



Rev.	Popis revize	Datum revize	Vydal
VYPRACOVAL:	KONTROLOVAL:	ZODP. PROJEKTANT:	
Ing. Lenka Ptáčnicková	Ing. Stanislav Tóth	Ing. Stanislav Tóth	
+420 725 319 232	+420 601 387 853	+420 601 387 853	
MÍSTO STAVBY: ZBRASLAVICE			
O. Ú.: ZBRASLAVICE		KRAJ: STŘEDOČESKÝ	
AKCE:		SMLUVNÍ GARANT	Jaroslav Nikodým
NOVOSTAVBA HALY NA S ŮL ZBRASLAVICE OCELOVÁ KONSTRUKCE HALY INVESTOR: KSÚS STŘEDOČESKÉHO KRAJE, ZBOROVSKÁ 81/11. 150 21 PRAHA 5 - SMÍCHOV		DATUM:	FORMÁT:
		28/03/24	1xA4
		ČÍSLO ZAKÁZKY:	OBJEKT:
		CZ001893	DSP
OBSAH: D.1.2.2 OCELOVÁ KONSTRUKCE HALY		ČÍSLO VÝKRESU:	REVIZE:
STATICKÝ VÝPOČET		CZ001893 - A003	

OBSAH

1	ÚVODNÍ ZPRÁVA	3
1.1	POPIS ZÁKLADNÍHO ZATÍŽENÍ	3
1.2	POŽÁRNÍ ODOLNOST	3
1.3	POUŽITÉ PROFILY A MATERIÁLY	3
2	SCHÉMA	4
2.1	PŮDORYS	4
2.2	ŘEZ	4
2.3	POHLEDY	5
3	ZATÍŽENÍ	6
3.1	KLIMATICKÉ ZATÍŽENÍ V MÍSTĚ STAVBY	6
3.2	VÝPIS ZATÍŽENÍ	7
3.3	SOUČINITELÉ VNĚJŠÍHO AERODYNAMICKÉHO TLAKU	8
4	VAZNICE PU1	9
4.1	POPIS	9
4.2	ZATÍŽENÍ	10
4.3	VNITŘNÍ SÍLY	12
4.4	POSUDEK ÚNOSNOSTI VAZNICE	13
4.5	POSUDEK DEFORMACE VAZNICE	20
4.6	POUŽITÉ PROFILY	20
5	RÁM FR1	21
5.1	POPIS, ZATĚŽOVACÍ ŠÍŘKA	21
5.2	STATICKE SCHÉMA KONSTRUKCE	21
5.3	ZATÍŽENÍ	22
5.4	KOMBINACE ZATĚŽOVACÍCH STAVŮ	25
5.5	POSUDEK SLOUPŮ RÁMU (MSÚ)	26
5.6	POSUDEK VAZNIKU (MSÚ)	35
5.7	POSOUZENÍ DEFORMACÍ RÁMU (MSP)	49
5.8	POUŽITÉ PROFILY	51
6	REAKCE DO ZÁKLADŮ	52
7	KOTVENÍ SLOUPŮ	55
8	PRŮŘEZOVÉ CHARAKTERISTIKY POUŽITÝCH PROFILŮ A PLECHŮ	63
9	POUŽITÉ NORMY, SOFTWARE	79
10	ZÁVĚR	79

1 Úvodní zpráva

1.1 POPIS ZÁKLADNÍHO ZATÍŽENÍ

Sněhová oblast :

Charakteristické zatížení sněhem na zemi:

(hodnota upřesněna dle: <https://clima-maps.info/snehovamapa/>)

III.

1.4 kPa

Větrná oblast:

Základní rychlost větru $v_{b,0}$

Kategorie terénu:

Maximální dynamický tlak větru $q_{p(z)}$

III.

27.5 m/s

II.

1.051 kPa

Vlastní tíha střešního pláště:

13 kg/m²

Vlastní tíha podhledu:

13 kg/m²

Vlastní tíha stěnového opláštění:

16 kg/m²

Technologické přitížení na konstrukci podhledu

10 kg/m²

FVE (v rovině střechy)

15 kg/m²

1.2 POŽÁRNÍ ODOLNOST

Popis	Odolnost	Způsob ochrany
Požární odolnost nosné konstrukce střechy	RO	bez požadavků PO
Požární odolnost svislých nosných konstrukcí	RO	bez požadavků PO
Požární odolnost opláštění		bez požadavků PO

Podrobné informace viz Požárně bezpečnostní řešení stavby.

1.3 POUŽITÉ PROFILY A MATERIÁLY

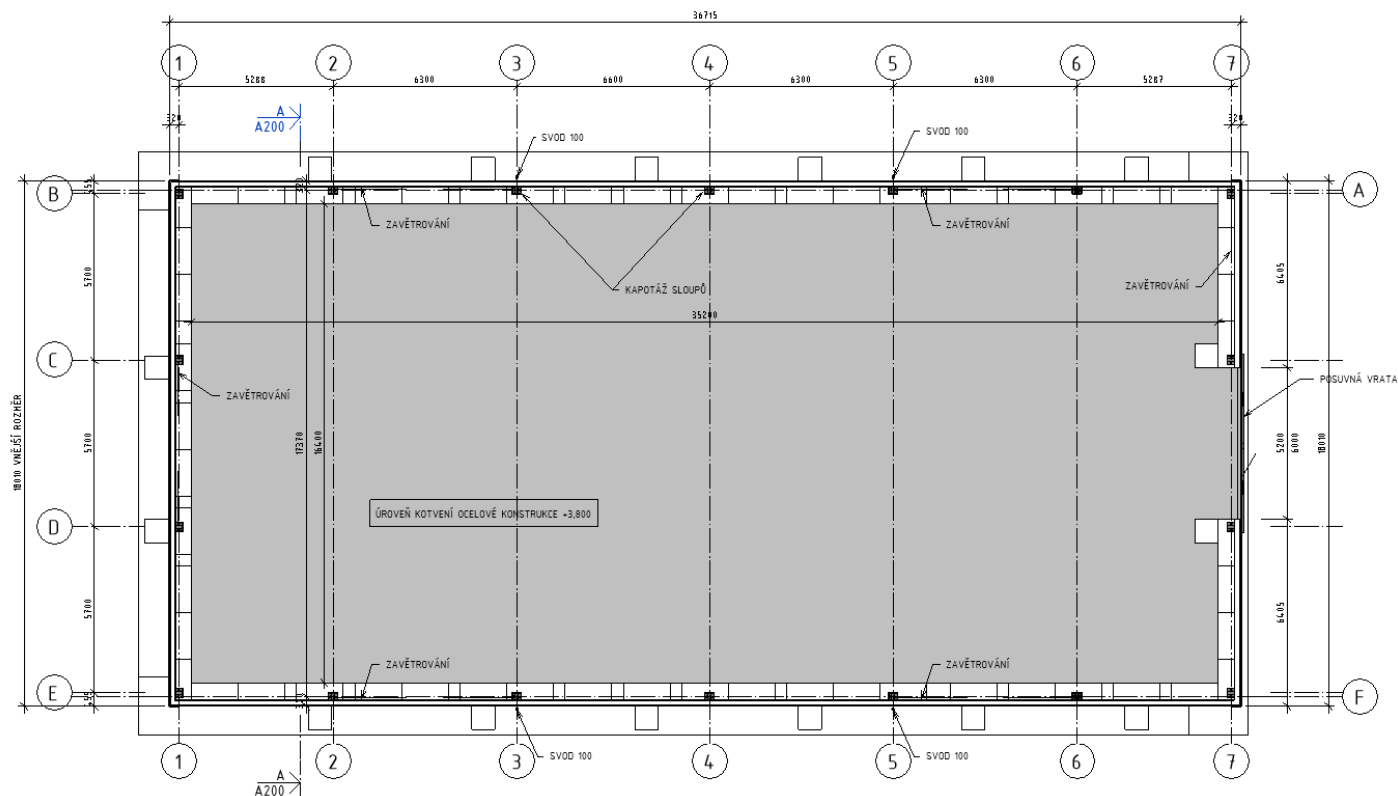
Ocelová konstrukce je z typizovaných za studena tvarovaných profilů. Konstrukce je navržena se šroubovými spoji. Pokud není specifikováno jinak, jsou použity pozinkované šrouby M12 třídy pevnosti 8.8 (dále mohou být použity šrouby M16). Pro spoje plechů jsou použity pozinkované/nerezové šrouby 4.8, 5.5 a 6.3 mm - přesné (pevnosti dle dodavatele spojovacího materiálu).

Používané materiály profilů:

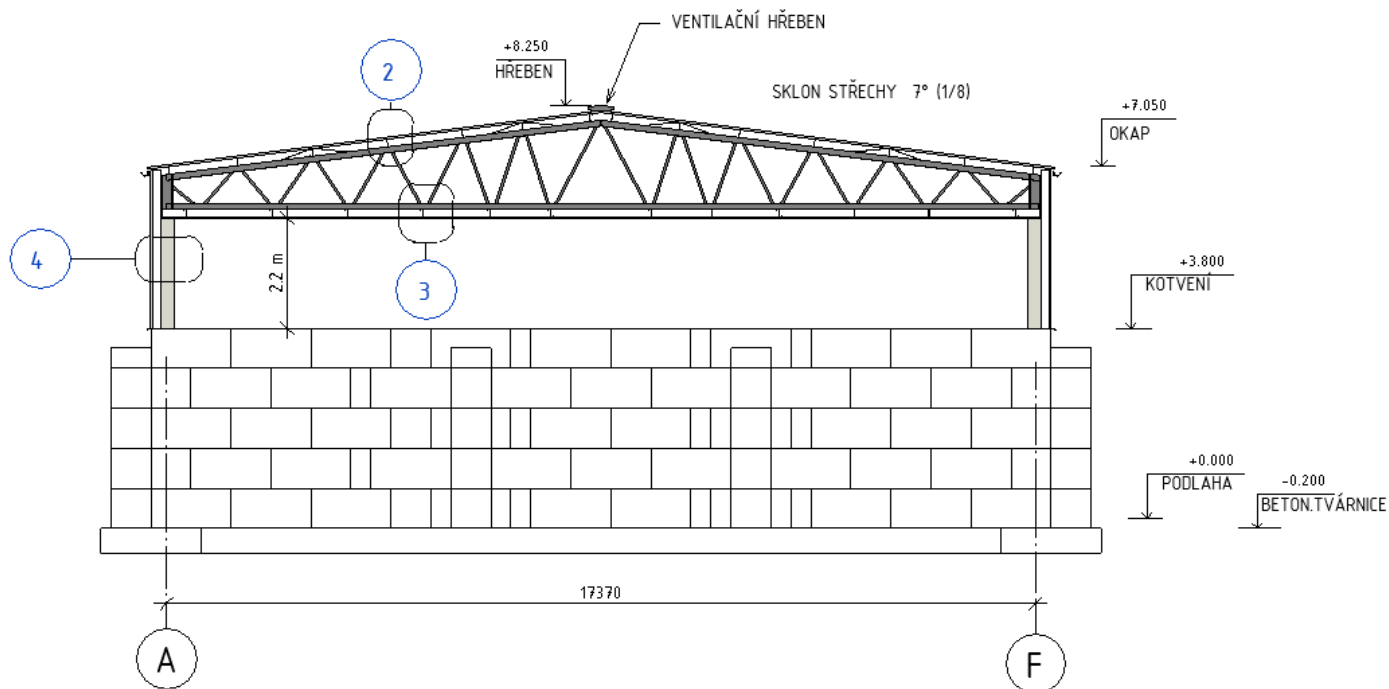
Ocel tl.- 1,5-2 mm	S350GD	Pozink – Z275MA	$f_{yb}=350$ MPa, $f_u=420$ MPa
Ocel tl.- 3 mm	S350GD	Pozink – Z450MA	$f_{yb}=350$ MPa, $f_u=420$ MPa
Ocel tl.- 4 mm	S420GD	Pozink – Z450MA	$f_{yb}=420$ MPa, $f_u=480$ MPa
Ocel tl.- 5-6 mm	HX500LAD	Pozink – Z450MA	$f_{yb}=500$ MPa, $f_u=550$ MPa
Ocel tl.- 7 mm	S420GD	Pozink – Z450MA	$f_{yb}=420$ MPa, $f_u=480$ MPa
Ocel tl. >7 mm	S355	Nátěr.	$f_{yb}=355$ MPa, $f_u=510$ MPa

2 SCHÉMA

2.1 PŮDORYS

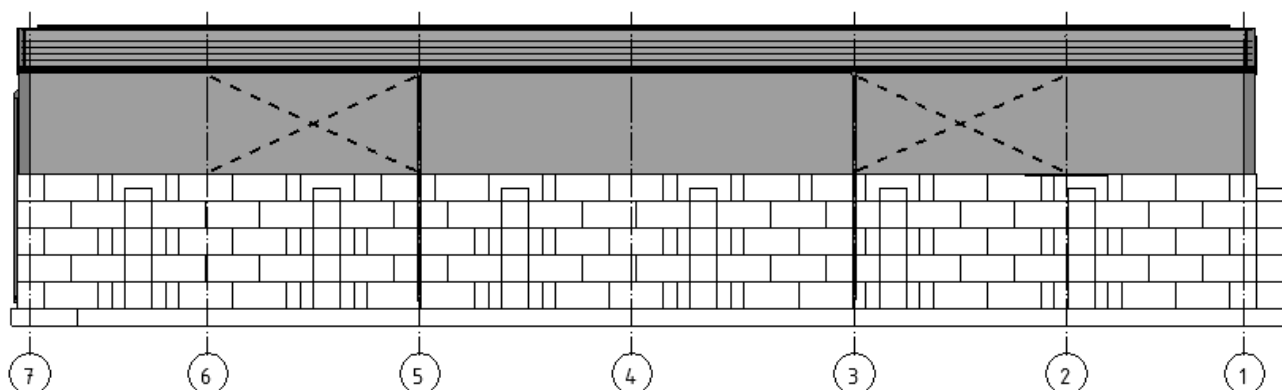


2.2 ŘEZ

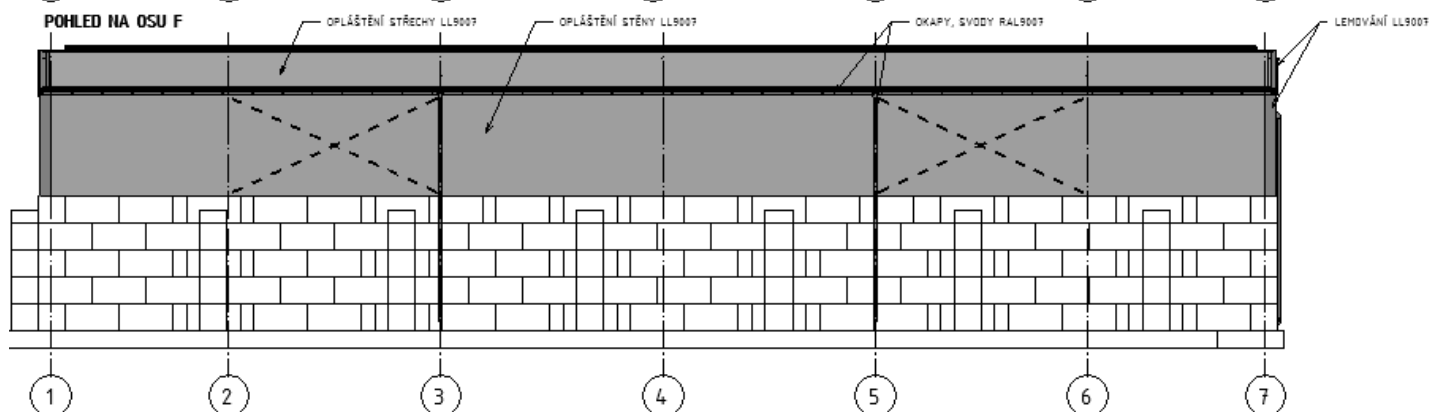


2.3 POHLEDY

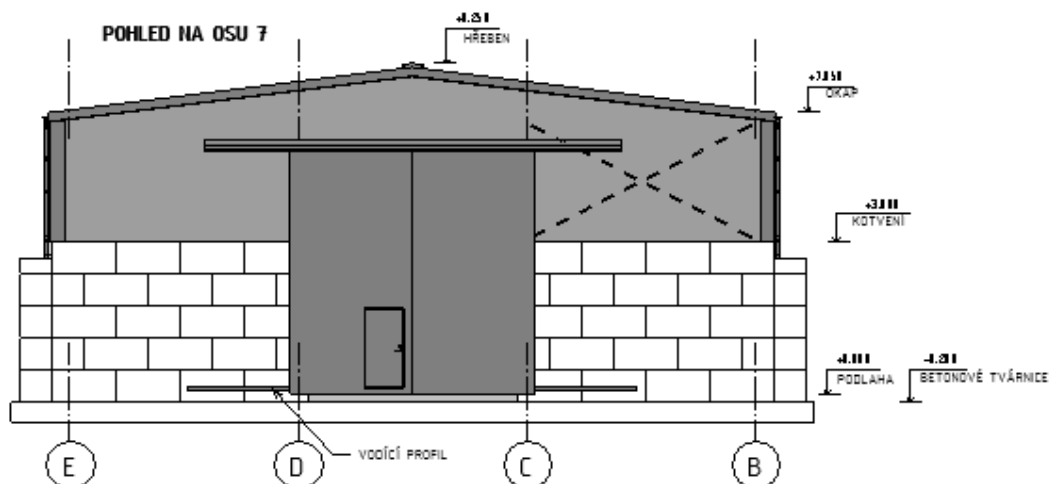
POHLED NA OSU A



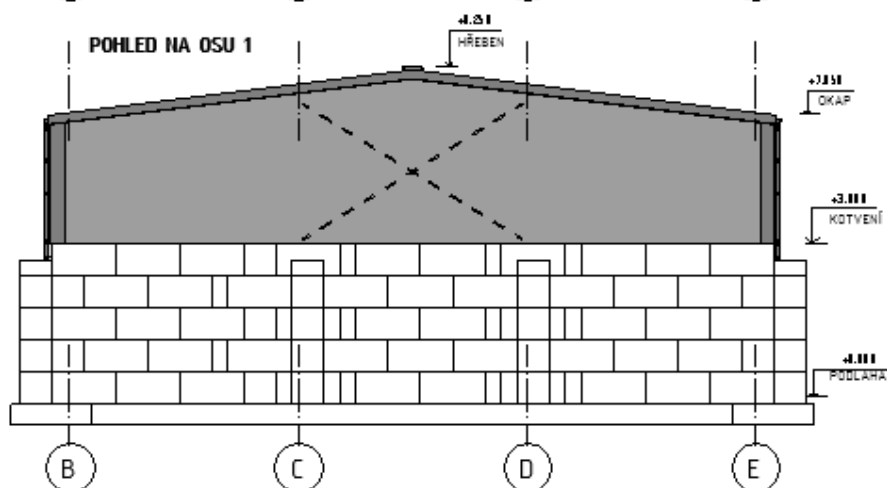
POHLED NA OSU F



POHLED NA OSU 7



POHLED NA OSU 1



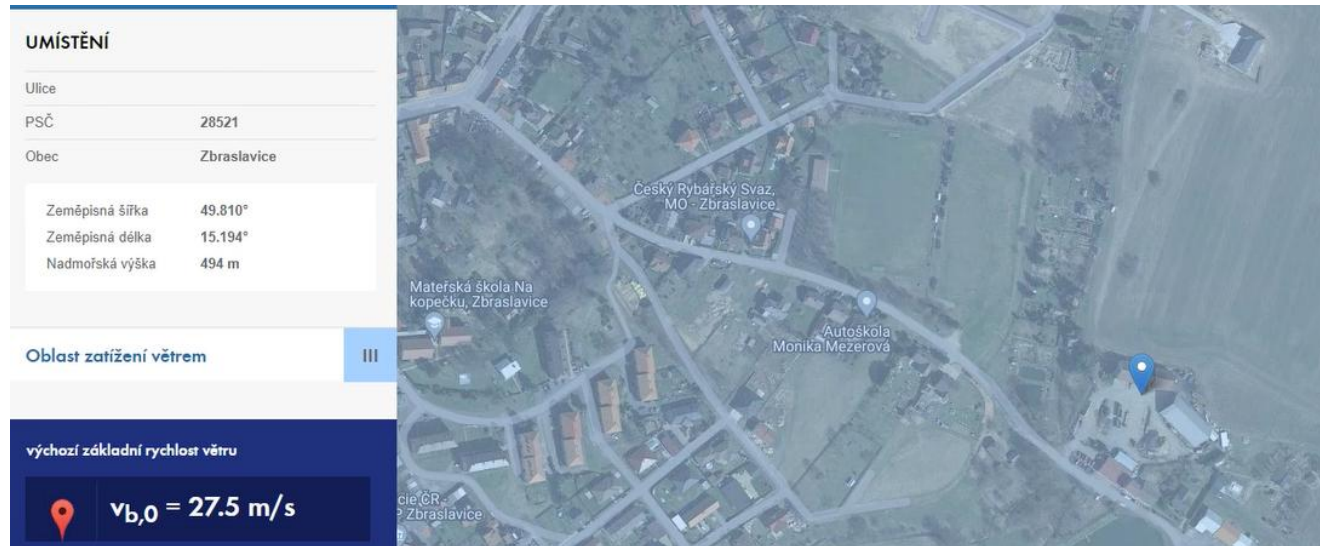
3 ZATÍŽENÍ

3.1 KLIMATICKÉ ZATÍŽENÍ V MÍSTĚ STAVBY

ZATÍŽENÍ SNĚHEM



ZATÍŽENÍ VĚTREM



3.2 VÝPIS ZATÍŽENÍ

B1. Zatížení (ČSN EN 1991)

Norma statického výpočtu:

Norma ČSN (CZ)/ STN (SK):

ČSN EN

CZ

Základní informace projektu:

Typ haly: S ☐ PULT

☐ HALA S ATIKOU

☐ VÍCE HŘEBENŮ

Typ izolace : Unisolated-Z150

Šířka haly: 18.010 m

Délka haly: 36.715 m

Horní pás: 7.13 °

Dolní pás: 0 °

Výška u žlabu: 7.02 m

Výška hřebene: 8.15 m

Stálé zatížení:

ČSN EN 1991 ()

Gravitační tíhu zadávat se znaménkem "-"

FTV 0.15kN/m2 + extra 0.1kN/m2

Tíha střechy R = -0.13 kN/m²

Extra přitížení E = -0.25 kN/m²

Tíha podhledu C = 0.00 kN/m²

☒ Extra zatížení zahrnout do podhledu

Přítížení od kapotáže vazníku F = 0.00 kN/m

☐ Počítat s přítížením od kapotáže vazníku

Zatížení sněhem

ČSN EN 1991-1-3 ()

$l_c = 27.19$ m

Charakteristická hodnota $s_k = -1.40$ kN/m²

Tvarový součinitel $\mu_i = 0.8$

Součinitel expozice $c_e = 1.00$

Tepelný součinitel $c_t = 1.0$

$s = s_k \cdot \mu_i \cdot c_e \cdot c_t = -1.12$ kN/m²

Tvarový součinitel:

Platí pro sklony $0^\circ \leq \alpha \leq 30^\circ$

$\mu_1 = 0.80$

$\mu_2 = 0.99$

Horní hodnota $m_2 = 1,6$

Zatížení větrem

ČSN EN 1991-1-4 ()

Charakteristická hodnota rychlosti větru $v_{bo} = 27.5$ m/s

Kategorie terénu: II. Oblasti s nízkou vegetací jako je tráva nebo izolované překážky (stromy, budovy)

Základní rychlost větru $v_b = 27.5$ m/s

Součinitel terénu $k_r = 0.190$

Součinitel drsnosti terénu $c_{r,z} = 0.968$

Parametr drsnosti terénu $z_0 = 0.05$ m

Minimální výška $z_{min} = 2$ m

Výška nad zemí $z = 8.15$ m

Střední rychlost větru $v_m(z) = 26.6$ m/s

Základní dynamický tlak větru $q_b(z) = 442.6$ N/m²

Součinitel expozice $c_e(z) = 2.374$

Součinitel směru = 1.0

Součinitel období = 1.0

Součinitel orografie $c_o(z) = 1.0$

Součinitel turbulence $k_1 = 1.0$

Maximální dynamický tlak $q_p(z) = 1.051$ kN/m²

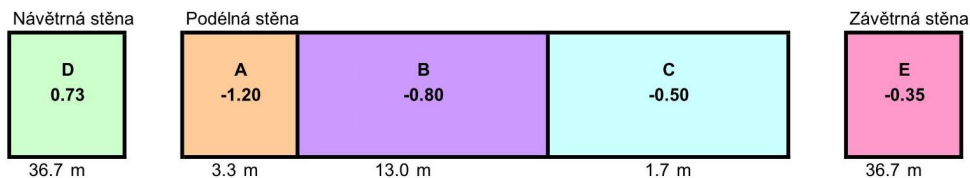
3.3 SOUČINITELE VNĚJŠÍHO AERODYNAMICKÉHO TLAKU

B3. Sedlová střecha - Schéma zatížení c_{pe}

Stěny

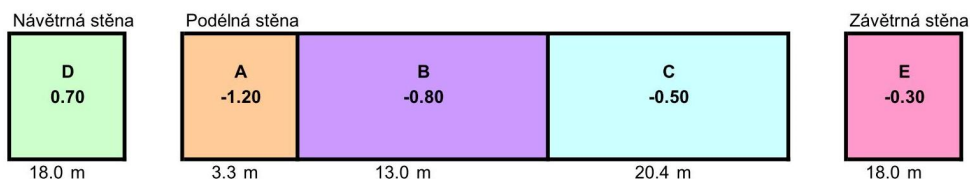
Příčný vítr

ČSN EN 1991-1-4 (7.2.2)
Obrázek 7.5



Podélný vítr

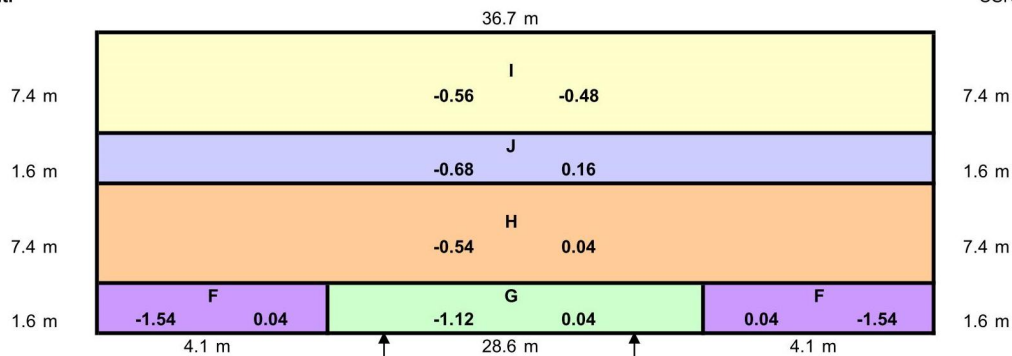
ČSN EN 1991-1-4 (7.2.2)
Obrázek 7.5



Střecha

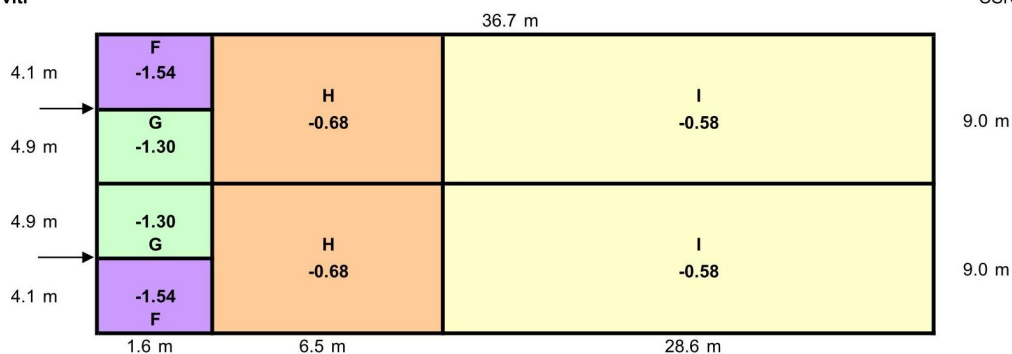
Příčný vítr

ČSN EN 1991-1-4 (7.2.5)
Obrázek 7.8



Podélný vítr

ČSN EN 1991-1-4 (7.2.5)
Obrázek 7.8



4 VAZNICE PU1 - STANDARDNÍ

4.1 POPIS

Vaznice jsou navrženy jako spojité nosníky přes celou délku haly.

Maximální tlakové zatížení vaznice – kombinace zatížení vlastní tíhou, zatížení vlastní tíhou střechy, vlastní tíhou FVE, zatížením sněhem a tlakem větru (uvažováno s vnitřním podtlakem větru -0.3).

Maximální sání větru – kombinace vlastní tíhy, vlastní tíhy střechy a sání vyvozeného větrem (uvažováno s vnitřním přetlakem větru +0.2).

Uvažovaná tlaková osová síla $N_{ed} = 5 \text{ kN}$

Zatěžovací šířka (L_w) = 1.5 m

Bez požadavků na požární odolnost.

4.2 ZATÍŽENÍ

Zatěžovací šířka standardní $L_{w1} = 1.50$ m
 Zatěžovací šířka krajní $L_{w2} = 1.30$ m

Šířka haly: 18.01 m
 Délka haly: 36.72 m

Typ střechy: **Sedlová**

Stálé zatížení

ČSN EN 1991

Normová tíha střechy $g_{r,n} = -0.13$ kN/m²
 Normové extra přitížení $E_{x,n} = -0.15$ kN/m²
 Celkem stálé zatížení normové $g_n = -0.28$ kN/m²
 Součinitel zatížení $\gamma_{fg,n} = 1.35$
 Součinitel zatížení $\gamma_f = 1.35$
 Výpočtová tíha střechy $g_{r,d} = -0.18$ kN/m²
 Výpočtové extra přitížení $E_{x,d} = -0.20$ kN/m²
 Celkem stálé zatížení výpočtové $g_d = -0.38$ kN/m²

Zatížení sněhem

ČSN EN 1991-1-3

Charakteristická hodnota $s_k = -1.4$ kN/m²
 Tvarový součinitel $\mu_i = 0.8$
 Součinitel expozice $c_e = 1.0$
 Tepelný součinitel $c_t = 1.0$
 Normové zatížení sněhem $s_n = -1.12$ kN/m²
 Součinitel zatížení $\gamma_s = 1.5$
 Výpočtové zatížení sněhem $s_d = -1.68$ kN/m²

Zatížení větrem

ČSN EN 1991-1-4

Základní větrné zatížení $w_0 = 27.5$ m/s
 Maximální dynamický tlak $q_p(z) = 1.051$ kN/m²
 Tlak zadáván zápornou hodnotou

Příčný vítr

Oblast =	F	G	H	I	J	
Součinitel vnějšího tlaku C_{pe} (sání) =	1.54	1.12	0.54	0.56	0.68	-
Součinitel vnějšího tlaku C_{pe} (tlak) =	-0.04	-0.04	-0.04	0.48	-0.16	-
Součinitel vnějšího tlaku C_{pe} (sání) =	0.00	0.00	0.00	0.00	0.00	-

Normová hodnota zatížení w_n (sání) =	1.62	1.18	0.57	0.59	0.71	kN/m ²
Normová hodnota zatížení w_n (tlak) =	-0.04	-0.04	-0.04	0.50	-0.17	kN/m ²
Normová hodnota zatížení w_n (sání) =	0.00	0.00	0.00	0.00	0.00	kN/m ²

Součinitel zatížení $\gamma_w =$	1.5	1.5	1.5	1.5	1.5	-
Výpočtová hodnota zatížení w_d (sání) =	2.43	1.77	0.85	0.88	1.07	kN/m ²
Výpočtová hodnota zatížení w_d (tlak) =	-0.06	-0.06	-0.06	0.76	-0.25	kN/m ²
Výpočtová hodnota zatížení w_d (sání) =	0.00	0.00	0.00	0.00	0.00	kN/m ²

Podélný vítr

Oblast =	F	-	G	H	I	
Součinitel vnějšího tlaku C_{pe} (sání) =	1.54	0.00	1.30	0.68	0.58	-
Součinitel vnějšího tlaku C_{pe} (tlak) =	0.00	0.00	0.00	0.00	0.00	-

Normová hodnota zatížení w_n (sání) =	1.62	0.00	1.37	0.71	0.61	kN/m ²
Normová hodnota zatížení w_n (tlak) =	0.00	0.00	0.00	0.00	0.00	kN/m ²

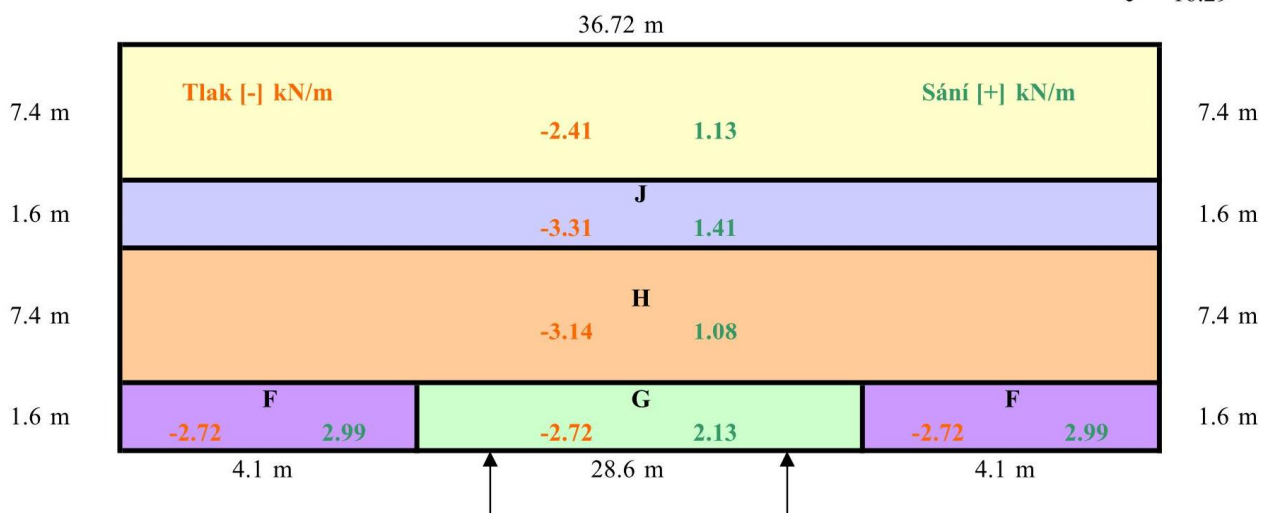
Součinitel zatížení $\gamma_w =$	1.5	1.5	1.5	1.5	1.5	-
Výpočtová hodnota zatížení w_d (sání) =	2.43	0.00	2.05	1.07	0.91	kN/m ²
Výpočtová hodnota zatížení w_d (tlak) =	0.00	0.00	0.00	0.00	0.00	kN/m ²

Zatížení vaznice - kombinace

A) Příčný vítr

Oblast =	F	G	H	I	J	
Zatěžovací šířka L_{w1}, L_{w2} =	1.3	1.3	1.5	1.5	1.5	m
Délka oblasti l =	1.6	1.6	7.4	7.4	1.6	m
1. Stálé + sníh q_d =	-2.68	-2.68	-3.09	-3.09	-3.09	kN/m
2. Stálé + vítr (sání) q_d =	2.99	2.13	1.08	1.13	1.41	kN/m
3. Stálé + vítr (tlak) + sníh dom. q_d =	-2.72	-2.72	-3.14	-2.41	-3.31	kN/m
4. Stálé + vítr (tlak) + sníh dom. (norm.) q_k =	-1.85	-1.85	-2.14	-1.65	-2.25	kN/m

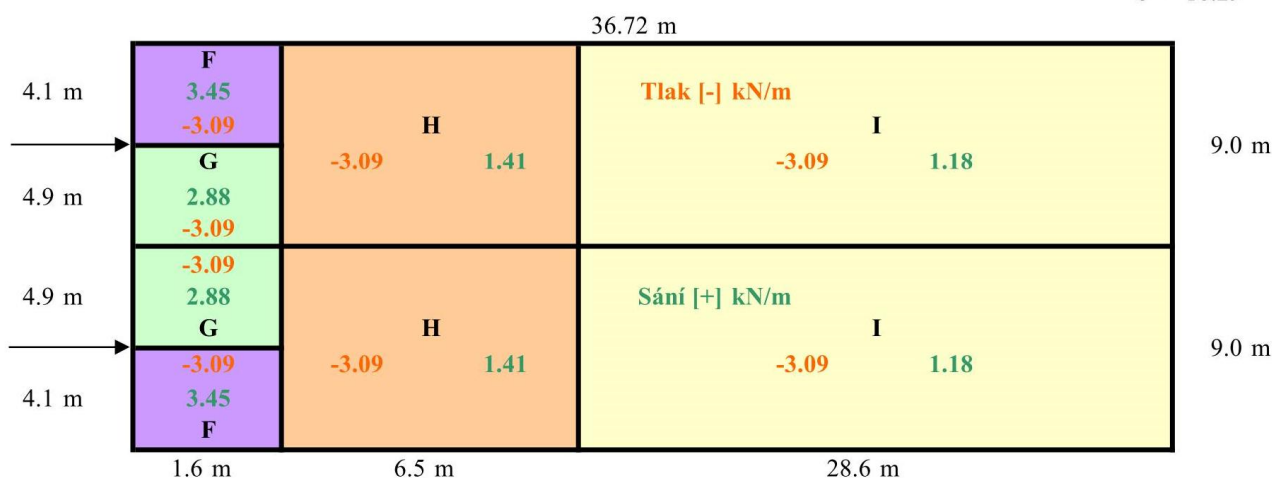
$e = 16.29$



B) Podélný vítr

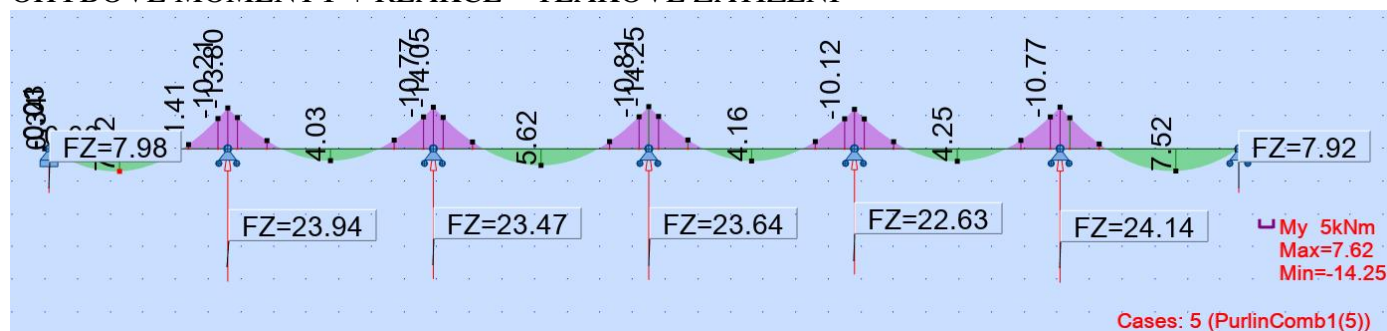
Oblast =	F	-	G	H	I	
Zatěžovací šířka L_{w1}, L_{w2} =	1.5	-	1.5	1.5	1.5	m
Délka oblasti l =	1.6	-	1.6	6.5	28.6	m
1. Stálé + sníh q_d =	-3.09	-	-3.09	-3.09	-3.09	kN/m
2. Stálé + vítr (sání) q_d =	3.45	-	2.88	1.41	1.18	kN/m
3. Stálé + vítr (tlak) + sníh dom. q_d =	-3.09	-	-3.09	-3.09	-3.09	kN/m
4. Stálé + vítr (tlak) + sníh dom. (norm.) q_k =	-2.10	-	-2.10	-2.10	-2.10	kN/m

$e = 16.29$

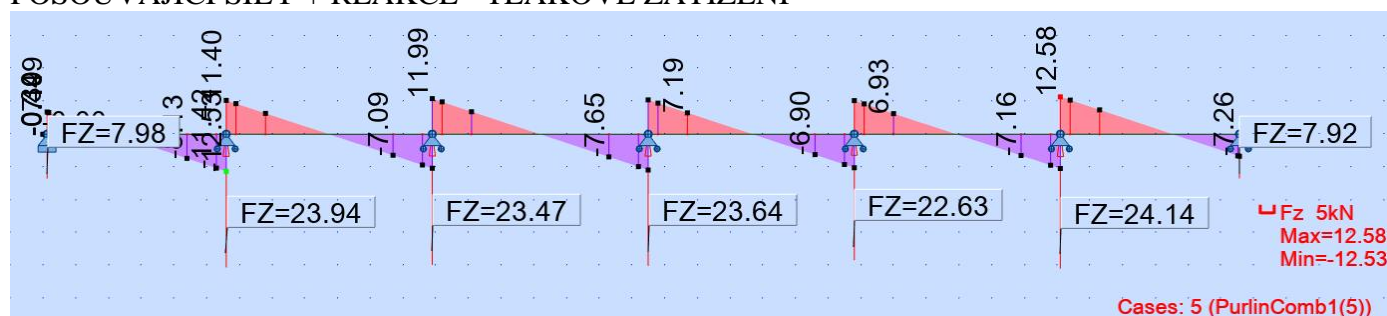


4.3 VNITŘNÍ SÍLY

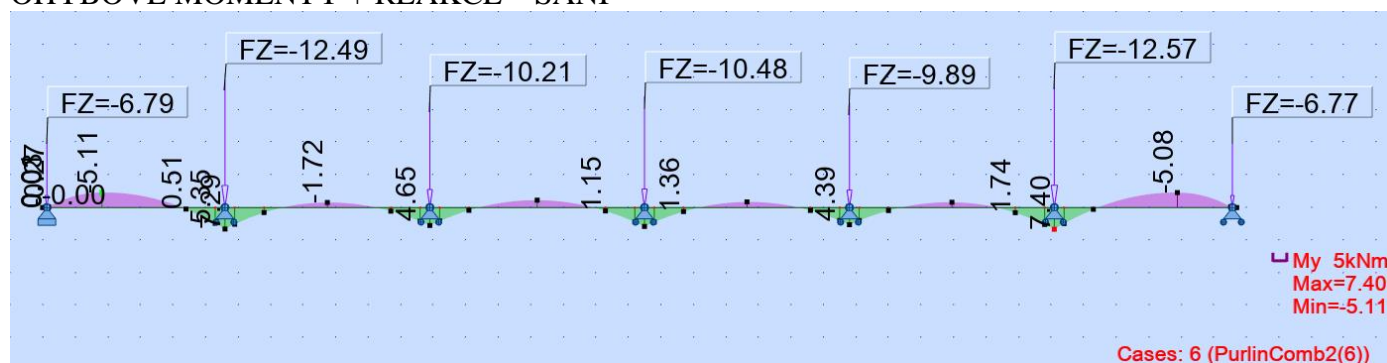
OHYBOVÉ MOMENTY + REAKCE – TLAKOVÉ ZATÍŽENÍ



POSOUBAJÍCÍ SÍLY + REAKCE - TLAKOVÉ ZATÍŽENÍ



OHYBOVÉ MOMENTY + REAKCE – SÁNÍ



4.4 POSUDEK ÚNOSNOSTI VAZNICE

C:\...slavice staticky vypocet 2024-3-28\CZ001893 Pu1 vaznice.purx (roof)

3/27/2024 14:51 by LenkaBur

Geometry of the purlin.

