Projekt izložbenog paviljona na Pelješcu

Bulić, Loris

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DIPLOMSKI RAD

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Sažetak:

Tema diplomskog rada je proračun čelične konstrukcije izložbenog paviljona smještenog na poluotoku Pelješcu. Napravljen je numerički model konstrukcije gdje je izvršena provjera stabilnosti i dimenzioniranje elemenata konstrukcije prema normi Eurokod 3. U finalnoj fazi proračunati su spojevi uz korištenje programa IDEA STATICA 2019, izrađeni nacrti te je napravljen iskaz materijala .

Ključne riječi:

Izložbeni paviljon, čelična konstrukcija, numerički model, spojevi, nacrti, iskaz materijala

Exhibition pavilion project on Pelješac peninsula

Abstract:

The topic of this thesis is the analysis of steel structure for exhibition pavilion located on Pelješac peninsula. A numerical model SCIA 2019 was used to check the stability of the structure and for member design (by using Eurocode 3). Finally, structure connections were calculated with the help of software IDEA STATICA 2019. The thesis contains basic design drawings and the bill of material.

Keywords:

Exhibition pavilion, steel structure, numerical model, connections, drawings, bill of material

SVEUČILIŠTE U SPLITU
FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE

STUDIJ: **DIPLOMSKI SVEUČILIŠNI STUDIJ GRAĐEVINARSTVA**

KANDIDAT: Loris Bulić

BROJ INDEKSA: 687

KATEDRA: **Katedra za metalne i drvene konstrukcije**

PREDMET: Metalne konstrukcije

ZADATAK ZA DIPLOMSKI RAD

Tema: Projekt izložbenog paviljona na Pelješcu

Opis zadatka:

Zadatak diplomskog rada je proračun nosive čelične konstrukcije izložbenog paviljona na otoku Pelješcu. Potrebno je za predmetnu konstrukciju izraditi analizu graničnog stanja nosivosti, graničnog stanja uporabljivosti, proračun karakterističnih spojeva te izraditi pripadajuće izvedbene nacrte (plan pozicija, karakteristične presjeke, detalje spojeva i radioničke nacrte).

U Splitu, 07.03.2019.

Voditelj Diplomskog rada:
doc.dr.sc. Neno Torić

Predsjednik Povjerenstva
za završne i diplomske ispite:
doc.dr.sc. Ivo Andrić

Sadržaj

1. Tehnički opis

1.1. Opis konstrukcije

Predmet ovog projekta je izrada čelične konstrukcije izložbenog paviljona na Pelješcu. Parcela predviđena za gradnju nalazi se na vrhu brežuljka, s pristupnom cestom smještenom na sjevernoj strani parcele.

Sjeverni dio parcele služit će kao parkirni prostor za 85 vozila, s uređenim pješačkim stazama i drvećem kao prirodnim zaklonom od sunca.

Konstrukcija se sastoji od izlomljenog poligonalnog oblika koji možemo promatrati kao dio osmerokuta s izbačenim južnim pročeljem. Možemo je podijeliti na tri zone: unutarnji prsten s razmakom od 6 metara između rešetki, vanjski prsten s razmakom od 8 metara i južno pročelje s razmakom od 5 metara.

Ukupna širina objekta iznosi 43,18 metara, ukupna duljina objekta iznosi 90,31 metar. Ukupna površina krovne plohe je 2168,13 m^2.

Visina objekta varira od 10,8 m do 11,5 m. Svi stupovi su visine 10 m, a varijabilna je visina rešetke koja ovisi o maksimalnom rasponu između stupova. Najviša rešetka nalazi se u vanjskom prstenu, te je visine 1,5m dok se najmanja nalazi u unutarnjem prstenu te je visine 0,8 m. Krovna ploha je u odnosu na horizontalnu ravninu nagnuta pod kutom $\alpha = 3°$ što je ekvivalentno padu od 5%.

Glavnu konstrukciju čine ravninske rešetke međusobne udaljenosti 6 m, odnosno 8 metara u vanjskom prstenu. One su međusobno pridržane ravninskim rešetkama čija udaljenost varira u rasponu od 2,65 m do 6,81 m. Vrsta rešetke je N rešetka (Prattova rešetka).

Sekundarnu konstrukciju tvore podrožnice i spregovi. Podrožnice se oslanjaju na gornji pojas rešetke. Kao pokrov koriste se aluminijski sendvič paneli. Stabilizacija paviljona je ostvarena sa spregovima u krovnim i bočnim ravninama, postavljanjem krovnih spregova u vanjskom prstenu i bočnih spregova na 3 pročelja. Sekundarna konstrukcija je zglobno vezana za glavnu konstrukciju.

Stupovi su upeto vezani za temelje. Spoj stupa i rešetkaste konstrukcije ostvarit će se čeonim pločama i vijcima, gdje se vrh stupa direktno veže za donji pojas rešetke.

Temelji su armirano betonski temelji samci, kvadratnog tlocrtnog oblika i dimenzija 3,0 x 3,0 x 0,5 metara.

1.2. Konstruktivni elementi

Krovna rešetka

Proračunom, za gornji i donji pojas rešetke, su odabrani šuplji vrućevaljani pravokutni profili:

- CFRHS 200x100x6
- CFRHS 180x100x5
- CFRHS 120x50x3
- CFRHS 120x80x5
- CFRHS 200x80x5
- CFRHS 140x60x5
- CFRHS 140x70x4

Za ispune rešetke odabrani su šuplji vrućevaljani pravokutni profili:

- CFRHS 150x50x3
- CFRHS 50x50x3
- CFRHS 60x60x4

Pri odabiru profila vodilo se računa o izbjegavanju proboja pri spajanju ispuna na pojas, stoga su ispune okrenute za 90°.

