1-8 §4.5.3.3)	0.299	ULS 24

Checkings	Status	Information
Plasticity condition of the lateral stiffener (EN 1993-1-1 §5.6)	OK	Class 1

Rafter side

Sketch and dimension table



Angle between elements = 34.04°

Gusset attached to diagonal brace	Thickness $t_{b,g}$	Width	Length	Drillings d_0	Weld throat $a_{b,g}$	
	10 mm	140 mm	91 mm	22 mm	4 mm	
End plate attached to diagonal brace	Thickness $t_{b,p}$	Width	Length	Drillings d_0	Weld throat $a_{b,p}$	
	20 mm	140 mm	140 mm	20 mm (galvanizing)	3 mm	
Gusset attached to the other element	Thickness t_i	Dimensions and position	Drillings d_0	Clearance with end plate	Weld throat $a_{os,g}$	
	10 mm	*(See sketch)*	22 mm	11 mm	4 mm	
Bolts	Designation	Screw diameter d	Hardened washer diameter	Spacing p_2	Edge distance e_2	End distance e_1
	M20 8.8 SB	20 mm	37 mm	70 mm > 52.8 mm	35.0 mm > 26.4 mm	40 mm > 26.4 mm
Web stiffeners	none	Gusset lateral stiffener	Thickness $t_{ls,g}$	Width $b_{ls,g}$	Height $h_{ls,g}$	Weld throat $a_{ls,g}$
			10 mm	65 mm	90 mm	4 mm

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations
Shear strength of bolts (EN 1993-1-8 table 3.4)	0.613	ULS 24
Tensile strength of bolts (EN 1993-1-8 table 3.4)	0.102	ULS 24
Combined shear and tensile strength of bolts (EN 1993-1-8 table 3.4)	0.686	ULS 24
Bearing strength of the gussets (EN 1993-1-8 table 3.4)	0.667	ULS 24
Tension in the gussets (EN 1993-1-1 §6.2.3)	0.331	ULS 25
Block tearing of the gussets (EN 1993-1-8 §3.10.2)	0.379	ULS 25
Compressive strength of the web (BNCM / CNC2M – N0175 table 18)	0.206	ULS 24
Resistance of the lateral stiffener to bending (EN 1993-1-1 §6.2.5)	0.33	ULS 24
Local failure of the diagonal brace walls due to gusset pressure (CIDECT DG 1 - §7.4)	**0.805**	**ULS 24**
Local failure of the gusset due to diagonal brace pressure (CIDECT DG 1 - §7.4)	0.465	ULS 24
Local failure of the diagonal brace lateral wall due to stiffener pressure (CIDECT DG 1 - §7.4)	0.432	ULS 24
Weldings strength of the end plate on the diagonal brace (EN 1993-1-8 §4.5.3.3)	0.484	ULS 24
Weldings strength of the gusset to the end plate (EN 1993-1-8 §4.5.3.3)	0.628	ULS 24
Weldings strength of the gusset to the other element (EN 1993-1-8 §4.5.3.3)	0.275	ULS 24

Checkings	Status	Information
Plasticity condition of the lateral stiffener (EN 1993-1-1 §5.6)	OK	Class 1

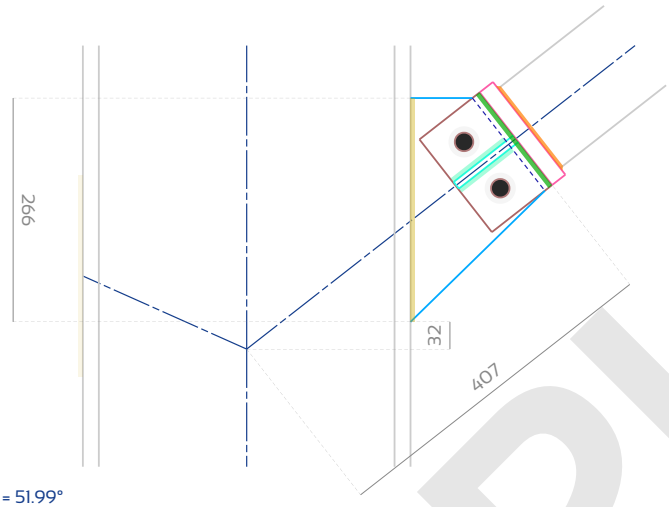
Element 8 (Right)