Profiles used in the construction.

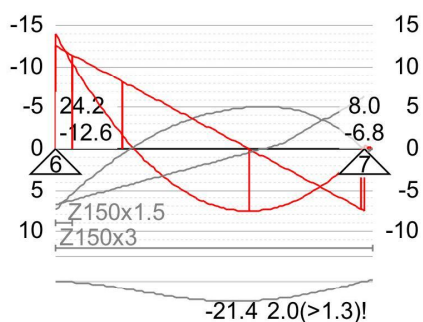
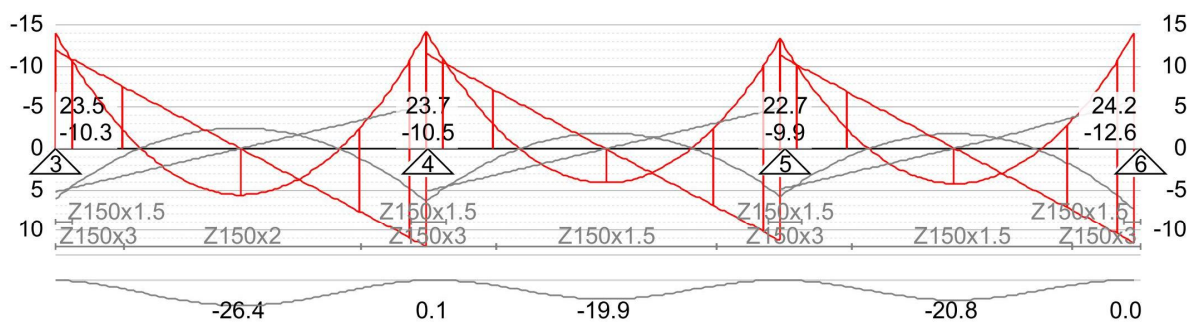
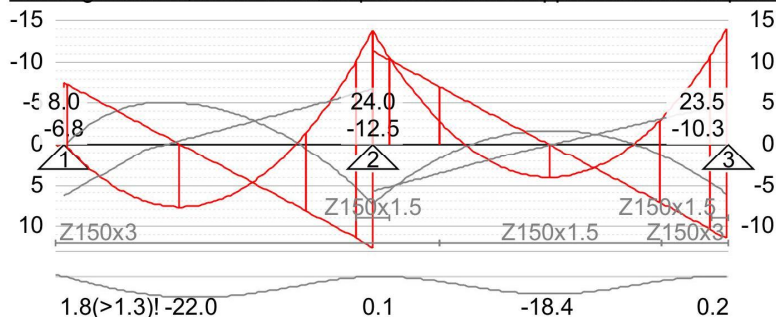
Nodes		
No.	x [m]	type
1	0.00	-
2	0.08	-
3	0.13	sup.
4	0.18	-
5	4.41	-
6	5.31	-
7	5.61	sup.
8	5.91	-
9	6.81	-
10	10.71	-
11	11.61	-
12	11.91	sup.
13	12.21	-
14	13.11	-
15	17.31	-
16	18.21	-
17	18.51	sup.
18	18.81	-
19	19.71	-
20	23.61	-
21	24.51	-
22	24.81	sup.
23	25.11	-
24	26.01	-
25	29.91	-
26	30.81	-
27	31.11	sup.
28	31.41	-
29	32.31	-
30	36.53	-
31	36.58	sup.
32	36.63	-
33	36.72	-

Bars			
start	end	section	len.[m]
1	6	Z 150x46x3	5.31
6	8	ZZ 150x46x4.5	0.60
8	9	Z 150x46x3	0.90
9	10	Z 150x46x1.5	3.90
10	11	Z 150x46x3	0.90
11	13	ZZ 150x46x4.5	0.60
13	14	Z 150x46x3	0.90
14	15	Z 150x46x2	4.20
15	16	Z 150x46x3	0.90
16	18	ZZ 150x46x4.5	0.60
18	19	Z 150x46x3	0.90
19	20	Z 150x46x1.5	3.90
20	21	Z 150x46x3	0.90
21	23	ZZ 150x46x4.5	0.60
23	24	Z 150x46x3	0.90
24	25	Z 150x46x1.5	3.90
25	26	Z 150x46x3	0.90
26	28	ZZ 150x46x4.5	0.60
28	33	Z 150x46x3	5.31

section	length [m]	weight [kg/m]	Iz [mm4]
Z 150x46x3	17.8	6.3	4.776 E05
ZZ 150x46x4.5	3.0	9.5	6.912 E05
Z 150x46x1.5	11.7	3.2	2.136 E05
Z 150x46x2	4.2	4.2	2.93 E05

av.weight = 5.33 [kg/m]

av.weight = 5.68 [kg/m] (inc.overlaps)

Bending moment, shear force, displacement and support reactions in purlin

Loads applied to the purlin

Distributed loads

name	(no.)	f1(↓)	f2(↑)	val.[kPa]
Self w.	(101)	1.35	1	-
roof	(102)	1.35	1	-0.13
extra	(104)	1.35	0	-0.15
snow	(200)	1.5	0	-1.12
windSuc	(300)	0	1.5	0.82
windPre	(301)	0.9	0	-0.36

Trapezoidal loads

name	(no.)	f1(↓)	f2(↑)	v1[kPa]	v2[kPa]	L[m]	x[m]
s1	(201)	0	1.5	0.110	0.110	6.50	1.60
s2	(202)	0	1.5	0.110	0.110	6.50	28.62
s3	(203)	0	1.5	1.010	1.010	1.60	0
s4	(204)	0	1.5	1.010	1.010	1.60	35.12

Combinations

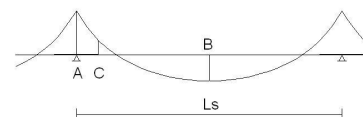
No.	Name and definition of combination
1	PurlinComb1(5) (ULS) 1.35x(101+102+104)+1.5x(200)+0.9x(301)
2	PurlinComb2(6) (ULS) 1x(101+102)+1.5x(300+201+202+203+204)
3	PurlinComb3(7) (SLS) 1x(101+102+104+200)+0.6x(301)

(301)=-0.540	x0.9
(200)=-1.680	x1.5
(104)=-0.225	x1.35
(102)=-0.195	x1.35
cc=1500mm	
(203)=1.515	x1.5
(202)=0.165	x1.5
(201)=0.165	x1.5
(300)=1.230	x1.5
(102)=-0.195	x1
(301)=-0.540	x0.6
(200)=-1.680	x1
(104)=-0.225	x1
(102)=-0.195	x1

Control of purlin Z-150 according to EN 1993-1-3

Global values: all measures in mm

t_{rp} = 0.58 thickness roof plate hw_{rp} = 45 height roof plate
 b_{roof} = 18010 width of roof (hall) $\gamma M0=1$ $\gamma M1=1$ $\gamma M2=1.25$



Stresses on roof purlin

qedg = max gravity load (case 1); qedu = max uplift load (case 2)

Situation	B1	B2	B3	B4
Section	Z 150x46x3	Z 150x46x3	Z 150x46x1.5	Z 150x46x2
cc _{pur} [mm]	1500	1500	1500	1500
qedg [kN/m]	3.57	3.57	3.57	3.57
qedu [kN/m]	4.12	4.12	2.09	1.85
Ls [m]	0.13	5.48	6.30	6.60
Gable	No	No	No	No
NEd g/u [kN]	5.00/5.00	5.00/5.00	5.00/5.00	5.00/5.00

Sections' dimensions

	Z 150x46x1.5	Z 150x46x2	Z 150x46x3
MyRk	5.49 kNm	7.80 kNm	12.36 kNm
VbhRk	24.62 kN	45.69 kN	87.25 kN
RwRk	kN	31.50 kN	66.55 kN
Wyeff	1.569 E04 mm ³	2.228 E04 mm ³	3.532 E04 mm ³
Iy	1.31 E06 mm ⁴	1.74 E06 mm ⁴	2.6 E06 mm ⁴
IT	2.82 E02 mm ⁴	6.837 E02 mm ⁴	2.325 E03 mm ⁴
I _ω	7.75 E08 mm ⁶	1.06 E09 mm ⁶	1.72 E09 mm ⁶

Lateral coefficient EN 1993-1-3: 10.1.4.1 (4): for uplift loading

$k_{h0} = \frac{hc \cdot t \cdot (bc^2 + 2 \cdot bc \cdot cc - 2 \cdot cc^2 \frac{bc}{hc})}{4 \cdot I_y}$		$k_{hu} = k_{h0} - ab/hc; \quad q_{hEdu} = q_{Edu} \cdot k_{hu}$	
Z 150x46x1.5		Z 150x46x2	
a _b = 25.3	mm	a _b = 25.6	mm
k _{h0} = 0.139	-	k _{h0} = 0.141	-
k _{hu} = -0.031	-	k _{hu} = -0.032	-
k _{h,u} = k _{h0} - a _b /h		k _{h,u} = k _{h0} - a _b /h	
q _{hEdu} = -0.07	kN/m	q _{hEdu} = -0.06	kN/m

Z 150x46x3	
a _b = 26.2	mm
k _{h0} = 0.144	-
k _{hu} = -0.034	-
k _{h,u} = k _{h0} - a _b /h	
q _{hEdu} = -0.14	kN/m

Rotational restraint given by sheeting EN 1993-1-3 10.1.5

Rotational spring stiffness K, EN 1993-1-3: 10.1.5.2

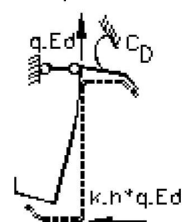
Rotational stiffness corresponding to flexural stiffness of sheeting EN 1993-1-3: 10.1.5.2 (4):

tension in upper flange: I_{effTP46_t} = 125,401 mm⁴/m C_{DC_t} = 6 * E * I_{effTP46_t} / cc_{pur}compression in upper flange: I_{effTP46_c} = 130,984 mm⁴/m C_{DC_c} = 6 * E * I_{effTP46_c} / cc_{pur}Rotational stiffness of connection between sheeting and purlin k_{tg} = (trp/(0.75*1mm))^{1.5} = 0.687for uplift load pin in every trough C_{100cc150_u} = 2.6kN; pin in alternate trough C_{100cc300_u} = 1.7kN; b=46mmC_{Dacc150_u} = C_{100cc150_u} * (b/1mm/100)² * k_{tg} = 0.4kNC_{Dacc300_u} = C_{100cc300_u} * (b/1mm/100)² * k_{tg} = 0.2kN

Rotational stiffness

C_{Dcc150_u} = [1/C_{Dacc150_u} + 1/C_{DC_t}]⁻¹ <=> pin in every troughC_{Dcc300_u} = [1/C_{Dacc300_u} + 1/C_{DC_t}]⁻¹ <=> pin in alternate trough

For uplift load EN 1993-1-3: 10.1.5.1(4): $b_{mod_u} = \begin{cases} 2 \cdot a \cdot b & \text{if } q_{hEd_u} < 0 \text{ and } K_{Bu} \\ a \cdot b & \text{Else} \end{cases}$ $K_{Bu} = \frac{E \cdot t^3}{4 \cdot (1 - \nu^2) \cdot h^2 \cdot (h + b_{mod_u})}$



Situation	B1	B2	B3	B4
b _{mod_u} [mm]	98.4	98.4	96.6	97.2
K _{Bu} [N/mm ²]	0.261	0.261	0.032	0.078
1/K _{Bu} [mm ² /N]	3.827	3.827	30.900	12.803
C _{Dcc150_u} [kN]	0.377	0.377	0.377	0.377
C _{Dcc300_u} [kN]	0.247	0.247	0.247	0.247

Lateral spring stiffness per unit length:

pin in every trough:

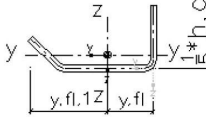
$$K_{ucc150} = \left(\frac{1}{K_{Bu}} + \frac{h^2}{c_{Dcc150_u}} \right)^{-1}$$

pin in alternate trough:

$$K_{ucc300} = \left(\frac{1}{K_{Bu}} + \frac{h^2}{c_{Dcc300_u}} \right)^{-1}$$

Situation	B1	B2	B3	B4
K_ucc150 [N/mm2]	0.0157	0.0157	0.0110	0.0138
K_ucc300 [N/mm2]	0.0105	0.0105	0.0082	0.0096

Gross properties of the free flange EN 1993-1-3: 10.1.4.1

	Z 150x46x1.5	Z 150x46x2	Z 150x46x3	
	t = 1.5 mm	t = 2.0 mm	t = 2.9 mm	
	I_zf1 = 50,407 mm ⁴	I_zf1 = 68,656 mm ⁴	I_zf1 = 109,682 mm ⁴	
	W_zf1 = 1,404.6 mm ³	W_zf1 = 1,911.4 mm ³	W_zf1 = 3,021.4 mm ³	
	i_zf1 = 19.74 kmm	i_zf1 = 19.84 kmm	i_zf1 = 20.33 kmm	

Lateral bending moment for free flanges in compression EN 1993-1-3:10.1.4.1 (5)-(7):

Coefficient R of the spring support EN 1993-1-3: 10.1.4.1 (7):

$$R_{rp} = \frac{K_{ucc300} * L_{sp}^4}{\pi^4 * E * I_{zf1}}$$

Situation	B1	B2	B3	B4
R_rp [-]	0.00	4.21	12.51	12.99

Correction factor K_R and initial moment M0_fzEd acc. to table 10.1 EN 1993-1-3: 10.1.4.1

$$M_{0fzEd} = \begin{cases} 1 * |q_{hEd_u}| * L_s^2 / 24 <=> \text{no gable} \\ 9 * |q_{hEd_u}| * L_s^2 / 128 <=> \text{gable} \end{cases} \quad \kappa_{Rm} = \begin{cases} (1 - 0.0125 * R_{rp}) / (1 + 0.198 * R_{rp}) <=> \text{no gable} \\ (1 - 0.0141 * R_{rp}) / (1 + 0.416 * R_{rp}) <=> \text{gable} \end{cases}$$

$$M_{fzEd} = \kappa_{Rm} * M_{0fzEd}$$

Situation	B1	B2	B3	B4
M_0fzEd [Nm]	0.10	175.04	108.88	107.97
κ_Rm [-]	1.00	0.52	0.24	0.23
M_fzEd [Nm]	0.10	90.39	26.41	25.32

Stresses due to gravity load

Combined bending moment and support reaction EN 1993-1-3: 6.1.11. The web rotation is prevented.

$$Exertion = \{ [M_{yEd} * \gamma_{M0} / MyRk + R_{Ed} * \gamma_{M1} / RwRk] / 1.25 < 1$$

Situation	A1	A2
Section	Z 150x46x3	ZZ 150x46x4.5
Sup.width [m]	0.1	0.1
M_yEd [kNm]	0.03	14.25
M_yRk [kNm]	12.36	17.85
R_Ed [kN]	7.98	23.64
R_wRk [kN]	66.55	85.14
Exertion	0.10	0.86

Combined bending moment and compression force: EN 1993-1-3:10.1.4.1 eqv. 10.3a

$$Exertion = [M_{yEd} / Wyeff + N_{Ed} / Aeff] * \gamma_{M1} / f_{yb} < 1$$

Situation	A1-uplift	A2-gravity
M_yEd [kNm]	0.03	14.25
Wyeff [mm ³]	3.532 E04	5.101 E04
N_Ed [kN]	5.0	5.0
Aeff [mm ²]	676.8	676.8
Exertion	0.02	0.82

Bending moment and shear force:

$$Relation = 2 * V_{Ed} * \gamma_{M0} / VbhRk <= 1$$

Situation	A1-gravity	A2-gravity
V_Ed [kN]	7.49	12.58
VbhRk [kN]	87.25	111.87
Relation	0.17	0.22

If Relation <= 1 then combination of bending moment and shear force does not need to be checked.

Single profile at end of supporting profile:

$$Exertion = [M_{Ls}/W_{yeff} + N_{Ed}/A_{eff}] \cdot \gamma_{M0} / f_{yb} \leq 1$$

Situation	C1-gravity	C2-gravity	C3-gravity
Section	Z 150x46x3	Z 150x46x1.5	Z 150x46x2
M _{Ls} [kNm]	10.94	2.99	2.44
W _{yeff} [mm ³]	3.532 E04	1.569 E04	2.228 E04
A _{eff} [mm ²]	676.8	229.3	362.8
N _{Ed} [kN]	5.00	5.00	5.00
Exertion	0.91	0.61	0.35

Combined bending moment and compression force in span

$$Exertion = [M_{yEd}/W_{yeff} + N_{Ed}/A_{eff}] \cdot \gamma_{M1} / f_{yb} < 1$$

Situation	B1	B2	B3	B4
Section	Z 150x46x3	Z 150x46x3	Z 150x46x1.5	Z 150x46x2
M _{yEd} [kNm]	0.00	7.65	4.25	5.62
W _{yeff} [mm ³]	3.532 E04	3.532 E04	1.569 E04	2.228 E04
N _{Ed} [kN]	5.0	5.0	5.0	5.0
A _{eff} [mm ²]	676.8	676.8	229.3	362.8
Exertion	0.02	0.64	0.84	0.76

Stresses due to Uplift load:

Non-dim. slenderness:

$$\lambda_{-1} = \sqrt{\frac{E}{f_{yb}}}$$

Coefficients from table 10.2b:

$$\lambda_{-1} = 76.95 \text{ gable} \Leftrightarrow \eta_1 = 0.515 \quad \eta_2 = 1.260 \quad \eta_3 = 0.868 \quad \eta_4 = -0.242$$

$$\text{no gable} \Leftrightarrow \eta_1 = 0.306 \quad \eta_2 = 0.232 \quad \eta_3 = 0.742 \quad \eta_4 = -0.279$$

Buckling length for free flange in compression EN 1993-1-3:

$$L_{fz} = \eta_1 \cdot L_{sp} \cdot (1 + \eta_2 \cdot R_{rp} \eta_3)^{\eta_4}$$

Relative slenderness for flexural buckling of free flange:

$$\lambda_{rfz} = \frac{L_{fz}}{i_{zf1} \cdot \lambda_{-1}}$$

Reduction factor for lateral torsional buckling: Acc. to 10.1.4.2 (1): use values given in EN 1993-1-1: 6.3.2.3

$$\alpha_{LT} = 0.34 \quad \lambda_{rLT} = 0.4 \quad \beta = 0.75 \quad \phi_{LT} = 0.5 \cdot [1 + \alpha_{LT} \cdot (\lambda_{rfz} - \lambda_{rLT}) + \beta \cdot \lambda^2]$$

$$\chi_{LT} = \min\left(\frac{1}{\phi_{LT} + \sqrt{\phi_{LT}^2 + \beta \cdot \lambda_{rfz}^2}}, 1, \frac{1}{\lambda_{rfz}^2}\right)$$

Reduction factor for flexural buckling: According to EN 1993-1-1: 6.3.1:

$$i_y = \sqrt{\frac{I_{yrc}}{A_{grc}}} \quad \lambda_{ryFB} = \frac{L_{sp}}{i_y} \cdot \sqrt{\frac{A_{eff}}{A_{grc}}} \cdot \frac{1}{\lambda_{-1}} \quad N_{cry} = \frac{\pi^2 \cdot E \cdot I_{yrc}}{L_{sp}^2}$$

$$\phi_{yFB} = 0.5 \cdot [1 + \alpha_{yFB} \cdot (\lambda_{ryFB} - 0.2) + \lambda_{ryFB}^2]$$

Reduction factor for span:

$$\chi_{yFB} = \min\left(\frac{1}{\phi_{yFB} + \sqrt{\phi_{yFB}^2 - \lambda_{ryFB}^2}}, 1\right)$$

Single profile in span uplift load:

$$Exertion = \left(\frac{1}{\chi_{LT}} \cdot \frac{M_{yEd}}{W_{yeff}} + \frac{1}{\min(\chi_{LT}, \chi_{yFB})} \cdot \frac{N_{Ed}}{A_{eff}}\right) \cdot \frac{\gamma_{M1}}{f_{yb}} + \frac{|M_{fzEd}| \cdot \gamma_{M1}}{W_{zf1} \cdot f_{yb}} < 1.0$$

Situation	B1	B2	B3	B4
Section	Z 150x46x3	Z 150x46x3	Z 150x46x1.5	Z 150x46x2
L _{sp} [m]	0.13	5.48	6.30	6.60
M _{yEd} [kNm]	0.00	5.12	1.91	2.51
M _{fzEd} [Nm]	0.10	90.39	26.41	25.32
L _{fz} [m]	0.04	1.45	1.49	1.55
λ _{rfz}	0.03	0.93	0.98	1.02
φ _{LT}	0.44	0.91	0.96	0.99
χ _{LT}	1.00	0.74	0.71	0.69
λ _{ryFB}	0.03	1.15	1.08	1.24
N _{Ed} [kN]	5.0	5.0	5.0	5.0
φ _{yFB}	0.47	1.32	1.24	1.44
χ _{yFB}	1.00	0.51	0.54	0.46
Exertion	0.03	0.69	0.65	0.60

Check joints between purlins:

$$Exertion = \frac{|M_S| \cdot \gamma M2}{4 \cdot F_{bRk} \cdot h/2} + \frac{N_{Ed} \cdot \gamma M2}{4 \cdot F_{bRk}} < 1.0$$

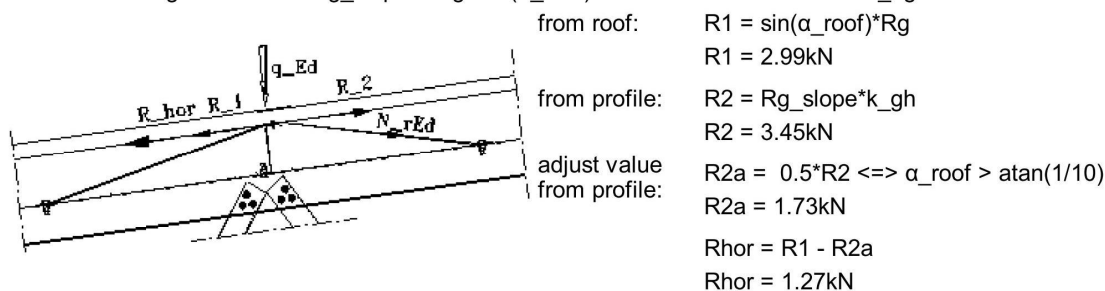
Situation	S1	S2	S3
Section	Z 150x46x3	Z 150x46x1.5	Z 150x46x2
F _{bRk} [kN]	25.2	0.0	18.9
M _S [kNm]	-1.62	-2.99	-2.44
N _{Ed} [kN]	5.0	5.0	5.0
Exertion	0.22	0.74	0.47

Bracing of Z-roof purlin

Type of hall = S-hall => broof_1 = broof = 18.01m Loadig width frame LW = 6.7m

Roofslope $\alpha_{roof} = 7^\circ$ Rigde flashing = No

Max reaction Rg = 24.14kN Rg_slope = Rg*cos(α_{roof}) = 23.96kN Lateral coeff. k_{hg} = 0.144



Force acting in the roof plane for one half of the building:

$$P_{roof} = 0.5 \cdot broof1 \cdot Rhor / cc_pur$$

$$P_{roof} = 7.62kN$$

Shear resistance of screws:

$$-\Phi 4.8: F_{4.8_sRd} = 3.33kN / \gamma M2 = 2.7kN$$

$$-\Phi 6.3: F_{6.3_sRd} = 6.24kN / \gamma M2 = 5.0kN$$

Overlap screw for use in ridge connection ($\Phi 4.8$):

$$d_{oscr} = 4.8mm \quad t_{ridgeplat} = 0.5mm \quad \text{ultimate strength ridge plate: } f_{urp} = 330N/mm^2$$

$$\alpha_{oscr} = 3.2 \cdot \sqrt{(t_{ridgeplat} / d_{oscr})} = 1.03 \quad F_{oscr_bRd1} = (\alpha_{oscr} \cdot f_{urp} \cdot d_{oscr} \cdot t_{ridgeplat}) / \gamma M2 = 0.654kN$$

$$F_{oscr_bRd} = \min(F_{oscr_bRd1}, F_{4.8_sRd}) = 0.654kN \quad \text{Bearing resistance plate to plate or shear capacity of screw}$$

Plate screw for use in fastening of roofbrace to purlin ($\Phi 6.3$):

$$d_{dscr} = 6.3mm \quad dw_{dscr} = 19.0mm \quad \text{thickness of z-support} = 1.5mm \quad \text{thickness of plate } t_{bra} = 0.58mm$$

$$\alpha = 3.2 \cdot \sqrt{(t_{bra} / d_{dscr})} = 0.974 \quad \alpha_1 = \min(\alpha, 2.1) = 0.974 \quad \alpha_2 = (2.1 - \alpha_1) \cdot (t_1 / t_{bra} - 1) / (2.5 - 1) + \alpha_1 = 2.10$$

$$t_{bra} \geq 1mm \Rightarrow \alpha_q = 2.1 \quad \alpha_{qq} = (\alpha_q - \alpha_1) \cdot (t_1 / t_{bra} - 1) / (2.5 - 1) + \alpha_1 = 0.97$$

$$t_{bra} = t_1 \Rightarrow \alpha_{dscrEN} = \alpha_1 \quad F_{dscr_brdEN} = (\alpha_{dscrEN} \cdot f_u \cdot d_{dscr} \cdot t_{bra}) / \gamma M2 = 4.16kN \quad F_{plabRd} = 5.6kN$$

$$F_{dscr_brd} = \min(F_{6.3_sRd}, F_{dscr_brdEN}, F_{plabRd}) = 4.16kN$$

Part of force in plane of roof which is taken by ridge flashing:

$$\text{Ridge flashing} = \text{No} \Rightarrow LW_{ridge} = 0m$$

$$P_{Rd_ridge} = LW_{ridge} \cdot F_{oscr_bRd} / 0.3m = 0.00kN$$

Number of braces needed for each half of the roof: (FIRST CHOICE)

Design resistance for one brace 38x1.5 mm fastened with platescrew: ($\Phi 6.3$):

$$N_B = \max\{1, \text{ceil}[(P_{roof} - P_{Rd_ridge}) / F_{dscr_brd}]\} \quad N_B = 2$$

If using C-profile:

$$d_{dscr} = 6.3mm \quad dw_{dscr} = 19.0mm \quad \text{thickness of c-profile} = 2.0mm \quad \text{thickness of plate } t_{rp} = 0.58mm$$

$$\alpha = 3.2 \cdot \sqrt{(t_{rp} / d_{dscr})} = 0.974 \quad \alpha_1 = \min(\alpha, 2.1) = 0.974 \quad \alpha_2 = (2.1 - \alpha_1) \cdot (t_1 / t_{rp} - 1) / (2.5 - 1) + \alpha_1 = 2.793$$

$$t_{rp} < 1mm \Rightarrow \alpha_q = \alpha_1 \quad \alpha_{qq} = (\alpha_q - \alpha_1) \cdot (t_1 / t_{rp} - 1) / (2.5 - 1) + \alpha_1 = 0.974 \quad f_{utp} = 0.390kN/mm^2$$

$$t_1 \geq 2.5 \cdot t_{rp} \text{ and } t_{rp} < 1mm \Rightarrow \alpha_{dscrEN} = \alpha_1 \quad F_{dscr_brdEN} = (\alpha_{dscrEN} \cdot f_{utp} \cdot d_{dscr} \cdot t_{rp}) / \gamma M2 = 1.12kN$$

$$F_{dscr_brd} = \min(F_{6.3_sRd}, F_{dscr_brdEN}) = 1.12kN$$

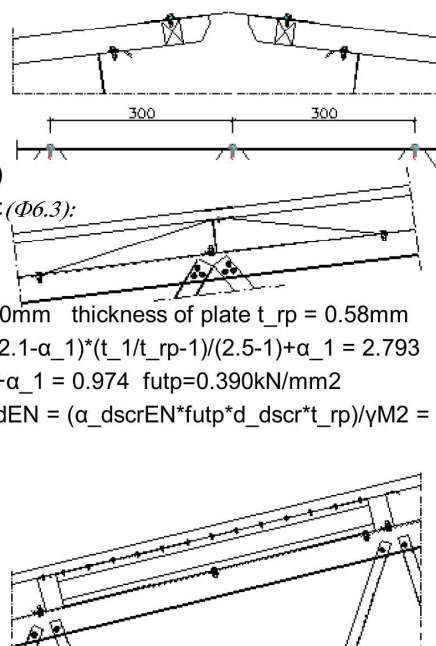
Design resistance for one C-profile ($t \geq 2mm$):

$$P_{Rd_Cprof} = 7 \cdot F_{dscr_bRd} = 7.8kN$$

Number of C-profiles needed for each half of the roof:

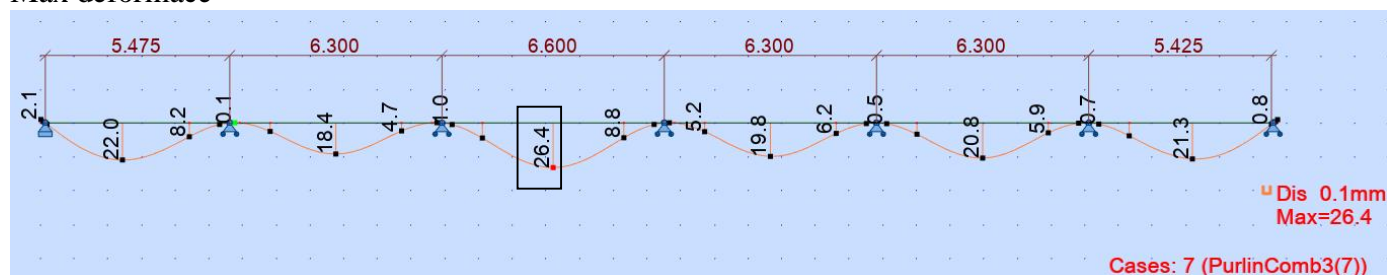
$$N_C = \max\{1, \text{ceil}[(P_{roof} - P_{Rd_ridge}) / P_{Rd_Cprof}]\}$$

$$\min N_C = 1, \min \text{ total amount of screws } 7$$



4.5 POSUDEK DEFORMACE VAZNICE

Max deformace



Limitní svislá deformace vaznice pro rozpon 6600 mm = $6600/200 = 33.0$ mm

Max deformace = 26.4 mm

26.4 mm < 33.0 mm

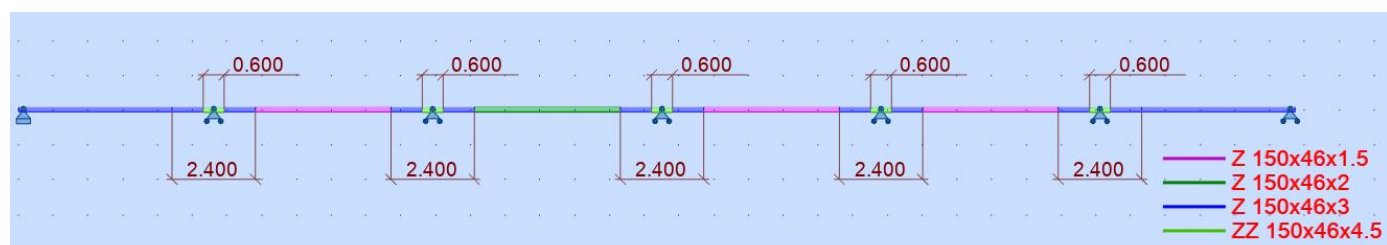
Limitní svislá deformace vaznice pro rozpon 5475 mm = $5475/200 = 27.4$ mm

Max deformace = 22.0 mm

22.0 mm < 27.4 mm

Svislá deformace vyhoví.

4.6 POUŽITÉ PROFILY



5 RÁM FR1

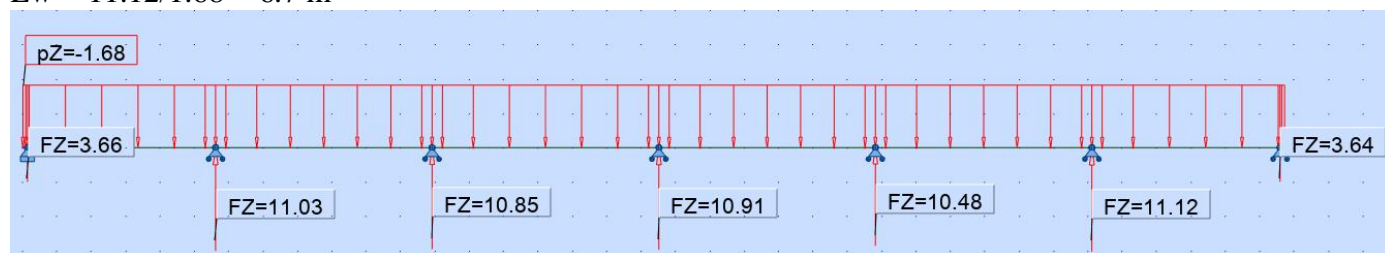
5.1 POPIS, ZATĚŽOVACÍ ŠÍŘKA

Příhradový vazník je navržen s tuhými rámovými rohy a kloubově kotvenými sloupy.

Požární odolnost rámu: R0 - bez požadavků na požární odolnost

Zatěžovací šířka vazníku (L_w) = 6.7 m

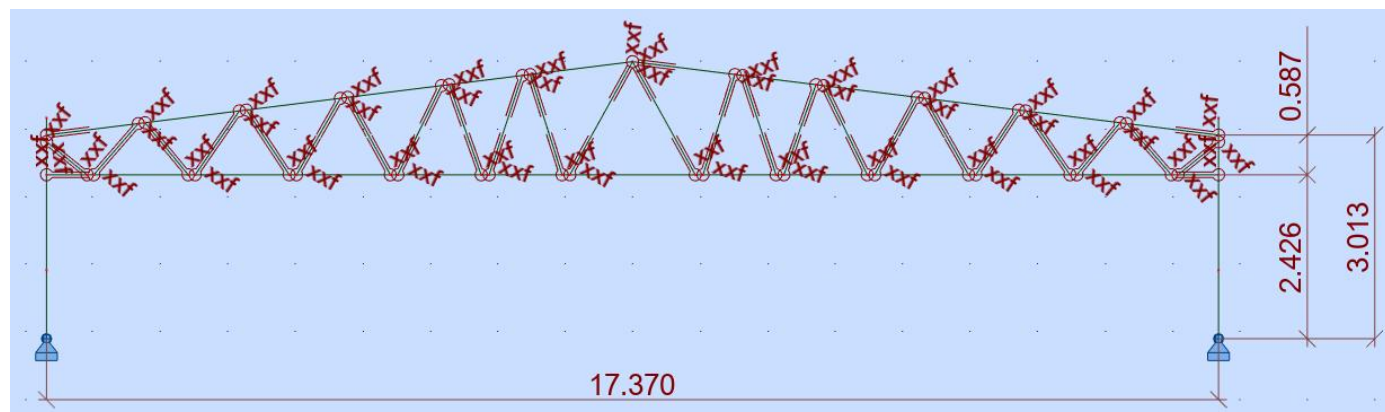
$$L_w = 11.12 / 1.68 = 6.7 \text{ m}$$



Zatěžovací šířka sloupů (L_s) = 6.45 m

(průměrná rozteč rámu)