Stupovi

Proračunom su odabrani vanjski stupovi europskih širokopojasnih H profila HEA 550 i HEA 320, ukupne dužine 10 000 (mm).

Podrožnice

Proračunom su odabrane podrožnice europskih širokopojasnih H profila IPE 160 AA.

Spregovi

Proračunom su odabrani puni kružni profili RD20 (čelična šipka ∅20)

1.3. Proračun konstrukcije

Proračun konstrukcije izveden je u programskom paketu SCIA engineer 2018. Proračun reznih sila, pomaka konstrukcije te dimenzioniranje konstruktivnih elemenata izveden je korištenjem programa SCIA engineer 2018, dok je za nacrte korišten AutoCAD 2017. Proračun spojeva je napravljen u IDEA StatiCi 10.

Proračun je proveden po teoriji prvoga reda dakle na nedeformiranoj konstrukciji pri čemu nisu uzete u obzir početne imperfekcije konstruktivnih elementa.

Proračunom su obuhvaćena sva djelovanja na konstrukciju:

- Vlastita težina
- Dodatno stalno opterećenje
- Opterećenje vjetrom
- Opterećenje snijegom
- Temperaturno opterećenje

Opterećenja su na konstrukciju zadana uz pomoć naredbe load panela, koja opterećenje po površini panela raspodjeljuju na krovnu rešetku.

Konstrukcija je prikazana prostornim modelom s opterećenjima koja djeluju okomito i u ravnini krovnih i bočnih ploha(panela).

Uzimajući u obzir lokaciju objekta napravljena je analiza opterećenja koja obuhvaća djelovanje snijega, vjetra i temperature. Objekt se nalazi na području Pelješca, nadmorske visine 215 m što spada u I. zonu te daje karakterističnu vrijednost opterećenja snijegom na tlu. Za opterećenje vjetrom uzeta je zona I, kategorija zemljišta II te je uzeta u obzir visina objekta i njegova zaštićenost.

Vjetar je dominantno opterećenje za ovakav tip objekta stoga mu je posvećena velika pažnja te je proračunat kao 3D vjetar u SCIA Enginneru, sa 16 različitih vrsta opterećenja ovisno o smjeru vjetra.

Za svaki element konstrukcije određena je mjerodavna kombinacija opterećenja za provjeru graničnog stanja nosivosti i graničnog stanja uporabljivosti.

Rezultati prikazani u ovom projektu uključuju rezne sile i pomake određenih dijelova konstrukcije. Rezne sile su dane u jedinicama kN za poprečne i uzdužne sile, kNm za momente te u mm za pomake konstrukcije.

1.4. Svojstva materijala

Svi elementi konstrukcije (krovna rešetka, stupovi, podrožnice, spregovi i spojne ploče) izrađeni su od građevinskog čelika S355.

Name	S 355
Code independent	
Material type	Steel
Thermal expansion [m/mK]	0,00
Unit mass [kg/m^3]	7850,0
E modulus [MPa]	2,1000e+05
Poisson coeff.	0,3
Independent G modulus	☐
G modulus [MPa]	8,0769e+04
Log. decrement (non-uniform...	0,15
Colour	
Thermal expansion (for fire r...	0,00
Specific heat [J/gK]	6,0000e-01
Thermal conductivity [W/mK]	4,5000e+01
Material behaviour for n...	
Material behaviour	Elastic
EC3	
Ultimate strength [MPa]	490,0
Yield strength [MPa]	355,0
Thickness range	...

Slika 1.4.1 Svojstva odabranog čelika

Korišteni vijci u konstrukciji su: M12,M27 i M30 kvalitete vijaka 5.6., M16 kvalitete vijaka 5.8. i M20 kvalitete vijaka 6.8.

Temelji su izrađeni od armiranog betona klase C 25/35, s betonskim čelikom B500B kao armaturom.

Za oblogu paviljona koriste se sendvič paneli vlastite težine 25 kg/m^2 .

1.5. Zaštita elemenata

1.5.1. Antikorozivna zaštita

Prema odredbama ''Pravilnika o tehničkim mjerama i uvjetima za zaštitu čeličnih konstrukcije od korozije'' svi dijelovi čelične konstrukcije moraju biti zaštićeni.

Korozija je oksidacija željeza do koje dolazi uz prisustvo vlage i raznih nečistoća. Svi elementi objekta zaštićeni su od korozije pocinčavanjem. To podrazumijeva nanošenje prevlake cinka po toplom postupku. Masa i debljina prevlake određene su pravilnikom i ne mogu biti manje od 500 g/m^2 na elementu debljine 5mm. Prije samog pocinčavanja potrebno je sve čelične elemente odmastiti, očistiti razblaženom otopinom klorovodične kiseline te isprati hladnom vodom. Neposredno prije pocinčavanja, čelična konstrukcija se stavlja u taljevinu ili otopinu za flusiranje. Kao vrsta zaštite od korozije odabrana je zaštita vrućim pocinčavanjem i zaštitnim premazom. Ukupna debljina zaštitnog sloja usvaja se 200 µm.

1.5.2. Protupožarna zaštita

Pri izvedbi osigurat će se provedba svih propisa o zaštiti od požara. Pristup i intervencija vatrogasnog vozila omogućit će se sa sjeverne strane parcele. Zahtijevana vatrootpornost elemenata čelične konstrukcije F60. Odabrana je zaštita F60 jer sa radi o tipu objekta u kojem se, u svom punom kapacitetu, može nalaziti veći broj ljudi. Osiguranje vatrootpornosti osiguravamo specijalnim ekspandirajućim premazima.