Envelopes of maximum stresses in the element

Gusset attached to	Column			Rafter		
Dominant stress	N_X	V_Z	Combination	N_X	V_Z	Combination
tension	9869.6 daN	22.0 daN	ULS 33	9904.0 daN	-22.0 daN	ULS 33
compression	-12906.7 daN	29.7 daN	ULS 32	-12860.3 daN	-29.7 daN	ULS 32

Column side

Sketch and dimension table



Angle between elements = 51.99°

Gusset attached to diagonal brace	Thickness $t_{b,g}$	Width	Length	Drillings d_0	Weld throat $a_{b,g}$	
	10 mm	140 mm	91 mm	22 mm	4 mm	
End plate attached to diagonal brace	Thickness $t_{b,p}$	Width	Length	Drillings d_0	Weld throat $a_{b,p}$	
	20 mm	140 mm	140 mm	20 mm (galvanizing)	3 mm	
Gusset attached to the other element	Thickness t_s	Dimensions and position	Drillings d_0	Clearance with end plate	Weld throat $a_{os,g}$	
	10 mm	*(See sketch)*	22 mm	11 mm	4 mm	
Bolts	Designation	Screw diameter d	Hardened washer diameter	Spacing p_2	Edge distance e_2	End distance e_1
	M20 8.8 SB	20 mm	37 mm	70 mm > 52.8 mm	35.0 mm > 26.4 mm	40 mm > 26.4 mm
Web stiffeners	none	Gusset lateral stiffener	Thickness $t_{ls,g}$	Width $b_{ls,g}$	Height $h_{ls,g}$	Weld throat $a_{ls,g}$
			10 mm	65 mm	90 mm	4 mm

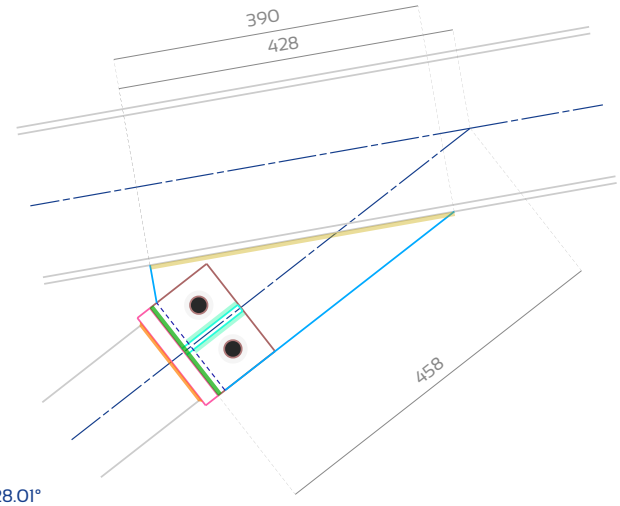
Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations
Shear strength of bolts (EN 1993-1-8 table 3.4)	0.687	ULS 32
Tensile strength of bolts (EN 1993-1-8 table 3.4)	0.114	ULS 32
Combined shear and tensile strength of bolts (EN 1993-1-8 table 3.4)	0.768	ULS 32
Bearing strength of the gussets (EN 1993-1-8 table 3.4)	0.747	ULS 32
Tension in the gussets (EN 1993-1-1 §6.2.3)	0.397	ULS 33
Block tearing of the gussets (EN 1993-1-8 §3.10.2)	0.455	ULS 33
Compressive strength of the web (BNCM / CNC2M – N0175 table 18)	0.106	ULS 32
Resistance of the lateral stiffener to bending (EN 1993-1-1 §6.2.5)	0.369	ULS 32
Local failure of the diagonal brace walls due to gusset pressure (CIDECT DG 1 - §7.4)	**0.902**	**ULS 32**
Local failure of the gusset due to diagonal brace pressure (CIDECT DG 1 - §7.4)	0.521	ULS 32
Local failure of the diagonal brace lateral wall due to stiffener pressure (CIDECT DG 1 - §7.4)	0.484	ULS 32
Weldings strength of the end plate on the diagonal brace (EN 1993-1-8 §4.5.3.3)	0.543	ULS 32
Weldings strength of the gusset to the end plate (EN 1993-1-8 §4.5.3.3)	0.703	ULS 32
Weldings strength of the gusset to the other element (EN 1993-1-8 §4.5.3.3)	0.335	ULS 32