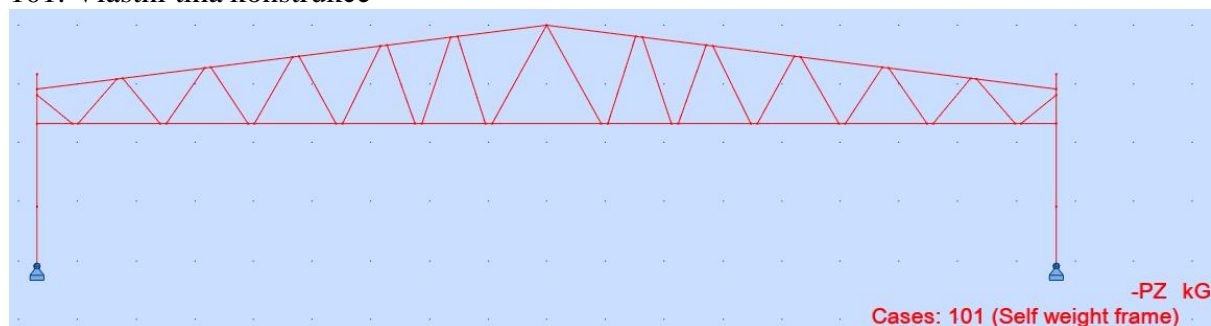
5.2 STATICKÉ SCHÉMA KONSTRUKCE



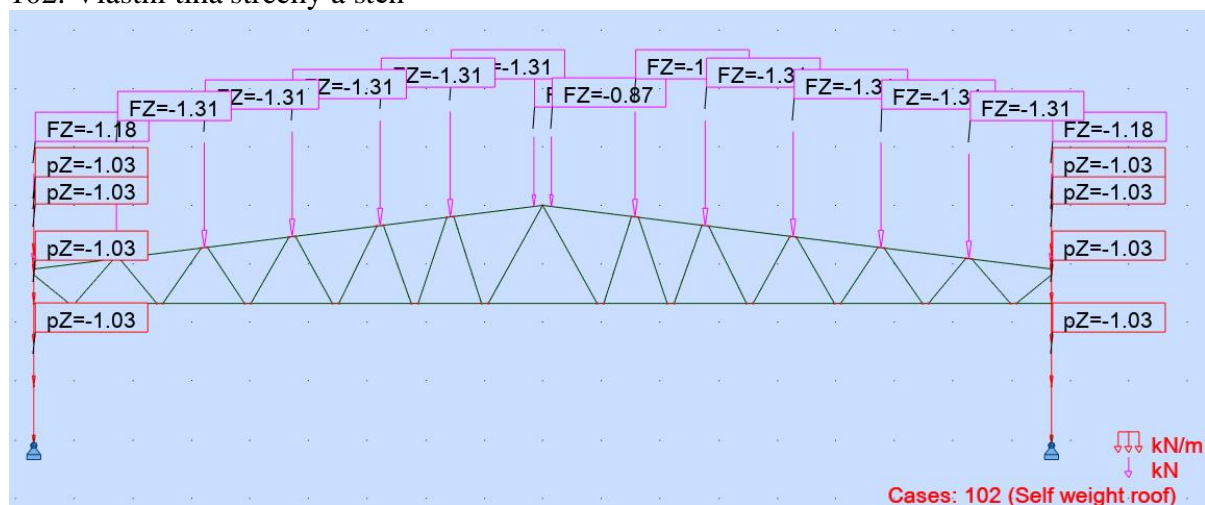
5.3 ZATÍŽENÍ

Zatěžovací stavy

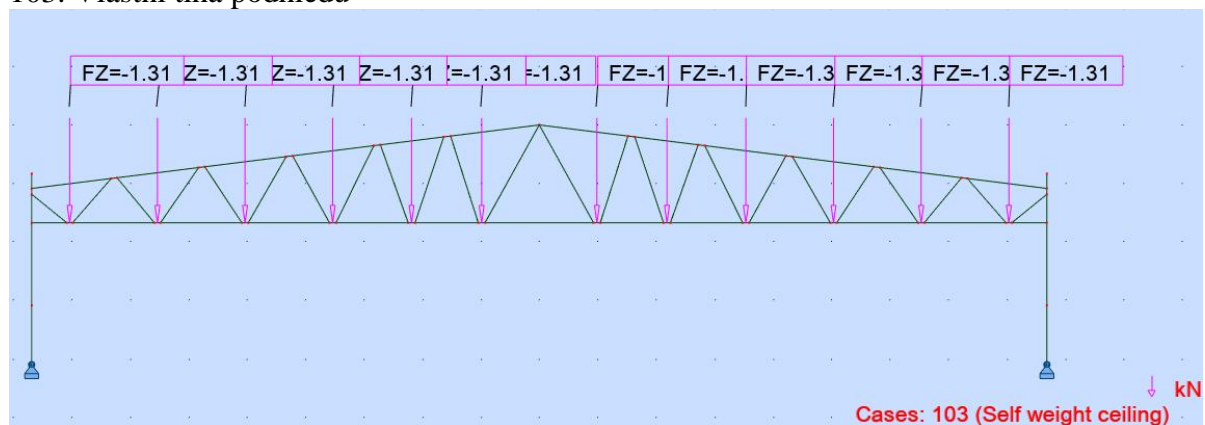
101. Vlastní tíha konstrukce



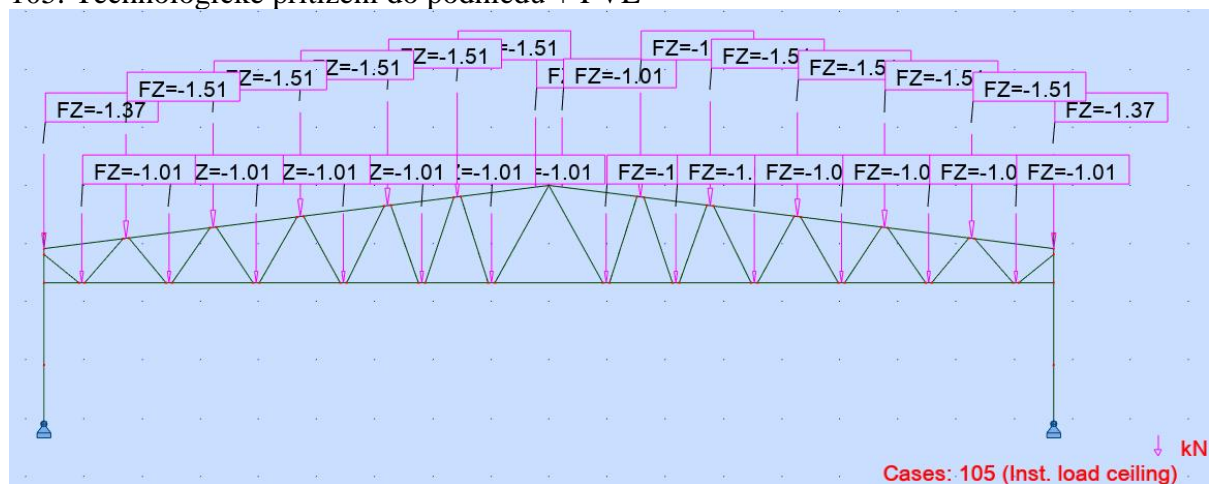
102. Vlastní tíha střechy a stěn



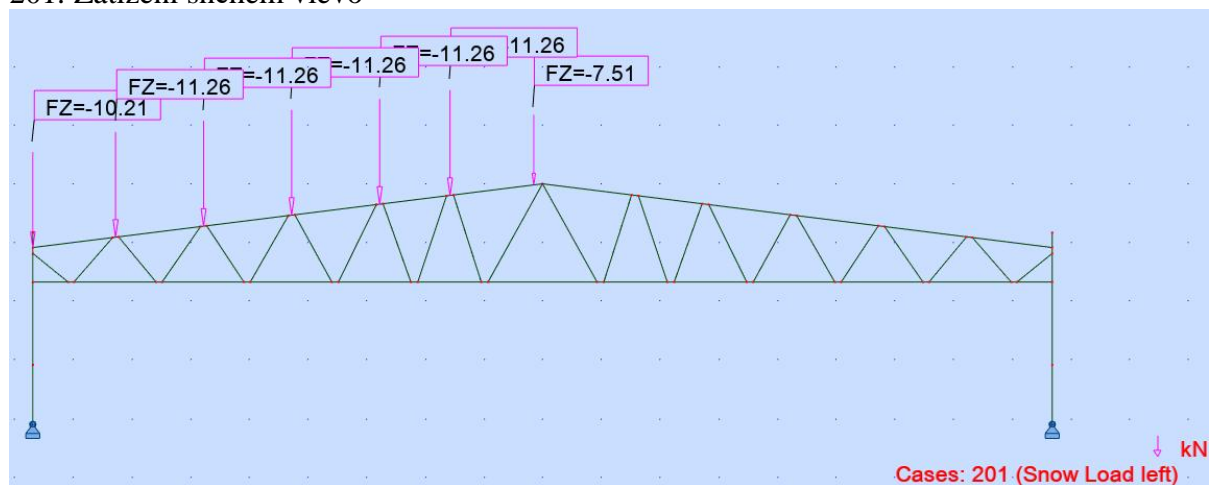
103. Vlastní tíha podhledu



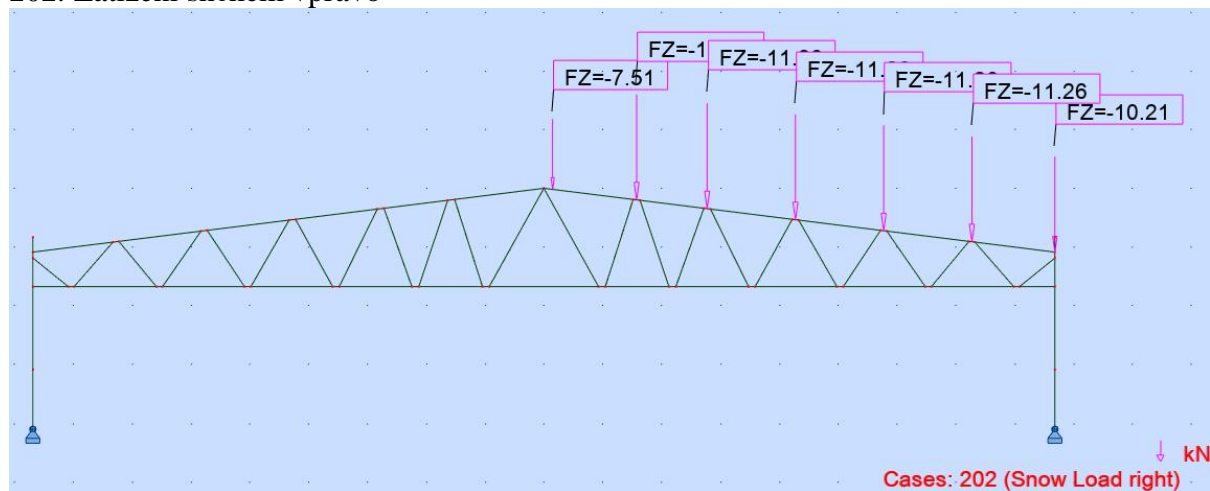
105. Technologické přetížení do podhledu + FVE



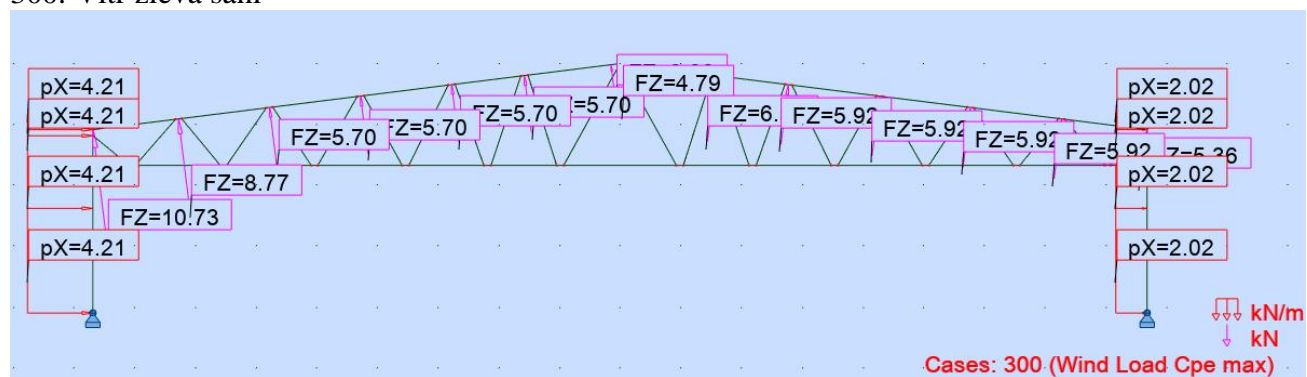
201. Zatížení sněhem vlevo



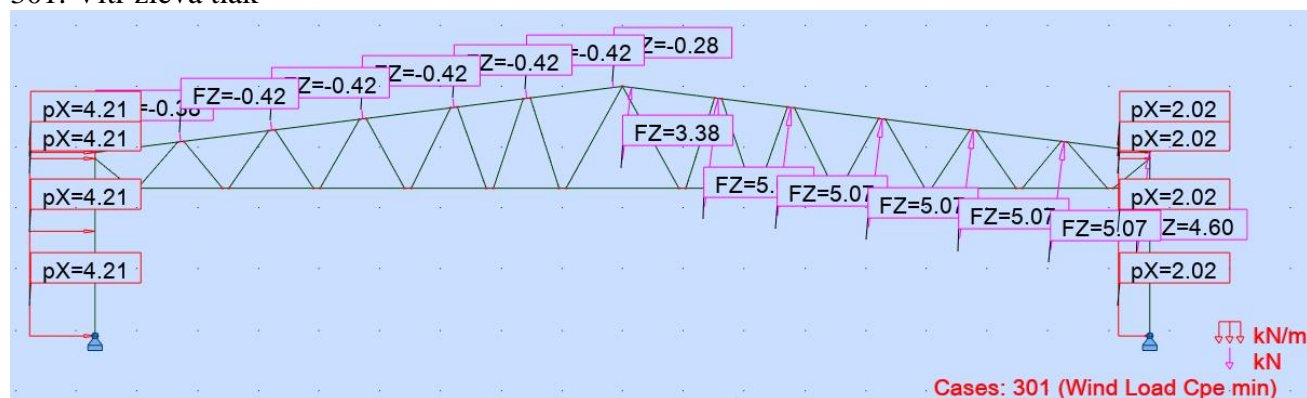
202. Zatížení sněhem vpravo



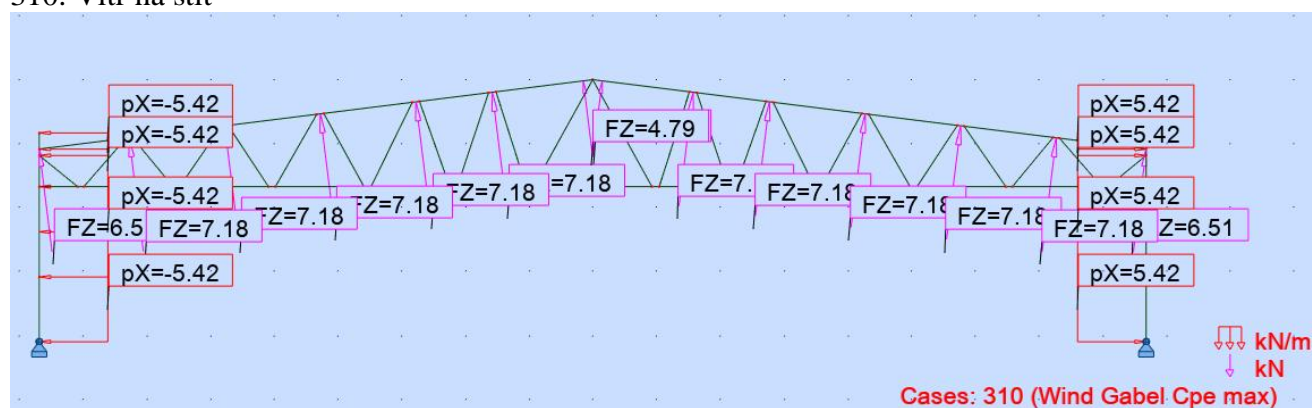
300. Vítr zleva sání



301. Vítr zleva tlak



310. Vítr na štít



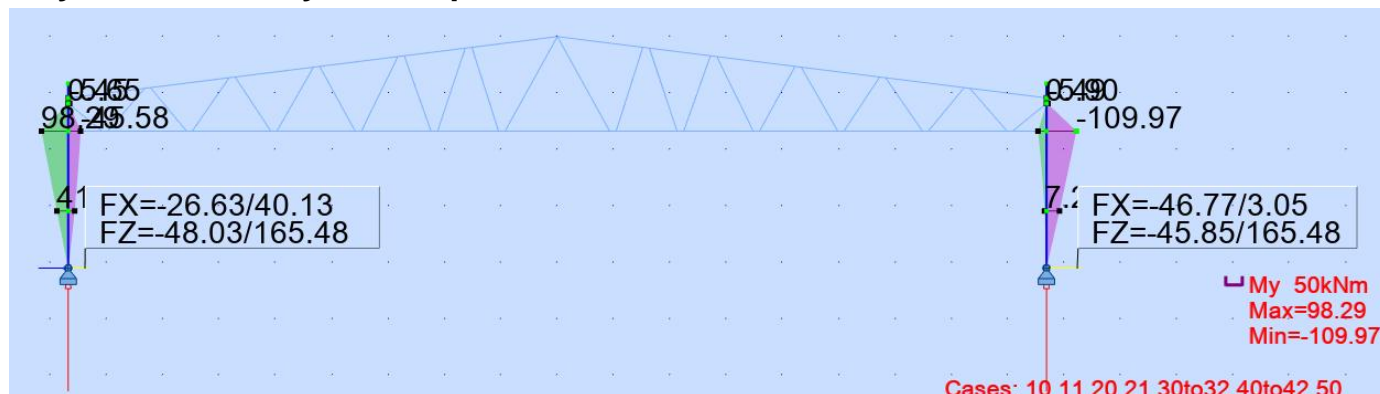
5.4 KOMBINACE ZATĚŽOVACÍCH STAVŮ

Nr	Combination	Type	101 Self weight frame	102 Self weight roof and walls	103 Self weight ceiling	105 Inst. load ceiling + FVE	201 Snow Load left	202 Snow Load right	300 Wind Load Cpe max	301 Wind Load Cpe min	310 Wind Gabel Cpe max
10	Snow	ULS	1.35	1.35	1.35	1.35	1.5	1.5	-	-	-
11	Snow 0.5 right	ULS	1.35	1.35	1.35	1.35	1.5	0.75	-	-	-
20	Wind max	ULS	1	1	1	-	-	-	1.5	-	-
21	Wind min	ULS	1.35	1.35	1.35	1.35	-	-	-	1.5	-
30	Snow + reduced wind	ULS	1.35	1.35	1.35	1.35	1.5	1.5	-	0.9	-
31	Snow 0.5 left + reduced wind	ULS	1.35	1.35	1.35	1.35	0.75	1.5	-	0.9	-
32	Snow 0.5 right + reduced wind	ULS	1.35	1.35	1.35	1.35	1.5	0.75	-	0.9	-
40	Wind + reduced Snow	ULS	1.35	1.35	1.35	1.35	0.75	0.75	-	1.5	-
41	Wind + reduced Snow 0.5 left	ULS	1.35	1.35	1.35	1.35	0.375	0.75	-	1.5	-
42	Wind + reduced Snow 0.5 Right	ULS	1.35	1.35	1.35	1.35	0.75	0.375	-	1.5	-
50	Wind from gabel	ULS	1	1	1	-	-	-	-	-	1.5

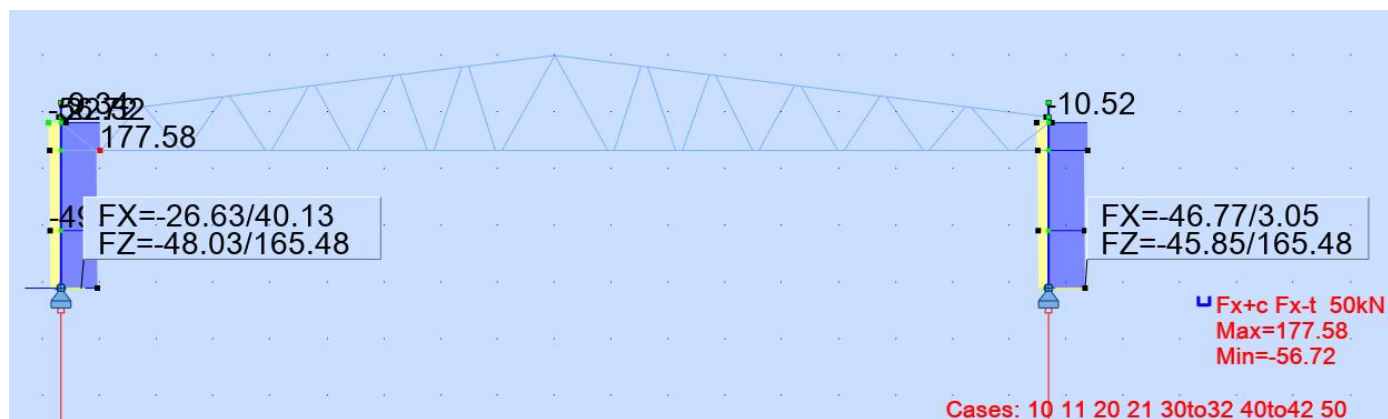
5.5 POSUDEK SLOUPŮ RÁMU (MSÚ)

VNITŘNÍ SÍLY

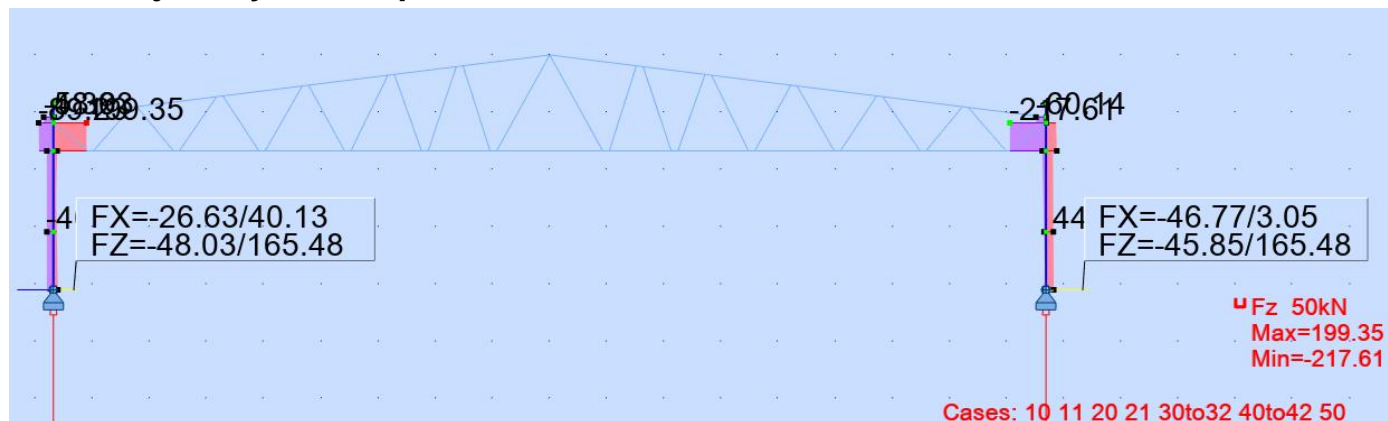
Ohybové momenty ve sloupech



Normálové síly ve sloupech



Posouvající síly ve sloupech



POSUDEK SLOUPŮ



Frame Column

$$h \equiv 250 \cdot \text{mm}$$

$$b \equiv 100 \cdot \text{mm}$$

$$c \equiv 39 \cdot \text{mm}$$

$$t \equiv 5 \cdot \text{mm}$$

$$\gamma_{M0} \equiv 1.0$$

$$d := 100 \cdot \text{mm}$$

$$cc_{batt} := 1500 \cdot \text{mm}$$

distance between battens

$$h_{batt} := 200 \cdot \text{mm}$$

$$t_{batt} := 4 \cdot \text{mm}$$

$$kb = 489.63 \text{ mm}$$

$$\gamma_{M1} \equiv 1.0$$

$$A_{gg} := 2 \cdot A_g \quad A_{gg} = 4.951 \times 10^3 \text{ mm}^2$$

$$I_{zz} := 2 \cdot \left[I_z + A_g \cdot \left(e_1 + \frac{d}{2} \right)^2 \right] \quad I_{zz} = 4.15 \times 10^7 \text{ mm}^4$$

$$I_{yy} := 2 \cdot I_y \quad I_{yy} = 4.68 \times 10^7 \text{ mm}^4 \text{ angle C:}$$

$$W_{yy} := 2 \cdot W_y \quad W_{yy} = 3.82 \times 10^5 \text{ mm}^3$$

$$W_{yy,eff} := 2 \cdot W_{eff,y,1} \quad W_{yy,eff} = 3.75 \times 10^5 \text{ mm}^3$$

$$W_{zz} := \frac{I_{zz}}{b + \frac{d}{2}} \quad W_{zz} = 2.77 \times 10^5 \text{ mm}^3$$

$$I_{TT} = 42333.33 \text{ mm}^4$$

$$i_{yy} := \sqrt{\frac{I_{yy}}{A_{gg}}} \quad i_{yy} = 97.26 \text{ mm}$$

$$i_{zz} := \sqrt{\frac{I_{zz}}{A_{gg}}} \quad i_{zz} = 91.54 \text{ mm}$$

torsion_plate_pillar = "NO"

$$M_{yy,cRk} := 2 \cdot M_{ycRk}$$

$$M_{yy,cRk} = 187.5 \text{ kN} \cdot \text{m}$$

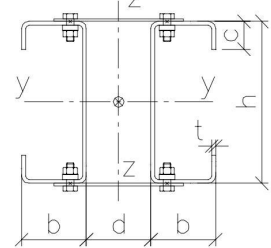
$$M_{ycRk} = 93.75 \text{ kN} \cdot \text{m}$$

$$N_{cc,Rk} := 2 \cdot N_{c,Rk}$$

$$N_{cc,Rk} = 1997.23 \text{ kN}$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 550 \frac{\text{N}}{\text{mm}^2}$$



Stresses and buckling length according to first order frame analys

$$M_{Ed,1} := 110 \cdot \text{kN} \cdot \text{m}$$

max moment in pillar

$$M_{Ed,1,z} := 0 \cdot \text{kN} \cdot \text{m}$$

moment about z-z

$$N_{Ed} := 178 \cdot \text{kN}$$

axial force in pillar = reaction force

$$N_{Ed,1} := N_{Ed}$$

axial force in element between top and bottom beam

$$N_{Ed,2} := 178 \cdot \text{kN}$$

reaction force in second pillar

$$V_{Ed} := 218 \cdot \text{kN}$$

$\rightarrow n_{cross} := 4$ =Numbers of holes in **ONE** web
 $d_0 := 12.5 \cdot \text{mm}$

Global geometry.

$$L := 2.5 \cdot \text{m}$$

length pillar

$$L_z := 3.1 \cdot \text{m}$$

length pillar for buckling z-z

$$B_{fr} := 17.4 \cdot \text{m}$$

width frame

$$H_{tr} := 1150 \cdot \text{mm}$$

height truss

$$A_{u, chord} := 1209 \cdot \text{mm}^2$$

Area upper chord

$$I_{u, chord} := 2.46 \cdot 10^6 \cdot \text{mm}^4$$

I upper chord

$$X_{u, chord} := 1$$

number of profiles upper chord

$$A_{lo, chord} := 1209 \cdot \text{mm}^2$$

Area lower chord

$$I_{lo, chord} := 2.46 \cdot 10^6 \cdot \text{mm}^4$$

I lower chord

$$X_{lo, chord} := 1$$

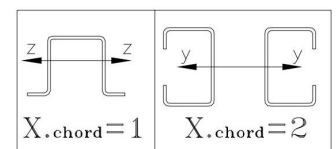
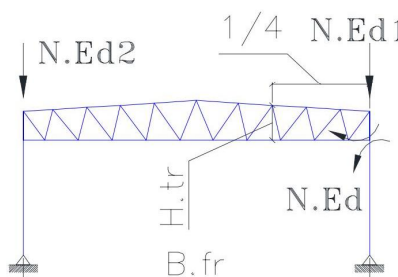
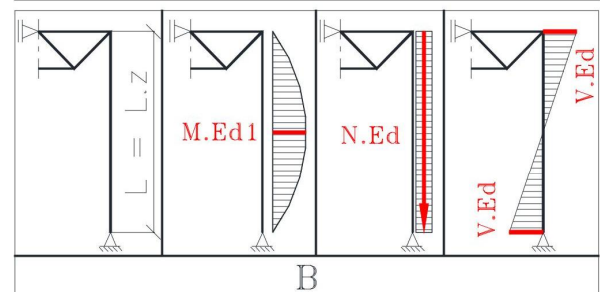
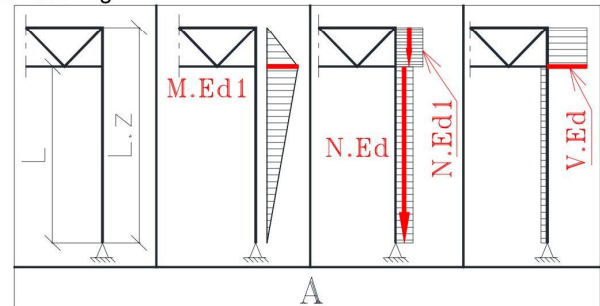
number of profiles lower chord

The moment is distributed according to frame modelling

forces from:

Loadcase := ALL

Moment_dis := "A"



Buckling lengths:

The global buckling length in y-y is calculated accounting for the stiffness behavior of the frame. The method from "Stahlbau in Beispielen, Berechnungspraxis nach DIN 18800-1 bis 3", Hünersen, Fritzsche is used.

$$L_y := \beta_y \cdot L$$

$L_y = 5.35 \text{ m}$ exural buckling axis y-y: according to modelled system

$\beta_y = 2.14$ = factor for buckling length in plane (y-y)

$$L_z = 3.1 \text{ m}$$

Flexural buckling axis z-z

$$L_{LT} := 1.0 \cdot L$$

$L_{LT} = 2.5 \text{ m}$ Distance flange bracings - LTB inner flange in compression

$$b = 100 \text{ mm} \quad h = 250 \text{ mm} \quad c = 39 \text{ mm} \quad t = 5 \text{ mm}$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2} \quad f_u = 550 \frac{\text{N}}{\text{mm}^2} \quad \gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Flexural buckling resistance - axis y-y and z-z EN 1993-1-3: 6.2.2 and EN 1993-1-1: 6.3.1:

Buckling curve for double C-section: EN 1993-1-3 table 6.3 about

y-y: a EN1993-1-1, table 6.1: $\alpha = 0.21$
z-z: b EN1993-1-1, table 6.1: $\alpha = 0.34$

Slenderness for flexural buckling EN 1993-1-1: 6.3.1.3: about y-y

$$\lambda_1 := \pi \cdot \sqrt{\frac{E}{f_{yb}}} \quad \lambda_1 = 64.38 \quad \lambda_{r,y,FBcc} := \frac{L_y}{i_{yy}} \cdot \sqrt{\frac{2 \cdot A_{eff}}{2 \cdot A_g} \cdot \frac{1}{\lambda_1}} \quad \lambda_{r,y,FBcc} = 0.77 \quad \text{Imperfection factor } \alpha \text{ relating to buckling curve a} \quad \alpha_y := 0.21$$

$$\phi_{y,FB} := 0.5 \cdot \left[1 + \alpha_y \cdot (\lambda_{r,y,FBcc} - 0.2) + \lambda_{r,y,FBcc}^2 \right] \quad \chi_{y,FBcc} := \min \left(\frac{1}{\phi_{y,FB} + \sqrt{\phi_{y,FB}^2 - \lambda_{r,y,FBcc}^2}}, 1 \right) \quad \chi_{y,FBcc} = 0.81$$

$$\phi_{y,FB} = 0.85$$

Design buckling resistance for buckling mode
-flexural buckling-: y-y

$$N_{b,Rd,y,FBcc} := \frac{\chi_{y,FBcc} \cdot 2 \cdot A_{eff} \cdot f_{yb}}{\gamma_{M1}} \quad N_{b,Rd,y,FBcc} = 1626 \text{ kN}$$

Slenderness for flexural buckling EN 1993-1-1: 6.3.1.3: about z-z

$$\lambda_1 = 64.38 \quad \lambda_{r,z,FBcc} := \frac{L_z}{i_{zz}} \cdot \sqrt{\frac{2 \cdot A_{eff}}{2 \cdot A_g} \cdot \frac{1}{\lambda_1}} \quad \lambda_{r,z,FBcc} = 0.47 \quad \text{Imperfection factor } \alpha \text{ relating to buckling curve b} \quad \alpha_z := 0.34$$

$$\phi_{z,FB} := 0.5 \cdot \left[1 + \alpha_z \cdot (\lambda_{r,z,FBcc} - 0.2) + \lambda_{r,z,FBcc}^2 \right] \quad \chi_{z,FBcc} := \min \left(\frac{1}{\phi_{z,FB} + \sqrt{\phi_{z,FB}^2 - \lambda_{r,z,FBcc}^2}}, 1 \right) \quad \chi_{z,FBcc} = 0.9$$

$$\phi_{z,FB} = 0.66$$

Design buckling resistance for buckling mode
-flexural buckling-: z-z

$$N_{b,Rd,z,FBcc} := \frac{\chi_{z,FBcc} \cdot 2 \cdot A_{eff} \cdot f_{yb}}{\gamma_{M1}} \quad N_{b,Rd,z,FBcc} = 1789.9 \text{ kN}$$

Lateral-torsional buckling resistance for uniform member in bending EN 1993-1-3: 6.2.4 and EN 1993-1-1: 6.3.2:

Procedure to calculate the elastic critical buckling moment M_{cr} , based on gross cross sectional properties, taking into account the loading conditions, real moment distribution and lateral restraints, is given neither in EN 1993-1-1 nor in EN 1993-1-3. Any appropriate calculation method can be used, here the procedure given in German ENV 1993-1-1 Annex F.

$$\text{Moment_dis} = "A" \quad L_{LT} = 2.5 \text{ m} \quad k_{M,cr} := 1.0 \quad (\text{hinged at ends}) \quad k_{w,M,cr} := 1.0 \quad (\text{no special wrap restraints at ends})$$

For frame pillar with fixed both upper and lower beam (end moments): according to picture "A":

$$\psi_{md,A} := \begin{cases} \frac{M_{Ed,2}}{M_{Ed,1}} & \text{if } |M_{Ed,1}| \geq |M_{Ed,2}| \\ \frac{M_{Ed,1}}{M_{Ed,2}} & \text{if } |M_{Ed,1}| < |M_{Ed,2}| \end{cases} \quad \psi_{md,A} = 0$$

$$C_{1,A} := \min \left(1.88 - 1.40 \cdot \psi_{md,A} + 0.52 \cdot \psi_{md,A}^2, 2.7 \right) \quad C_{1,A} = 1.88$$

$$M_{cr,A} := C_{1,A} \cdot \frac{\pi^2 \cdot E \cdot I_{zz}}{(k_{M,cr} \cdot L_{LT})^2} \cdot \left[\left(\frac{k_{M,cr}}{k_{w,M,cr}} \right)^2 \cdot \frac{I_{\omega\omega}}{I_{zz}} + \frac{(k_{M,cr} \cdot L_{LT})^2 \cdot G \cdot I_{TT}}{\pi^2 \cdot E \cdot I_{zz}} \right]^{0.5} \quad M_{cr,A} = 1368.91 \text{ kN} \cdot \text{m}$$

For frame pillar with moment distribution according to picture "B":

$$C_{1,B} := 1.132$$

$$M_{cr,B} := C_{1,B} \cdot \frac{\pi^2 \cdot E \cdot I_{zz}}{(k_{M,cr} \cdot L_{LT})^2} \cdot \left[\left(\frac{k_{M,cr}}{k_{w,M,cr}} \right)^2 \cdot \frac{I_{\omega\omega}}{I_{zz}} + \frac{(k_{M,cr} \cdot L_{LT})^2 \cdot G \cdot I_{TT}}{\pi^2 \cdot E \cdot I_{zz}} \right]^{0.5} \quad M_{cr,B} = 824.26 \text{ kN} \cdot \text{m}$$

Elastic critical moment for lateral-torsional buckling

based on gross cross sectional properties, taking into account the loading conditions, real moment distribution and lateral restraints for double C-section:

$$M_{cr} := \begin{cases} M_{cr,A} & \text{if Moment_dis} = "A" \\ M_{cr,B} & \text{if Moment_dis} = "B" \end{cases} \quad M_{cr} = 1369 \text{ kN} \cdot \text{m}$$

$$b = 100 \text{ mm} \quad h = 250 \text{ mm} \quad c = 39 \text{ mm} \quad t = 5 \text{ mm} \quad f_{yb} = 500 \frac{\text{N}}{\text{mm}^2} \quad f_u = 550 \frac{\text{N}}{\text{mm}^2} \quad \gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Relative slenderness: $\lambda_{rLT} := \sqrt{\frac{2 \cdot W_{eff,y} \cdot I \cdot f_{yb}}{M_{cr}}} \quad \lambda_{rLT} = 0.37 \quad \alpha_{LT} := 0.34 \quad \phi_{LT} := 0.5 \cdot \left[1 + \alpha_{LT} \cdot (\lambda_{rLT} - 0.2) + \lambda_{rLT}^2 \right] \quad \phi_{LT} = 0.6$

$$\chi_{LT,y} := \min \left(\frac{1}{\phi_{LT} + \sqrt{\phi_{LT}^2 - \lambda_{rLT}^2}}, 1 \right) \quad \chi_{LT,y} = 0.94 \quad \chi_{LT} := \begin{cases} \chi_{LT,y} & \text{if } I_{yy} \geq I_{zz} \\ 1 & \text{otherwise} \end{cases} \quad \text{Reduction buckling factor: } \chi_{LT} = 0.94$$

Design buckling resistance moment EN 1993-1-1:6.3 and EN 1993-1-3: 6.2.4:

Design buckling moment resistance double profile based on effective section modulus W_{eff} .

$$M_{b,Rd} := \frac{\chi_{LT} \cdot M_{yy,crk}}{\gamma_{M1}}$$

$$M_{b,Rd} = 175.83 \text{ kN}\cdot\text{m}$$

Check Uniform built-up member EN 1993-1-1: 6.4

bow imperfection: $e_0 := \frac{L}{500}$

non-dimensional slenderness: $\lambda_1 = 64.38$ if $\left(\frac{cc_{batt}}{i_z} \leq 70, \text{"OK"}, \text{"Shorter-cc.bat"} \right) = \text{"OK"}$

Effective second moment of area of battened built-up member:

$$h_0 := d + 2 \cdot e_1 \quad h_0 = 167 \text{ mm} \quad \text{distance centroids of chords}$$

$$I_{L,CC} := 0.5 \cdot h_0^2 \cdot A_{ch} + 2 \cdot I_{ch} \quad \text{I built-up member}$$

$$i_{0,CC} := \sqrt{\frac{I_{L,CC}}{2 \cdot A_{ch}}}$$

$$A_{ch} := A_g \quad \text{: area of one chord}$$

$$I_{ch} := I_z \quad \text{: I of one chord}$$

$$\lambda_{CC} := \frac{L_z}{i_{0,CC}} \quad \lambda_{CC} = 33.87$$

EN 1993-1-1: table 6.8

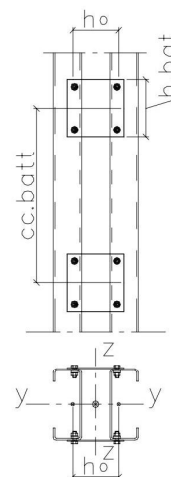
Efficiency factor:

$$I_{L,CC} = 4.15 \times 10^7 \text{ mm}^4$$

$$\mu_{CC} := \begin{cases} 0 & \text{if } \lambda_{CC} \geq 150 \\ \left(2 - \frac{\lambda_{CC}}{75} \right) & \text{if } 75 < \lambda_{CC} < 150 \\ 1.0 & \text{if } \lambda_{CC} \leq 75 \end{cases}$$

$$\mu_{CC} = 1$$

$$r_{CC} := 2$$



$$I_{eff} := 0.5 \cdot h_0^2 \cdot A_{ch} + 2 \cdot \mu_{CC} \cdot I_{ch} \quad I_{eff} = 4.15 \times 10^7 \text{ mm}^4 \quad \text{effective I of built-up member}$$

Shear stiffness EN 1993-1-1:6.4.3.1:(2)

$$I_b := \frac{t_{batt} \cdot h_{batt}^3}{12} \quad \text{I of batten}$$

$$n_{batt} := 2 \quad \text{number of planes of lacings}$$

$$S_v := \min \left[\frac{24 \cdot E \cdot I_{ch}}{cc_{batt}^2 \cdot \left(1 + \frac{2 \cdot I_{ch}}{n_{batt} \cdot I_b} \cdot \frac{h_0}{cc_{batt}} \right)}, \left(\frac{2 \cdot \pi^2 \cdot E \cdot I_{ch}}{cc_{batt}^2} \right) \right] \quad S_v = 6416 \text{ kN}$$

effective critical force of built-up member:

$$N_{cr,CC} := \frac{\pi^2 \cdot E \cdot I_{eff}}{L_z^2} \quad N_{cr,CC} = 8947.21 \text{ kN}$$

Maximum moment in middle of built-up member: EN 1993-1-1:6.4.1 (6):

$$M_{z,Ed,I} := \max(|M_{Ed,1,z}|, |M_{Ed,2,z}|) \quad \text{moment with second order effects}$$

moment with second order effects

$$M_{z,Ed,C} := \frac{N_{Ed} \cdot e_0 + M_{z,Ed,I}}{1 - \frac{N_{Ed}}{N_{cr,CC}} - \frac{N_{Ed}}{S_v}}$$

$$M_{z,Ed,C} = 0.93 \text{ kN}\cdot\text{m}$$

Compression force in one member: EN 1993-1-1:6.4.1 (6) Compression force in built-up member taking account to second order effects:

$$X_d := \begin{cases} 1 & \text{if } d \geq 8 \text{ mm} \\ 0 & \text{otherwise} \end{cases}$$

$$\chi_{ch,Ed} := \frac{N_{Ed}}{r_{CC}} + \frac{|M_{z,Ed,C}| \cdot h_0 \cdot A_{ch} \cdot X_d}{2 \cdot I_{eff}}$$

$$N_{ch,Ed} = 93.66 \text{ kN}$$

$$b = 100 \text{ mm} \quad h = 250 \text{ mm} \quad c = 39 \text{ mm} \quad t = 5 \text{ mm}$$

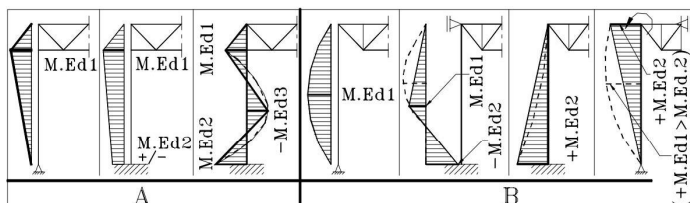
$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2} \quad f_u = 550 \frac{\text{N}}{\text{mm}^2} \quad \gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Interaction formula according to EN 1993-1-1: 6.3.3 (4) eqv.(6.61+6.62):

The interaction factors k_{yy} and k_{zy} are obtained from Annex B with **method 2** of EN 1993-1-1: 6.3.3(4)

Equivalent uniform moment factors: EN 1993-1-1, Annex B, Table B.3

Moment distribution like shown on figure: Moment_dis = "A"



$$\psi_{m,A} = 0 \quad \psi_{m,B} = 0 \quad \psi_{m,z} = 0$$

$$\alpha_{h,2} = 0 \quad \alpha_{h,2,z} = 0 \quad \alpha_{s,2} = 1$$

$$C_{my,2,A} := 0.9 \quad C_{my,2,B} = 1$$

$$C_{my,2} = 0.9 \quad C_{mz,2} = 0.95$$

$$C_{mLT,2} = 0.6$$

Interaction factors k_{ij} for members susceptible to torsional deformations: EN 1993-1-1, Annex B, Table B.2

$$n_{y,2} := \frac{N_{Ed} \cdot \gamma_{M1}}{\chi_{y,FBcc} \cdot N_{cc,Rk}} \quad n_{y,2} = 0.11 \quad n_{z,2} := \frac{N_{Ed} \cdot \gamma_{M1}}{\chi_{z,FBcc} \cdot N_{cc,Rk}} \quad n_{z,2} = 0.1$$

$$k_{yy,2} := \min \left[C_{my,2} \cdot (1 + 0.6 \cdot \lambda_{r,z,FBcc} \cdot n_{y,2}), C_{my,2} \cdot (1 + 0.6 \cdot n_{y,2}) \right] \quad k_{yy,2} = 0.95$$

$$k_{zy,2} := \max \left(1 - \frac{0.05 \cdot \lambda_{r,z,FBcc}}{C_{mLT,2} - 0.25} \cdot n_{z,2}, 1 - \frac{0.05}{C_{mLT,2} - 0.25} \cdot n_{z,2} \right) \quad k_{zy,2} = 0.99$$

$$k_{zz,2} := \min \left[C_{mz,2} \cdot (1 + 0.6 \cdot \lambda_{r,z,FBcc} \cdot n_{z,2}), C_{mz,2} \cdot (1 + 0.6 \cdot n_{z,2}) \right] \quad k_{zz,2} = 0.98 \quad k_{yz,2} := k_{zz,2}$$

$$I_{zz,eff} := 2 \cdot I_z + A_g \cdot \left(e_1 + \frac{d}{2} \right)^2 + A_{eff} \cdot \left(e_N + \frac{d}{2} \right)^2 \quad W_{zz,eff} := \frac{I_{zz,eff}}{b + \frac{d}{2}} \quad I_{zz,eff} = 3.88 \times 10^7 \text{ mm}^4 \quad M_{zz,cRk} := W_{zz,eff} \cdot f_{yb}$$

$$W_{zz,eff} = 2.59 \times 10^5 \text{ mm}^3$$

Reduction factor
for L-T buckling:
 $\chi_{LT} = 0.94$

Reduction factor
for F-buckling:
 $\chi_{y,FBcc} = 0.81$
 $\chi_{z,FBcc} = 0.9$

Double CC-profile: Combined bending and axial compression EN 1993-1-3: 6.1.9 (1):

$$\frac{\max(N_{Ed}, N_{Ed,1}) \cdot \gamma_{M0}}{2 \cdot N_{c,Rk}} + \frac{\max(|M_{Ed,1}|, |M_{Ed,2}|, |M_{Ed,3}|) \cdot \gamma_{M0}}{2 \cdot M_{y,cRk}} + \frac{|M_{z,Ed,C}| \cdot \gamma_{M0}}{M_{z,cRk}} = 0.68 < 1.0$$

Double CC-profile: Combined M + N + V acc to EN 1993-1-3: 6.1.10

$$\frac{V_{Ed} \cdot \gamma_{M0}}{2 \cdot V_{bh,Rk,pillar}} = 0.39 < 1.0 \text{ according to EN 1993-1-3: 6.1.10} \quad M_{N,V_{EC}} = 0 < 1.0$$

Double CC-profile: Combined bending and axial compression EN 1993-1-1: 6.3.3 (4):

Evading in y-y:

$$\frac{N_{Ed} \cdot \gamma_{M1}}{\chi_{y,FBcc} \cdot N_{cc,Rk}} + k_{yy,2} \cdot \frac{\max(|M_{Ed,1}|, |M_{Ed,2}|, |M_{Ed,3}|) \cdot \gamma_{M1}}{\chi_{LT} \cdot M_{yy,cRk}} + k_{yz,2} \cdot \frac{|M_{z,Ed,C}| \cdot \gamma_{M1}}{M_{z,cRk}} = 0.71 < 1.0$$

Evading in z-z:

$$\psi_{c,N} := \frac{N_{Ed}}{N_{Ed,1}} \quad k_{c,N} := \frac{1}{1.33 - 0.33 \cdot \psi_{c,N}} \quad k_{c,N} = 1 \quad \text{EN 1993-1-1 Tab. 6.6}$$

$$\frac{\max(N_{Ed}, N_{Ed,1}) \cdot k_{c,N} \cdot \gamma_{M1}}{\chi_{z,FBcc} \cdot N_{cc,Rk}} + k_{zy,2} \cdot \frac{\max(|M_{Ed,1}|, |M_{Ed,2}|, |M_{Ed,3}|) \cdot \gamma_{M1}}{\chi_{LT} \cdot M_{yy,cRk}} + k_{zz,2} \cdot \frac{|M_{z,Ed,C}| \cdot \gamma_{M1}}{M_{z,cRk}} = 0.73 < 1.0$$

$$b = 100 \text{ mm} \quad h = 250 \text{ mm} \quad c = 39 \text{ mm} \quad t = 5 \text{ mm}$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2} \quad f_u = 550 \frac{\text{N}}{\text{mm}^2} \quad \gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

The chords and battens are checked for the actual moments and forces according to EN 1993-1-1:6.4.3.1 (1).