1.6. Montaža konstrukcije

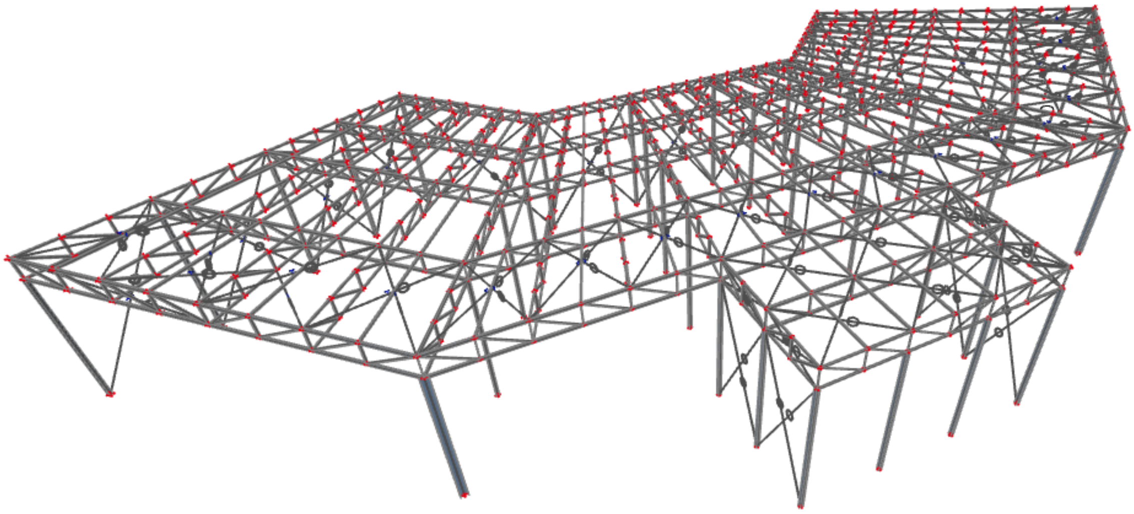
Način izvedbe konstrukcije objekta je montažno. Elementi predgotovljeni stižu na gradilište te se međusobno spajaju vijcima. Spajanjem segmenata montirat će se nosiva konstrukcija.

Montaža započinje s postavljanjem stupova u temelje, koji se pridržavaju dizalicom dok se ne postigne vertikalnost. Nakon učvršćivanja stupova u temelj, koje se izvodi vijcima na pločama, može se krenuti si montažom krovne konstrukcije. Prvo se montiraju svi dijelovi konstrukcije iznad stupova a nakon toga slijedi montaža ostalih dijelova konstrukcije.

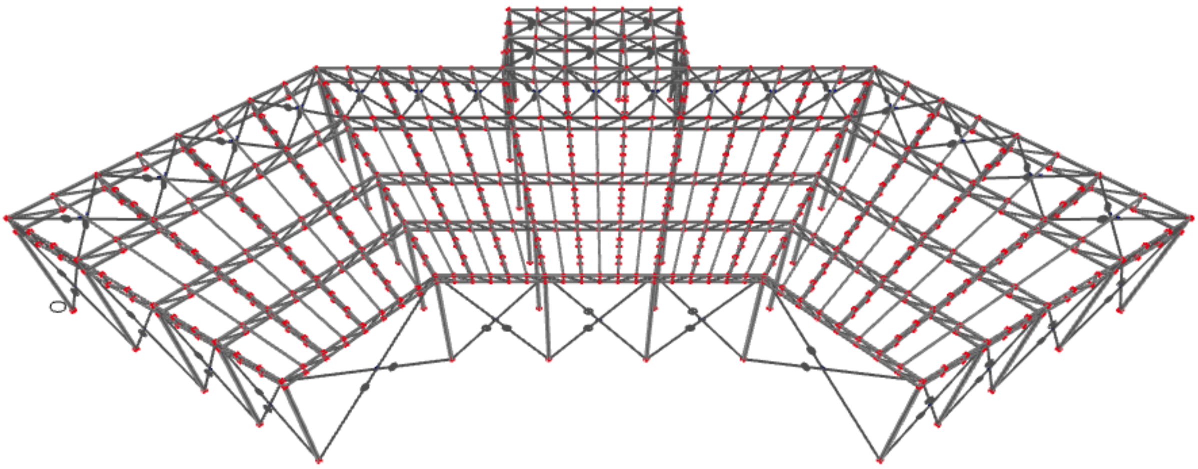
Pri montaži je potrebno u suradnji s geodetima vršiti stalne kontrole kako bi montaža što bolje prošla.