Checkings	Status	Information
Plasticity condition of the lateral stiffener (EN 1993-1-1 §5.6)	OK	Class 1

Rafter side

Sketch and dimension table



Angle between elements = 28.01°

Gusset attached to diagonal brace	Thickness $t_{b,g}$	Width	Length	Drillings d_0	Weld throat $a_{b,g}$	
	10 mm	140 mm	91 mm	22 mm	4 mm	
End plate attached to diagonal brace	Thickness $t_{b,p}$	Width	Length	Drillings d_0	Weld throat $a_{b,p}$	
	20 mm	140 mm	140 mm	20 mm (galvanizing)	3 mm	
Gusset attached to the other element	Thickness t_f	Dimensions and position	Drillings d_0	Clearance with end plate	Weld throat $a_{o,s,g}$	
	10 mm	*(See sketch)*	22 mm	11 mm	4 mm	
Bolts	Designation	Screw diameter d	Hardened washer diameter	Spacing p_2	Edge distance e_2	End distance e_1
	M20 8.8 SB	20 mm	37 mm	70 mm > 52.8 mm	35.0 mm > 26.4 mm	40 mm > 26.4 mm
Web stiffeners	none	Gusset lateral stiffener	Thickness $t_{ls,g}$	Width $b_{ls,g}$	Height $h_{ls,g}$	Weld throat $a_{ls,g}$
			10 mm	65 mm	90 mm	4 mm

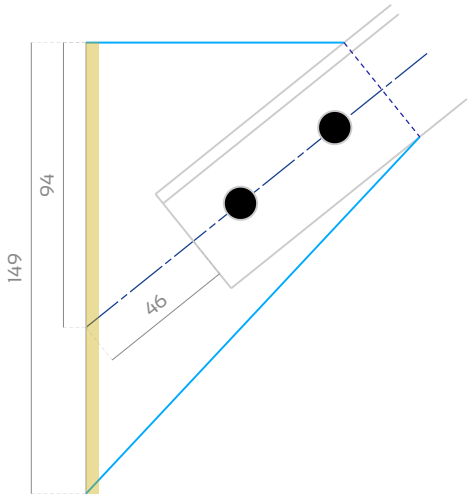
Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations
Shear strength of bolts (EN 1993-1-8 table 3.4)	0.684	ULS 32
Tensile strength of bolts (EN 1993-1-8 table 3.4)	0.114	ULS 32
Combined shear and tensile strength of bolts (EN 1993-1-8 table 3.4)	0.765	ULS 32
Bearing strength of the gussets (EN 1993-1-8 table 3.4)	0.744	ULS 32
Tension in the gussets (EN 1993-1-1 §6.2.3)	0.398	ULS 33
Block tearing of the gussets (EN 1993-1-8 §3.10.2)	0.457	ULS 33
Compressive strength of the web (BNCM / CNC2M – N0175 table 18)	0.181	ULS 32
Resistance of the lateral stiffener to bending (EN 1993-1-1 §6.2.5)	0.368	ULS 32
Local failure of the diagonal brace walls due to gusset pressure (CIDECT DG 1 - §7.4)	**0.899**	**ULS 32**
Local failure of the gusset due to diagonal brace pressure (CIDECT DG 1 - §7.4)	0.519	ULS 32
Local failure of the diagonal brace lateral wall due to stiffener pressure (CIDECT DG 1 - §7.4)	0.482	ULS 32
Weldings strength of the end plate on the diagonal brace (EN 1993-1-8 §4.5.3.3)	0.541	ULS 32
Weldings strength of the gusset to the end plate (EN 1993-1-8 §4.5.3.3)	0.701	ULS 32
Weldings strength of the gusset to the other element (EN 1993-1-8 §4.5.3.3)	0.265	ULS 32