Procedure to calculate the elastic critical buckling moment M_{cr} for singly symmetric sections is taken from: "The North American Specification for the Design of Cold-Formed Steel Structural Members" 2001.

$$M_{y,\max,C} := \max(|M_{Ed,1}|, |M_{Ed,2}|, |M_{Ed,3}|) \cdot 0.5 \quad M_{y,\max,C} = 55 \text{ kN}\cdot\text{m}$$

$$\text{Moment at quarter point of unbraced segment:} \quad x_{1_4} := 0.25 \cdot cc_{batt} \quad M_{y,AA} := 0.5 \cdot M_{y,Ed,ccbatt_A}(x_{1_4}) \quad M_{y,AA} = 30.25 \text{ kN}\cdot\text{m}$$

$$\text{Moment at centerline of unbraced segment:} \quad x_{1_2} := 0.5 \cdot cc_{batt} \quad M_{y,BA} := 0.5 \cdot M_{y,Ed,ccbatt_A}(x_{1_2}) \quad M_{y,BA} = 38.5 \text{ kN}\cdot\text{m}$$

$$\text{Moment at 3/4-point of unbraced segment:} \quad x_{3_4} := 0.75 \cdot cc_{batt} \quad M_{y,CA} := 0.5 \cdot M_{y,Ed,ccbatt_A}(x_{3_4}) \quad M_{y,CA} = 46.75 \text{ kN}\cdot\text{m}$$

$$C_{bA} := \frac{12.5 \cdot M_{y,\max,C}}{2.5 \cdot M_{y,\max,C} + 3 \cdot |M_{y,AA}| + 4 \cdot |M_{y,BA}| + 3 \cdot |M_{y,CA}|} \quad y_{0,cr} := (y_M + e_{1c,rc}) \cdot -1 \quad z_{0,cr} := 0 \cdot \text{mm} \quad (\text{coord. shear centre})$$

$$\sigma_{ez} := \frac{\pi^2 \cdot E}{\left(\frac{1 \cdot cc_{batt}}{i_z}\right)^2} \quad \sigma_{ez} = 1295.74 \frac{\text{N}}{\text{mm}^2} \quad r_0 := \sqrt{i_y^2 + i_z^2 + y_{0,cr}^2 + z_{0,cr}^2} \quad \text{Polar radius of gyration about shear center}$$

$$\sigma_T := \frac{1}{A_g \cdot r_0^2} \cdot \left(G \cdot I_T + \frac{\pi^2 \cdot E \cdot I_\omega}{cc_{batt}^2} \right) \quad \sigma_T = 1074.55 \frac{\text{N}}{\text{mm}^2}$$

Elastic critical moment for singly-symmetric sections, bending about the axis of symmetry:

$$M_{e,cr,C_A} := C_{bA} \cdot r_0 \cdot A_g \cdot \sqrt{\sigma_{ez} \cdot \sigma_T} \quad M_{e,cr,C_A} = 503.8 \text{ kN}\cdot\text{m}$$

$$\text{Relative slenderness:} \quad \lambda_{rLT,C_A} := \begin{cases} \sqrt{\frac{W_{eff,y,1} \cdot f_{yb}}{M_{e,cr,C_A}}} & \text{if } M_{e,cr,C_A} > 0 \\ 0.2 & \text{if } M_{e,cr,C_A} = 0 \end{cases}$$

$$\lambda_{rLT,C_A} = 0.43 \quad \text{Imperfection factor } \alpha \text{ rel. to buckling curve b:} \quad \alpha_{LT,C} := 0.34$$

$$\phi_{LT,C_A} := 0.5 \cdot \left[1 + \alpha_{LT,C} \cdot (\lambda_{rLT,C_A} - 0.2) + \lambda_{rLT,C_A}^2 \right] \quad \chi_{LT,C_A} := \min\left(\frac{1}{\phi_{LT,C_A} + \sqrt{\phi_{LT,C_A}^2 - \lambda_{rLT,C_A}^2}}, 1\right) \quad \chi_{LT,C_A} = 0.91$$

$$\phi_{LT,C_A} = 0.63$$

For moment distribution accord. to modell B:

$$q_{wind_pillar} := \frac{|M_{Ed,1} \cdot 0.5| \cdot 8}{L^2} \quad M_{y,i}(x_i) := \frac{q_{wind_pillar}}{2} \cdot (L \cdot x_i - x_i^2)$$

$$\text{Moment at quarter point of unbraced segment:} \quad x_{1_4} := \frac{L - cc_{batt}}{2} + \frac{1}{4} \cdot cc_{batt} \quad x_{1_4} = 0.88 \text{ m} \quad M_{y,i}(x_{1_4}) = 50.05 \text{ kN}\cdot\text{m} \quad M_{y,AB} := M_{y,i}(x_{1_4})$$

$$M_{y,AB} = 50.05 \text{ kN}\cdot\text{m}$$

$$\text{Moment at centerline of unbraced segment:} \quad x_{1_2} := \frac{L - cc_{batt}}{2} + \frac{1}{2} \cdot cc_{batt} \quad x_{1_2} = 1.25 \text{ m} \quad M_{y,i}(x_{1_2}) = 55 \text{ kN}\cdot\text{m} \quad M_{y,BB} := M_{y,i}(x_{1_2})$$

$$M_{y,BB} = 55 \text{ kN}\cdot\text{m}$$

$$\text{Moment at 3/4-point of unbraced segment:} \quad x_{3_4} := \frac{L - cc_{batt}}{2} + \frac{3}{4} \cdot cc_{batt} \quad x_{3_4} = 1.63 \text{ m} \quad M_{y,i}(x_{3_4}) = 50.05 \text{ kN}\cdot\text{m} \quad M_{y,CB} := M_{y,i}(x_{3_4})$$

$$M_{y,CB} = 50.05 \text{ kN}\cdot\text{m}$$

$$C_{bB} := \frac{12.5 \cdot (|M_{Ed,1} \cdot 0.5|)}{2.5 \cdot (|M_{Ed,1} \cdot 0.5|) + 3 \cdot M_{y,AB} + 4 \cdot M_{y,BB} + 3 \cdot M_{y,CB}}$$

Elastic critical moment for singly-symmetric sections, bending about the axis of symmetry:

$$M_{e,cr,C_B} := C_{bB} \cdot r_0 \cdot A_g \cdot \sqrt{\sigma_{ez} \cdot \sigma_T} \quad M_{e,cr,C_B} = 400.2 \text{ kN}\cdot\text{m}$$

$$\text{Relative slenderness:} \quad \lambda_{rLT,C_B} := \begin{cases} \sqrt{\frac{W_{eff,y,1} \cdot f_{yb}}{M_{e,cr,C_B}}} & \text{if } M_{e,cr,C_B} > 0 \\ 0.2 & \text{if } M_{e,cr,C_B} = 0 \end{cases}$$

$$\phi_{LT,C_B} := 0.5 \cdot \left[1 + \alpha_{LT,C} \cdot (\lambda_{rLT,C_B} - 0.2) + \lambda_{rLT,C_B}^2 \right]$$

$$\lambda_{rLT,C_B} = 0.48 \quad \phi_{LT,C_B} = 0.67$$

$$\chi_{LT,C_B} := \min\left(\frac{1}{\phi_{LT,C_B} + \sqrt{\phi_{LT,C_B}^2 - \lambda_{rLT,C_B}^2}}, 1\right) \quad \chi_{LT,C_B} = 0.89$$

$$\text{Moment distribution:} \quad \text{Moment_dis} = "A" \quad \chi_{LT,C} := \begin{cases} \chi_{LT,C_A} & \text{if Moment_dis} = "A" \\ \chi_{LT,C_B} & \text{if Moment_dis} = "B" \end{cases} \quad \chi_{LT,C} = 0.91$$

$$b = 100 \text{ mm} \quad h = 250 \text{ mm} \quad c = 39 \text{ mm} \quad t = 5 \text{ mm} \quad f_{yb} = 500 \frac{\text{N}}{\text{mm}^2} \quad f_u = 550 \frac{\text{N}}{\text{mm}^2} \quad \gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Stresses on one member profile at mid-span from above: chord force from above: $N_{ch.Ed} = 93.66 \text{ kN}$ max moment y-y: $M_{y,max.C} = 55 \text{ kN}\cdot\text{m}$

Chord at end panel: highest shear force: $V_{Ed,max} := \pi \cdot \frac{M_{z.Ed.C}}{L} \quad V_{Ed,max} = 1.17 \text{ kN} \quad V_{ch} := \frac{V_{Ed,max}}{r_{CC}} \quad V_{ch} = 0.59 \text{ kN}$

$$V_{bb,Rd} = 274.24 \text{ kN} \quad \frac{V_{ch}}{V_{bb,Rd}} = 0.002 \quad \ll 1,0 \text{ The shear force is negligible}$$

Chord at end panel: "corner" moment: $M_{z,ch} := \frac{V_{Ed,max}}{r_{CC}} \cdot \frac{cc_{batt}}{2} \quad \text{maximum moment z-z:} \quad M_{z,ch} = 0.44 \text{ kN}\cdot\text{m}$

maximum chord force at batten (end): $M_{z.Ed.C,end} := M_{z.Ed.C} \cdot \sin\left(\frac{\pi \cdot cc_{batt}}{L}\right) \quad M_{z.Ed.C,end} = 0.89 \text{ kN}\cdot\text{m}$ moment due to bow imperfection at end of panel

maximum compression force: $N_{ch,end} := \frac{N_{Ed}}{r_{CC}} + M_{z.Ed.C,end} \cdot \frac{(h_0 \cdot A_{ch})}{(2 \cdot I_{eff})} \quad N_{ch,end} = 93.43 \text{ kN}$

Interaction factors kij for members susceptible to torsional deformations: EN 1993-1-1, Annex B, Table B.2

$$n_{y,C.2} := \frac{N_{ch,end} \cdot \gamma_{M1}}{\chi_{y,FB}(cc_{batt}) \cdot N_{c,Rk}} \quad n_{y,C.2} = 0.09 \quad n_{z,C.2} := \frac{N_{ch,end} \cdot \gamma_{M1}}{\chi_{z,FB}(cc_{batt}) \cdot N_{c,Rk}} \quad n_{z,C.2} = 0.11 \quad \chi_{y,FB}(cc_{batt}) = 0.99 \quad \chi_{z,FB}(cc_{batt}) = 0.86$$

Equivalent uniform moment factors:

Moment_dis = "A"

Moment at start of unbraced segment: $x_{0_0} := 0 \cdot cc_{batt} \quad M_{y,A0} := 0.5 \cdot M_{y,Ed,ccbatt_A}(x_{0_0}) \quad M_{y,A0} = 22 \text{ kN}\cdot\text{m}$

Moment at end of unbraced segment: $M_{y,max.C} = 55 \text{ kN}\cdot\text{m}$

$$\psi_{m.C.A} := \frac{M_{y,A0}}{\begin{cases} M_{Ed,1} \cdot 0.5 & \text{if } |M_{Ed,1}| \geq |M_{Ed,2}| \\ M_{Ed,2} \cdot 0.5 & \text{if } |M_{Ed,1}| < |M_{Ed,2}| \end{cases}} \quad \psi_{m.C.A} = 0.4 \quad \text{range for model "A"}$$

Moment at centerline of unbraced segment: $x_{1_2} := \frac{L - cc_{batt}}{2} + \frac{1}{2} \cdot cc_{batt} \quad x_{1_2} = 1.25 \text{ m} \quad M_{y,i}(x_{1_2}) = 55 \text{ kN}\cdot\text{m} \quad M_{y,BB} := M_{y,i}(x_{1_2}) \quad M_{y,BB} = 55 \text{ kN}\cdot\text{m}$

Moment at start of unbraced segment: $x_{0_0} := \frac{L - cc_{batt}}{2} + 0 \cdot cc_{batt} \quad x_{0_0} = 0.5 \text{ m} \quad M_{y,i}(x_{0_0}) = 35.2 \text{ kN}\cdot\text{m} \quad M_{y,B0} := M_{y,i}(x_{0_0}) \quad M_{y,B0} = 35.2 \text{ kN}\cdot\text{m}$

$$\alpha_{h,C.2} := \frac{|M_{y,B0}|}{|M_{y,BB}|} \quad \alpha_{h,C.2} = 0.64 \quad \psi_{m.C.B} := 1 \quad \text{range for model "B"}$$

$$C_{mLT,C.2} := \begin{cases} \max(0.6 + 0.4 \cdot \psi_{m.C.A}, 0.4) & \text{if Moment_dis = "A"} \\ (0.95 + 0.05 \cdot \alpha_{h,C.2}) & \text{if Moment_dis = "B"} \end{cases} \quad C_{mLT,C.2} = 0.760 \quad C_{my,C.2} := C_{mLT,C.2} \quad C_{mz,C.2} := 1$$

Interaction factors kij for members susceptible to torsional deformations: EN 1993-1-1, Annex B, Table B.2

$$\lambda_{r,y,FB}(cc_{batt}) = 0.22 \quad k_{yy,C.2} := \min[C_{my,C.2} \cdot (1 + 0.6 \cdot \lambda_{r,y,FB}(cc_{batt}) \cdot n_{y,C.2}), C_{my,C.2} \cdot (1 + 0.6 \cdot n_{y,C.2})] \quad k_{yy,C.2} = 0.77$$

$$\lambda_{r,z,FB}(cc_{batt}) = 0.56 \quad k_{zz,C.2} := \min[C_{mz,C.2} \cdot (1 + 0.6 \cdot \lambda_{r,z,FB}(cc_{batt}) \cdot n_{z,C.2}), C_{mz,C.2} \cdot (1 + 0.6 \cdot n_{z,C.2})] \quad k_{zz,C.2} = 1.04$$

$$k_{zy,C.2} := \max\left(1 - \frac{0.05 \cdot \lambda_{r,z,FB}(cc_{batt})}{C_{my,C.2} - 0.25} \cdot n_{z,C.2}, 1 - \frac{0.05}{C_{mLT,C.2} - 0.25} \cdot n_{z,C.2}\right) \quad k_{zy,C.2} = 0.99 \quad k_{yz,C.2} := k_{zz,C.2}$$

$$b = 100 \text{ mm} \quad h = 250 \text{ mm} \quad c = 39 \text{ mm} \quad t = 5 \text{ mm}$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2} \quad f_u = 550 \frac{\text{N}}{\text{mm}^2} \quad \gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Control single C-profile between battens:

$$M_{y,\max,C} = 55 \text{ kN}\cdot\text{m} \quad M_{z,\text{ch}} = 0.44 \text{ kN}\cdot\text{m}$$

$$\Delta M_{z,\text{shift}} := \left| \Delta e_N \cdot N_{\text{ch},\text{end}} \right| \quad \Delta M_{z,\text{shift}} = 0.41 \text{ kN}\cdot\text{m} \quad N_{\text{ch},\text{end}} = 93.43 \text{ kN}$$

Buckling moment resistance y-y

EN 1993-1-1:6.3 and EN 1993-1-3: 6.2.4:

$$M_{y,Rk,C} := \chi_{LT,C} \cdot M_{y,cRk} \quad \chi_{LT,C} = 0.91 \quad M_{y,Rk,C} = 85.63 \text{ kN}\cdot\text{m}$$

Buckling resistance moment z-z

EN 1993-1-1:6.3 and EN 1993-1-3: 6.2.4:

$$M_{z,Rk,C} := \min(M_{z1cRk}, M_{z2cRk}) \quad M_{z,Rk,C} = 26.77 \text{ kN}\cdot\text{m}$$

Resistance for one profile buckling mode

flexural buckling-: y-y

$$cc_{\text{batt}} = 1.5 \text{ m} \quad \chi_{y,FB}(cc_{\text{batt}}) = 0.99 \quad N_{b,Rk,y,FB}(cc_{\text{batt}}) = 993.25 \text{ kN}$$

Resistance for one profile buckling mode

flexural buckling-: z-z

$$cc_{\text{batt}} = 1.5 \text{ m} \quad \chi_{z,FB}(cc_{\text{batt}}) = 0.86 \quad N_{b,Rk,z,FB}(cc_{\text{batt}}) = 856.42 \text{ kN}$$

Resistance for one profile buckling mode

-torsional or torsional-flexural

$$cc_{\text{batt}} = 1.5 \text{ m} \quad \chi_{TF}(cc_{\text{batt}}, cc_{\text{batt}}) = 0.82 \quad N_{b,Rk,TF}(cc_{\text{batt}}, cc_{\text{batt}}) = 821.9 \text{ kN}$$

single C-profile: Axial compression EN 1993-1-1: 6.3.1 (3): Buckling about relevant axis in mid-span or en panel of built-up member

$$\frac{\max(N_{\text{ch},\text{Ed}}, N_{\text{ch},\text{end}}) \cdot \gamma_{M1}}{\min(\chi_{y,FB}(cc_{\text{batt}}), \chi_{z,FB}(cc_{\text{batt}}), \chi_{TF}(cc_{\text{batt}}, cc_{\text{batt}})) \cdot N_{c,Rk}} = 0.11 < 1.0$$

Control built-up member: single C-profile (chords) in mid-span of member:

Combined bending an axial compression EN 1993-1-3: 6.1.9 (1):

$$\frac{N_{\text{ch},\text{Ed}} \cdot \gamma_{M0}}{N_{c,Rk}} + \frac{M_{y,\max,C} \cdot \gamma_{M0}}{M_{y,cRk}} + \frac{(|\Delta M_{z,\text{shift}}|) \cdot \gamma_{M0}}{M_{z,Rk,C}} = 0.70 < 1.0$$

Combined bending and axial compression EN 1993-1-1: 6.3.3 (4):

$$\begin{aligned} \text{Evading in y-y:} \quad & \frac{N_{\text{ch},\text{Ed}} \cdot \gamma_{M1}}{\chi_{y,FB}(cc_{\text{batt}}) \cdot N_{c,Rk}} + k_{yy,C.2} \cdot \frac{M_{y,\max,C} \cdot \gamma_{M1}}{\chi_{LT,C} \cdot M_{y,cRk}} + k_{yz,C.2} \cdot \frac{(|\Delta M_{z,\text{shift}}|) \cdot \gamma_{M1}}{M_{z,Rk,C}} = 0.6 < 1.0 \\ \text{Evading in z-z:} \quad & \frac{N_{\text{ch},\text{Ed}} \cdot \gamma_{M1}}{\chi_{z,FB}(cc_{\text{batt}}) \cdot N_{c,Rk}} + k_{zy,C.2} \cdot \frac{M_{y,\max,C} \cdot \gamma_{M1}}{\chi_{LT,C} \cdot M_{y,cRk}} + k_{zz,C.2} \cdot \frac{(|\Delta M_{z,\text{shift}}|) \cdot \gamma_{M1}}{M_{z,Rk,C}} = 0.76 < 1.0 \end{aligned}$$

Control built-up member: single C-profile (chords) at end panel of member:

Combined bending an axial compression EN 1993-1-3: 6.1.9 (1):

$$\frac{N_{\text{ch},\text{end}} \cdot \gamma_{M0}}{N_{c,Rk}} + \frac{M_{y,\max,C} \cdot \gamma_{M0}}{M_{y,cRk}} + \frac{(M_{z,\text{ch}} + |\Delta M_{z,\text{shift}}|) \cdot \gamma_{M0}}{M_{z,Rk,C}} = 0.71 < 1.0$$

Combined bending and axial compression EN 1993-1-1: 6.3.3 (4):

$$\begin{aligned} \text{Evading in y-y:} \quad & \frac{N_{\text{ch},\text{end}} \cdot \gamma_{M1}}{\chi_{y,FB}(cc_{\text{batt}}) \cdot N_{c,Rk}} + k_{yy,C.2} \cdot \frac{M_{y,\max,C} \cdot \gamma_{M1}}{\chi_{LT,C} \cdot M_{y,cRk}} + k_{yz,C.2} \cdot \frac{(M_{z,\text{ch}} + |\Delta M_{z,\text{shift}}|) \cdot \gamma_{M1}}{M_{z,Rk,C}} = 0.62 < 1.0 \\ \text{Evading in z-z:} \quad & \frac{N_{\text{ch},\text{end}} \cdot \gamma_{M1}}{\chi_{z,FB}(cc_{\text{batt}}) \cdot N_{c,Rk}} + k_{zy,C.2} \cdot \frac{M_{y,\max,C} \cdot \gamma_{M1}}{\chi_{LT,C} \cdot M_{y,cRk}} + k_{zz,C.2} \cdot \frac{(M_{z,\text{ch}} + |\Delta M_{z,\text{shift}}|) \cdot \gamma_{M1}}{M_{z,Rk,C}} = 0.78 < 1.0 \end{aligned}$$

$$b = 100 \text{ mm} \quad h = 250 \text{ mm} \quad c = 39 \text{ mm} \quad t = 5 \text{ mm}$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2} \quad f_u = 550 \frac{\text{N}}{\text{mm}^2} \quad \gamma_{M0} = 1.00$$

$$\gamma_{M1} = 1.00$$

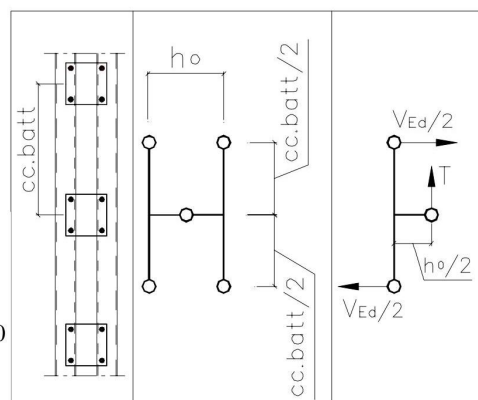
Forces on battens: max shear flow in one batten:

$$T_{\text{batt}} := \frac{V_{\text{Ed,max}} \cdot c_{\text{c batt}}}{h_0 \cdot r_{\text{CC}}} \quad T_{\text{batt}} = 5.27 \text{ kN}$$

max moment in one batten:

$$M_{\text{batt}} := \frac{T_{\text{batt}} \cdot h_0}{2} \quad M_{\text{batt}} = 0.44 \text{ kN} \cdot \text{m}$$

$$\lambda_{w,\text{batt}} := 0.346 \cdot \frac{h_{\text{batt}}}{t_{\text{batt}}} \cdot \sqrt{\frac{f_{yb}}{E}} \quad f_{v,\text{batt}} := \begin{cases} \frac{1}{\sqrt{3}} \cdot f_{yb} & \text{if } \lambda_{w,\text{batt}} \leq 0.83 \\ 0.48 \cdot \frac{f_{yb}}{\lambda_{w,\text{batt}}} & \text{if } 0.83 < \lambda_{w,\text{batt}} < 1.40 \\ 0.67 \cdot \frac{f_{yb}}{\lambda_{w,\text{batt}}^2} & \text{if } \lambda_{w,\text{batt}} \geq 1.40 \end{cases}$$



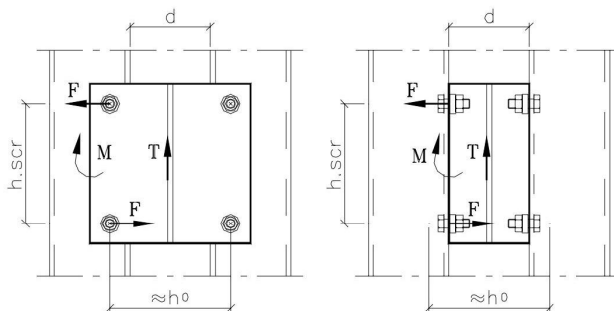
$$V_{\text{bbatt,Rd}} := \frac{h_{\text{batt}} \cdot t_{\text{batt}} \cdot f_{v,\text{batt}}}{\gamma_{M0}} \quad V_{\text{bbatt,Rd}} = 227.45 \text{ kN}$$

$$\frac{T_{\text{batt}}}{V_{\text{bbatt,Rd}}} = 0.02 < 1,0$$

$$M_{\text{Rd,batt}} := \frac{f_{yb}}{\gamma_{M0}} \cdot \frac{t_{\text{batt}} \cdot h_{\text{batt}}^2}{6} \quad M_{\text{Rd,batt}} = 13.33 \text{ kN} \cdot \text{m}$$

$$\frac{M_{\text{batt}}}{M_{\text{Rd,batt}}} = 0.03 < 1,0$$

Forces on screws:



$$h_{\text{scr}} := 150 \cdot \text{mm} \quad n_c := 2 \quad \text{numbers of screws on one side of one PPK}$$

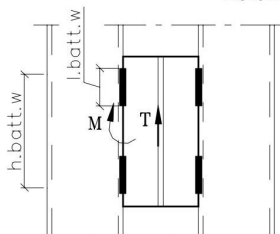
$$T_{\text{batt}} = 5.27 \text{ kN} \quad F := \frac{T_{\text{batt}} \cdot h_0}{2 \cdot h_{\text{scr}}} \quad F = 2.94 \text{ kN}$$

$$F_{\text{screw}} := \sqrt{F^2 + \left(\frac{T_{\text{batt}}}{n_c} \right)^2}$$

$$F_{\text{screw}} = 3.95 \text{ kN} = \text{force on one screw} < 30 \text{ kN}$$

Forces on weld:

$$\text{welding high: } h_{\text{batt,w}} := 150 \cdot \text{mm} \quad \text{welding length: } l_{\text{batt,w}} := 2 \cdot 40 \cdot \text{mm} \quad \text{welding } t: a_{\text{batt,w}} := 4 \cdot \text{mm}$$



$$\sigma_{\text{batt,w}} := \frac{3 \cdot T_{\text{batt}} \cdot h_0}{a_{\text{batt,w}} \cdot h_{\text{batt,w}}^2} \quad \tau_{\text{batt,w}} := \frac{T_{\text{batt}}}{l_{\text{batt,w}} \cdot a_{\text{batt,w}}}$$

$$\sigma_{V,\text{batt,w}} := \sqrt{\sigma_{\text{batt,w}}^2 + 3 \cdot \tau_{\text{batt,w}}^2}$$

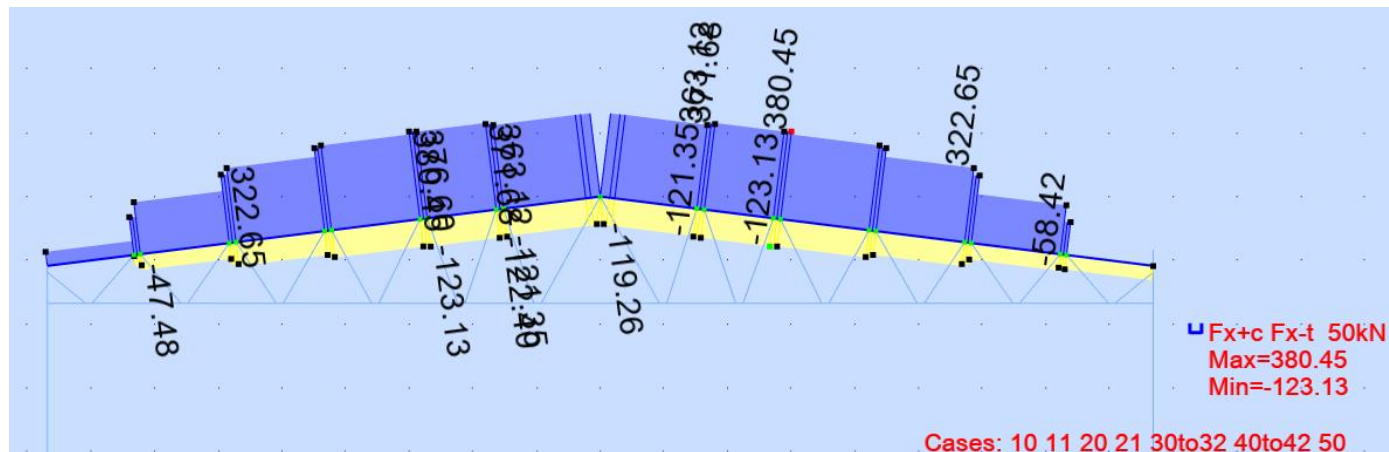
$$\sigma_{V,\text{batt,w}} = 40.95 \frac{\text{N}}{\text{mm}^2} = \text{stress in one weld}$$

5.6 POSUDEK VAZNÍKU (MSÚ)

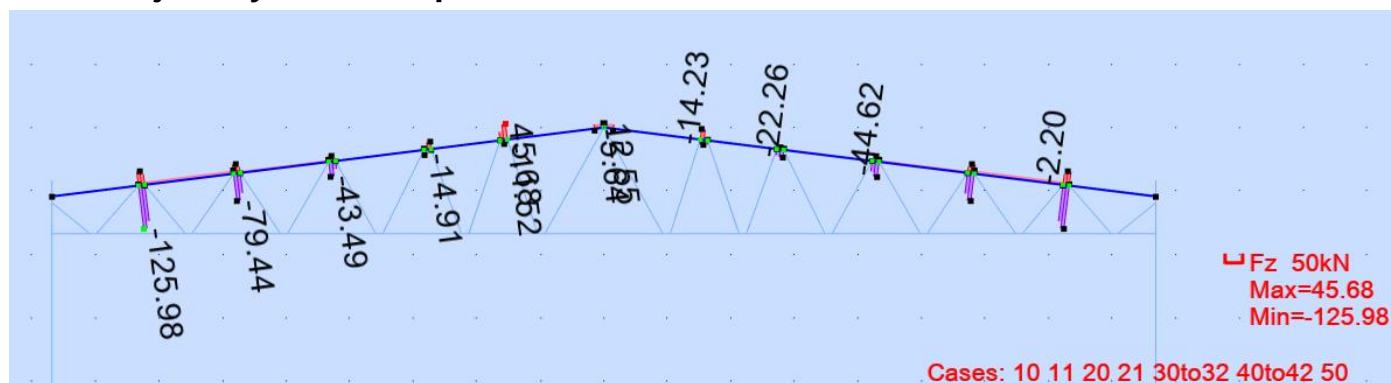
HORNÍ PAS

VNITŘNÍ SÍLY

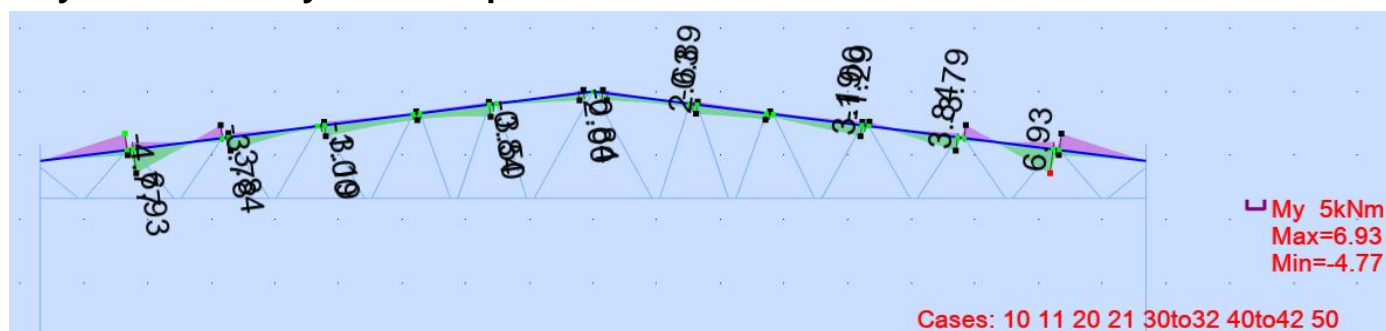
Normálové síly v horním pasu vazníku



Posouvající síly v horním pasu vazníku



Ohybové momenty v horním pasu vazníku



POSUDEK HORNÍHO PASU VAZNÍKU

Horní pas

4

74 %

Profil: Vzpěr

10 Snow

Materiál:

Prvek	Typ	Member type	Profil	Délka [m]	Materiál	Hmotnost [kg]	A [m²]	A_eff [m²]	Komb. N_Ed
4	Top	Top beam	H 112x120x5	1.529	HX500LAD	15.39	2090	2090	10
5	Top	Top beam	H 112x120x5	1.529	HX500LAD	15.39	2090	2090	10
12	Top	Top beam	H 112x120x5	0.118	HX500LAD	15.39	2090	2090	10
13	Top	Top beam	H 112x120x5	0.118	HX500LAD	15.39	2090	2090	10
16	Top	Top beam	H 112x120x5	1.092	HX500LAD	15.39	2090	2090	10
17	Top	Top beam	H 112x120x5	1.092	HX500LAD	15.39	2090	2090	10
24	Top	Top beam	H 112x120x5	0.114	HX500LAD	15.39	2090	2090	10
25	Top	Top beam	H 112x120x5	0.114	HX500LAD	15.39	2090	2090	10
28	Top	Top beam	H 112x120x5	1.4	HX500LAD	15.39	2090	2090	10
29	Top	Top beam	H 112x120x5	1.4	HX500LAD	15.39	2090	2090	10
36	Top	Top beam	H 112x120x5	0.11	HX500LAD	15.39	2090	2090	10
37	Top	Top beam	H 112x120x5	0.11	HX500LAD	15.39	2090	2090	10
40	Top	Top beam	H 112x120x5	1.404	HX500LAD	15.39	2090	2090	10
41	Top	Top beam	H 112x120x5	1.404	HX500LAD	15.39	2090	2090	10
48	Top	Top beam	H 112x120x5	0.106	HX500LAD	15.39	2090	2090	10
49	Top	Top beam	H 112x120x5	0.106	HX500LAD	15.39	2090	2090	10
52	Top	Top beam	H 112x120x5	1.408	HX500LAD	15.39	2090	2090	30
53	Top	Top beam	H 112x120x5	1.408	HX500LAD	15.39	2090	2090	10
60	Top	Top beam	H 112x120x5	0.1	HX500LAD	15.39	2090	2090	10
61	Top	Top beam	H 112x120x5	0.1	HX500LAD	15.39	2090	2090	10
64	Top	Top beam	H 112x120x5	1.372	HX500LAD	15.39	2090	2090	30
65	Top	Top beam	H 112x120x5	1.372	HX500LAD	15.39	2090	2090	30

Vnitřní síly:

Prvek	Typ	Profil	N_Ed [kN]	N_t,Ed [kN]	N_c,Ed [kN]	M_z,Ed [kNm]	V_y,Ed [kN]	dM_z,Ed [kNm]	Komb. N_Ed
4	Top	H 112x120x5	363.12	-119.26	363.12	-0.25	-1.48	0	10
5	Top	H 112x120x5	363.12	-119.26	363.12	-0.25	-1.48	0	10
12	Top	H 112x120x5	371.68	-121.35	371.68	-2.63	10.2	0	10
13	Top	H 112x120x5	371.68	-121.35	371.68	-2.63	10.2	0	10
16	Top	H 112x120x5	376.6	-122.4	376.6	-1.59	-0.19	0	10
17	Top	H 112x120x5	376.6	-122.4	376.6	-1.59	-0.19	0	10
24	Top	H 112x120x5	377.88	-123.13	380.45	-1.83	5.63	0	10
25	Top	H 112x120x5	380.45	-123.13	380.45	-1.83	-14.9	0	10
28	Top	H 112x120x5	368.17	-118.71	368.17	-3.19	3.37	0	10
29	Top	H 112x120x5	368.17	-118.71	368.17	-3.19	3.37	0	10
36	Top	H 112x120x5	357.87	-116.06	360.44	-3.19	-22.94	0	10
37	Top	H 112x120x5	357.87	-116.06	360.44	-3.19	-22.94	0	10
40	Top	H 112x120x5	322.65	-103.75	322.65	-3.84	5.7	0	10
41	Top	H 112x120x5	322.65	-103.75	322.65	-3.84	5.7	0	10
48	Top	H 112x120x5	293.78	-94.65	297.38	3.78	-79.44	0	10
49	Top	H 112x120x5	293.78	-94.65	293.78	3.78	-79.44	0	10
52	Top	H 112x120x5	225.84	-68.92	225.84	-6.48	8.78	0	30
53	Top	H 112x120x5	212.49	-71.29	212.49	-6.93	9.54	0	10
60	Top	H 112x120x5	143.04	-47.48	164.56	4.77	-125.98	0	10
61	Top	H 112x120x5	143.04	-58.42	143.04	4.77	-125.97	0	10
64	Top	H 112x120x5	30.57	-4.84	60.9	4.03	3.39	0	30
65	Top	H 112x120x5	-38.74	-62.47	-1.2	4.7	3.24	0	30

Vzpěr:

Prvek	Typ	Profil	X _y [-]	N _{y,b,Rd} [kN]		N _{z,b,Rd} [kN]	X _t [-]	N _{b,t,Rd} [kN]	X _{tf} [-]	N _{b,tf,Rd} [kN]
4	Top	H 112x120x5	0.91	950.33	0.9	937.81	0.5	520.09	0.47	487.79
5	Top	H 112x120x5	0.91	950.33	0.9	937.81	0.5	520.09	0.47	487.79
12	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
13	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
16	Top	H 112x120x5	0.96	1001.68	0.95	993.75	0.69	719.63	0.66	693.46
17	Top	H 112x120x5	0.96	1001.68	0.95	993.75	0.69	719.63	0.66	693.46
24	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
25	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
28	Top	H 112x120x5	0.92	966.13	0.91	955.13	0.55	574.02	0.52	542.1
29	Top	H 112x120x5	0.92	966.13	0.91	955.13	0.55	574.02	0.52	542.1
36	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
37	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
40	Top	H 112x120x5	0.92	965.73	0.91	954.69	0.55	572.56	0.52	540.61
41	Top	H 112x120x5	0.92	965.73	0.91	954.69	0.55	572.56	0.52	540.61
48	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
49	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
52	Top	H 112x120x5	0.92	965.15	0.91	954.06	0.55	570.46	0.52	538.49
53	Top	H 112x120x5	0.92	965.15	0.91	954.06	0.55	570.46	0.52	538.49
60	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
61	Top	H 112x120x5	1	1045	1	1045	1	1045	1	1045
64	Top	H 112x120x5	0.93	969.52	0.92	958.84	0.56	586.61	0.53	554.9
65	Top	H 112x120x5	0.93	969.52	0.92	958.84	1	0	1	0

Pevnosti:

Prvek	Typ	Profil	N _{c,Rd} [kN]	N _{t,Rd} [kN]	N _{b,Rd} [kN]	Vy _{c,Rd} [kN]	M _{z,c,Rd,ten} [kNm]	M _{z,c,Rd,com} [kNm]	Komb. N _{Ed}
4	Top	H 112x120x5	1066.82	1080	937.81	333.5	35.44	39.93	10
5	Top	H 112x120x5	1066.82	1080	937.81	333.5	35.44	39.93	10
12	Top	H 112x120x5	1066.82	1080	1045	333.5	35.44	39.93	10
13	Top	H 112x120x5	1066.82	1080	1045	333.5	35.44	39.93	10
16	Top	H 112x120x5	1066.82	1080	993.75	333.5	35.44	39.93	10
17	Top	H 112x120x5	1066.82	1080	993.75	333.5	35.44	39.93	10
24	Top	H 112x120x5	1066.82	1080	1045	333.5	35.44	39.93	10
25	Top	H 112x120x5	1066.82	1080	1045	333.5	35.44	39.93	10
28	Top	H 112x120x5	1066.82	1080	955.13	333.5	35.44	39.93	10
29	Top	H 112x120x5	1066.82	1080	955.13	333.5	35.44	39.93	10
36	Top	H 112x120x5	1066.82	1080	1045	333.5	35.44	39.93	10
37	Top	H 112x120x5	1066.82	1080	1045	333.5	35.44	39.93	10
40	Top	H 112x120x5	1066.82	1080	954.69	333.5	35.44	39.93	10
41	Top	H 112x120x5	1066.82	1080	954.69	333.5	35.44	39.93	10
48	Top	H 112x120x5	1066.82	1080	1045	333.5	39.93	35.44	10
49	Top	H 112x120x5	1066.82	1080	1045	333.5	39.93	35.44	10
52	Top	H 112x120x5	1066.82	1080	954.06	333.5	35.44	39.93	30
53	Top	H 112x120x5	1066.82	1080	954.06	333.5	35.44	39.93	10
60	Top	H 112x120x5	1066.82	1080	1045	333.5	39.93	35.44	10
61	Top	H 112x120x5	1066.82	1080	1045	333.5	39.93	35.44	10
64	Top	H 112x120x5	1066.82	1080	958.84	333.5	39.93	35.44	30
65	Top	H 112x120x5	1066.82	1080	958.84	333.5	39.93	38.38	30

Profil:

Prvek	Profil	N _c [%]	N _t [%]	N _{cM} z [%]	N _{cM} z2 [%]	V _y [%]	N _t [%]	N _b [%]	NyMy Mz [%]	NzMy Mz [%]	Profil [%]	Rozh. profil	Komb. N _{Ed}
4	H 112x120x5	34	0	35	33	0	14	74	42	43	74	Vzpěr	10
5	H 112x120x5	34	0	35	33	0	14	74	42	43	74	Vzpěr	10
12	H 112x120x5	35	0	41	27	3	1	36	41	41	41	Tlak a ohyb	10
13	H 112x120x5	35	0	41	27	3	1	36	41	41	41	Tlak a ohyb	10
16	H 112x120x5	35	0	39	31	0	10	54	43	43	54	Vzpěr	10
17	H 112x120x5	35	0	39	31	0	10	54	43	43	54	Vzpěr	10
24	H 112x120x5	35	0	40	30	2	1	36	40	40	40	Tlak a ohyb	10
25	H 112x120x5	36	0	40	30	4	1	36	40	40	40	Tlak a ohyb	10
28	H 112x120x5	35	0	42	26	1	13	68	45	46	68	Vzpěr	10
29	H 112x120x5	35	0	42	26	1	13	68	45	46	68	Vzpěr	10
36	H 112x120x5	34	0	42	25	7	1	34	41	41	42	Tlak a ohyb	10
37	H 112x120x5	34	0	42	25	7	1	34	41	41	42	Tlak a ohyb	10
40	H 112x120x5	30	0	40	19	2	13	60	42	43	60	Vzpěr	10
41	H 112x120x5	30	0	40	19	2	13	60	42	43	60	Vzpěr	10
48	H 112x120x5	28	0	38	18	24	1	28	36	36	38	Tlak a ohyb	10
49	H 112x120x5	28	0	38	18	24	1	28	36	36	38	Tlak a ohyb	10
52	H 112x120x5	21	0	37	3	3	13	42	38	39	42	Vzpěr	30
53	H 112x120x5	20	0	37	0	3	13	39	38	38	39	Vzpěr	10
60	H 112x120x5	13	0	27	1	38	1	14	29	29	38	Smyk	10
61	H 112x120x5	13	0	27	1	38	1	14	29	29	38	Smyk	10
64	H 112x120x5	3	0	14	7	1	13	6	13	13	14	Tlak a ohyb	30
65	H 112x120x5	0	4	15	9	1	0	0	0	0	15	Tah a ohyb	30

Spoje:

Prvek	Profil	Spoj	N _{t,Ed} [kN]	N _{c,Ed} [kN]	F _v [%]	F _{b,c} [%]	F _{b,t} [%]	F _n [%]	V _{eff} [%]	Spoj [%]	Rozh. spoj
4	H 112x120x5	HC06	-119.26	363.12	70	60	20	16	0	70	Střih
5	H 112x120x5	HC06	-119.26	363.12	70	60	20	16	0	70	Střih
12	H 112x120x5	X02	-121.35	371.68	0	0	0	16	0	16	Osl.průřez
13	H 112x120x5	X02	-121.35	371.68	0	0	0	16	0	16	Osl.průřez
16	H 112x120x5	X02	-122.4	376.6	0	0	0	16	0	16	Osl.průřez
17	H 112x120x5	X02	-122.4	376.6	0	0	0	16	0	16	Osl.průřez
24	H 112x120x5	X02	-123.13	380.45	0	0	0	16	0	16	Osl.průřez
25	H 112x120x5	X02	-123.13	380.45	0	0	0	16	0	16	Osl.průřez
28	H 112x120x5	X02	-118.71	368.17	0	0	0	16	0	16	Osl.průřez
29	H 112x120x5	X02	-118.71	368.17	0	0	0	16	0	16	Osl.průřez
36	H 112x120x5	X02	-116.06	360.44	0	0	0	15	0	15	Osl.průřez
37	H 112x120x5	X02	-116.06	360.44	0	0	0	15	0	15	Osl.průřez
40	H 112x120x5	HH06	-103.75	322.65	62	47	15	14	0	62	Střih
41	H 112x120x5	HH06	-103.75	322.65	62	47	15	14	0	62	Střih
48	H 112x120x5	X02	-94.65	297.38	0	0	0	12	0	12	Osl.průřez
49	H 112x120x5	X02	-94.65	293.78	0	0	0	12	0	12	Osl.průřez
52	H 112x120x5	X02	-68.92	225.84	0	0	0	9	0	9	Osl.průřez
53	H 112x120x5	X02	-71.29	212.49	0	0	0	9	0	9	Osl.průřez
60	H 112x120x5	X02	-47.48	164.56	0	0	0	6	0	6	Osl.průřez
61	H 112x120x5	X02	-58.42	143.04	0	0	0	8	0	8	Osl.průřez
64	H 112x120x5	HC04	-4.84	60.9	18	14	1	1	0	18	Střih
65	H 112x120x5	HC04	-62.47	-1.2	18	0	14	8	0	18	Střih

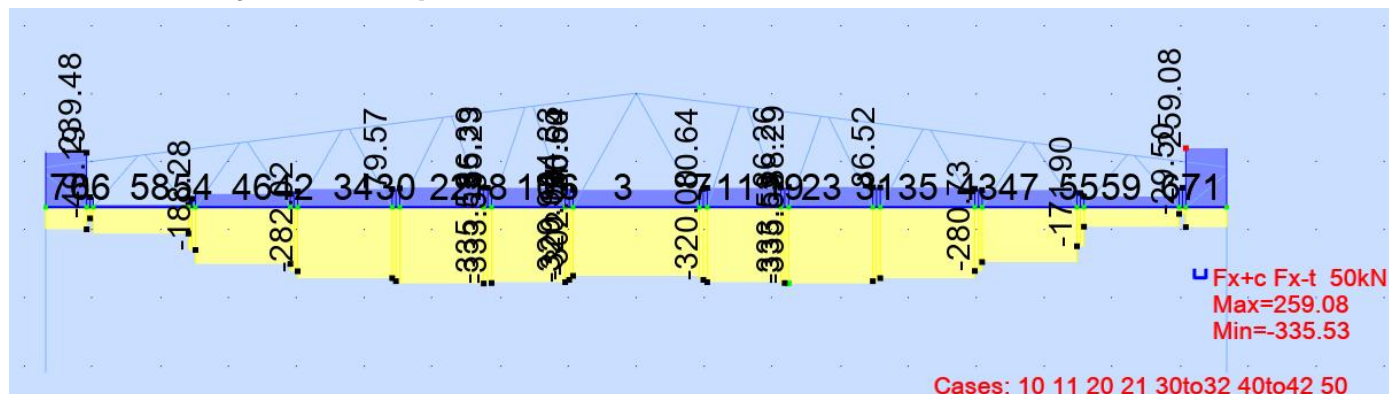
Souhrn:

Prvek	Member type	Profil	Materiál	Komb. N_Ed	Profil [%]	Spoj [%]	Vyhodnocení	Posouzení
4	Top beam	H 112x120x5	HX500LAD	10	74	70	Vzpěr	Vyhovuje
5	Top beam	H 112x120x5	HX500LAD	10	74	70	Vzpěr	Vyhovuje
12	Top beam	H 112x120x5	HX500LAD	10	41	16	Tlak a ohyb	Vyhovuje
13	Top beam	H 112x120x5	HX500LAD	10	41	16	Tlak a ohyb	Vyhovuje
16	Top beam	H 112x120x5	HX500LAD	10	54	16	Vzpěr	Vyhovuje
17	Top beam	H 112x120x5	HX500LAD	10	54	16	Vzpěr	Vyhovuje
24	Top beam	H 112x120x5	HX500LAD	10	40	16	Tlak a ohyb	Vyhovuje
25	Top beam	H 112x120x5	HX500LAD	10	40	16	Tlak a ohyb	Vyhovuje
28	Top beam	H 112x120x5	HX500LAD	10	68	16	Vzpěr	Vyhovuje
29	Top beam	H 112x120x5	HX500LAD	10	68	16	Vzpěr	Vyhovuje
36	Top beam	H 112x120x5	HX500LAD	10	42	15	Tlak a ohyb	Vyhovuje
37	Top beam	H 112x120x5	HX500LAD	10	42	15	Tlak a ohyb	Vyhovuje
40	Top beam	H 112x120x5	HX500LAD	10	60	62	Střih	Vyhovuje
41	Top beam	H 112x120x5	HX500LAD	10	60	62	Střih	Vyhovuje
48	Top beam	H 112x120x5	HX500LAD	10	38	12	Tlak a ohyb	Vyhovuje
49	Top beam	H 112x120x5	HX500LAD	10	38	12	Tlak a ohyb	Vyhovuje
52	Top beam	H 112x120x5	HX500LAD	30	42	9	Vzpěr	Vyhovuje
53	Top beam	H 112x120x5	HX500LAD	10	39	9	Vzpěr	Vyhovuje
60	Top beam	H 112x120x5	HX500LAD	10	38	6	Smyk	Vyhovuje
61	Top beam	H 112x120x5	HX500LAD	10	38	8	Smyk	Vyhovuje
64	Top beam	H 112x120x5	HX500LAD	30	14	18	Střih	Vyhovuje
65	Top beam	H 112x120x5	HX500LAD	30	15	18	Střih	Vyhovuje

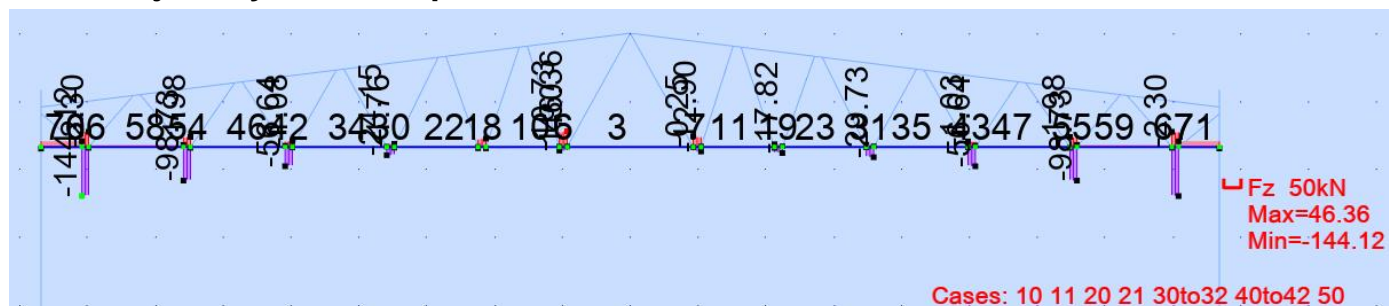
DOLNÍ PAS

VNITŘNÍ SÍLY

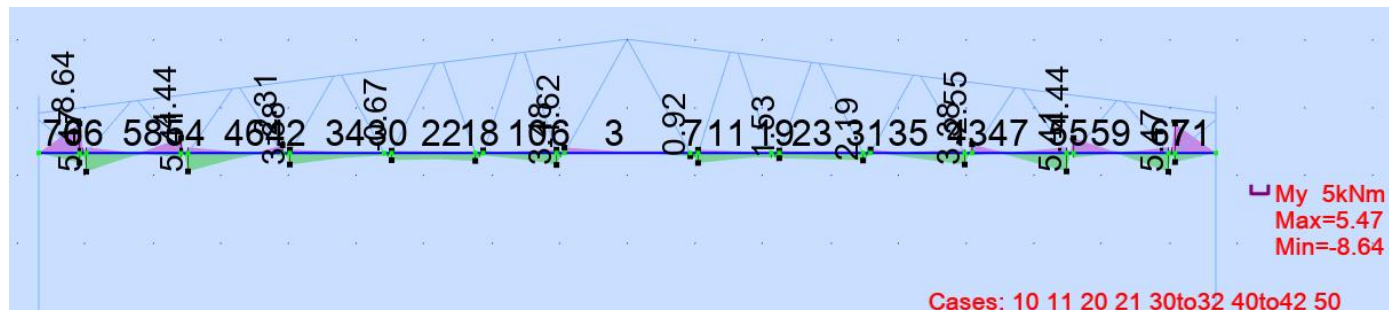
Normálové síly v dolním pasu vazníku



Posouvající síly v dolním pasu vazníku



Ohybové momenty v dolním pasu vazníku



POSUDEK DOLNÍHO PASU VAZNÍKU

Dolní pas 71 75 % Spoj: Strih 30 Snow + reduced wind
Materiál:

Prvek	Typ	Member type	Profil	Délka [m]	Materiál	Hmotnost [kg]	A [m²]	A_eff [m²]	Komb. N_Ed
3	Bottom	Bottom beam 6.0m	H 110x119x4	1.858	HX420LAD	12.32	1591.47	1591.47	50
6	Bottom	Bottom beam 6.0m	H 110x119x4	0.115	HX420LAD	12.32	1591.47	1591.47	10
7	Bottom	Bottom beam 6.0m	H 110x119x4	0.115	HX420LAD	12.32	1591.47	1591.47	10
10	Bottom	Bottom beam 6.0m	H 110x119x4	1.082	HX420LAD	12.32	1591.47	1591.47	10
11	Bottom	Bottom beam 6.0m	H 110x119x4	1.082	HX420LAD	12.32	1591.47	1591.47	10
18	Bottom	Bottom beam 6.0m	H 110x119x4	0.117	HX420LAD	12.32	1591.47	1591.47	10
19	Bottom	Bottom beam 6.0m	H 110x119x4	0.117	HX420LAD	12.32	1591.47	1591.47	10
22	Bottom	Bottom beam 6.0m	H 110x119x4	1.235	HX420LAD	12.32	1591.47	1591.47	10
23	Bottom	Bottom beam 6.0m	H 110x119x4	1.235	HX420LAD	12.32	1591.47	1591.47	10
30	Bottom	Bottom beam 4.5m	H 110x119x4	0.112	HX420LAD	12.32	1591.47	1591.47	10
31	Bottom	Bottom beam 4.5m	H 110x119x4	0.112	HX420LAD	12.32	1591.47	1591.47	10
34	Bottom	Bottom beam 4.5m	H 110x119x4	1.39	HX420LAD	12.32	1591.47	1591.47	10
35	Bottom	Bottom beam 4.5m	H 110x119x4	1.39	HX420LAD	12.32	1591.47	1591.47	10
42	Bottom	Bottom beam 4.5m	H 112x120x5	0.108	HX500LAD	15.39	2090	2090	10
43	Bottom	Bottom beam 4.5m	H 112x120x5	0.108	HX500LAD	15.39	2090	2090	10
46	Bottom	Bottom beam 4.5m	H 112x120x5	1.394	HX500LAD	15.39	2090	2090	10
47	Bottom	Bottom beam 4.5m	H 112x120x5	1.394	HX500LAD	15.39	2090	2090	10
54	Bottom	Bottom beam 4.5m	H 112x120x5	0.103	HX500LAD	15.39	2090	2090	30
55	Bottom	Bottom beam 4.5m	H 112x120x5	0.103	HX500LAD	15.39	2090	2090	10
58	Bottom	Bottom beam 4.5m	H 112x120x5	1.4	HX500LAD	15.39	2090	2090	30
59	Bottom	Bottom beam 4.5m	H 112x120x5	1.4	HX500LAD	15.39	2090	2090	10
66	Bottom	Bottom beam 1.5m	H 112x120x5	0.099	HX500LAD	15.39	2090	2090	10
67	Bottom	Bottom beam 1.5m	H 112x120x5	0.099	HX500LAD	15.39	2090	2090	10
70	Bottom	Bottom beam 1.5m	H 112x120x5	0.602	HX500LAD	15.39	2090	2090	10
71	Bottom	Bottom beam 1.5m	H 112x120x5	0.602	HX500LAD	15.39	2090	2090	30

Vnitřní síly:

Prvek	Typ	Profil	N_Ed [kN]	N_t,Ed [kN]	N_c,Ed [kN]	M_z,Ed [kNm]	V_y,Ed [kN]	dM_z,Ed [kNm]	Komb. N_Ed
3	Bottom	H 110x119x4	75.5	-302.04	75.5	0.23	0	0	50
6	Bottom	H 110x119x4	-320	-320	80.64	2.89	-28.98	0	10
7	Bottom	H 110x119x4	-320	-320	80.64	2.89	-28.98	0	10
10	Bottom	H 110x119x4	-329.94	-329.94	84.33	2.89	2.35	0	10
11	Bottom	H 110x119x4	-329.94	-329.94	84.6	2.89	2.35	0	10
18	Bottom	H 110x119x4	-333.53	-333.53	85.23	1.53	-4.93	0	10
19	Bottom	H 110x119x4	-333.53	-333.53	86.26	1.53	-4.93	0	10
22	Bottom	H 110x119x4	-335.53	-335.53	86.39	2.09	0.98	0	10
23	Bottom	H 110x119x4	-335.53	-335.53	88.29	2.09	0.98	0	10
30	Bottom	H 110x119x4	-325.61	-325.61	82.98	2.09	21.01	0	10
31	Bottom	H 110x119x4	-325.61	-325.61	87.22	2.09	21.01	0	10
34	Bottom	H 110x119x4	-312.13	-312.13	79.57	3.38	-0.38	0	10
35	Bottom	H 110x119x4	-312.13	-312.13	86.52	3.38	-0.38	0	10
42	Bottom	H 112x120x5	-280.73	-282.02	69.53	3.38	53.49	0	10
43	Bottom	H 112x120x5	-280.73	-280.73	81	3.38	53.49	0	10
46	Bottom	H 112x120x5	-241.53	-249.56	58.28	5.41	-3.19	0	10
47	Bottom	H 112x120x5	-241.53	-241.53	75.17	5.41	-3.19	0	10
54	Bottom	H 112x120x5	-188.28	-188.28	36.47	4.95	84.5	0	30
55	Bottom	H 112x120x5	-171.9	-171.9	61.72	-4.44	98.73	0	10
58	Bottom	H 112x120x5	-112.3	-116.14	11.1	5.22	-5.13	0	30
59	Bottom	H 112x120x5	-86.18	-86.18	46.5	5.47	-6.03	0	10
66	Bottom	H 112x120x5	44.5	-49.19	44.5	-8.64	144.12	0	10
67	Bottom	H 112x120x5	44.5	-29.5	84.96	-8.64	144.12	0	10
70	Bottom	H 112x120x5	239.48	-97.46	239.48	-4.31	-16.77	0	10
71	Bottom	H 112x120x5	259.08	-88.01	259.08	-8.24	-15.91	0	30

Vzpěr:

Prvek	Typ	Profil	X _y [-]	N _{y,b,Rd} [kN]		N _{z,b,Rd} [kN]	X _t [-]	N _{b,t,Rd} [kN]	X _{tf} [-]	N _{b,tf,Rd} [kN]
3	Bottom	H 110x119x4	0.31	205.61	0.87	582.21	0.44	293.43	0.22	145.56
6	Bottom	H 110x119x4	0.31	205.61	1	668.42	1	0	1	0
7	Bottom	H 110x119x4	0.31	205.61	1	668.42	1	0	1	0
10	Bottom	H 110x119x4	0.31	205.61	0.96	642.38	1	0	1	0
11	Bottom	H 110x119x4	0.31	205.61	0.96	642.38	1	0	1	0
18	Bottom	H 110x119x4	0.31	205.61	1	668.42	1	0	1	0
19	Bottom	H 110x119x4	0.31	205.61	1	668.42	1	0	1	0
22	Bottom	H 110x119x4	0.31	205.61	0.94	631.48	1	0	1	0
23	Bottom	H 110x119x4	0.31	205.61	0.94	631.48	1	0	1	0
30	Bottom	H 110x119x4	0.48	319.34	1	668.42	1	0	1	0
31	Bottom	H 110x119x4	0.48	319.34	1	668.42	1	0	1	0
34	Bottom	H 110x119x4	0.48	319.34	0.93	620.08	1	0	1	0
35	Bottom	H 110x119x4	0.48	319.34	0.93	620.08	1	0	1	0
42	Bottom	H 112x120x5	0.43	447.1	1	1045	1	0	1	0
43	Bottom	H 112x120x5	0.43	447.1	1	1045	1	0	1	0
46	Bottom	H 112x120x5	0.43	447.1	0.91	955.99	1	0	1	0
47	Bottom	H 112x120x5	0.43	447.1	0.91	955.99	1	0	1	0
54	Bottom	H 112x120x5	0.43	447.1	1	1045	1	0	1	0
55	Bottom	H 112x120x5	0.43	447.1	1	1045	1	0	1	0
58	Bottom	H 112x120x5	0.43	447.1	0.91	955.23	1	0	1	0
59	Bottom	H 112x120x5	0.43	447.1	0.91	955.23	1	0	1	0
66	Bottom	H 112x120x5	0.91	953.98	1	1045	1	1045	0.91	951.86
67	Bottom	H 112x120x5	0.91	953.98	1	1045	1	1045	0.91	951.86
70	Bottom	H 112x120x5	0.91	953.98	1	1045	0.89	931.83	0.83	865.22
71	Bottom	H 112x120x5	0.91	953.98	1	1045	0.89	931.83	0.83	865.22

Pevnosti:

Prvek	Typ	Profil	N _{c,Rd} [kN]	N _{t,Rd} [kN]	N _{b,Rd} [kN]	Vy _{c,Rd} [kN]	M _{z,c,Rd,ten} [kNm]	M _{z,c,Rd,com} [kNm]	Komb. N _{Ed}
3	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.4	50
6	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.25	10
7	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.25	10
10	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.25	10
11	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.25	10
18	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.25	10
19	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.25	10
22	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.25	10
23	Bottom	H 110x119x4	671.68	695.3	205.61	224.11	25.37	22.25	10
30	Bottom	H 110x119x4	671.68	695.3	319.34	224.11	25.37	22.25	10
31	Bottom	H 110x119x4	671.68	695.3	319.34	224.11	25.37	22.25	10
34	Bottom	H 110x119x4	671.68	695.3	319.34	224.11	25.37	22.25	10
35	Bottom	H 110x119x4	671.68	695.3	319.34	224.11	25.37	22.25	10
42	Bottom	H 112x120x5	1066.82	1080	447.1	333.5	39.93	38.38	10
43	Bottom	H 112x120x5	1066.82	1080	447.1	333.5	39.93	38.38	10
46	Bottom	H 112x120x5	1066.82	1080	447.1	333.5	39.93	38.38	10
47	Bottom	H 112x120x5	1066.82	1080	447.1	333.5	39.93	38.38	10
54	Bottom	H 112x120x5	1066.82	1080	447.1	333.5	39.93	38.38	30
55	Bottom	H 112x120x5	1066.82	1080	447.1	333.5	35.44	39.93	10
58	Bottom	H 112x120x5	1066.82	1080	447.1	333.5	39.93	38.38	30
59	Bottom	H 112x120x5	1066.82	1080	447.1	333.5	39.93	38.38	10
66	Bottom	H 112x120x5	1066.82	1080	953.98	333.5	35.44	39.93	10
67	Bottom	H 112x120x5	1066.82	1080	953.98	333.5	35.44	39.93	10
70	Bottom	H 112x120x5	1066.82	1080	953.98	333.5	35.44	39.93	10
71	Bottom	H 112x120x5	1066.82	1080	953.98	333.5	35.44	39.93	30

Profil:

Prvek	Profil	N _c [%]	N _t [%]	N _{cM} z [%]	N _{cM} z2 [%]	V _y [%]	N _t [%]	N _b [%]	NyMy Mz [%]	NzMy Mz [%]	Profil [%]	Rozh. profil	Komb. N _{Ed}
3	H 110x119x4	11	0	12	10	0	54	52	38	14	52	Štíhlost	50
6	H 110x119x4	0	46	57	33	13	0	0	0	0	57	Tah a ohyb	10
7	H 110x119x4	0	46	57	33	13	0	0	0	0	57	Tah a ohyb	10
10	H 110x119x4	0	47	59	34	1	0	0	0	0	59	Tah a ohyb	10
11	H 110x119x4	0	47	59	34	1	0	0	0	0	59	Tah a ohyb	10
18	H 110x119x4	0	48	54	41	2	0	0	0	0	54	Tah a ohyb	10
19	H 110x119x4	0	48	54	41	2	0	0	0	0	54	Tah a ohyb	10
22	H 110x119x4	0	48	57	39	0	0	0	0	0	57	Tah a ohyb	10
23	H 110x119x4	0	48	57	39	0	0	0	0	0	57	Tah a ohyb	10
30	H 110x119x4	0	47	55	37	9	0	0	0	0	55	Tah a ohyb	10
31	H 110x119x4	0	47	55	37	9	0	0	0	0	55	Tah a ohyb	10
34	H 110x119x4	0	45	58	30	0	0	0	0	0	58	Tah a ohyb	10
35	H 110x119x4	0	45	58	30	0	0	0	0	0	58	Tah a ohyb	10
42	H 112x120x5	0	26	34	17	16	0	0	0	0	34	Tah a ohyb	10
43	H 112x120x5	0	26	34	17	16	0	0	0	0	34	Tah a ohyb	10
46	H 112x120x5	0	22	36	8	1	0	0	0	0	36	Tah a ohyb	10
47	H 112x120x5	0	22	36	8	1	0	0	0	0	36	Tah a ohyb	10
54	H 112x120x5	0	17	30	5	25	0	0	0	0	30	Tah a ohyb	30
55	H 112x120x5	0	16	28	5	30	0	0	0	0	30	Smyk	10
58	H 112x120x5	0	10	23	3	2	0	0	0	0	23	Tah a ohyb	30
59	H 112x120x5	0	8	22	6	2	0	0	0	0	22	Tah a ohyb	10
66	H 112x120x5	4	0	26	20	43	13	5	16	24	43	Smyk	10
67	H 112x120x5	4	0	26	20	43	13	5	16	24	43	Smyk	10
70	H 112x120x5	22	0	33	10	5	13	28	45	42	45	Vzpěr za ohybu	10
71	H 112x120x5	24	0	45	1	5	13	30	46	43	46	Vzpěr za ohybu	30

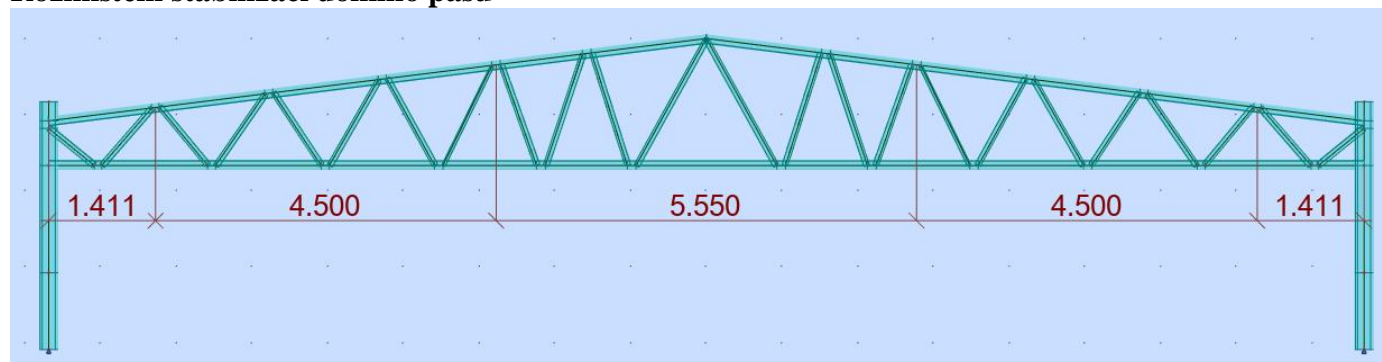
Spoje:

Prvek	Profil	Spoj	N _{t,Ed} [kN]	N _{c,Ed} [kN]	F _v [%]	F _{b,c} [%]	F _{b,t} [%]	F _n [%]	V _{eff} [%]	Spoj [%]	Rozh. spoj
3	H 110x119x4	HH06	-302.04	75.5	58	16	64	57	0	64	Otlačení
6	H 110x119x4	X02	-320	80.64	0	0	0	60	0	60	Osl.průřez
7	H 110x119x4	X02	-320	80.64	0	0	0	60	0	60	Osl.průřez
10	H 110x119x4	X02	-329.94	84.33	0	0	0	62	0	62	Osl.průřez
11	H 110x119x4	X02	-329.94	84.6	0	0	0	62	0	62	Osl.průřez
18	H 110x119x4	X02	-333.53	85.23	0	0	0	63	0	63	Osl.průřez
19	H 110x119x4	X02	-333.53	86.26	0	0	0	63	0	63	Osl.průřez
22	H 110x119x4	X02	-335.53	86.39	0	0	0	63	0	63	Osl.průřez
23	H 110x119x4	X02	-335.53	88.29	0	0	0	63	0	63	Osl.průřez
30	H 110x119x4	X02	-325.61	82.98	0	0	0	61	0	61	Osl.průřez
31	H 110x119x4	X02	-325.61	87.22	0	0	0	61	0	61	Osl.průřez
34	H 110x119x4	HH06	-312.13	79.57	60	17	66	59	0	66	Otlačení
35	H 110x119x4	HH06	-312.13	86.52	60	18	66	59	0	66	Otlačení
42	H 112x120x5	X02	-282.02	69.53	0	0	0	37	0	37	Osl.průřez
43	H 112x120x5	X02	-280.73	81	0	0	0	37	0	37	Osl.průřez
46	H 112x120x5	X02	-249.56	58.28	0	0	0	33	0	33	Osl.průřez
47	H 112x120x5	X02	-241.53	75.17	0	0	0	32	0	32	Osl.průřez
54	H 112x120x5	X02	-188.28	36.47	0	0	0	25	0	25	Osl.průřez
55	H 112x120x5	X02	-171.9	61.72	0	0	0	23	0	23	Osl.průřez
58	H 112x120x5	X02	-116.14	11.1	0	0	0	15	0	15	Osl.průřez
59	H 112x120x5	X02	-86.18	46.5	0	0	0	11	0	11	Osl.průřez
66	H 112x120x5	X02	-49.19	44.5	0	0	0	6	0	6	Osl.průřez
67	H 112x120x5	X02	-29.5	84.96	0	0	0	4	0	4	Osl.průřez
70	H 112x120x5	HC04	-97.46	239.48	69	55	23	13	0	69	Střih
71	H 112x120x5	HC04	-88.01	259.08	75	60	20	12	0	75	Střih

Souhrn:

Prvek	Member type	Profil	Materiál	Komb. N_Ed	Profil [%]	Spoj [%]	Vyhodnocení	Posouzení
3	Bottom beam 6.0m	H 110x119x4	HX420LAD	50	52	64	Otlačení	Vyhovuje
6	Bottom beam 6.0m	H 110x119x4	HX420LAD	10	57	60	Osl.průřez	Vyhovuje
7	Bottom beam 6.0m	H 110x119x4	HX420LAD	10	57	60	Osl.průřez	Vyhovuje
10	Bottom beam 6.0m	H 110x119x4	HX420LAD	10	59	62	Osl.průřez	Vyhovuje
11	Bottom beam 6.0m	H 110x119x4	HX420LAD	10	59	62	Osl.průřez	Vyhovuje
18	Bottom beam 6.0m	H 110x119x4	HX420LAD	10	54	63	Osl.průřez	Vyhovuje
19	Bottom beam 6.0m	H 110x119x4	HX420LAD	10	54	63	Osl.průřez	Vyhovuje
22	Bottom beam 6.0m	H 110x119x4	HX420LAD	10	57	63	Osl.průřez	Vyhovuje
23	Bottom beam 6.0m	H 110x119x4	HX420LAD	10	57	63	Osl.průřez	Vyhovuje
30	Bottom beam 4.5m	H 110x119x4	HX420LAD	10	55	61	Osl.průřez	Vyhovuje
31	Bottom beam 4.5m	H 110x119x4	HX420LAD	10	55	61	Osl.průřez	Vyhovuje
34	Bottom beam 4.5m	H 110x119x4	HX420LAD	10	58	66	Otlačení	Vyhovuje
35	Bottom beam 4.5m	H 110x119x4	HX420LAD	10	58	66	Otlačení	Vyhovuje
42	Bottom beam 4.5m	H 112x120x5	HX500LAD	10	34	37	Osl.průřez	Vyhovuje
43	Bottom beam 4.5m	H 112x120x5	HX500LAD	10	34	37	Osl.průřez	Vyhovuje
46	Bottom beam 4.5m	H 112x120x5	HX500LAD	10	36	33	Tah a ohyb	Vyhovuje
47	Bottom beam 4.5m	H 112x120x5	HX500LAD	10	36	32	Tah a ohyb	Vyhovuje
54	Bottom beam 4.5m	H 112x120x5	HX500LAD	30	30	25	Tah a ohyb	Vyhovuje
55	Bottom beam 4.5m	H 112x120x5	HX500LAD	10	30	23	Smyk	Vyhovuje
58	Bottom beam 4.5m	H 112x120x5	HX500LAD	30	23	15	Tah a ohyb	Vyhovuje
59	Bottom beam 4.5m	H 112x120x5	HX500LAD	10	22	11	Tah a ohyb	Vyhovuje
66	Bottom beam 1.5m	H 112x120x5	HX500LAD	10	43	6	Smyk	Vyhovuje
67	Bottom beam 1.5m	H 112x120x5	HX500LAD	10	43	4	Smyk	Vyhovuje
70	Bottom beam 1.5m	H 112x120x5	HX500LAD	10	45	69	Střih	Vyhovuje
71	Bottom beam 1.5m	H 112x120x5	HX500LAD	30	46	75	Střih	Vyhovuje

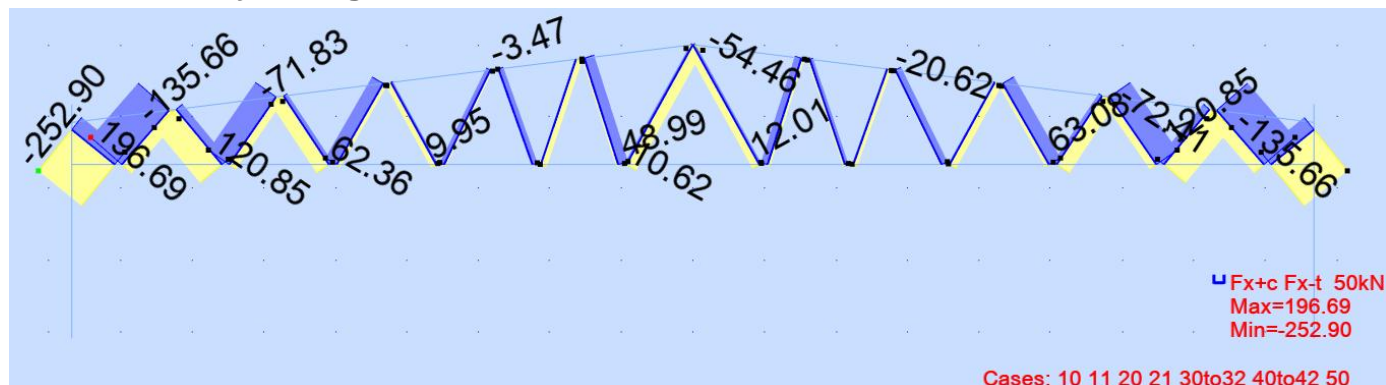
Rozmístění stabilizací dolního pasu



DAIGONÁLY

VNITŘNÍ SÍLY

Normálové síly v diagonálách vazníku



POSUDEK DIAGONÁL VAZNÍKU

Diagonály

56

78 %

Spoj: Vytržení

10 Snow

Materiál:

Prvek	Typ	Member type	Profil	Délka [m]	Materiál	Hmotnost [kg]	A [m²]	A_eff [m²]	Komb. N_Ed
1	Strut	Strut 2 screw	C 100x75x2	1.914	S350GD	4.13	521.08	521.08	10
2	Strut	Strut 2 screw	C 100x75x2	1.914	S350GD	4.13	521.08	521.08	32
8	Strut	Strut 2 screw	C 100x75x2	1.557	S350GD	4.13	521.08	465.39	32
9	Strut	Strut 2 screw	C 100x75x2	1.557	S350GD	4.13	521.08	465.39	10
14	Strut	Strut 2 screw	C 100x75x2	1.549	S350GD	4.13	521.08	521.08	32
15	Strut	Strut 2 screw	C 100x75x2	1.549	S350GD	4.13	521.08	465.39	42
20	Strut	Strut 2 screw	C 100x75x2	1.415	S350GD	4.13	521.08	465.39	32
21	Strut	Strut 2 screw	C 100x75x2	1.415	S350GD	4.13	521.08	521.08	42
26	Strut	Strut 1 screw	C 100x48x2	1.469	S350GD	3.31	415.24	372.73	10
27	Strut	Strut 1 screw	C 100x48x2	1.469	S350GD	3.31	415.24	372.73	32
32	Strut	Strut 1 screw	C 100x75x2	1.308	S350GD	4.13	521.08	521.08	10
33	Strut	Strut 1 screw	C 100x75x2	1.308	S350GD	4.13	521.08	521.08	32
38	Strut	Strut 1 screw	C 100x75x2	1.305	S350GD	4.13	521.08	465.39	10
39	Strut	Strut 1 screw	C 100x75x2	1.305	S350GD	4.13	521.08	465.39	30
44	Strut	Strut 1 screw	C 100x75x2	1.149	S350GD	4.13	521.08	521.08	10
45	Strut	Strut 1 screw	C 100x75x2	1.149	S350GD	4.13	521.08	521.08	30
50	Strut	Strut 2 screw	C 100x77x3	1.149	S350GD	6.19	790.33	790.33	10
51	Strut	Strut 2 screw	C 100x77x3	1.149	S350GD	6.19	790.33	790.33	10
56	Strut	Strut 2 screw	C 100x77x3	1.001	S350GD	6.19	790.33	790.33	10
57	Strut	Strut 2 screw	C 100x77x3	1.001	S350GD	6.19	790.33	790.33	10
62	Strut	Strut 2 screw	C 100x82x4	1.005	HX420LAD	8.93	1150.53	1150.53	10
63	Strut	Strut 2 screw	C 100x82x4	1.005	HX420LAD	8.93	1150.53	1150.53	10
68	Strut	Strut 2 screw	C 100x85x5	0.774	HX500LAD	11.55	1497.77	1497.77	10
69	Strut	Strut 2 screw	C 100x85x5	0.774	HX500LAD	11.55	1497.77	1497.77	10

Vnitřní síly:

Prvek	Typ	Profil	N _{Ed} [kN]	N _{t,Ed} [kN]	N _{c,Ed} [kN]	M _{z,Ed} [kNm]	V _{y,Ed} [kN]	dM _{z,Ed} [kNm]	Komb. N _{Ed}
1	Strut	C 100x75x2	-36.97	-37.02	12.01	0.01	0.01	0	10
2	Strut	C 100x75x2	-54.41	-54.46	10.62	0.01	-0.02	0	32
8	Strut	C 100x75x2	48.99	-12.18	48.99	0	-0.04	0.11	32
9	Strut	C 100x75x2	32.87	-15.02	32.87	0	-0.06	0.07	10
14	Strut	C 100x75x2	-30.09	-30.13	2.85	0.01	0.04	0	32
15	Strut	C 100x75x2	16.56	-11.27	16.56	0	-0.01	0.04	42
20	Strut	C 100x75x2	24.66	-3.47	24.66	0	-0.06	0.05	32
21	Strut	C 100x75x2	-20.58	-20.62	6.04	0	0.03	0	42
26	Strut	C 100x48x2	22.35	-11.71	22.35	0	-0.08	0.04	10
27	Strut	C 100x48x2	30.57	-7.79	30.6	0.01	-0.1	0.06	32
32	Strut	C 100x75x2	-28.23	-28.26	9.95	-0.01	0.15	0	10
33	Strut	C 100x75x2	-35.95	-35.99	7.08	-0.01	0.14	0	32
38	Strut	C 100x75x2	62.36	-20.67	62.36	0	-0.39	0.14	10
39	Strut	C 100x75x2	63.08	-20.24	63.08	0	-0.35	0.14	30
44	Strut	C 100x75x2	-71.81	-71.83	20.53	0	0.54	0	10
45	Strut	C 100x75x2	-72.39	-72.41	20.33	0	0.48	0	30
50	Strut	C 100x77x3	120.85	-38.47	120.85	0	-0.99	0	10
51	Strut	C 100x77x3	120.85	-38.47	120.85	0	-0.99	0	10
56	Strut	C 100x77x3	-135.62	-135.66	39.59	-0.01	1.23	0	10
57	Strut	C 100x77x3	-135.62	-135.66	39.59	-0.01	1.23	0	10
62	Strut	C 100x82x4	196.69	-61.98	196.69	0	-1.82	0	10
63	Strut	C 100x82x4	196.69	-61.98	196.69	0	-1.82	0	10
68	Strut	C 100x85x5	-252.86	-252.9	75.75	-0.01	2.34	0	10
69	Strut	C 100x85x5	-252.86	-252.9	75.19	-0.01	2.34	0	10