2. Numerički model

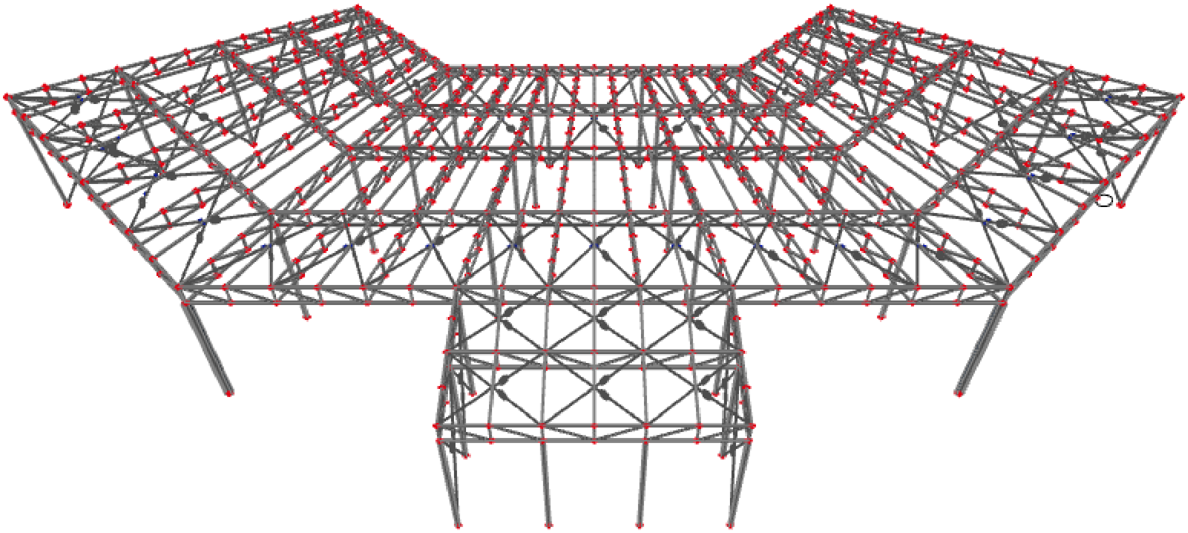
Numerički 3D model izrađen je u SCIA Engineer 18