Checkings	Status	Information
Plasticity condition of the lateral stiffener (EN 1993-1-1 §5.6)	OK	Class 1

Annex 6.4 - Roof cross-bracing gussets

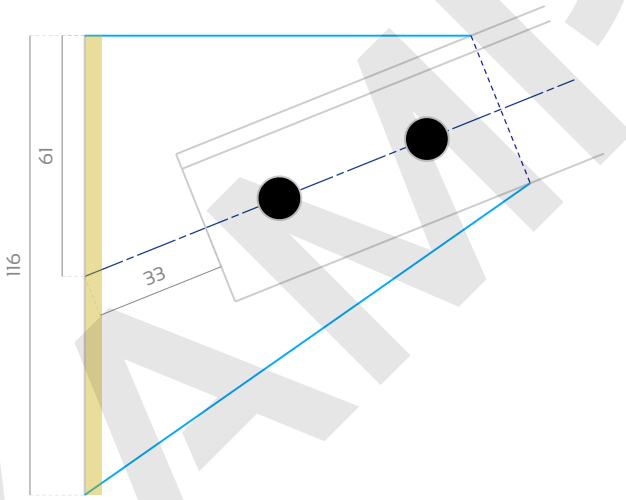
Sketch and dimension table



Angle = 38.77°

Element	Cross section	Gusset	Thickness t	Dimensions and position	Drillings d_0	Weld throat a_w
	L40x40x4		5 mm	*(See sketch)*	11 mm	3 mm
Bolts	Designation	Screw diameter d	Washer diameter	Edge distance e_2	Spacing p_1	End distance e_1
	M10 8.8 SB	10 mm	20 mm	20 mm > 13.2 mm	40 mm > 24.2 mm	20 mm > 13.2 mm

Sketch and dimension table



Angle = 21.88°

Element	Cross section	Gusset	Thickness t	Dimensions and position	Drillings d_0	Weld throat a_w
	L40x40x4		5 mm	*(See sketch)*	11 mm	3 mm
Bolts	Designation	Screw diameter d	Washer diameter	Edge distance e_2	Spacing p_1	End distance e_1
	M10 8.8 SB	10 mm	20 mm	20 mm > 13.2 mm	40 mm > 24.2 mm	20 mm > 13.2 mm

Maximum working rates by type of stress and associated combinations

Checkings	Working rates	Associated combinations
Shear strength of bolts (EN 1993-1-8 table 3.4)	0.481	1.5 x Wb-
Bearing resistance of the steel angle on x-x axis (EN 1993-1-8 table 3.4)	0.562	1.5 x Wb-
Bearing resistance of the steel angle on y-y axis (EN 1993-1-8 table 3.4)	0.247	1.5 x Wb-
Bearing resistance interaction on x-x and y-y axis of the steel angle (BNCM /CNC2M – N0175 §2.1(5))	0.377	1.5 x Wb-
Bearing resistance of the gusset on x-x axis (EN 1993-1-8 table 3.4)	0.45	1.5 x Wb-
Bearing resistance of the gusset on y-y axis (EN 1993-1-8 table 3.4)	0.198	1.5 x Wb-
Bearing resistance interaction on x-x and y-y axis of the gusset (BNCM /CNC2M – N0175 §2.1(5))	0.241	1.5 x Wb-
Block tearing of the steel angle (EN 1993-1-8 §3.10.2)	**0.614**	**1.5 x Wb-**
Block tearing of the gusset (EN 1993-1-8 §3.10.2)	0.491	1.5 x Wb-
Weldings strength of the gusset (EN 1993-1-8 §4.5.3.3)	0.151	1.5 x Wb-