Vzpěr:

Prvek	Typ	Profil	X _y [-]	N _{y,b,Rd} [kN]		N _{z,b,Rd} [kN]	X _t [-]	N _{b,t,Rd} [kN]	X _{tf} [-]	N _{b,tf,Rd} [kN]
1	Strut	C 100x75x2	0.84	152.77	0.72	130.53	1	0	1	0
2	Strut	C 100x75x2	0.84	152.77	0.72	130.53	1	0	1	0
8	Strut	C 100x75x2	0.9	146.81	0.82	134.18	0.7	114.25	0.65	105.76
9	Strut	C 100x75x2	0.9	146.81	0.82	134.18	0.7	114.25	0.65	105.76
14	Strut	C 100x75x2	0.89	162.49	0.81	147.06	1	0	1	0
15	Strut	C 100x75x2	0.9	146.98	0.83	134.46	0.7	114.69	0.65	106.25
20	Strut	C 100x75x2	0.92	149.64	0.85	138.82	0.75	121.65	0.7	114.23
21	Strut	C 100x75x2	0.91	165.72	0.84	152.46	1	0	1	0
26	Strut	C 100x48x2	0.9	117.65	0.59	77.3	0.68	89.06	0.65	84.16
27	Strut	C 100x48x2	0.9	117.65	0.59	77.3	0.68	89.06	0.65	84.16
32	Strut	C 100x75x2	0.92	168.23	0.83	151.11	1	0	1	0
33	Strut	C 100x75x2	0.92	168.23	0.83	151.11	1	0	1	0
38	Strut	C 100x75x2	0.93	151.75	0.85	137.82	0.78	127.15	0.74	120.65
39	Strut	C 100x75x2	0.93	151.75	0.85	137.82	0.78	127.15	0.74	120.65
44	Strut	C 100x75x2	0.94	171.77	0.87	157.8	1	0	1	0
45	Strut	C 100x75x2	0.94	171.77	0.87	157.8	1	0	1	0
50	Strut	C 100x77x3	0.94	260.05	0.89	247.15	0.82	225.47	0.78	215.13
51	Strut	C 100x77x3	0.94	260.05	0.89	247.15	0.82	225.47	0.78	215.13
56	Strut	C 100x77x3	0.96	264.94	0.92	254.28	1	0	1	0
57	Strut	C 100x77x3	0.96	264.94	0.92	254.28	1	0	1	0
62	Strut	C 100x82x4	0.94	455.77	0.92	443.64	0.86	417.61	0.82	397.96
63	Strut	C 100x82x4	0.94	455.77	0.92	443.64	0.86	417.61	0.82	397.96
68	Strut	C 100x85x5	0.96	720.65	0.95	710.62	1	0	1	0
69	Strut	C 100x85x5	0.96	720.65	0.95	710.62	1	0	1	0

Pevnosti:

Prvek	Typ	Profil	N _{c,Rd} [kN]	N _{t,Rd} [kN]	N _{b,Rd} [kN]	Vy _{c,Rd} [kN]	M _{z,c,Rd,ten} [kNm]	M _{z,c,Rd,com} [kNm]	Komb. N _{Ed}
1	Strut	C 100x75x2	182.38	190.22	130.53	59.28	2.85	4.1	10
2	Strut	C 100x75x2	182.38	190.22	130.53	59.28	2.85	4.1	32
8	Strut	C 100x75x2	162.89	190.22	134.18	59.28	3.11	5.09	32
9	Strut	C 100x75x2	162.89	190.22	134.18	59.28	3.11	5.09	10
14	Strut	C 100x75x2	182.38	190.22	147.06	59.28	2.85	4.1	32
15	Strut	C 100x75x2	162.89	190.22	134.46	59.28	3.11	5.09	42
20	Strut	C 100x75x2	162.89	190.22	138.82	59.28	3.11	5.09	32
21	Strut	C 100x75x2	182.38	190.22	152.46	59.28	5.09	3.11	42
26	Strut	C 100x48x2	130.46	153.17	77.3	37.35	1.59	2.94	10
27	Strut	C 100x48x2	130.46	153.17	77.3	37.35	1.44	2.3	32
32	Strut	C 100x75x2	182.38	190.22	151.11	59.28	5.09	3.11	10
33	Strut	C 100x75x2	182.38	190.22	151.11	59.28	5.09	3.11	32
38	Strut	C 100x75x2	162.89	190.22	137.82	59.28	3.11	5.09	10
39	Strut	C 100x75x2	162.89	190.22	137.82	59.28	3.11	5.09	30
44	Strut	C 100x75x2	182.38	190.22	157.8	59.28	5.09	3.11	10
45	Strut	C 100x75x2	182.38	190.22	157.8	59.28	5.09	3.11	30
50	Strut	C 100x77x3	276.62	294.26	247.15	90.13	4.96	7.79	10
51	Strut	C 100x77x3	276.62	294.26	247.15	90.13	4.96	7.79	10
56	Strut	C 100x77x3	276.62	294.26	254.28	90.13	7.79	4.96	10
57	Strut	C 100x77x3	276.62	294.26	254.28	90.13	7.79	4.96	10
62	Strut	C 100x82x4	483.22	510.1	443.64	152.01	10.31	13.76	10
63	Strut	C 100x82x4	483.22	510.1	443.64	152.01	10.31	13.76	10
68	Strut	C 100x85x5	759.92	783.88	710.62	232	20.93	16.93	10
69	Strut	C 100x85x5	759.92	783.88	710.62	232	20.93	16.93	10

Profil:

Prvek	Profil	N _c [%]	N _t [%]	N _{cM} z [%]	N _{cM} z2 [%]	V _y [%]	N _t [%]	N _b [%]	NyMy Mz [%]	NzMy Mz [%]	Profil [%]	Rozh. profil	Komb. N _{Ed}
1	C 100x75x2	0	19	20	19	0	0	0	0	0	20	Tah a ohyb	10
2	C 100x75x2	0	29	29	28	0	0	0	0	0	29	Prostý tah	32
8	C 100x75x2	30	0	32	27	0	24	46	37	40	46	Vzpěr	32
9	C 100x75x2	20	0	22	18	0	24	31	25	27	31	Vzpěr	10
14	C 100x75x2	0	16	16	16	0	0	0	0	0	16	Prostý tah	32
15	C 100x75x2	10	0	11	9	0	24	16	13	14	16	Štíhlost	42
20	C 100x75x2	15	0	16	14	0	22	22	18	19	22	Štíhlost	32
21	C 100x75x2	0	11	11	11	0	0	0	0	0	11	Prostý tah	42
26	C 100x48x2	17	0	19	15	0	39	29	22	32	32	Štíhlost	10
27	C 100x48x2	23	0	26	19	0	39	40	29	42	42	Vzpěr za ohybu	32
32	C 100x75x2	0	15	15	15	0	0	0	0	0	15	Prostý tah	10
33	C 100x75x2	0	19	19	19	0	0	0	0	0	19	Prostý tah	32
38	C 100x75x2	38	0	41	34	1	23	52	46	50	52	Vzpěr	10
39	C 100x75x2	39	0	41	34	1	23	52	46	51	52	Vzpěr	30
44	C 100x75x2	0	38	38	38	1	0	0	0	0	38	Prostý tah	10
45	C 100x75x2	0	38	38	38	1	0	0	0	0	38	Prostý tah	30
50	C 100x77x3	44	0	0	0	1	18	56	0	0	56	Vzpěr	10
51	C 100x77x3	44	0	0	0	1	18	56	0	0	56	Vzpěr	10
56	C 100x77x3	0	46	46	46	1	0	0	0	0	46	Prostý tah	10
57	C 100x77x3	0	46	46	46	1	0	0	0	0	46	Prostý tah	10
62	C 100x82x4	41	0	0	0	1	14	49	0	0	49	Vzpěr	10
63	C 100x82x4	41	0	0	0	1	14	49	0	0	49	Vzpěr	10
68	C 100x85x5	0	32	32	32	1	0	0	0	0	32	Prostý tah	10
69	C 100x85x5	0	32	32	32	1	0	0	0	0	32	Prostý tah	10

Spoje:

Prvek	Profil	Spoj	N _{t,Ed} [kN]	N _{c,Ed} [kN]	F _v [%]	F _{b,c} [%]	F _{b,t} [%]	F _n [%]	V _{eff} [%]	Spoj [%]	Rozh. spoj
1	C 100x75x2	C24v2	-37.02	12.01	21	15	46	28	43	46	Otlačení
2	C 100x75x2	C24v2	-54.46	10.62	31	13	68	42	64	68	Otlačení
8	C 100x75x2	C24v2	-12.18	48.99	28	61	15	9	14	61	Otlačení
9	C 100x75x2	C24v2	-15.02	32.87	19	41	19	12	18	41	Otlačení
14	C 100x75x2	C24v2	-30.13	2.85	17	4	37	23	35	37	Otlačení
15	C 100x75x2	C24v2	-11.27	16.56	10	21	14	9	13	21	Otlačení
20	C 100x75x2	C24v2	-3.47	24.66	14	31	4	3	4	31	Otlačení
21	C 100x75x2	C24v2	-20.62	6.04	12	7	26	16	24	26	Otlačení
26	C 100x48x2	C22v2	-11.71	22.35	26	55	29	10	15	55	Otlačení
27	C 100x48x2	C22v2	-7.79	30.6	35	76	19	7	10	76	Otlačení
32	C 100x75x2	C24v2	-28.26	9.95	16	12	35	22	33	35	Otlačení
33	C 100x75x2	C24v2	-35.99	7.08	21	9	45	28	42	45	Otlačení
38	C 100x75x2	C26v2	-20.67	62.36	24	55	21	16	20	55	Otlačení
39	C 100x75x2	C26v2	-20.24	63.08	24	56	21	16	19	56	Otlačení
44	C 100x75x2	C26v2	-71.83	20.53	28	18	74	55	68	74	Otlačení
45	C 100x75x2	C26v2	-72.41	20.33	28	18	75	56	68	75	Otlačení
50	C 100x77x3	C36v2	-38.47	120.85	46	72	27	19	24	72	Otlačení
51	C 100x77x3	C36v2	-38.47	120.85	46	72	27	19	24	72	Otlačení
56	C 100x77x3	C38v2	-135.66	39.59	39	18	71	68	78	78	Vytržení
57	C 100x77x3	C38v2	-135.66	39.59	39	18	71	68	78	78	Vytržení
62	C 100x82x4	C48v2	-61.98	196.69	57	62	21	18	23	62	Otlačení
63	C 100x82x4	C48v2	-61.98	196.69	57	62	21	18	23	62	Otlačení
68	C 100x85x5	C58v2	-252.9	75.75	73	16	60	50	63	73	Střih
69	C 100x85x5	C58v2	-252.9	75.19	73	16	60	50	63	73	Střih

Souhrn:

Prvek	Member type	Profil	Materiál	Komb. N _{Ed}	Profil [%]	Spoj [%]	Vyhodnocení	Posouzení
1	Strut 2 screw	C 100x75x2	S350GD	10	20	46	Otlačení	Vyhovuje
2	Strut 2 screw	C 100x75x2	S350GD	32	29	68	Otlačení	Vyhovuje
8	Strut 2 screw	C 100x75x2	S350GD	32	46	61	Otlačení	Vyhovuje
9	Strut 2 screw	C 100x75x2	S350GD	10	31	41	Otlačení	Vyhovuje
14	Strut 2 screw	C 100x75x2	S350GD	32	16	37	Otlačení	Vyhovuje
15	Strut 2 screw	C 100x75x2	S350GD	42	16	21	Otlačení	Vyhovuje
20	Strut 2 screw	C 100x75x2	S350GD	32	22	31	Otlačení	Vyhovuje
21	Strut 2 screw	C 100x75x2	S350GD	42	11	26	Otlačení	Vyhovuje
26	Strut 1 screw	C 100x48x2	S350GD	10	32	55	Otlačení	Vyhovuje
27	Strut 1 screw	C 100x48x2	S350GD	32	42	76	Otlačení	Vyhovuje
32	Strut 1 screw	C 100x75x2	S350GD	10	15	35	Otlačení	Vyhovuje
33	Strut 1 screw	C 100x75x2	S350GD	32	19	45	Otlačení	Vyhovuje
38	Strut 1 screw	C 100x75x2	S350GD	10	52	55	Otlačení	Vyhovuje
39	Strut 1 screw	C 100x75x2	S350GD	30	52	56	Otlačení	Vyhovuje
44	Strut 1 screw	C 100x75x2	S350GD	10	38	74	Otlačení	Vyhovuje
45	Strut 1 screw	C 100x75x2	S350GD	30	38	75	Otlačení	Vyhovuje
50	Strut 2 screw	C 100x77x3	S350GD	10	56	72	Otlačení	Vyhovuje
51	Strut 2 screw	C 100x77x3	S350GD	10	56	72	Otlačení	Vyhovuje
56	Strut 2 screw	C 100x77x3	S350GD	10	46	78	Vytržení	Vyhovuje
57	Strut 2 screw	C 100x77x3	S350GD	10	46	78	Vytržení	Vyhovuje
62	Strut 2 screw	C 100x82x4	HX420LAD	10	49	62	Otlačení	Vyhovuje
63	Strut 2 screw	C 100x82x4	HX420LAD	10	49	62	Otlačení	Vyhovuje
68	Strut 2 screw	C 100x85x5	HX500LAD	10	32	73	Střih	Vyhovuje
69	Strut 2 screw	C 100x85x5	HX500LAD	10	32	73	Střih	Vyhovuje

5.7 POSOUZENÍ DEFORMACÍ RÁMU (MSP)

- SVISLÁ DEFORMACE

Displacements: 1 - Cases: 10 11 20 21 30to32 40to42 50			
	UX (mm)	UZ (mm)	RY (Rad)
MAX	15.8	15.4	0.013
Node	39	7	42
Case	42	50	10
MIN	-5.9	-53.4	-0.013
Node	40	7	43
Case	10	10	10

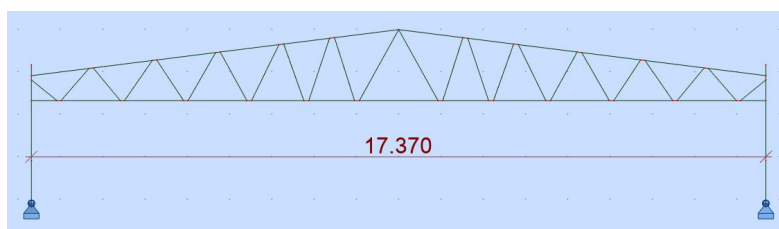
Posouzení svislé deformace rámu

Limitní deformace = $17370/250 = 69.5$ mm

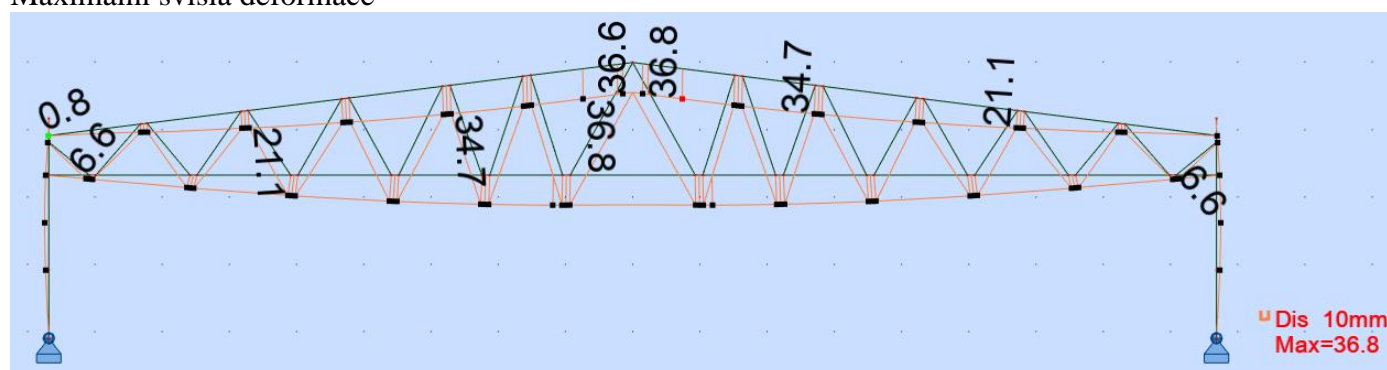
Max deformace = $53.4/1.45 = 36.8$ mm

$36.8 \text{ mm} < 69.5 \text{ mm}$

SVISLÁ DEFORMACE VYHOVÍ



Maximální svislá deformace



- VODOROVNÁ DEFORMACE

Displacements: 1 - Cases: 10 11 20 21 30to32 40to42 50

	UX (mm)	UZ (mm)	RY (Rad)
MAX	15.8	15.4	0.013
Node	39	7	42
Case	42	50	10
MIN	-5.9	-53.4	-0.013
Node	40	7	43
Case	10	10	10

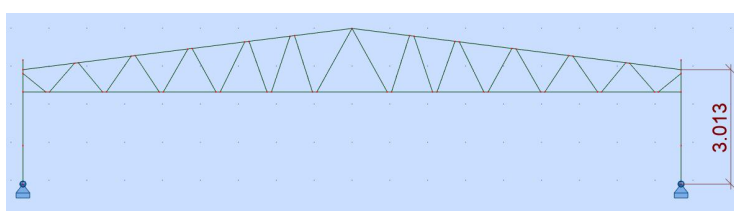
Posouzení vodorovné deformace rámu

Limitní deformace = $3013/150 = 20.1$ mm

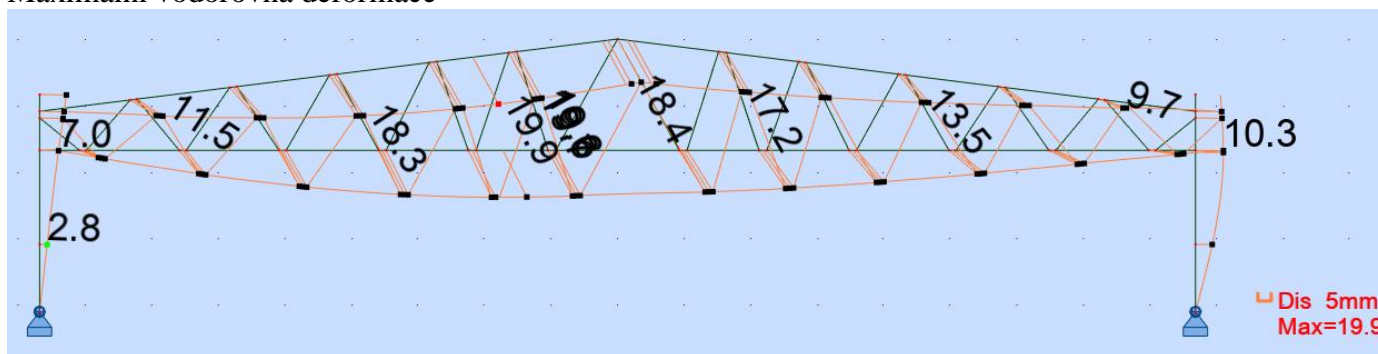
Max deformace = $15.8/1.45 = 10.9$ mm

10.9 mm = 20.1 mm

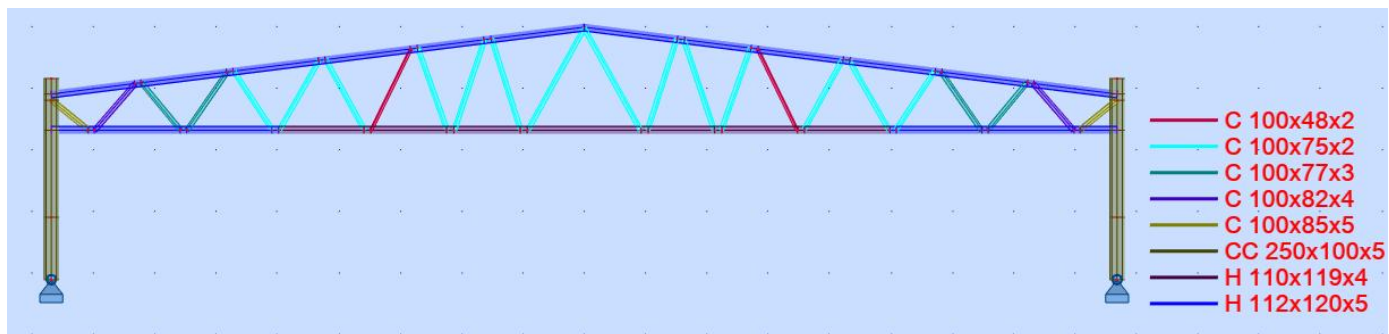
VODOROVNÁ DEFORMACE VYHOVÍ



Maximální vodorovná deformace



5.8 POUŽITÉ PROFILY



6 REAKCE DO ZÁKLADŮ

Informace k silám do základů

Konvence sil:

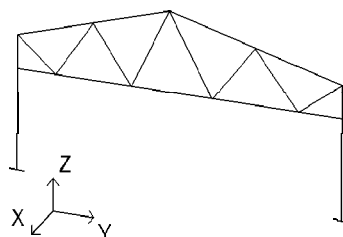
Směr X: podélný směr haly

Směr Y: příčný směr haly

(Značení reakcí v příložených schématech rámu a štítů této konvenci nemusí vždy odpovídat. Závazné jsou hodnoty v tabulkách, schémata slouží především ke snadnějšímu dohledání polohy sloupu ve výkresu.)

Hodnoty R_x , R_y a M_x mohou působit v obou směrech.

Záporná reakce '- R_z ' znamená tah.



Zatížení:

Všechny uvedené síly jsou v návrhových hodnotách.

Všechny kombinace zahrnují stálé zatížení.

Vlastní tíha opláštění je přenášena do spodní stavby přes kotevní U nebo L profil. Hmotnost stěnového opláštění je cca 16 kg/m².

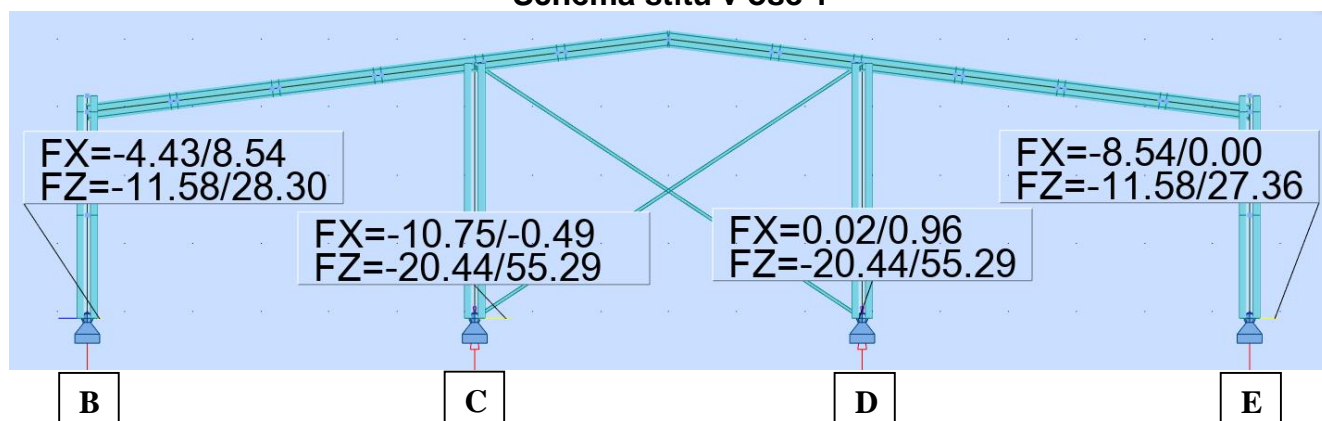
Hodnoty uvedené v závorkách jsou od podélného zavětrování.

Kombinace zatěžovacích stavů

Kombinace	Popis
10	Snow
11	Snow 0.5 right
20	Wind max
21	Wind min
30	Snow + reduced wind
31	Snow 0.5 left + reduced wind
32	Snow 0.5 right + reduced wind
40	Wind + reduced Snow
41	Wind + reduced Snow 0.5 left
42	Wind + reduced Snow 0.5 Right
50	Wind from gabel

Reakce štítových sloupů v příčných osách 1 a 7

Schéma štítu v ose 1



Krajní sloupy v podélných osách B a E:

Reakce v podporách:

Kombinace		RY [kN]	RZ [kN]	RX [kN]	MX [kNm]	MY [kNm]
Max sání/tlak		+/-15.18	-11.60/28.30	+/-9.83	0.00	0.00

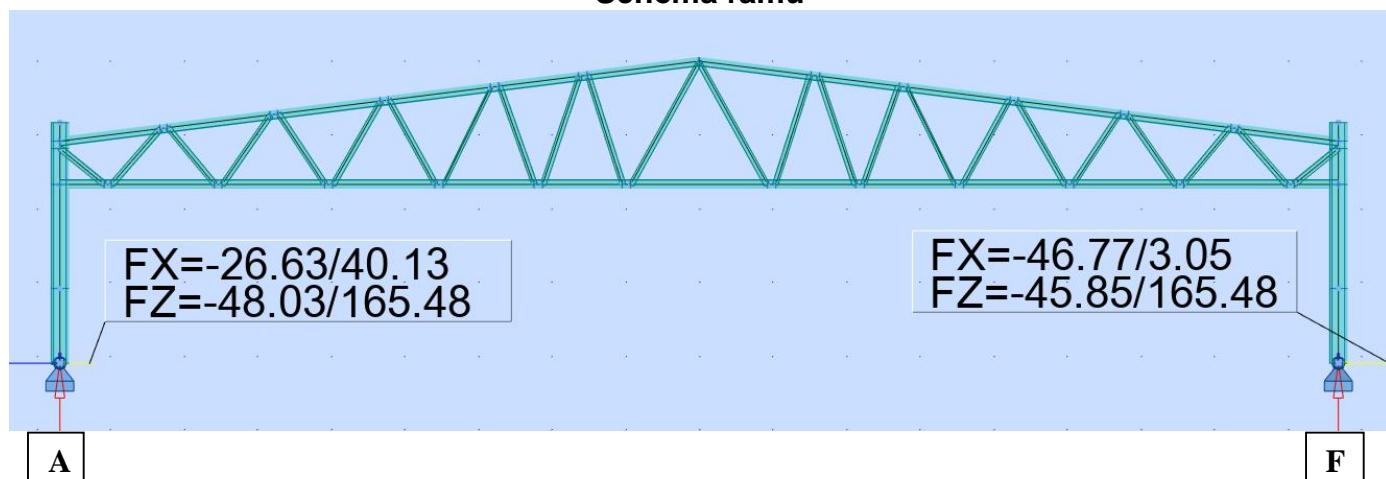
Středové sloupy v podélných osách C a D:

Reakce v podporách:

Kombinace		RY [kN]	RZ [kN]	RX [kN]	MX [kNm]	MY [kNm]
Max sání/tlak		+/-10.75	-20.51/74.47	+/-14.02	0.00	0.00

Reakce sloupů rámu v příčných osách 2 až 6

Schéma rámu



Sloupky v podélných osách A a F – příčné osy 2 až 6:

Reakce v podporách:

Kombinace		RY [kN]	RZ [kN]	RX [kN]	MX [kNm]	MY [kNm]
10		40.13	165.48	0.00	0.00	0.00
11		33.24	152.12	0.00	0.00	0.00
20		-26.63	-48.03	0.00	0.00	0.00
21		-13.75	41.41	0.00	0.00	0.00
30		24.43	157.53	0.00	0.00	0.00
31		17.48	115.42	0.00	0.00	0.00
32		17.58	144.19	0.00	0.00	0.00
40		0.14	96.83	0.00	0.00	0.00
41		-3.36	75.78	0.00	0.00	0.00
42		-3.29	90.17	0.00	0.00	0.00
50		-3.05	-45.85 (+/-8.01)	0.00 (+/-16.83)	0.00	0.00

Kombinace		RY [kN]	RZ [kN]	RX [kN]	MX [kNm]	MY [kNm]
10		-40.13	165.48	0.00	0.00	0.00
11		-33.24	123.35	0.00	0.00	0.00
20		-2.83	-31.89	0.00	0.00	0.00
21		-23.48	22.07	0.00	0.00	0.00
30		-46.77	146.14	0.00	0.00	0.00
31		-39.83	132.75	0.00	0.00	0.00
32		-39.92	103.98	0.00	0.00	0.00
40		-37.38	77.65	0.00	0.00	0.00
41		-33.87	70.95	0.00	0.00	0.00
42		-33.95	56.56	0.00	0.00	0.00
50		3.05	-45.85 (+/-8.01)	0.00 (+/-16.83)	0.00	0.00

7 KOTVENÍ SLOUPŮ



Hilti PROFIS Engineering 3.0.93

www.hilti.cz


Společnost:
Adresa:
Telefon I fax:
Návrh:
Dílčí projekt / pozice č.:

CZ001893 Sklad soli Zbraslavice

Strana: 1
Projektant:
E-mail:
Datum: 28.03.2024

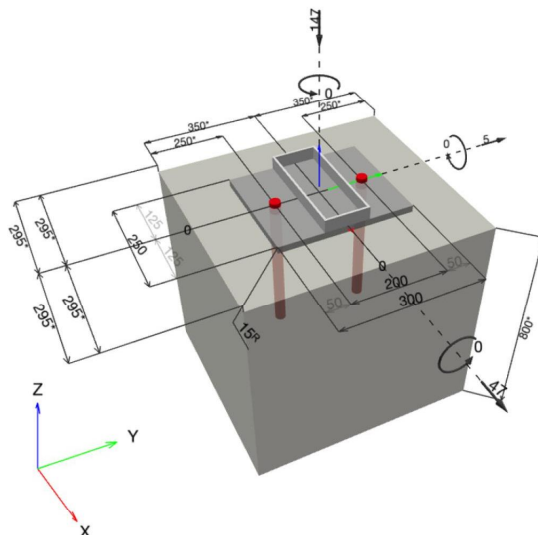
Komentář projektanta:

1 Vstupní data

Typ a velikost kotvy:	HIT-HY 200-A V3 + HAS-U 5.8 100 Years M24	
Předpokládaná životnost (životnost v letech):	100	
Číslo artiklu:	2223882 HAS-U 5.8 M24x450 (vložit) / 2378171 HIT-HY 200-A V3 (chemická hmota)	
Efektivní kotvení hloubka:	$h_{ef,act} = 300,0 \text{ mm}$ ($h_{ef,limit} = - \text{ mm}$)	
Materiál:	5.8	
Certifikát č.:	ETA 19/0601	
Vydání I Platný:	29.01.2024 -	
Posouzení:	Návrhová metoda ETAG BOND (EOTA TR 029)	
Distanční montáž:	$e_b = 0,0 \text{ mm}$ (bez distanční montáže); $t = 15,0 \text{ mm}$	
Kotvení deska ^R :	$l_x \times l_y \times t = 250,0 \text{ mm} \times 300,0 \text{ mm} \times 15,0 \text{ mm}$; (Doporučená tloušťka kotvení desky: nepočítána)	
Profil:	Obdélníkový dutý profil, ; ($V \times \text{Š} \times T$) = $250,0 \text{ mm} \times 100,0 \text{ mm} \times 5,0 \text{ mm}$	
Základní materiál:	bez trhlín beton, C20/25, $f_{c,cube} = 25,00 \text{ N/mm}^2$; $h = 800,0 \text{ mm}$, teplota krátkodobá/dlouhodobá: 40/24 °C	
Montáž:	kotvení otvor vrtaný přiklepem, montážní podmínky: suché	
Výztuž:	Žádná výztuž nebo osová vzdálenost výztuže $\geq 150 \text{ mm}$ (jakýkoliv Ø) nebo $\geq 100 \text{ mm}$ ($\text{Ø} \leq 10 \text{ mm}$) žádná podélná výztuž okraje	

^R - Výpočet kotvy je proveden na základě předpokladu tuhé kotvení desky.

Geometrie [mm] & Zatížení [kN, kNm]



Je nutné zkontrolovat shodu vstupních údajů se skutečnými podmínkami a přijatelnost výsledků!
PROFIS Engineering (c) 2003-2024 Hilti AG, FL-9494 Schaan Hilti je registrovaná značka společnosti Hilti AG, Schaan

1

www.hilti.cz

Společnost:
Adresa:
Telefon I fax:
Návrh:
Dílčí projekt / pozice č.:

Strana: 2
Projektant:
E-mail:
Datum: 28.03.2024

1.1 Kombinace zatížení

Stav	Popis	Síly [kN] / Momenty [kNm]	Seizmický	Požár	Max. využití kotvy [%]
1	Kombinace 50	$N = 54,000; V_x = 4,000; V_y = 17,000;$ $M_x = 0,000; M_y = 0,000; M_z = 0,000;$ $N_{sus} = 0,000; M_{x,sus} = 0,000; M_{y,sus} = 0,000;$	Ne	ne	59
<u>2</u>	<u>Kombinace 30</u>	<u>$N = -147,000; V_x = 47,000; V_y = 5,000;$</u> <u>$M_x = 0,000; M_y = 0,000; M_z = 0,000;$</u> <u>$N_{sus} = 0,000; M_{x,sus} = 0,000; M_{y,sus} = 0,000;$</u>	<u>Ne</u>	<u>ne</u>	<u>88</u>
3	Kombinace 51	$N = -166,000; V_x = 41,000; V_y = 5,000;$ $M_x = 0,000; M_y = 0,000; M_z = 0,000;$ $N_{sus} = 0,000; M_{x,sus} = 0,000; M_{y,sus} = 0,000;$	Ne	ne	77
4	Kombinace 20	$N = 49,000; V_x = 27,000; V_y = 5,000;$ $M_x = 0,000; M_y = 0,000; M_z = 0,000;$ $N_{sus} = 0,000; M_{x,sus} = 0,000; M_{y,sus} = 0,000;$	Ne	ne	68

2 Zatěžovací stav/Výsledné síly na kotvu

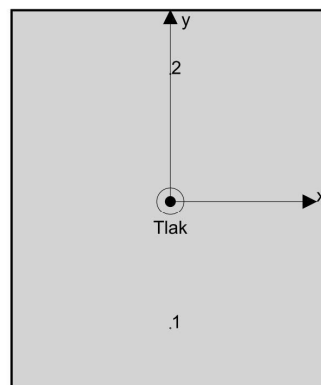
Kontrolovaný zatěžovací stav: 2 Kombinace 30

Reakce kotvy [kN]

Tahová síla: (+ Tah, - Tlak)

Kotva	Tahová síla	Smyková síla	Smyková síla x	Smyková síla y
1	0,000	23,633	23,500	2,500
2	0,000	23,633	23,500	2,500

max. tlakové přetvoření betonu: 0,07 [%]
max. tlakové napětí v betonu: 1,96 [N/mm²]
výsledná tahová síla v (x/y)=(-/-): 0,000 [kN]
výsledná tlaková síla v (x/y)=(0,0/0,0): 147,000 [kN]



Kotevní síly jsou vypočítány na základě předpokladu tuhé kotevní desky.



www.hilti.cz

Společnost:

Adresa:

Telefon I fax:

Návrh:

Dílčí projekt / pozice č.:

|
CZ001893 Sklad soli Zbraslavice

Strana:

Projektant:

E-mail:

Datum:

3

28.03.2024

3 Tahové zatížení (EOTA TR 029, bod 5.2.2)

	Zatížení [kN]	Únosnost [kN]	Využití β_N [%]	Stav
Porušení oceli*	Není k dispozici	Není k dispozici	Není k dispozici	Není k dispozici
Porušení vytržením betonového kuželu**	Není k dispozici	Není k dispozici	Není k dispozici	Není k dispozici
Porušení rozštěpením**	Není k dispozici	Není k dispozici	Není k dispozici	Není k dispozici

* nejnepříznivější kotva ** skupina kotev (kotvy v tahu)

Je nutné zkontrolovat shodu vstupních údajů se skutečnými podmínkami a přijatelnost výsledků!
PROFIS Engineering (c) 2003-2024 Hilti AG, FL-9494 Schaan Hilti je registrovaná značka společnosti Hilti AG, Schaan



www.hilti.cz

Společnost:
Adresa:
Telefon I fax:
Návrh:
Dílčí projekt / pozice č.:

Strana: 4
Projektant:
E-mail:
Datum: 28.03.2024

4 Smykové zatížení (EOTA TR 029, bod 5.2.3)

	Zatížení [kN]	Únosnost [kN]	Využití β_v [%]	Stav
Porušení oceli (bez distanční montáže)*	23,633	84,720	28	OK
Porušení oceli (s distanční montáží)*	Není k dispozici	Není k dispozici	Není k dispozici	Není k dispozici
Porušení vylomením betonu**	47,265	210,246	23	OK
Porušení okraje betonu ve směru x+**	47,265	54,022	88	OK

* nejnepříznivější kotva ** skupina kotev (rovnocenné kotvy)

4.1 Porušení oceli (bez distanční montáže)

$$V_{Sd} \leq V_{Rd,s} = \frac{V_{Rk,s}}{\gamma_{M,s}} \quad \text{EOTA TR 029, Tabulka 5.2.3.1}$$

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
105,900	1,250	84,720	23,633

www.hilti.cz

Společnost:
Adresa:
Telefon I fax:
Návrh:
Dílní projekt / pozice č.:

Strana: 5
Projektant:
E-mail:
Datum: 28.03.2024

4.2 Porušení vylomením betonu (relevantní k vytažení)

$$V_{Sd} \leq V_{Rd,cp} = \frac{V_{Rk,cp}}{\gamma_{M,c,p}}$$

$$V_{Rk,cp} = k \cdot \min(N_{Rk,p}; N_{Rk,c})$$

$$N_{Rk,c} = N_{Rk,c}^0 \cdot \frac{A_{c,N}}{A_{c,N}^0} \cdot \psi_{s,N} \cdot \psi_{re,N} \cdot \psi_{ec1,N} \cdot \psi_{ec2,N}$$

$$N_{Rk,c}^0 = k_1 \cdot \sqrt{f_{ck,cube}} \cdot h_{ef}^{1,5}$$

$$A_{c,N}^0 = s_{cr,N} \cdot s_{cr,N}$$

$$\psi_{s,N} = 0,7 + 0,3 \cdot \frac{c}{c_{cr,N}} \leq 1,00$$

$$\psi_{re,N} = 0,5 + \frac{h_{ef}}{200} \leq 1,00$$

$$\psi_{ec1,N} = \frac{1}{1 + \frac{2 \cdot e_{c1,V}}{s_{cr,N}}} \leq 1,00$$

$$\psi_{ec2,N} = \frac{1}{1 + \frac{2 \cdot e_{c2,V}}{s_{cr,N}}} \leq 1,00$$

$$h_{ef}' = \max\left(\frac{c_{max}}{c_{cr,N}}, \frac{s_{max}}{s_{cr,N}}\right) \cdot h_{ef}$$

EOTA TR 029, Tabulka 5.2.3.1

EOTA TR 029, Rovnice (5.7), (5.7a)

EOTA TR 029, Rovnice (5.3)

EOTA TR 029, Rovnice (5.3a)

EOTA TR 029, Rovnice (5.3b)

EOTA TR 029, Rovnice (5.3c)

EOTA TR 029, Rovnice (5.3d)

EOTA TR 029, Rovnice (5.3e)

EOTA TR 029, Rovnice (5.3e)

$A_{c,N}$ [mm ²]	$A_{c,N}^0$ [mm ²]	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]	k-factor	k_1
413 000	348 100	450,0	900,0	2,000	10,100
h_{ef}' [mm]	$c_{cr,N}'$ [mm]	$s_{cr,N}'$ [mm]			
196,7	295,0	590,0			
$e_{c1,V}$ [mm]	$\psi_{ec1,N}$	$e_{c2,V}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$
0,0	1,000	0,0	1,000	0,954	1,000
$N_{Rk,c}^0$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,cp}$ [kN]	V_{Sd} [kN]		
139,280	1,500	210,246	47,265		
ID skupiny kotev					
1, 2					

Je nutné zkontrolovat shodu vstupních údajů se skutečnými podmínkami a přijatelnost výsledků!
PROFIS Engineering (c) 2003-2024 Hilti AG, FL-9494 Schaan Hilti je registrovaná značka společnosti Hilti AG, Schaan

www.hilti.cz

Společnost:
Adresa:
Telefon I fax:
Návrh:
Dílčí projekt / pozice č.:

Strana: 6
Projektant:
E-mail:
Datum: 28.03.2024

4.3 Porušení okraje betonu ve směru x+

$$V_{Sd} \leq V_{Rd,c} = \frac{V_{Rk,c}}{\gamma_{M,c}} \quad \text{EOTA TR 029, Tabulka 5.2.3.1}$$

$$V_{Rk,c} = V_{Rk,c}^0 \cdot \frac{A_{c,V}}{A_{c,V}^0} \cdot \psi_{s,V} \cdot \psi_{h,V} \cdot \psi_{\alpha,V} \cdot \psi_{ec,V} \cdot \psi_{re,V} \quad \text{EOTA TR 029, Rovnice (5.8)}$$

$$V_{Rk,c}^0 = k_1 \cdot d_{nom}^{\alpha} \cdot h_{ef}^{\beta} \cdot \sqrt{f_{ck,cube}} \cdot c_1^{1,5} \quad \text{EOTA TR 029, Rovnice (5.8a)}$$

$$\alpha = 0,1 \cdot \left(\frac{h_{ef}}{c_1} \right) \quad \text{EOTA TR 029, Rovnice (5.8b)}$$

$$\beta = 0,1 \cdot \left(\frac{d_{nom}}{c_1} \right)^{0,2} \quad \text{EOTA TR 029, Rovnice (5.8c)}$$

$$A_{c,V}^0 = 4,5 \cdot c_1^2 \quad \text{EOTA TR 029, Rovnice (5.8d)}$$

$$\psi_{s,V} = 0,7 + 0,3 \cdot \frac{c_2}{1,5 \cdot c_1} \leq 1,00 \quad \text{EOTA TR 029, Rovnice (5.8e)}$$

$$\psi_{h,V} = \left(\frac{1,5 \cdot c_1}{h} \right)^{0,5} \geq 1,00 \quad \text{EOTA TR 029, Rovnice (5.8f)}$$

$$\psi_{\alpha,V} = \sqrt{\frac{1}{(\cos \alpha_V)^2 + \left(\frac{\sin \alpha_V}{2,5} \right)^2}} \geq 1,00 \quad \text{EOTA TR 029, Rovnice (5.8g)}$$

$$\psi_{ec,V} = \frac{1}{1 + \frac{2 \cdot e_{c,V}}{3 \cdot c_1}} \leq 1,00 \quad \text{EOTA TR 029, Rovnice (5.8h)}$$

h_{ef} [mm]	d_{nom} [mm]	k_1	α	β		
288,0	24,00	2,400	0,099	0,061		
c_1 [mm]	$A_{c,V}$ [mm ²]	$A_{c,V}^0$ [mm ²]				
295,0	309 750	391 612				
$\psi_{s,V}$	$\psi_{h,V}$	α_v [°]	$\psi_{\alpha,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$
0,869	1,000	6,07	1,005	0,0	1,000	1,000
$V_{Rk,c}^0$ [kN]	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]			
117,271	1,500	54,022	47,265			

5 Posuny (nejvíce zatížená kotva)

Krátkodobé zatížení:

$$N_{Sk} = 0,000 \text{ [kN]} \quad \delta_N = 0,0000 \text{ [mm]}$$

$$V_{Sk} = 17,506 \text{ [kN]} \quad \delta_V = 0,5252 \text{ [mm]}$$

$$\delta_{NV} = 0,5252 \text{ [mm]}$$

Dlouhodobé zatížení:

$$N_{Sk} = 0,000 \text{ [kN]} \quad \delta_N = 0,0000 \text{ [mm]}$$

$$V_{Sk} = 17,506 \text{ [kN]} \quad \delta_V = 0,8753 \text{ [mm]}$$

$$\delta_{NV} = 0,8753 \text{ [mm]}$$

Poznámka: Posuny vlivem tahové síly jsou platné při poloviční hodnotě předepsaného utahovacího momentu pro bez trhlin beton! Smykové posuny jsou platné za předpokladu žádného tření mezi betonem a kotevní deskou! Mezery mezi kotvou a vrtaným kotevním otvorem a mezery mezi kotvou a otvorem v kotevní desce nejsou v tomto výpočtu zahrnuty!