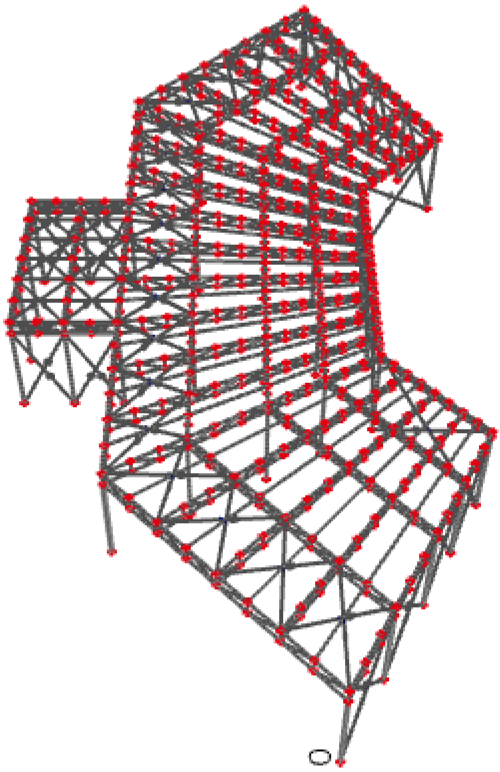
Slika 1.6.1 Izometrijski prikaz modela



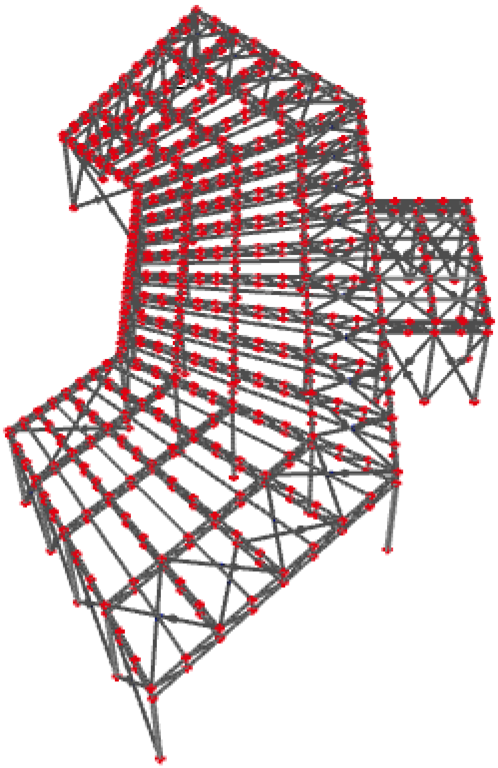
Slika 1.6.2 Sjeverno pročelje



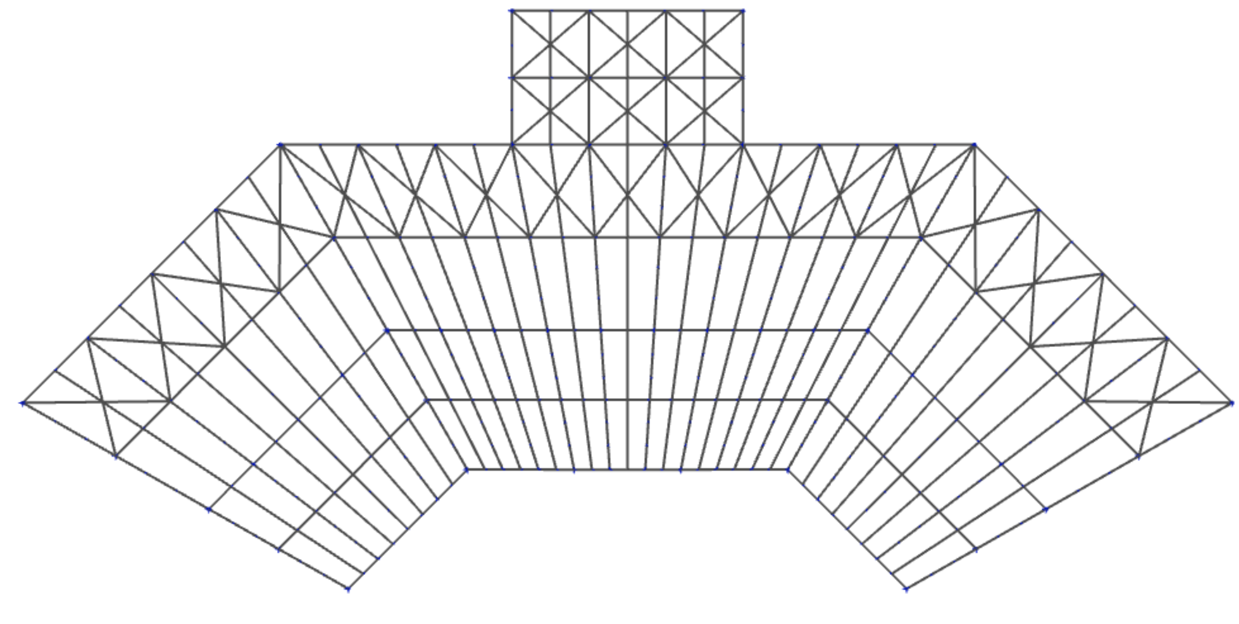
Slika 1.6.3 Južno pročelje



Slika 1.6.4 Istočno pročelje



Slika 1.6.5 Zapadno pročelje



Slika 1.6.6 Tlocrt

3. Analiza opterećenja

3.1. Dodatno stalno opterećenje

- pokrov $g = 0.25 kN/m^2$

- instalacije $g = 0.10 kN/m^2$

- vlastita težina – biti će dodana u sklopu računalnog programa

$\sum g = 0.35 kN/m^2$

3.2. Opterećenje snijegom

Proračun djelovanja snijega napravljen je prema Eurocodu 1 [1].

Opterećenje snijegom na krovu

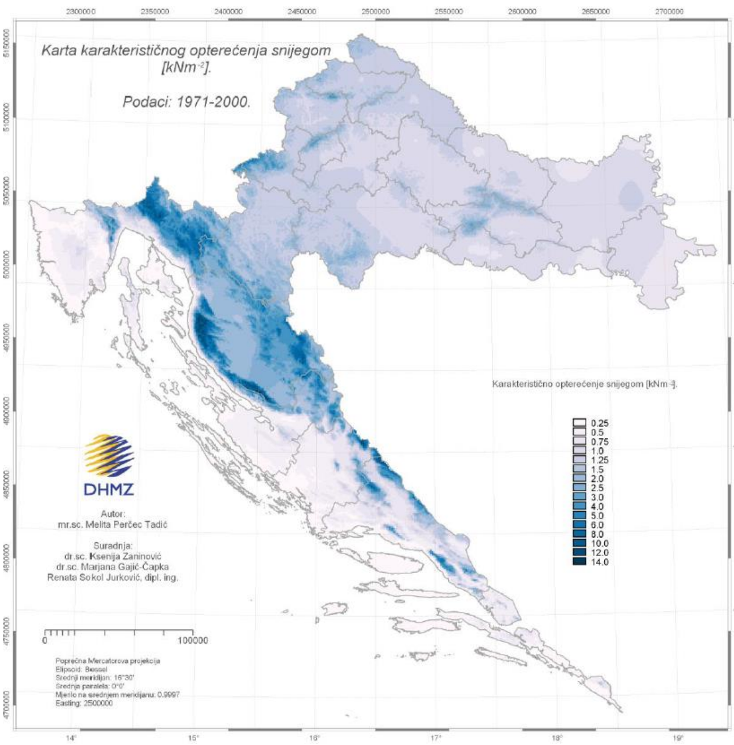
$$s = \mu_1 \cdot C_e \cdot C_t \cdot s_k$$

- μ_1 - koef. oblika za opterećenje snijegom

krov nagiba $0^\circ \leq \alpha \leq 30^\circ \Rightarrow \mu_1 = 0{,}8$

- s_k - karakteristična vrijednost opterećenja na tlu u $\left[kN/m^2\right]$

zona Pelješac, područje 1., nadmorska visina 215 m $\Rightarrow s_k = 0.25 kN/m^2$



Slika 3.2.1 Karta karakterističnog opterećenja snijegom [kNm²]

- C_e - koef. izloženosti $\Rightarrow C_e = 1{,}0$

- C_t - toplinski koef. $\Rightarrow C_t = 1{,}0$

$$\Rightarrow s = 0{,}8 \cdot 1{,}0 \cdot 1{,}0 \cdot 0{,}25 = 0{,}2 \left[kN/m^2\right]$$

3.3. Opterećenje vjetrom

Proračun djelovanja vjetra na konstrukciju napravljen je prema Eurocodu 1 [2].

- pritisak vjetra na vanjske površine: $w_e = q_p * c_e(z_e) * c_{pe}$ [kN/m^2]

- pritisak vjetra na unutarnje površine: $w_i = q_p * c_e(z_i) * c_{pi}$ [kN/m^2]

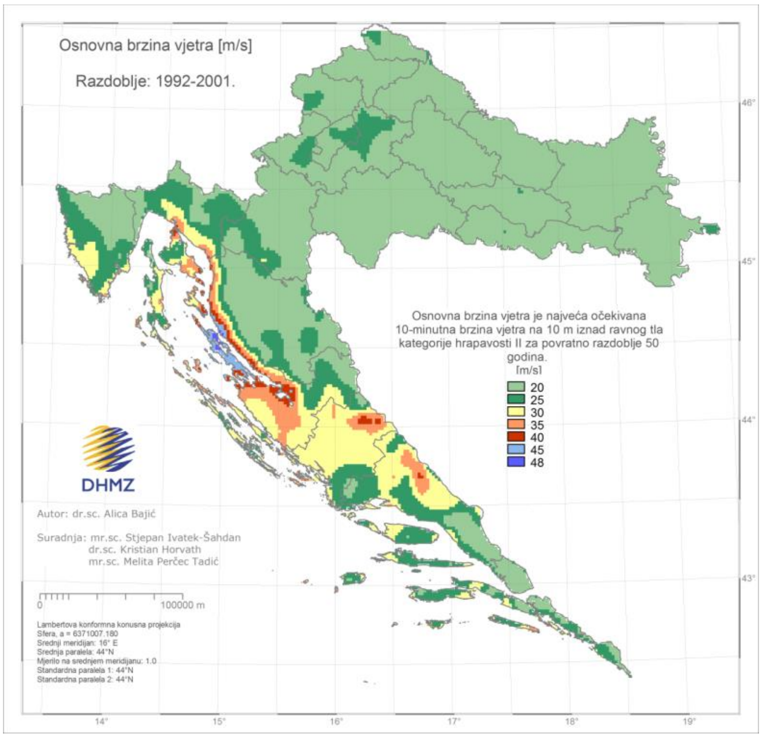
gdje je:

q_{ref} – poredbeni tlak vjetra pri srednjoj brzini vjetra

$C_e(z_e);C_e(z_i)$ – koeficijenti izloženosti koji uzimaju u obzir neravnine terena

$z_e;z_i$ – poredbene visine za lokalni ili unutarnji tlak

$c_{pe};c_{pi}$ – vanjski i unutarnji koeficijent pritiska



Slika 3.3.1 Karta osnovne brzine vjetra

$q_b = \frac{1}{2} \cdot \rho \cdot v_b^2$[kN/m^2]

gdje je:

v_b – osnovna brzina vjetra

ρ – gustoća zraka (ρ=1,25 kg/m^3)

Osnovna brzina vjetra v_b ,dana je izrazom:

$v_b = c_{dir} * c_{season} * v_{b0}$

gdje je:

v_b – osnovna brzina vjetra

c_{dir} – koeficijent smjera vjetra (obično uzima vrijednost 1,0)

c_{season} – koeficijent ovisan o godišnjem dobu (obično uzima vrijednost 1,0)

Osnovni pritisak vjetra:

$$v_b = 20,0(\frac{m}{s}) \rightarrow$$

očitano za Pelješac

$$C_{dir} = C_{season} = 1,0$$

$$v_b = v_{b,0} \cdot C_{dir} \cdot C_{season} = 20 \cdot 1,0 \cdot 1,0 = 20,0(\frac{m}{s})$$

$$\rho = 1,25\frac{kg}{m^3}$$

$$q_b = \frac{\rho}{2} \cdot v_b^2 = \frac{1,25}{2} \cdot 20,0^2 = 250(\frac{N}{m^2}) = 0,25(\frac{kN}{m^2})$$

Faktor terena k_r -za kategoriju terena II :

$$\mathrm{k_r} = 0,19 \cdot \left(\frac{\mathrm{z_0}}{\mathrm{z_{0,II}}}\right)^{0,07} = 0,19 \cdot \left(\frac{0,3}{0,05}\right)^{0,07} = 0,215$$

$$C_{r(z)} = k_r \cdot \ln\left(\frac{z}{z_0}\right) = 0{,}215 \cdot \ln\left(\frac{12}{0{,}3}\right) = 0{,}793$$

$$C_{0(z)} = 1{,}0$$

Srednja brzina vjetra iznad terena:

$$v_{m(11,84)} = v_b \cdot C_{r(z)} \cdot C_{0(z)} = 20 \cdot 0{,}793 \cdot 1{,}0 = 15{,}86(\frac{m}{s})$$

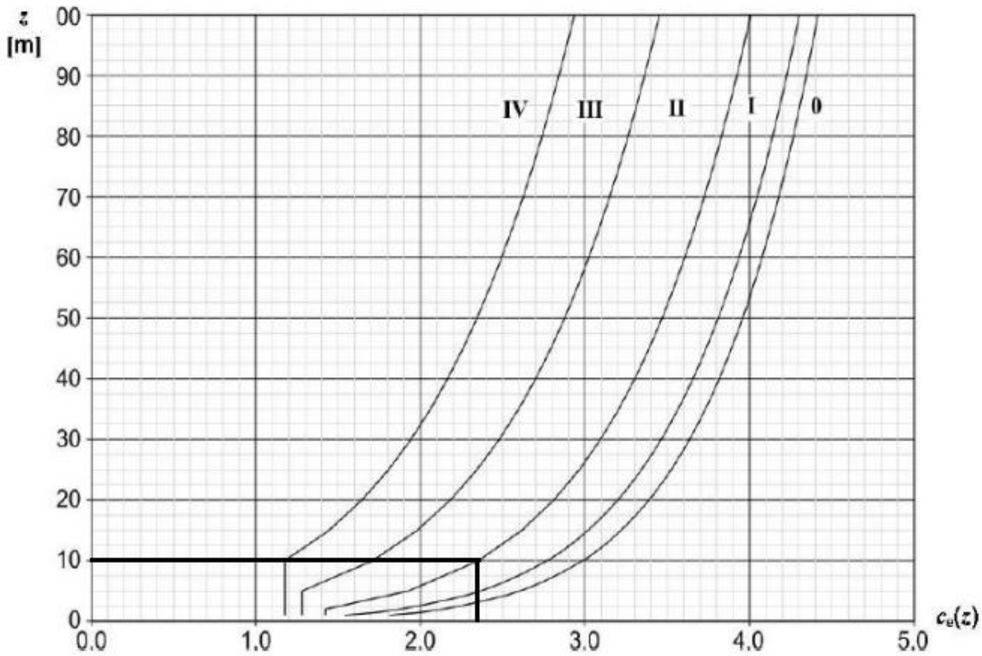
Intezitet turbulencije:

$$I_{v(z)} = \frac{k_I}{C_{0(z)} \cdot \ln\left(\frac{z}{z_0}\right)} = \frac{1}{1 \cdot \ln\left(\frac{12{,}0}{0{,}3}\right)} = 0{,}271$$