Připustné posuny kotev závisí na připevňované konstrukci a musejí být definovány projektantem!

Je nutné zkontrolovat shodu vstupních údajů se skutečnými podmínkami a přijatelnost výsledků!
PROFIS Engineering (c) 2003-2024 Hilti AG, FL-9494 Schaan Hilti je registrovaná značka společnosti Hilti AG, Schaan



www.hilti.cz

Společnost:		Strana:	7
Adresa:		Projektant:	
Telefon I fax:		E-mail:	
Návrh:	CZ001893 Sklad soli Zbraslavice	Datum:	28.03.2024
Dílčí projekt / pozice č.:			

6 Upozornění

- S přerozdělením zatížení na jednotlivé kotvy vlivem elastických deformací kotevní desky se neuvažuje. Předpokládá se natolik tuhá kotevní deska, u které při zatěžování nedochází k deformacím! Musí být zkontolováno, zda jsou vstupní data a výsledky v souladu s aktuálními podmínkami a zda jsou věrohodné!
- Kontrolu přenosu zatížení do základního materiálu je požadováno provést v souladu s EOTA TR 029 část 7!
- Návrh je platný pouze v případě, když průměry otvorů pro kotvy v kotevní desce nejsou větší než je stanoveno v EOTA TR029, tabulka 4.1! Komentář ohledně větších otvorů je uveden v EOTA TR029, článek 1.1!
- Seznam příslušenství v tomto protokolu slouží pouze jako informace uživateli. V každém případě je třeba dodržovat návod k použití dodávaný s výrobkem, aby byla zajištěna správná instalace.
- Čištění vyvrtaného kotevního otvoru musí být provedeno dle návodu na použití (2x vyfoukat stlačeným vzduchem bez oleje (min. 6bar), 2x vykartáčovat a opět 2x vyfoukat stlačeným vzduchem bez oleje (min. 6bar)).
- Charakteristická pevnost lepicí hmoty (soudržnost) závisí na krátkodobých a dlouhodobých teplotách.
- Okrajová výztuž není požadovaná pro zabránění porušení rozštěpením.
- Charakteristická odolnost spoje závisí na údržbě a životnosti (životnosti v letech): 100

Upevnění je bezpečné!

Je nutné zkontrolovat shodu vstupních údajů se skutečnými podmínkami a přijatelnost výsledků!
PROFIS Engineering (c) 2003-2024 Hilti AG, FL-9494 Schaan Hilti je registrovaná značka společnosti Hilti AG, Schaan

www.hilti.cz

Společnost:

Adresa:

Telefon I fax:

Návrh:

Dílčí projekt / pozice č.:

CZ001893 Sklad soli Zbraslavice

Strana:

Projektant:

E-mail:

Datum:

8

28.03.2024

7 Montážní pokyny

Kotevní deska, ocel: S 355; E = 210 000,00 N/mm²; f_{yk} = 355,00 N/mm²

Profil: Obdélníkový dutý profil, ; (V x Š x T) = 250,0 mm x 100,0 mm x 5,0 mm

Průměr otvoru v kotevní desce: d_f = - mm

Tloušťka kotevní desky (vstup): 15,0 mm

Doporučená tloušťka kotevní desky: nepočítána

Metoda vrtání: Vyvrtáno přiklepem

Čištění: Je požadováno kvalitní vyčištění kotevního otvoru

Typ a velikost kotvy: HIT-HY 200-A V3 + HAS-U 5.8 100 Years M24

Číslo artiklu: 2223882 HAS-U 5.8 M24x450 (vložit) / 2378171 HIT-HY 200-A V3 (chemická hmota)

Maximální utahovací moment: 200 Nm

Průměr otvoru v základním materiálu: 28,0 mm

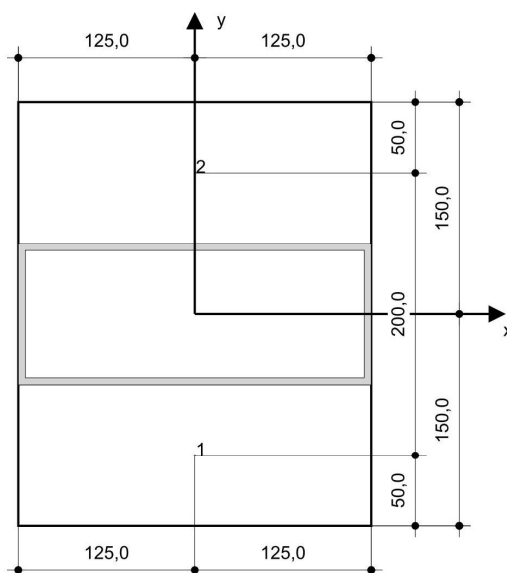
Hloubka kotevního otvoru v základním materiálu: 300,0 mm

Minimální tloušťka základního materiálu: 356,0 mm

Hilti HAS-U závitová tyč s HIT-HY 200-A V3 lepicí hmota s 300 mm kotevní hloubka h_{ef}, M24, Galvanicky pozinkováno, Vrtání přiklepem montáž dle ETA 19/0601

7.1 Doporučené příslušenství

Vrtání	Čištění	Osazení
<ul style="list-style-type: none"> Vhodná pro vrtací kladivo Vrták správného průměru 	<ul style="list-style-type: none"> Stlačený vzduch s požadovaným příslušenstvím pro vyfoukání kotevního otvoru ode dna Odpovídající průměr drátkového kartáče 	<ul style="list-style-type: none"> Výtlačovací přístroj včetně vodící kazety a směšovače U hlubokých instalací je nezbytné použít výtlačovací pístovou koncovku Momentový klíč



Souřadnice kotev [mm]

Kotva	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}
1	0,0	-100,0	295,0	295,0	250,0	450,0
2	0,0	100,0	295,0	295,0	450,0	250,0

Je nutné zkontrolovat shodu vstupních údajů se skutečnými podmínkami a přijatelnost výsledků!
PROFIS Engineering (c) 2003-2024 Hilti AG, FL-9494 Schaan Hilti je registrovaná značka společnosti Hilti AG, Schaan

8 PRŮŘEZOVÉ CHARAKTERISTIKY POUŽITÝCH PROFILŮ A PLECHŮ

DIAGONÁLY VAZNÍKU

Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section ZB

$$k_b = 215 \text{ mm}$$

$$M_{ycRd} = 4.67 \text{ kN}\cdot\text{m}$$

Bending moment resistance y-y (6.1.4)

$$M_{z1cRd} = 1.58 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z tension in web (6.1.4)

$$M_{z2cRd} = 1.57 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z compression in web (6.1.4)

$$V_{bh,Rd} = 39.61 \text{ kN}$$

Shear force resistance perpendicular to y-axis web only (6.1.5)

$$V_{b,Rd} = 52.54 \text{ kN}$$

Shear force resistance perpendicular to y-axis web+lips (6.1.5)

$$V_{bb,Rd} = 37.18 \text{ kN}$$

Shear force resistance perpendicular to z-axis (6.1.5)

$$R_{w,Rd2.1} = 20.8 \text{ kN}$$

Reaction force (RF) resistance web, 100mm support (6.1.7)

$$R_{w,Rd1.1} = 11.02 \text{ kN}$$

RF resistance web, 100mm support, close to end (6.1.7)

$$R_{w,Rd2.2} = 28.51 \text{ kN}$$

RF resistance web, 200mm support (6.1.7)

$$R_{w,Rd1.2} = 14.69 \text{ kN}$$

RF resistance web, 200mm support close to end (6.1.7)

$$R_{w,Rd4.1} = 23.91 \text{ kN}$$

RF resistance restrained web, 100mm supp. (6.1.7)

$$R_{w,Rd3.1} = 24.73 \text{ kN}$$

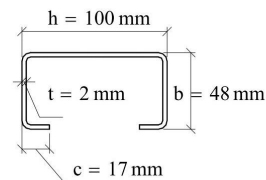
RF resistance restrained web, 100mm supp., close to end (6.1.7)

$$N_{t,Rd} = 156.03 \text{ kN}$$

Axial tension resistance (6.1.2)

$$N_{c,Rd} = 130.72 \text{ kN}$$

Axial compression resistance (6.1.3):



$$h = 100 \text{ mm}$$

$$b = 48 \text{ mm}$$

$$c = 17 \text{ mm}$$

$$t = 2 \text{ mm}$$

$$A_g = 423.40 \text{ mm}^2$$

$$f_{yb} = 350 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 420 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 16.83 \text{ mm}$$

$$y_M = 23.99 \text{ mm}$$

$$W_y = 1.34 \times 10^4 \text{ mm}^3$$

$$W_{z1} = 8630.61 \text{ mm}^3$$

$$W_{z2} = 4528.18 \text{ mm}^3$$

$$I_y = 6.56 \times 10^5 \text{ mm}^4$$

$$I_z = 1.37 \times 10^5 \text{ mm}^4$$

$$E \cdot I_y = 137862 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 28690 \text{ N}\cdot\text{m}^2$$

$$i_y = 39.38 \text{ mm}$$

$$i_z = 17.96 \text{ mm}$$

$$I_T = 592 \text{ mm}^4$$

$$I_\omega = 2.93 \times 10^8 \text{ mm}^6$$

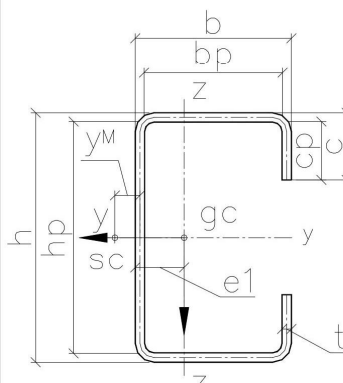
$$g_p = 3.31 \frac{\text{kg}}{\text{m}}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = -1.42 \text{ mm}$$

$$L_z := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m} \quad y := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y) = N_{b,Rd,z,FB}(L_z) =$	$N_{TF,Rd}$
0.5 m	130.72 kN	124.10 kN
1	125.55	103.95
1.5	117.57	76.46
2	108.10	52.23
2.5	96.71	36.40
3	83.92	26.47
3.5	71.16	20.02
4	59.74	15.64
4.5	50.18	12.54
5	42.42	10.28
5.5	36.17	8.57
6	31.13	7.26
6.5	27.03	6.22
7	23.66	5.39
7.5	20.87	4.72
8	18.54	4.17
8.5	16.57	3.70
9	14.90	3.31
9.5	13.46	2.98
10	12.22	2.70



corners = "Rounded corners"

date: 2011-05-07

Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section HB

$$k_b = 268 \text{ mm}$$

$$M_{ycRd} = 5.81 \text{ kN}\cdot\text{m}$$

Bending moment resistance y-y (6.1.4)

$$M_{z1cRd} = 2.89 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z tension in web (6.1.4)

$$M_{z2cRd} = 3.06 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z compression in web (6.1.4)

$$V_{bh,Rd} = 39.61 \text{ kN}$$

Shear force resistance perpendicular to y-axis web only (6.1.5)

$$V_{b,Rd} = 52.54 \text{ kN}$$

Shear force resistance perpendicular to y-axis web+lips (6.1.5)

$$V_{bb,Rd} = 59.01 \text{ kN}$$

Shear force resistance perpendicular to z-axis (6.1.5)

$$R_{w,Rd2.1} = 20.8 \text{ kN}$$

Reaction force (RF) resistance web, 100mm support (6.1.7)

$$R_{w,Rd1.1} = 11.02 \text{ kN}$$

RF resistance web, 100mm support, close to end (6.1.7)

$$R_{w,Rd2.2} = 28.51 \text{ kN}$$

RF resistance web, 200mm support (6.1.7)

$$R_{w,Rd1.2} = 14.69 \text{ kN}$$

RF resistance web, 200mm support close to end (6.1.7)

$$R_{w,Rd4.1} = 23.91 \text{ kN}$$

RF resistance restrained web, 100mm supp. (6.1.7)

$$R_{w,Rd3.1} = 24.73 \text{ kN}$$

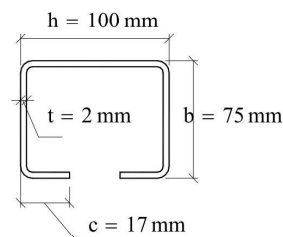
RF resistance restrained web, 100mm supp., close to end (6.1.7)

$$N_{t,Rd} = 193.83 \text{ kN}$$

Axial tension resistance (6.1.2)

$$N_{c,Rd} = 148.97 \text{ kN}$$

Axial compression resistance (6.1.3):



$$h = 100 \text{ mm}$$

$$b = 75 \text{ mm}$$

$$c = 17 \text{ mm}$$

$$t = 2 \text{ mm}$$

$$A_g = 531.40 \text{ mm}^2$$

$$f_{yb} = 350 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 420 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 28.43 \text{ mm}$$

$$y_M = 37.65 \text{ mm}$$

$$W_y = 1.87 \times 10^4 \text{ mm}^3$$

$$W_{z1} = 1.47 \times 10^4 \text{ mm}^3$$

$$W_{z2} = 8860.64 \text{ mm}^3$$

$$I_y = 9.16 \times 10^5 \text{ mm}^4$$

$$I_z = 4.04 \times 10^5 \text{ mm}^4$$

$$E \cdot I_y = 192325 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 84787 \text{ N}\cdot\text{m}^2$$

$$i_y = 41.51 \text{ mm}$$

$$i_z = 27.56 \text{ mm}$$

$$I_T = 736 \text{ mm}^4$$

$$I_{\omega} = 8.67 \times 10^8 \text{ mm}^6$$

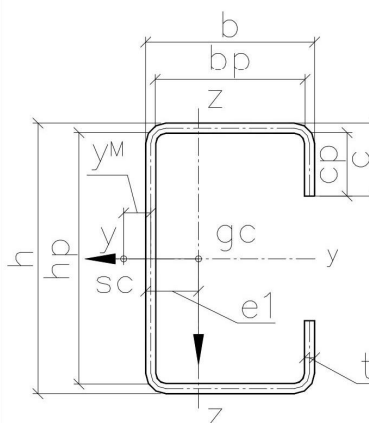
$$g_p = 4.16 \frac{\text{kg}}{\text{m}}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = 1.52 \text{ mm}$$

$$L_z := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m} \quad y := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y) = N_{b,Rd,z,FB}(L_z) =$	$N_{TF,Rd}$
0.5 m	148.97 kN	148.39 kN
1	144.70	136.65
1.5	136.75	122.19
2	127.59	103.84
2.5	116.72	83.82
3	104.16	66.10
3.5	90.79	52.28
4	77.92	41.94
4.5	66.49	34.21
5	56.82	28.36
5.5	48.81	23.86
6	42.23	20.33
6.5	36.80	17.52
7	32.31	15.25
7.5	28.57	13.40
8	25.42	11.85
8.5	22.76	10.56
9	20.49	9.47
9.5	18.53	8.54
10	16.84	7.74



corners = "Rounded corners"

date: 2011-05-07

2016-06-10

13

Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section OB

$$k_b = 268 \text{ mm}$$

$$M_{ycRd} = 9.49 \text{ kN}\cdot\text{m}$$

Bending moment resistance y-y (6.1.4)

$$M_{z1cRd} = 4.91 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z tension in web (6.1.4)

$$M_{z2cRd} = 4.91 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z compression in web (6.1.4)

$$V_{bh,Rd} = 58.8 \text{ kN}$$

Shear force resistance perpendicular to y-axis web only (6.1.5)

$$V_{b,Rd} = 80.02 \text{ kN}$$

Shear force resistance perpendicular to y-axis web+lips (6.1.5)

$$V_{bb,Rd} = 89.72 \text{ kN}$$

Shear force resistance perpendicular to z-axis (6.1.5)

$$R_{w,Rd2.1} = 46.22 \text{ kN}$$

Reaction force (RF) resistance web, 100mm support (6.1.7)

$$R_{w,Rd1.1} = 26.46 \text{ kN}$$

RF resistance web, 100mm support, close to end (6.1.7)

$$R_{w,Rd2.2} = 55.59 \text{ kN}$$

RF resistance web, 200mm support (6.1.7)

$$R_{w,Rd1.2} = 33.07 \text{ kN}$$

RF resistance web, 200mm support close to end (6.1.7)

$$R_{w,Rd4.1} = 43.8 \text{ kN}$$

RF resistance restrained web, 100mm supp. (6.1.7)

$$R_{w,Rd3.1} = 49.78 \text{ kN}$$

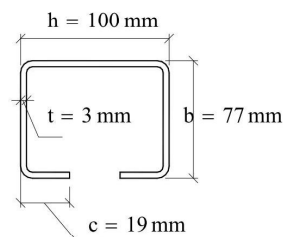
RF resistance restrained web, 100mm supp., close to end (6.1.7)

$$N_{t,Rd} = 299.92 \text{ kN}$$

Axial tension resistance (6.1.2)

$$N_{c,Rd} = 269.74 \text{ kN}$$

Axial compression resistance (6.1.3):



$$h = 100 \text{ mm}$$

$$b = 77 \text{ mm}$$

$$c = 19 \text{ mm}$$

$$t = 3 \text{ mm}$$

$$A_g = 806.52 \text{ mm}^2$$

$$f_{yb} = 350 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 420 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 29.97 \text{ mm}$$

$$y_M = 38.94 \text{ mm}$$

$$W_y = 2.8 \times 10^4 \text{ mm}^3$$

$$W_{z1} = 2.24 \times 10^4 \text{ mm}^3$$

$$W_{z2} = 1.4 \times 10^4 \text{ mm}^3$$

$$I_y = 1.36 \times 10^6 \text{ mm}^4$$

$$I_z = 6.39 \times 10^5 \text{ mm}^4$$

$$E \cdot I_y = 285635 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 134090 \text{ N}\cdot\text{m}^2$$

$$i_y = 41.07 \text{ mm}$$

$$i_z = 28.14 \text{ mm}$$

$$I_T = 2520 \text{ mm}^4$$

$$I_{\omega} = 1.42 \times 10^9 \text{ mm}^6$$

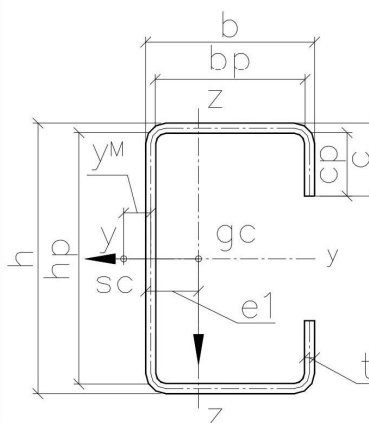
$$g_p = 6.28 \frac{\text{kg}}{\text{m}}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = 1.5 \text{ mm}$$

$$L_z := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m} \quad y := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y) = N_{b,Rd,z,FB}(L_z) =$	$N_{TF,Rd}$
0.5 m	269.74 kN	267.27 kN
1	259.13	244.14
1.5	242.72	214.83
2	223.23	177.84
2.5	199.81	139.81
3	173.49	108.32
3.5	147.19	84.79
4	123.62	67.61
4.5	103.88	54.94
5	87.83	45.44
5.5	74.91	38.15
6	64.46	32.47
6.5	55.97	27.96
7	49.00	24.32
7.5	43.22	21.34
8	38.39	18.87
8.5	34.32	16.81
9	30.85	15.07
9.5	27.88	13.58
10	25.32	12.31



corners = "Rounded corners"

date: 2011-05-07

2016-06-10

15

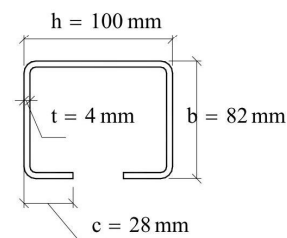
Section properties according to EN 1993-1-3:

$\gamma_{M0} = 1.00$ $\gamma_{M1} = 1.00$

Section VB

kb = 290mm

$M_{ycRd} = 16.5 \text{ kN}\cdot\text{m}$	Bending moment resistance y-y (6.1.4)
$M_{z1cRd} = 10.31 \text{ kN}\cdot\text{m}$	Bending moment resistance z-z tension in web (6.1.4)
$M_{z2cRd} = 10.31 \text{ kN}\cdot\text{m}$	Bending moment resistance z-z compression in web (6.1.4)
$V_{bh,Rd} = 93.12 \text{ kN}$	Shear force resistance perpendicular to y-axis web only (6.1.5)
$V_{b,Rd} = 143.55 \text{ kN}$	Shear force resistance perpendicular to y-axis web+lips (6.1.5)
$V_{bb,Rd} = 151.31 \text{ kN}$	Shear force resistance perpendicular to z-axis (6.1.5)
$R_{w,Rd2.1} = 90.08 \text{ kN}$	Reaction force (RF) resistance web (h), 100mm support (6.1.7)
$R_{w,Rd1.1} = 50.44 \text{ kN}$	RF resistance web (h), 100mm support, close to end (6.1.7)
$R_{w,Rd2.2} = 103.49 \text{ kN}$	RF resistance web (h), 200mm support (6.1.7)
$R_{w,Rd1.2} = 60.53 \text{ kN}$	RF resistance web (h), 200mm support close to end (6.1.7)
$R_{w,Rd4.1} = 69.69 \text{ kN}$	RF resistance restrained web (h), 100mm supp. (6.1.7)
$R_{w,Rd3.1} = 99.17 \text{ kN}$	RF resistance restrained web (h), 100mm supp., close to end (6.1.7)
$N_{t,Rd} = 517.41 \text{ kN}$	Axial tension resistance (6.1.2)
$N_{c,Rd} = 488.08 \text{ kN}$	Axial compression resistance (6.1.3):



h = 100 mm

b = 82 mm

c = 28 mm

t = 4 mm

$A_g = 1167.93 \text{ mm}^2$

$f_{yb} = 420 \frac{\text{N}}{\text{mm}^2}$

$f_u = 480 \frac{\text{N}}{\text{mm}^2}$

$e_1 = 35.12 \text{ mm}$

$y_M = 44.9 \text{ mm}$

$W_y = 3.93 \times 10^4 \text{ mm}^3$

$W_{z1} = 3.33 \times 10^4 \text{ mm}^3$

$W_{z2} = 2.45 \times 10^4 \text{ mm}^3$

$I_y = 1.89 \times 10^6 \text{ mm}^4$

$I_z = 1.1 \times 10^6 \text{ mm}^4$

$E \cdot I_y = 396050 \text{ N}\cdot\text{m}^2$

$E \cdot I_z = 231314 \text{ N}\cdot\text{m}^2$

$i_y = 40.18 \text{ mm}$

$i_z = 30.71 \text{ mm}$

$I_T = 6485.33 \text{ mm}^4$

$I_{\omega} = 3.25 \times 10^9 \text{ mm}^6$

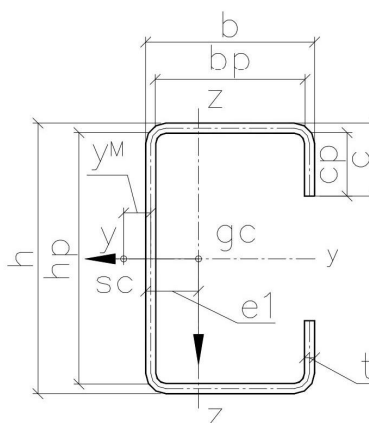
$g_p = 9.05 \frac{\text{kg}}{\text{m}}$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$\Delta e_N = 0.16 \text{ mm}$

$L_z := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m}$ $L_y := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m}$

$L_z =$	$N_{b,Rd,y,FB}(L_y) = N_{b,Rd,z,FB}(L_z) =$	$N_{TF,Rd}$
0.5 m	488.08 kN	482.67 kN
1	460.84	439.52
1.5	424.95	384.28
2	380.65	314.93
2.5	327.91	245.31
3	273.05	188.98
3.5	223.82	147.46
4	183.55	117.35
4.5	151.83	95.26
5	127.04	78.71
5.5	107.56	66.06
6	92.09	56.19
6.5	79.65	48.37
7	69.53	42.06
7.5	61.19	36.90
8	54.25	32.63
8.5	48.42	29.06
9	43.48	26.05
9.5	39.25	23.47
10	35.60	21.27



corners = "Rounded corners"

date: 2013-03-06

Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section FB

$$k_b = 300 \text{ mm}$$

$$M_{yc,Rd} = 24.8 \text{ kN}\cdot\text{m}$$

Bending moment resistance y-y (6.1.4)

$$M_{z1c,Rd} = 17.31 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z tension in web (6.1.4)

$$M_{z2c,Rd} = 17.31 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z compression in web (6.1.4)

$$V_{bh,Rd} = 137.12 \text{ kN}$$

Shear force resistance perpendicular to y-axis web only (6.1.5)

$$V_{b,Rd} = 225.17 \text{ kN}$$

Shear force resistance perpendicular to y-axis web+lips (6.1.5)

$$V_{bb,Rd} = 230.94 \text{ kN}$$

Shear force resistance perpendicular to z-axis (6.1.5)

$$R_{w,Rd2.1} = 150.46 \text{ kN}$$

Reaction force (RF) resistance web, 100mm support (6.1.7)

$$R_{w,Rd1.1} = 79.34 \text{ kN}$$

RF resistance web, 100mm support, close to end (6.1.7)

$$R_{w,Rd2.2} = 168.94 \text{ kN}$$

RF resistance web, 200mm support (6.1.7)

$$R_{w,Rd1.2} = 92.56 \text{ kN}$$

RF resistance web, 200mm support close to end (6.1.7)

$$R_{w,Rd4.1} = 110.17 \text{ kN}$$

RF resistance restrained web, 100mm supp. (6.1.7)

$$R_{w,Rd3.1} = 175.84 \text{ kN}$$

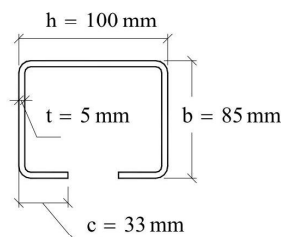
RF resistance restrained web, 100mm supp., close to end (6.1.7)

$$N_{t,Rd} = 792.81 \text{ kN}$$

Axial tension resistance (6.1.2)

$$N_{c,Rd} = 757.81 \text{ kN}$$

Axial compression resistance (6.1.3):



$$h = 100 \text{ mm}$$

$$b = 85 \text{ mm}$$

$$c = 33 \text{ mm}$$

$$t = 5 \text{ mm}$$

$$A_g = 1515.62 \text{ mm}^2$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 550 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 38.01 \text{ mm}$$

$$y_M = 47.78 \text{ mm}$$

$$W_y = 4.96 \times 10^4 \text{ mm}^3$$

$$W_{z1} = 4.34 \times 10^4 \text{ mm}^3$$

$$W_{z2} = 3.46 \times 10^4 \text{ mm}^3$$

$$I_y = 2.36 \times 10^6 \text{ mm}^4$$

$$I_z = 1.54 \times 10^6 \text{ mm}^4$$

$$E \cdot I_y = 494738 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 323343 \text{ N}\cdot\text{m}^2$$

$$i_y = 39.43 \text{ mm}$$

$$i_z = 31.87 \text{ mm}$$

$$I_T = 1.32 \times 10^4 \text{ mm}^4$$

$$I_o = 5.32 \times 10^9 \text{ mm}^6$$

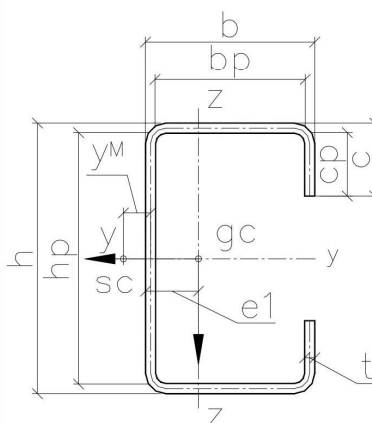
$$g_p = 11.68 \frac{\text{kg}}{\text{m}}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = 0 \text{ mm}$$

$$L_z := 0.5\text{ m}, 1.0\text{ m} \dots 10.0\text{ m} \quad \rightarrow \quad 0.5\text{ m}, 1.0\text{ m} \dots 10.0\text{ m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y) = N_{b,Rd,z,FB}(L_z) =$	$N_{TF,Rd}$
0.5 m	757.81 kN	746.05 kN
1	703.60	674.30
1.5	637.76	580.44
2	554.63	464.70
2.5	459.72	354.90
3	369.86	270.26
3.5	296.13	209.54
4	239.30	166.14
4.5	196.11	134.54
5	163.09	110.99
5.5	137.49	93.04
6	117.35	79.08
6.5	101.26	68.02
7	88.23	59.11
7.5	77.54	51.84
8	68.67	45.83
8.5	61.22	40.80
9	54.92	36.56
9.5	49.55	32.94
10	44.92	29.83



corners = "Rounded corners"

date: 2011-05-07

2016-06-10

17

SPOJKY PAS VAZNÍKU – SLOUP

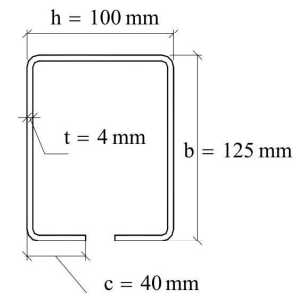
Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section GC

$$k_b = 400 \text{ mm}$$

$M_{ycRd} = 22.74 \text{ kN}\cdot\text{m}$	Bending moment resistance y-y (6.1.4)
$M_{z1cRd} = 23.18 \text{ kN}\cdot\text{m}$	Bending moment resistance z-z tension in web (6.1.4)
$M_{z2cRd} = 23.18 \text{ kN}\cdot\text{m}$	Bending moment resistance z-z compression in web (6.1.4)
$V_{bh,Rd} = 93.12 \text{ kN}$	Shear force resistance perpendicular to y-axis web only (6.1.5)
$V_{b,Rd} = 166.83 \text{ kN}$	Shear force resistance perpendicular to y-axis web+lips (6.1.5)
$V_{bb,Rd} = 234.73 \text{ kN}$	Shear force resistance perpendicular to z-axis (6.1.5)
$R_{w,Rd2.1} = 90.08 \text{ kN}$	Reaction force (RF) resistance web (h), 100mm support (6.1.7)
$R_{w,Rd1.1} = 50.44 \text{ kN}$	RF resistance web (h), 100mm support, close to end (6.1.7)
$R_{w,Rd2.2} = 103.49 \text{ kN}$	RF resistance web (h), 200mm support (6.1.7)
$R_{w,Rd1.2} = 60.53 \text{ kN}$	RF resistance web (h), 200mm support close to end (6.1.7)
$R_{w,Rd4.1} = 69.69 \text{ kN}$	RF resistance restrained web (h), 100mm supp. (6.1.7)
$R_{w,Rd3.1} = 99.17 \text{ kN}$	RF resistance restrained web (h), 100mm supp., close to end (6.1.7)
$N_{t,Rd} = 702.21 \text{ kN}$	Axial tension resistance (6.1.2)
$N_{c,Rd} = 638.15 \text{ kN}$	Axial compression resistance (6.1.3):



$$h = 100 \text{ mm}$$

$$b = 125 \text{ mm}$$

$$c = 40 \text{ mm}$$

$$t = 4 \text{ mm}$$

$$A_g = 1607.93 \text{ mm}^2$$

$$f_{yb} = 420 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 480 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 59.49 \text{ mm}$$

$$\gamma_M = 71.66 \text{ mm}$$

$$W_y = 5.63 \times 10^4 \text{ mm}^3$$

$$W_{z1} = 6.1 \times 10^4 \text{ mm}^3$$

$$W_{z2} = 5.52 \times 10^4 \text{ mm}^3$$

$$I_y = 2.7 \times 10^6 \text{ mm}^4$$

$$I_z = 3.51 \times 10^6 \text{ mm}^4$$

$$E \cdot I_y = 567990 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 736173 \text{ N}\cdot\text{m}^2$$

$$i_y = 41.01 \text{ mm}$$

$$i_z = 46.69 \text{ mm}$$

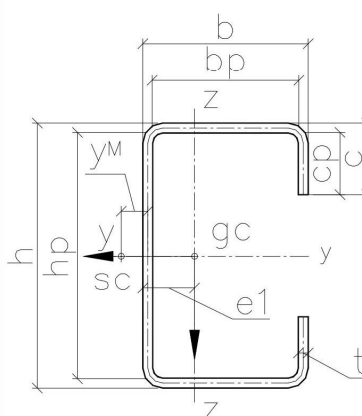
$$I_T = 8832 \text{ mm}^4$$

$$I_w = 1.55 \times 10^{10} \text{ mm}^6$$

$$g_p = 12.5 \frac{\text{kg}}{\text{m}}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = 2.44 \text{ mm}$$



corners = "Rounded corners"

date: 2011-05-07

$$L_z := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m} \quad -y := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y) = N_{b,Rd,z,FB}(L_z) =$	$N_{TF,Rd}$
0.5 m	638.15 kN	602.33 kN
1	606.39	498.77
1.5	562.53	363.17
2	509.08	251.06
2.5	444.96	179.93
3	376.06	135.72
3.5	311.80	107.05
4	257.64	87.52
4.5	214.16	73.64
5	179.77	63.38
5.5	152.55	55.57
6	130.81	49.44
6.5	113.28	44.52
7	98.97	40.49
7.5	87.17	37.12
8	77.33	34.26
8.5	69.05	31.8
9	62.02	29.65
9.5	56.01	27.75
10	50.82	26.06

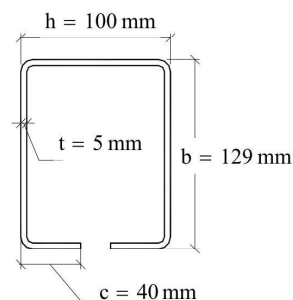
Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section AC

$$k_b = 400 \text{ mm}$$

$M_{ycRd} = 34.15 \text{ kN}\cdot\text{m}$	Bending moment resistance y-y (6.1.4)
$M_{z1cRd} = 35.25 \text{ kN}\cdot\text{m}$	Bending moment resistance z-z tension in web (6.1.4)
$M_{z2cRd} = 35.25 \text{ kN}\cdot\text{m}$	Bending moment resistance z-z compression in web (6.1.4)
$V_{bh,Rd} = 137.12 \text{ kN}$	Shear force resistance perpendicular to y-axis web only (6.1.5)
$V_{b,Rd} = 245.37 \text{ kN}$	Shear force resistance perpendicular to y-axis web+lips (6.1.5)
$V_{bb,Rd} = 357.96 \text{ kN}$	Shear force resistance perpendicular to z-axis (6.1.5)
$R_{w,Rd2.1} = 150.46 \text{ kN}$	Reaction force (RF) resistance web (h), 100mm support (6.1.7)
$R_{w,Rd1.1} = 79.34 \text{ kN}$	RF resistance web (h), 100mm support, close to end (6.1.7)
$R_{w,Rd2.2} = 168.94 \text{ kN}$	RF resistance web (h), 200mm support (6.1.7)
$R_{w,Rd1.2} = 92.56 \text{ kN}$	RF resistance web (h), 200mm support close to end (6.1.7)
$R_{w,Rd4.1} = 110.17 \text{ kN}$	RF resistance restrained web (h), 100mm supp. (6.1.7)
$R_{w,Rd3.1} = 175.84 \text{ kN}$	RF resistance restrained web (h), 100mm supp., close to end (6.1.7)
$N_{t,Rd} = 1047.81 \text{ kN}$	Axial tension resistance (6.1.2)
$N_{c,Rd} = 960.87 \text{ kN}$	Axial compression resistance (6.1.3):



$$h = 100 \text{ mm}$$

$$b = 129 \text{ mm}$$

$$c = 40 \text{ mm}$$

$$t = 5 \text{ mm}$$

$$A_g = 2025.62 \text{ mm}^2$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 550 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 61.44 \text{ mm}$$

$$y_M = 73.07 \text{ mm}$$

$$W_y = 7.08 \times 10^4 \text{ mm}^3$$

$$W_{z1} = 7.78 \times 10^4 \text{ mm}^3$$

$$W_{z2} = 7.05 \times 10^4 \text{ mm}^3$$

$$I_y = 3.36 \times 10^6 \text{ mm}^4$$

$$I_z = 4.59 \times 10^6 \text{ mm}^4$$

$$E \cdot I_y = 706147 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 963239 \text{ N}\cdot\text{m}^2$$

$$i_y = 40.74 \text{ mm}$$

$$i_z = 47.59 \text{ mm}$$

$$I_T = 1.74 \times 10^4 \text{ mm}^4$$

$$I_{\omega} = 1.98 \times 10^{10} \text{ mm}^6$$

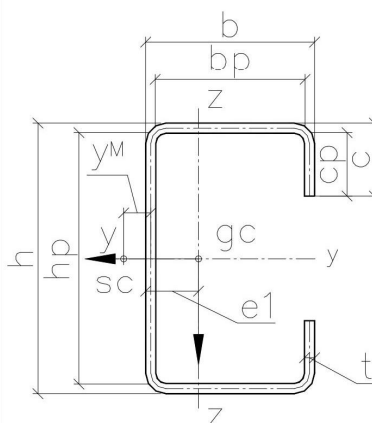
$$g_p = 15.69 \frac{\text{kg}}{\text{m}}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = 2.44 \text{ mm}$$

$$L_z := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m} \quad \gamma_y := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y) = N_{b,Rd,z,FB}(L_z) =$	$N_{TF,Rd}$
0.5 m	960.87 kN	893.07 kN
1	900.63	710.72
1.5	824.50	489.42
2	729.40	331.2
2.5	617.82	237.63
3	506.33	180.93
3.5	410.37	144.47
4	334.12	119.65
4.5	275.12	101.91
5	229.50	88.7
5.5	193.91	78.51
6	165.77	70.4
6.5	143.21	63.8
7	124.90	58.29
7.5	109.85	53.61
8	97.33	49.58
8.5	86.83	46.04
9	77.93	42.92
9.5	70.32	40.13
10	63.78	37.63



corners = "Rounded corners"

date: 2011-05-07

2016-06-10

21

Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section GA

$$k_b = 400 \text{ mm}$$

$$M_{yRd} = 20.25 \text{ kN}\cdot\text{m} \quad \text{Bending moment resistance y-y (6.1.4)}$$

$$M_{z1Rd} = 22.57 \text{ kN}\cdot\text{m} \quad \text{Bending moment resistance z-z tension in web (6.1.4)}$$

$$M_{z2Rd} = 22.58 \text{ kN}\cdot\text{m} \quad \text{Bending moment resistance z-z compression in web (6.1.4)}$$

$$V_{bh,Rd} = 102.81 \text{ kN} \quad \text{Shear force resistance perpendicular to y-axis web only (6.1.5)}$$

$$V_{bhc,Rd} = 180.41 \text{ kN} \quad \text{Shear force resistance perpendicular to y-axis web+lips (6.1.5)}$$