Pritisak brzine vjetra pri udaru:

$q_{p(z)} = Ce(z) \cdot q_b$ =2,35 $*$ 0,25 =0,59 kN/m^2

$C_{e(z)}$=2,35 -očitani faktor izloženosti sa slike 3.3.2

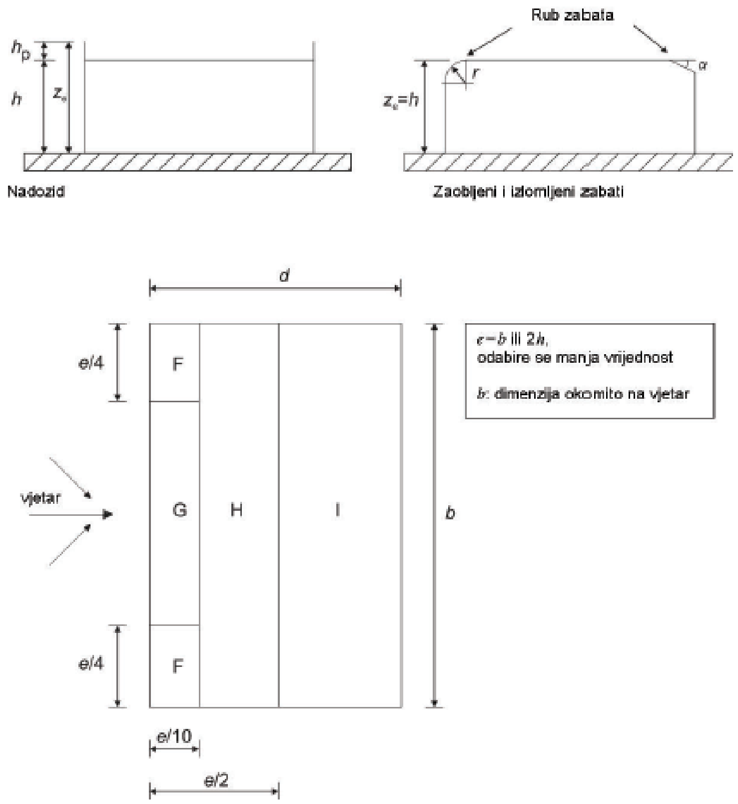


Slika 5. Grafički prikaz faktora izloženosti $c_e(z)$ za c_o=1,0 i k_I =1,0

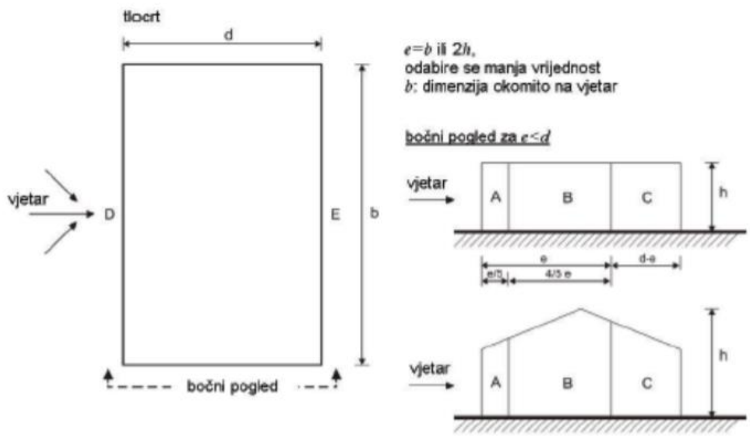
Slika 3.3.2 Grafički prikaz faktora izloženosti

3.3.1. Djelovanje vjetra na krov

Djelovanje vjetra na konstrukciju modeliramo kao djelovanje na halu pravokutnog oblika dimenzija 90 x 33 m, visine 11,5 m.



Slika 3.3.3 Prikaz područja vjetra za ravne krovove



Slika 3.3.4 Prikaz područja vjetra za vertikalne zidove

Vrsta krova		Područje							
		F		G		H		I	
		$c_{pe,10}$	$c_{pe,1}$	$c_{pe,10}$	$c_{pe,1}$	$c_{pe,10}$	$c_{pe,1}$	$c_{pe,10}$	$c_{pe,1}$
Oštri zabati		−1,8	−2,5	−1,2	−2,0	−0,7	−1,2	+0,2 −0,2	
S nadozidima	$h_p/h = 0{,}025$	−1,6	−2,2	−1,1	−1,8	−0,7	−1,2	+0,2 −0,2	
	$h_p/h = 0{,}05$	−1,4	−2,0	−0,9	−1,6	−0,7	−1,2	+0,2 −0,2	
	$h_p/h = 0{,}10$	−1,2	−1,8	−0,8	−1,4	−0,7	−1,2	+0,2 −0,2	
Zaobljeni zabati	$r/h = 0{,}05$	−1,0	−1,5	−1,2	−1,8	−0,4		+0,2 −0,2	
	$r/h = 0{,}10$	−0,7	−1,2	−0,8	−1,4	−0,3		+0,2 −0,2	
	$r/h = 0{,}20$	−0,5	−0,8	−0,5	−0,8	−0,3		+0,2 −0,2	
Izlomljeni zabati	$\alpha = 30°$	−1,0	−1,5	−1,0	−1,5	−0,3		+0,2 −0,2	
	$\alpha = 45°$	−1,2	−1,8	−1,3	−1,9	−0,4		+0,2 −0,2	
	$\alpha = 60°$	−1,3	−1,9	−1,3	−1,9	−0,5		+0,2 −0,2	

NAPOMENA 1: Za krovove s nadozidima ili zaobljenim zabatima, smije se upotrebljavati linearna interpolacija za međuvrijednosti h_p/h i r/h.