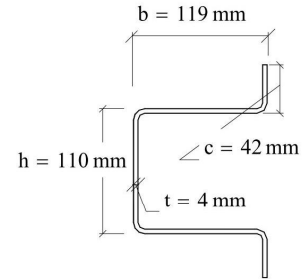
$$V_{bb,Rd} = 223.09 \text{ kN} \quad \text{Shear force resistance perpendicular to z-axis (6.1.5)}$$

$$N_{t,Rd} = 705.57 \text{ kN} \quad \text{Axial tension resistance (6.1.2)}$$

$$N_{c,Rd} = 652.65 \text{ kN} \quad \text{Axial compression resistance (6.1.3):}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = 1.74 \text{ mm}$$



$$h = 110 \text{ mm}$$

$$b = 119 \text{ mm}$$

$$c = 42 \text{ mm}$$

$$t = 4 \text{ mm}$$

$$A_g = 1615.93 \text{ mm}^2$$

$$f_{yb} = 420 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 480 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 55.80 \text{ mm}$$

$$y_M = 49.12 \text{ mm}$$

$$W_y = 5.05 \times 10^4 \text{ mm}^3$$

$$W_{z1} = 6.11 \times 10^4 \text{ mm}^3$$

$$W_{z2} = 5.38 \times 10^4 \text{ mm}^3$$

$$I_y = 4.60 \times 10^6 \text{ mm}^4$$

$$I_z = 3.29 \times 10^6 \text{ mm}^4$$

$$E \cdot I_y = 965046 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 690857 \text{ N}\cdot\text{m}^2$$

$$i_y = 53.33 \text{ mm}$$

$$i_z = 45.12 \text{ mm}$$

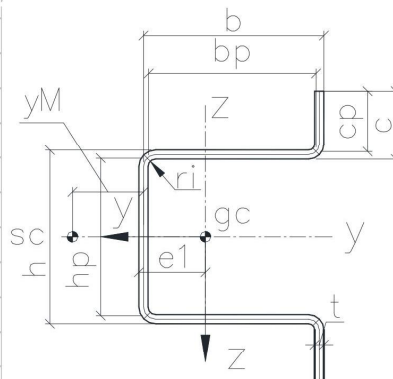
$$I_T = 8.87 \times 10^3 \text{ mm}^4$$

$$I_\omega = 5.15 \times 10^9 \text{ mm}^6$$

$$g_p = 12.57 \frac{\text{kg}}{\text{m}}$$

$$L_z := 1.0\cdot\text{m}, 1.5\cdot\text{m} \dots 15.0\cdot\text{m} \quad L_y := 1.0\cdot\text{m}, 1.5\cdot\text{m} \dots 15.0\cdot\text{m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y)$	$N_{b,Rd,z,FB}(L_z)$	$N_{TF,Rd}$
1.00 m	638.28 kN	626.97 kN	0.5 578.7 kN
1.50	606.30	587.25	1 403.65
2.00	570.18	540.09	1.5 249.49
2.50	527.87	483.41	2 167.46
3.00	478.70	419.70	2.5 123.9
3.50	424.72	356.05	3 98.58
4.00	370.36	299.03	3.5 82.6
4.50	319.95	251.27	4 71.82
5.00	275.84	212.46	4.5 64.14
5.50	238.46	181.18	5 58.4
6.00	207.22	155.92	5.5 53.94
6.50	181.20	135.38	6 50.35
7.00	159.49	118.52	6.5 47.37
7.50	141.28	104.55	7 44.83
8.00	125.91	92.87	7.5 42.62
8.50	112.85	83.01	8 40.64
9.00	101.68	74.63	8.5 38.86
9.50	92.06	67.44	9 37.22
10.00	83.72	61.24	9.5 35.7
10.50	76.46	55.85	10 34.28
11.00	70.09	51.13	10.5 32.94
11.50	64.48	46.99	11 31.67
12.00	59.51	43.33	11.5 30.46
12.50	55.09	40.08	12 29.31
13.00	51.14	37.18	12.5 28.22
13.50	47.60	34.58	13 27.17
14.00	44.41	32.25	13.5 26.16
14.50	41.54	30.14	14 25.2
15.00	38.93	28.24	14.5 24.27
			15 23.39



corners = "Rounded corners"

date: 2012-05-08

Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

$$M_{yRd} = 30.73 \text{ kN}\cdot\text{m} \quad \text{Bending moment resistance y-y (6.1.4)}$$

$$M_{z1Rd} = 33.76 \text{ kN}\cdot\text{m} \quad \text{Bending moment resistance z-z tension in web (6.1.4)}$$

$$M_{z2Rd} = 33.77 \text{ kN}\cdot\text{m} \quad \text{Bending moment resistance z-z compression in web (6.1.4)}$$

$$V_{bh,Rd} = 154.44 \text{ kN} \quad \text{Shear force resistance perpendicular to y-axis web only (6.1.5)}$$

$$V_{bhc,Rd} = 271.35 \text{ kN} \quad \text{Shear force resistance perpendicular to y-axis web+lips (6.1.5)}$$

$$V_{bb,Rd} = 331.98 \text{ kN} \quad \text{Shear force resistance perpendicular to z-axis (6.1.5)}$$

$$N_{t,Rd} = 1047.81 \text{ kN} \quad \text{Axial tension resistance (6.1.2)}$$

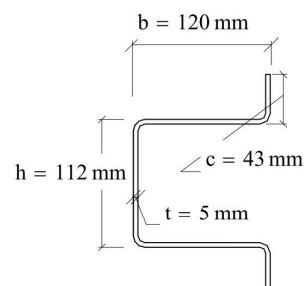
$$N_{c,Rd} = 981.63 \text{ kN} \quad \text{Axial compression resistance (6.1.3):}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = 1.39 \text{ mm}$$

Section AA

$$k_b = 400 \text{ mm}$$



$$h = 112 \text{ mm}$$

$$b = 120 \text{ mm}$$

$$c = 43 \text{ mm}$$

$$t = 5 \text{ mm}$$

$$A_g = 2025.62 \text{ mm}^2$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 550 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 56.31 \text{ mm}$$

$$y_M = 49.01 \text{ mm}$$

$$W_y = 6.42 \times 10^4 \text{ mm}^3$$

$$W_{z1} = 7.68 \times 10^4 \text{ mm}^3$$

$$W_{z2} = 6.75 \times 10^4 \text{ mm}^3$$

$$I_y = 5.88 \times 10^6 \text{ mm}^4$$

$$I_z = 4.13 \times 10^6 \text{ mm}^4$$

$$E \cdot I_y = 1234446 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 867806 \text{ N}\cdot\text{m}^2$$

$$i_y = 53.87 \text{ mm}$$

$$i_z = 45.17 \text{ mm}$$

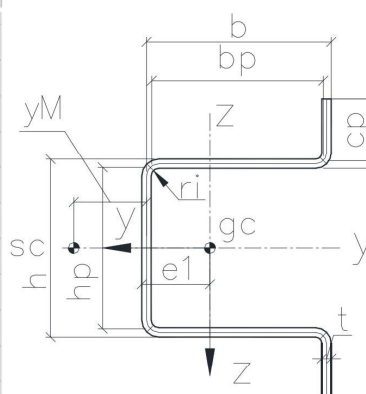
$$I_T = 1.74 \times 10^4 \text{ mm}^4$$

$$I_\omega = 6.60 \times 10^9 \text{ mm}^6$$

$$g_p = 15.69 \frac{\text{kg}}{\text{m}}$$

$$L_z := 1.0\cdot\text{m}, 1.5\cdot\text{m}.. 15.0\cdot\text{m} \quad L_y := 1.0\cdot\text{m}, 1.5\cdot\text{m}.. 15.0\cdot\text{m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y)$	$N_{b,Rd,z,FB}(L_z)$	$N_{TF,Rd}$
1.00 m	952.19 kN	932.35 kN	0.5 852.85 kN
1.50	898.90	864.56	1 566.2
2.00	837.28	781.86	1.5 347.1
2.50	763.95	682.68	2 238.47
3.00	679.45	576.35	2.5 181.78
3.50	590.13	477.46	3 148.85
4.00	504.94	394.29	3.5 127.89
4.50	429.92	327.62	4 113.52
5.00	366.81	274.95	4.5 103.03
5.50	314.78	233.27	5 94.95
6.00	272.10	200.01	5.5 88.45
6.50	237.03	173.18	6 83.01
7.00	208.02	151.30	6.5 78.31
7.50	183.86	133.25	7 74.15
8.00	163.57	118.20	7.5 70.39
8.50	146.39	105.54	8 66.94
9.00	131.75	94.80	8.5 63.74
9.50	119.16	85.60	9 60.74
10.00	108.28	77.68	9.5 57.93
10.50	98.81	70.80	10 55.26
11.00	90.53	64.79	10.5 52.74
11.50	83.23	59.51	11 50.35
12.00	76.78	54.86	11.5 48.08
12.50	71.05	50.72	12 45.93
13.00	65.93	47.04	12.5 43.88
13.50	61.35	43.74	13 41.94
14.00	57.22	40.78	13.5 40.1
14.50	53.50	38.10	14 38.35
15.00	50.13	35.68	14.5 36.69
			15 35.12



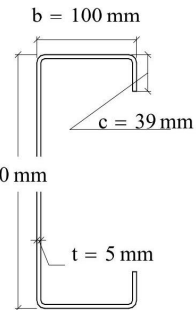
Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section UA

$$k_b = 490 \text{ mm}$$

$M_{ycRd} = 93.75 \text{ kN}\cdot\text{m}$	Bending moment resistance y-y (6.1.4)
$M_{z1cRd} = 27.21 \text{ kN}\cdot\text{m}$	Bending moment resistance z-z tension in web (6.1.4)
$M_{z2cRd} = 26.77 \text{ kN}\cdot\text{m}$	Bending moment resistance z-z compression in web (6.1.4)
$V_{bh,Rd} = 353.63 \text{ kN}$	Shear force resistance perpendicular to y-axis web only (6.1.5)
$V_{b,Rd} = 458.99 \text{ kN}$	Shear force resistance perpendicular to y-axis web+lips (6.1.5)
$V_{bb,Rd} = 274.24 \text{ kN}$	Shear force resistance perpendicular to z-axis (6.1.5)
$R_{w,Rd2,1} = 144.09 \text{ kN}$	Reaction force (RF) resistance web (h), 100mm support (6.1.7)
$R_{w,Rd1,1} = 74.79 \text{ kN}$	RF resistance web (h), 100mm support, close to end (6.1.7)
$R_{w,Rd2,2} = 161.79 \text{ kN}$	RF resistance web (h), 200mm support (6.1.7)
$R_{w,Rd1,2} = 87.25 \text{ kN}$	RF resistance web (h), 200mm support close to end (6.1.7)
$R_{w,Rd4,1} = 110.17 \text{ kN}$	RF resistance restrained web (h), 100mm supp. (6.1.7)
$R_{w,Rd3,1} = 182.7 \text{ kN}$	RF resistance restrained web (h), 100mm supp., close to end (6.1.7)
$N_{t,Rd} = 1272.81 \text{ kN}$	Axial tension resistance (6.1.2)
$N_{c,Rd} = 998.61 \text{ kN}$	Axial compression resistance (6.1.3):



$$h = 250 \text{ mm}$$

$$b = 100 \text{ mm}$$

$$c = 39 \text{ mm}$$

$$t = 5 \text{ mm}$$

$$A_g = 2475.62 \text{ mm}^2$$

$$f_{yb} = 500 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 550 \frac{\text{N}}{\text{mm}^2}$$

$$e_1 = 33.5 \text{ mm}$$

$$y_M = 48.46 \text{ mm}$$

$$W_y = 1.91 \times 10^5 \text{ mm}^3$$

$$W_{z1} = 1.12 \times 10^5 \text{ mm}^3$$

$$W_{z2} = 5.44 \times 10^4 \text{ mm}^3$$

$$I_y = 2.34 \times 10^7 \text{ mm}^4$$

$$I_z = 3.48 \times 10^6 \text{ mm}^4$$

$$E \cdot I_y = 4917656 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 731281 \text{ N}\cdot\text{m}^2$$

$$i_y = 97.26 \text{ mm}$$

$$i_z = 37.51 \text{ mm}$$

$$I_T = 2.12 \times 10^4 \text{ mm}^4$$

$$I_\omega = 4.78 \times 10^{10} \text{ mm}^6$$

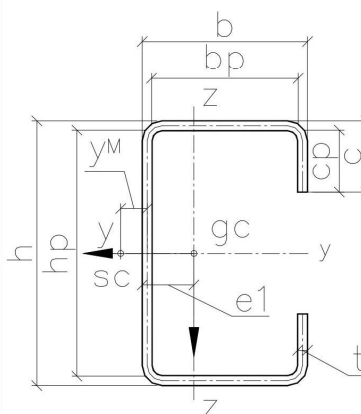
$$g_p = 19.22 \frac{\text{kg}}{\text{m}}$$

Change of centre of gravity in y-direction, due to effective plates under compression:
(-) = to the right

$$\Delta e_N = -4.36 \text{ mm}$$

$$L_z := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m} \quad -y := 0.5\text{-m}, 1.0\text{-m} \dots 10.0\text{-m}$$

$L_z =$	$N_{b,Rd,y,FB}(L_y) = N_{b,Rd,z,FB}(L_z) =$	$N_{TF,Rd}$
0.5 m	998.61 kN	998.61 kN
1	998.61	935.75
1.5	993.25	856.42
2	967.56	757.28
2.5	940.88	641.03
3	912.59	525.05
3.5	882.09	425.38
4	848.83	346.25
4.5	812.45	285.06
5	772.83	237.78
5.5	730.25	200.89
6	685.43	171.72
6.5	639.46	148.35
7	593.61	129.38
7.5	549.05	113.78
8	506.70	100.82
8.5	467.15	89.94
9	430.67	80.72
9.5	397.31	72.84
10	367.00	66.06



corners = "Rounded corners"

date: 2011-05-07

Section properties according to EN 1993-1-3:

$\gamma_{M0} = 1.00$ $\gamma_{M1} = 1.00$

Section XA

kb = 268mm

$M_{yRd} = 5.76 \text{ kN}\cdot\text{m}$

Bending moment resistance y-y (6.1.4)

$M_{zRd} = 1.35 \text{ kN}\cdot\text{m}$

Bending moment resistance z-z (6.1.4)

$V_{bh,Rd} = 26.76 \text{ kN}$

Shear force resistance perpendicular to y-axis web only (6.1.5)

$V_{bb,Rd} = 13.62 \text{ kN}$

Shear force resistance perpendicular to z-axis (both flanges) (6.1.5)

$R_{w,Rd1} = 12.79 \text{ kN}$

Reaction force (RF) resistance web, 108mm support (6.1.7)

$R_{w,Rd1.1} = 7.01 \text{ kN}$

RF resistance web, 108mm support, close to end (6.1.7)

$R_{w,Rd4.1} = 15.71 \text{ kN}$

RF resistance restrained web, 108mm supp. (6.1.7)

$R_{w,Rd3.1} = 16.17 \text{ kN}$

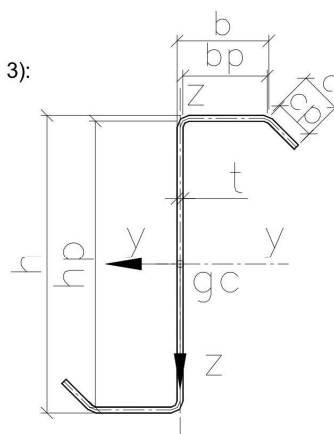
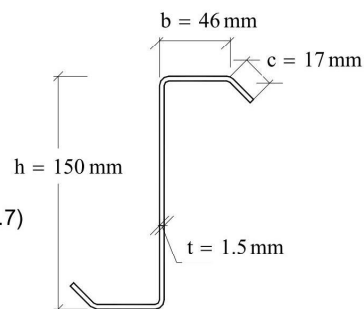
RF resistance restrained web, 108mm supp., close to end (6.1.7)

$N_{t,Rd} = 144.12 \text{ kN}$

Axial tension resistance (6.1.2)

$N_{c,Rd} = 83.9 \text{ kN}$

Axial compression resistance (6.1.3):



h = 150 mm

b = 46 mm

c = 17 mm

t = 1.5 mm

$A_g = 402.32 \text{ mm}^2$

$f_{yb} = 350 \frac{\text{N}}{\text{mm}^2}$

$f_u = 420 \frac{\text{N}}{\text{mm}^2}$

$W_y = 1.83 \times 10^4 \text{ mm}^3$

$W_z = 3873.81 \text{ mm}^3$

Flexural buckling resistance (6.3.1.3)

$L_y =$	$N_{b,Rd,y,FB}(L_y) =$	$N_{b,Rk,z,FB}(L_z) =$
0.5 m	83.90 kN	83.47 kN
1	83.90	76.71
1.5	82.13	68.34
2	79.47	57.71
2.5	76.62	46.28
3	73.51	36.33
3.5	70.04	28.65
4	66.19	22.95
4.5	61.96	18.70
5	57.44	15.49
5.5	52.78	13.03
6	48.18	11.10
6.5	43.79	9.56
7	39.71	8.32
7.5	36.01	7.31
8	32.69	6.46
8.5	29.73	5.76
9	27.10	5.16
9.5	24.78	4.66
10	22.71	4.22
10.5	20.88	3.84
11	19.25	3.51
11.5	17.80	3.22
12	16.49	2.97

torsional buckling resistance (6.3.1.4)

$L_T =$	$N_{b,Rd,T}(L_T) =$
0.5 m	83.35 kN
1	76.52
1.5	68.22
2	58.08
2.5	47.55
3	38.52
3.5	31.58
4	26.41
4.5	22.56
5	19.66
5.5	17.42
6	15.67
6.5	14.28
7	13.16
7.5	12.25
8	11.49
8.5	10.86
9	10.32

$I_y = 1.36 \times 10^6 \text{ mm}^4$

$I_z = 2.2 \times 10^5 \text{ mm}^4$

$E \cdot I_y = 285056.7 \text{ N}\cdot\text{m}^2$

$E \cdot I_z = 46158.4 \text{ N}\cdot\text{m}^2$

$i_y = 58.09 \text{ mm}$

$i_z = 23.37 \text{ mm}$

$I_T = 305.73 \text{ mm}^4$

$I_{\omega} = 8.28 \times 10^8 \text{ mm}^6$

$g_p = 3.15 \frac{\text{kg}}{\text{m}}$

corners = "Rounded corners"

date: 2011-05-16

2016-06-10

73

Section properties according to EN 1993-1-3:

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00$$

Section HA

$$k_b = 268 \text{ mm}$$

$$M_{y,Rd} = 8.07 \text{ kN}\cdot\text{m}$$

Bending moment resistance y-y (6.1.4)

$$M_{z,Rd} = 1.84 \text{ kN}\cdot\text{m}$$

Bending moment resistance z-z (6.1.4)

$$V_{bh,Rd} = 47.57 \text{ kN}$$

Shear force resistance perpendicular to y-axis web only (6.1.5)

$$V_{bb,Rd} = 18.02 \text{ kN}$$

Shear force resistance perpendicular to z-axis (both flanges) (6.1.5)

$$R_{w,Rd2.1} = 21.8 \text{ kN}$$

Reaction force (RF) resistance web, 108mm support (6.1.7)

$$R_{w,Rd1.1} = 12.82 \text{ kN}$$

RF resistance web, 108mm support, close to end (6.1.7)

$$R_{w,Rd4.1} = 24.47 \text{ kN}$$

RF resistance restrained web, 108mm supp. (6.1.7)

$$R_{w,Rd3.1} = 25.97 \text{ kN}$$

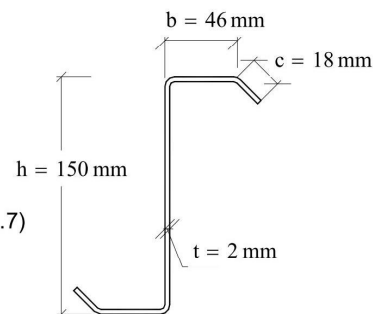
RF resistance restrained web, 108mm supp., close to end (6.1.7)

$$N_{t,Rd} = 193.88 \text{ kN}$$

Axial tension resistance (6.1.2)

$$N_{c,Rd} = 131.31 \text{ kN}$$

Axial compression resistance (6.1.3):



$$h = 150 \text{ mm}$$

$$b = 46 \text{ mm}$$

$$c = 18 \text{ mm}$$

$$t = 2 \text{ mm}$$

$$A_g = 537.13 \text{ mm}^2$$

$$f_{yb} = 350 \frac{\text{N}}{\text{mm}^2}$$

$$f_u = 420 \frac{\text{N}}{\text{mm}^2}$$

$$W_y = 2.43 \times 10^4 \text{ mm}^3$$

$$W_z = 5250.04 \text{ mm}^3$$

$$I_y = 1.8 \times 10^6 \text{ mm}^4$$

$$I_z = 2.99 \times 10^5 \text{ mm}^4$$

$$E \cdot I_y = 377828.8 \text{ N}\cdot\text{m}^2$$

$$E \cdot I_z = 62865.9 \text{ N}\cdot\text{m}^2$$

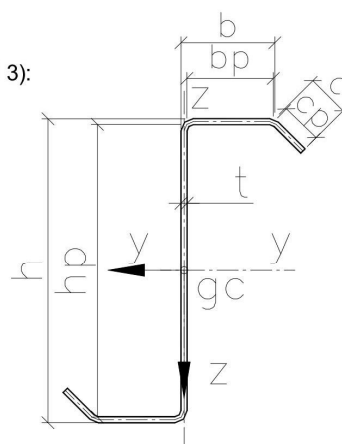
$$i_y = 57.88 \text{ mm}$$

$$i_z = 23.61 \text{ mm}$$

$$I_T = 726.25 \text{ mm}^4$$

$$I_{\omega} = 1.12 \times 10^9 \text{ mm}^6$$

$$g_p = 4.2 \frac{\text{kg}}{\text{m}}$$



Flexural buckling resistance (6.3.1.3)

$L_y =$	$N_{b,Rd,y,FB}(L_y) =$	$N_{b,Rk,z,FB}(L_z) =$
m	kN	kN
0.5	131.31	129.91
1	131.31	118.37
1.5	127.48	103.64
2	122.87	85.12
2.5	117.87	66.43
3	112.30	51.24
3.5	106.04	40.01
4	99.06	31.85
4.5	91.48	25.86
5	83.58	21.37
5.5	75.74	17.94
6	68.27	15.26
6.5	61.39	13.14
7	55.20	11.42
7.5	49.71	10.02
8	44.88	8.86
8.5	40.64	7.89
9	36.92	7.08
9.5	33.66	6.38
10	30.78	5.78
10.5	28.24	5.26
11	26.00	4.81
11.5	24.00	4.41
12	22.22	4.06

torsional buckling resistance (6.3.1.4)

$L_T =$	$N_{b,Rd,T}(L_T) =$
m	kN
0.5	129.73
1	118.19
1.5	104.04
2	87.30
2.5	71.05
3	57.93
3.5	48.20
4	41.09
4.5	35.85
5	31.92
5.5	28.92
6	26.58
6.5	24.72
7	23.22
7.5	22.00
8	20.99
8.5	20.15
9	19.44

corners = "Rounded corners"

date: 2011-05-16

Section properties according to EN 1993-1-3:

$\gamma_{M0} = 1.00$ $\gamma_{M1} = 1.00$

Section OA

$k_b = 268\text{mm}$

$M_{y,Rd} = 12.79\text{ kN}\cdot\text{m}$ Bending moment resistance y-y (6.1.4)

$M_{z,Rd} = 2.93\text{ kN}\cdot\text{m}$ Bending moment resistance z-z (6.1.4)

$V_{bh,Rd} = 89.11\text{ kN}$ Shear force resistance perpendicular to y-axis web only (6.1.5)

$V_{bb,Rd} = 26.6\text{ kN}$ Shear force resistance perpendicular to z-axis (both flanges) (6.1.5)

$R_{w,Rd2.1} = 47.7\text{ kN}$ Reaction force (RF) resistance web, 108mm support (6.1.7)

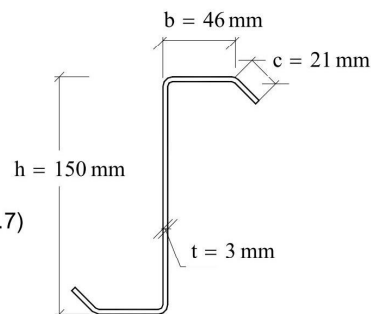
$R_{w,Rd1.1} = 29.01\text{ kN}$ RF resistance web, 108mm support, close to end (6.1.7)

$R_{w,Rd4.1} = 44.76\text{ kN}$ RF resistance restrained web, 108mm supp. (6.1.7)

$R_{w,Rd3.1} = 51.68\text{ kN}$ RF resistance restrained web, 108mm supp., close to end (6.1.7)

$N_{t,Rd} = 298.06\text{ kN}$ Axial tension resistance (6.1.2)

$N_{c,Rd} = 245.22\text{ kN}$ Axial compression resistance (6.1.3):



$h = 150\text{ mm}$

$b = 46\text{ mm}$

$c = 21\text{ mm}$

$t = 3\text{ mm}$

$A_g = 813.79\text{ mm}^2$

$f_{yb} = 350\frac{\text{N}}{\text{mm}^2}$

$f_u = 420\frac{\text{N}}{\text{mm}^2}$

$W_y = 3.66 \times 10^4\text{ mm}^3$

$W_z = 8376.98\text{ mm}^3$

$I_y = 2.69 \times 10^6\text{ mm}^4$

$I_z = 4.88 \times 10^5\text{ mm}^4$

$E \cdot I_y = 564218.5\text{ N}\cdot\text{m}^2$

$E \cdot I_z = 102539.3\text{ N}\cdot\text{m}^2$

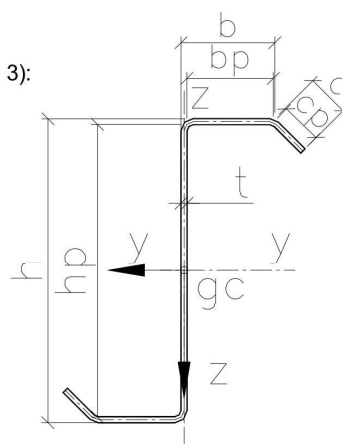
$i_y = 57.46\text{ mm}$

$i_z = 24.5\text{ mm}$

$I_T = 2479.63\text{ mm}^4$

$I_{\omega} = 1.83 \times 10^9\text{ mm}^6$

$g_p = 6.33\frac{\text{kg}}{\text{m}}$



Flexural buckling resistance (6.3.1.3)

$L_y =$	$N_{b,Rd,y,FB}(L_y) =$	$N_{b,Rk,z,FB}(L_z) =$
0.5 m	245.22 kN	241.20 kN
1	244.37	217.67
1.5	235.08	186.76
2	225.16	148.82
2.5	214.11	113.24
3	201.56	86.06
3.5	187.32	66.65
4	171.62	52.81
4.5	155.14	42.75
5	138.83	35.26
5.5	123.50	29.55
6	109.64	25.11
6.5	97.42	21.59
7	86.79	18.76
7.5	77.59	16.46
8	69.65	14.55
8.5	62.79	12.95
9	56.84	11.60
9.5	51.66	10.45
10	47.13	9.47
10.5	43.16	8.61
11	39.66	7.87
11.5	36.56	7.22
12	33.80	6.65

torsional buckling resistance (6.3.1.4)

$L_T =$	$N_{b,Rd,T}(L_T) =$
0.5 m	240.91 kN
1	217.96
1.5	190.48
2	160.13
2.5	132.91
3	111.98
3.5	96.80
4	85.84
4.5	77.82
5	71.82
5.5	67.24
6	63.68
6.5	60.86
7	58.59
7.5	56.74
8	55.22
8.5	53.95
9	52.87

corners = "Rounded corners"

date: 2011-05-16

2016-06-10

75

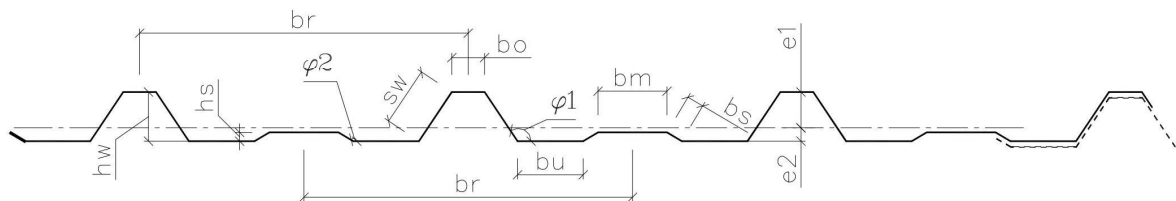
STŘEŠNÍ PLECH

Cross section properties: Roofplate TP46 according to EN 1993-1-3

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00 \quad \gamma_{M2} = 1.25 \quad f_{yb} = 320 \frac{\text{N}}{\text{mm}^2} \quad f_u = 390 \frac{\text{N}}{\text{mm}^2}$$

Measurements at centrelines: corners = "Rounded corners"

$$\begin{aligned} b_o &= 29.58 \text{ mm} & b_r &= 300 \text{ mm} & h_w &= 45 \text{ mm} & t_n &= 0.63 \text{ mm} & \Delta t &= 0.05 \text{ mm} & t &= 0.5842 \text{ mm} & r_i &= 3 \text{ mm} \\ b_u &= 59.76 \text{ mm} & b_s &= 15.63 \text{ mm} & s_w &= 53.67 \text{ mm} & \phi_1 &= 123.69 \text{ deg} & \phi_2 &= 149.35 \text{ deg} \\ b_m &= 62.94 \text{ mm} & h_s &= 8 \text{ mm} \end{aligned}$$



Gross cross section properties per meter:

$$e_1 = 32.51 \text{ mm} \quad I_{y,1} = 160563 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,1} = 4938.83 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,1} = 1.58 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Bending resistance: COMPRESSION IN UPPER FLANGE acc. to EN 1993 1-3: 5.5.3.4 + 6.1.4:

$$e_1 = 34.33 \text{ mm} \quad e_2 = 10.67 \text{ mm} \quad I_{y,\text{eff}} = 130983.88 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,\text{eff}} = 3817.84 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,\text{eff}} = 1.22 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Bending resistance: COMPRESSION IN LOWER FLANGE acc. to EN 1993 1-3: 5.5.3.4 + 6.1.4:

$$e_1 = 27.56 \text{ mm} \quad e_2 = 17.44 \text{ mm} \quad I_{y,\text{eff}} = 125704.58 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,\text{eff}} = 4560.48 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,\text{eff}} = 1.46 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Shear resistance for one meter plate (6.1.5)

$$V_{b,Rd} = 26.08 \text{ kN} \cdot \frac{1}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate close to end

$$S_{s,1} = 46 \text{ mm}$$

$$R_{w,Rd,\text{end},1} = 3.28 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate at midsupport

$$S_{s,1} = 46 \text{ mm}$$

$$R_{w,Rd,\text{mid},1} = 10.6 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate close to end

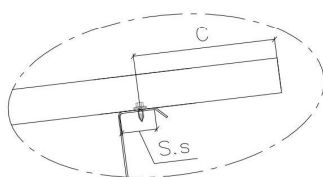
$$S_{s,2} = 60 \text{ mm}$$

$$R_{w,Rd,\text{end},2} = 3.28 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate at midsupport

$$S_{s,2} = 60 \text{ mm}$$

$$R_{w,Rd,\text{mid},2} = 11.68 \frac{\text{kN}}{\text{m}}$$



close to end
c = less than 85mm

EXTERIÉROVÝ STĚNOVÝ PLECH

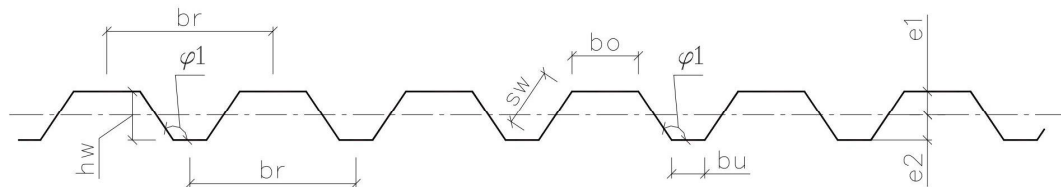
Cross section properties: Wallplate VP45 according to EN 1993-1-3

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00 \quad \gamma_{M2} = 1.25 \quad f_{yb} = 250 \frac{\text{N}}{\text{mm}^2} \quad f_u = 330 \frac{\text{N}}{\text{mm}^2}$$

Measurements at centrelines: corners = "Rounded corners"

$$b_o = 59.59 \text{ mm} \quad b_r = 150 \text{ mm} \quad h_w = 45 \text{ mm} \quad t_n = 0.5 \text{ mm} \quad \Delta t = 0.06 \text{ mm} \quad t = 0.4358 \text{ mm} \quad r_i = 3 \text{ mm}$$

$$b_u = 29.59 \text{ mm} \quad s_w = 53.68 \text{ mm} \quad \phi_1 = 123.69 \text{ deg}$$



Gross cross section properties per meter:

$$e_1 = 19.07 \text{ mm} \quad I_{y,1} = 176873 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,1} = 6822.3 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,1} = 1.706 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Bending resistance: COMPRESSION IN UPPER FLANGE acc. to EN 1993 1-3: 5.5.3.4 + 6.1.4:

$$e_1 = 24.13 \text{ mm} \quad e_2 = 20.87 \text{ mm} \quad I_{y,\text{eff}} = 124138.98 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,\text{eff}} = 5144.04 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,\text{eff}} = 1.29 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Bending resistance: COMPRESSION IN LOWER FLANGE acc. to EN 1993 1-3: 5.5.3.4 + 6.1.4:

$$e_1 = 17.32 \text{ mm} \quad e_2 = 27.68 \text{ mm} \quad I_{y,\text{eff}} = 137927.8 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,\text{eff}} = 4982.42 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,\text{eff}} = 1.25 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Shear resistance for one meter plate

$$V_{b,Rd} = 24.35 \text{ kN} \cdot \frac{1}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate close to end

$$S_{s,1} = 46 \text{ mm} \quad R_{w,Rd,\text{end},1} = 3.34 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate at midsupport

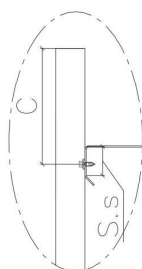
$$S_{s,1} = 46 \text{ mm} \quad R_{w,Rd,\text{mid},1} = 11.07 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate close to end

$$S_{s,2} = 60 \text{ mm} \quad R_{w,Rd,\text{end},2} = 3.34 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate at midsupport

$$S_{s,2} = 60 \text{ mm} \quad R_{w,Rd,\text{mid},2} = 12.24 \frac{\text{kN}}{\text{m}}$$



close to end
c = less than 85mm

date: 2012-05-11

2016-06-10

91

INTERIÉROVÉ PLECHY (PODHLÉD, STĚNY)

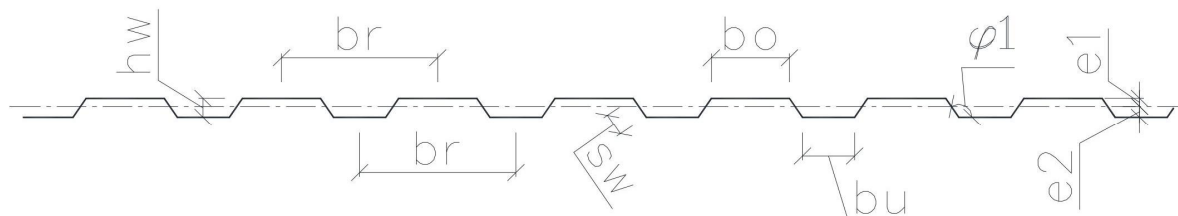
Cross section properties: Plate IP18 according to EN 1993-1-3

$$\gamma_{M0} = 1.00 \quad \gamma_{M1} = 1.00 \quad \gamma_{M2} = 1.25 \quad f_{yb} = 250 \frac{\text{N}}{\text{mm}^2} \quad f_u = 330 \frac{\text{N}}{\text{mm}^2}$$

Measurements at centrelines: corners = "Rounded corners"

$$b_o = 74.6 \text{ mm} \quad b_r = 150 \text{ mm} \quad h_w = 18.5 \text{ mm} \quad t_n = 0.5 \text{ mm} \quad \Delta t = 0.064 \text{ mm} \quad t = 0.4358 \text{ mm} \quad r_i = 3 \text{ mm}$$

$$b_u = 49.6 \text{ mm} \quad s_w = 21.928 \text{ mm} \quad \phi_1 = 124.046 \text{ deg}$$



Gross cross section properties per meter:

$$e_1 = 5.748 \text{ mm} \quad I_{y,1} = 33519 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,1} = 3155.64 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,1} = 0.789 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Bending resistance: COMPRESSION IN UPPER FLANGE acc. to EN 1993 1-3: 5.5.3.4 + 6.1.4:

$$e_1 = 11.412 \text{ mm} \quad e_2 = 7.088 \text{ mm} \quad I_{y,\text{eff}} = 19818.13 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,\text{eff}} = 1736.68 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,\text{eff}} = 0.43 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Bending resistance: COMPRESSION IN LOWER FLANGE acc. to EN 1993 1-3: 5.5.3.4 + 6.1.4:

$$e_1 = 6.427 \text{ mm} \quad e_2 = 12.073 \text{ mm} \quad I_{y,\text{eff}} = 20747.61 \text{ mm}^4 \cdot \frac{1}{\text{m}} \quad W_{y,\text{eff}} = 1718.484 \text{ mm}^3 \cdot \frac{1}{\text{m}} \quad M_{y,\text{eff}} = 0.43 \text{ kN} \cdot \text{m} \cdot \frac{1}{\text{m}}$$

Shear resistance for one meter plate

$$V_{b,Rd} = 18.73 \text{ kN} \cdot \frac{1}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate close to end

$$S_{s,1} = 46 \text{ mm}$$

$$R_{w,Rd,\text{end},1} = 3.33 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate at midsupport

$$S_{s,1} = 46 \text{ mm}$$

$$R_{w,Rd,\text{mid},1} = 11.05 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate close to end

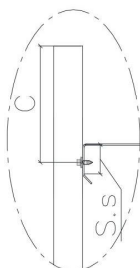
$$S_{s,2} = 60 \text{ mm}$$

$$R_{w,Rd,\text{end},2} = 3.33 \frac{\text{kN}}{\text{m}}$$

Reaction force resistance (6.1.7) for one meter plate at midsupport

$$S_{s,2} = 60 \text{ mm}$$

$$R_{w,Rd,\text{mid},2} = 12.22 \frac{\text{kN}}{\text{m}}$$



close to end
c = less than 85mm

date: 2012-05-11

2016-06-10

93

9 POUŽITÉ NORMY, SOFTWARE

Normy:

ČSN EN 1990 Zásady navrhování konstrukcí
ČSN EN 1991-1-1 Zatížení konstrukcí - Část 1-1: Obecná zatížení - Objemové tíhy, vlastní tíha a užitná zatížení pozemních staveb
ČSN EN 1991-1-2 Zatížení konstrukcí - Část 1-2: Obecná zatížení - Zatížení konstrukcí vystavených účinkům požáru
ČSN EN 1991-1-3 Zatížení konstrukcí - Část 1-3: Obecná zatížení - Zatížení sněhem
ČSN EN 1991-1-4 Zatížení konstrukcí - Část 1-4: Obecná zatížení - Zatížení větrem
ČSN EN 1991-1-5 Zatížení konstrukcí - Část 1-5: Obecná zatížení - Zatížení teplotou
ČSN EN 1993-1-1 Navrhování ocelových konstrukcí - Část 1-1: Obecná pravidla a pravidla pro pozemní stavby
ČSN EN 1993-1-2 Navrhování ocelových konstrukcí - Část 1-2: Obecná pravidla - Navrhování konstrukcí na účinky požáru
ČSN EN 1993-1-3 Navrhování ocelových konstrukcí - Část 1-3: Obecná pravidla - Doplnující pravidla pro tenkostěnné za studena tvarované prvky a plošné profily
ČSN EN 1993-1-8 Navrhování ocelových konstrukcí - Část 1-8: Navrhování styčníků
ČSN EN 1993-1-9 Navrhování ocelových konstrukcí - Část 1-9: Únava
ČSN EN 1993-1-12 Navrhování ocelových konstrukcí - Část 1-12: Doplnující pravidla pro oceli vysoké pevnosti do třídy S 700
ČSN EN 1090-1 Provádění ocelových konstrukcí a hliníkových konstrukcí - Část 1: Požadavky na posouzení shody konstrukčních dílců
ČSN EN 1090-1+A1 Provádění ocelových konstrukcí a hliníkových konstrukcí - Část 1: Požadavky na posouzení shody konstrukčních dílců
ČSN EN 1090-2+A1 Provádění ocelových konstrukcí a hliníkových konstrukcí - Část 2: Technické požadavky na ocelové konstrukce
ČSN EN 24015 Šrouby se šestihrannou hlavou s redukovanou hladkou částí dříku

Software:

Autodesk Robot Structural Analysis
Microsoft Excel

10 ZÁVĚR

Výpočet je proveden metodou konečných prvků v programu Autodesk Robot Structural Analysis. Splněním požadavků ČSN EN 1993-1-1 Navrhování ocelových konstrukcí (12/2006) Část 1.1 Obecná pravidla a pravidla pro pozemní stavby a ČSN EN 1993-1-3 Navrhování ocelových konstrukcí (02/2008) Část 1.3 Doplnující pravidla pro tenkostěnné za studena tvarované prvky a plošné profily je stavba bezpečná a staticky vyhovuje. Tento výpočet je vypracovaný pro účely stavebního řízení. Pro účely realizace bude vytvořen podrobný autorizovaný statický výpočet a prováděcí dokumentace, která bude obsahovat detaily ocelových prvků, konstrukcí a kotvení a bude to zpětně doloženo.