NAPOMENA 2: Za krovove s izlomljenim zabatima, smije se upotrebljavati linearna interpolacija između $\alpha = 30°$, 45° i $\alpha = 60°$. Za $\alpha > 60°$ smije se upotrebljavati linearna interpolacija između vrijednosti za $\alpha = 60°$ i vrijednosti za ravne krovove s oštrim (izlomljenim) zabatima.

NAPOMENA 3: U području I, gdje su dane i pozitivne i negativne vrijednosti, u obzir treba uzeti obje vrijednosti.

NAPOMENA 4: Za sami izlomljeni zabat, koeficijenti vanjskog tlaka dani su u tablici 7.4a „Koeficijenti vanjskog tlaka za dvostrešne krovove; smjer vjetra 0°", područje F i G, ovisno o nagibu izlomljenog zabata.

NAPOMENA 5: Za sami zaobljeni zabat, koeficijen i vanjskog tlaka dani su linearnom interpolacijom duž krivulje, između vrijednosti na zidu i na krovu.

NAPOMENA 6: Za mansardne strehe čije su horizontalne dimenzije manje od $e/10$ treba uzeti vrijednosti za oštre strehe. Za definiciju e vidjeti sliku 7.6

Tablica 3.3-1 Preporučene vrijednosti koeficijenata vanjskog tlaka za ravne krovove

Određivanje koeficijenata unutarnjeg pritiska

Koeficijenti c_{pi} ovise o veličini i raspodjeli otvora na oblozi hale (fasada i krov). U ovom primjeru nije definiran raspored i veličina otvora, zato se za vrijednost c_{pi} usvaja vrijednost iz normi.

- Unutrašnji koeficijent pritiska → $c_{pi} = \pm 0{,}3$

Pri određivanju vjetra na vertikalne zidove izračunat je odnos visine i bočne stranice

h/d=11,5/33=0,35

Područje	A		B		C		D		E	
h/d	$c_{pe,10}$	$c_{pe,1}$	$c_{pe,10}$	$c_{pe,1}$	$c_{pe,10}$	$c_{pe,1}$	$c_{pe,10}$	$c_{pe,1}$	$c_{pe,10}$	$c_{pe,1}$
5	−1,2	−1,4	−0,8	−1,1	−0,5		+0,8	+1,0	−0,7	
1	−1,2	−1,4	−0,8	−1,1	−0,5		+0,8	+1,0	−0,5	
≤ 0,25	−1,2	−1,4	−0,8	−1,1	−0,5		+0,7	+1,0	−0,3	

Tablica 3.3-2 Preporučene vrijednosti tlaka za vertikalne zidove

Rezultirajuće djelovanje tlaka po zonama

$w_e = q_{ref} \cdot c_e(z_e) \cdot c_{pe}$ [kN/m^2]

q_{ref} = 0,25 kN/m^2, $c_e(z_e)$ = 2,35

PODRUČJE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
$\mathbf{c_{pe,10}}$	-1,20	-0,80	-0,50	0,70	-0,30	-1,80	-1,20	-0,70	-0,20
$\mathbf{w_{e1}}$ **(kN/m^2)**	-0,71	-0,21	-0,29	0,41	0,17	-1,06	-0,71	-0,41	-0,12

Tablica 3.3-3 Djelovanje tlaka po zonama

Rezultirajuće djelovanje podtlaka po zonama

$w_i = q_{ref} \cdot c_i(z_i) \cdot c_{pi}$ [kN/m^2]

q_{ref} = 0,25 kN/m^2, $c_e(z_e)$ = 2,35

w_i = 0,25 · 2,35 · ±0,3 = ±0,176 kN/m^2

Rezultirajuće djelovanje vjetra

$w_k = w_e - w_i$ [kN/m^2]

Vjetar W1 pozitivni unutarnji pritisak-nadtlak (c_{pi} = +0,3)

PODRUČJE	A	B	C	D	E	F	G	H	I
w_e (kN/m²)	-0,71	-0,21	-0,29	0,41	0,17	-1,06	-0,71	-0,41	-0,12
w_i (kN/m²)	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176	0,176
w_{uk} (kN/m²)	-0,534	-0,034	-0,114	0,586	0,346	-0,884	-0,534	-0,768	0,056

Tablica 3.3-4 Ukupno djelovanje po zonama - tlak

Vjetar W2 negativni unutarnji pritisak-podtlak (c_{pi} = –0,3)

PODRUČJE	A	B	C	D	E	F	G	H	I
w_e (kN/m²)	-0,71	-0,21	-0,29	0,41	0,17	-1,06	-0,71	-0,41	-0,12
w_i (kN/m²)	-0,176	-0,176	-0,176	-0,176	-0,176	-0,176	-0,176	-0,176	-0,176
w_{uk} (kN/m²)	-0,886	-0,386	-0,466	0,234	-0,006	-1,236	-0,886	-0,586	-0,296

Tablica 3.3-5 ukupno djelovanje po zonama - podtlak

3.3.2. Opterećenje vjetrom trenjem po krovu

$F_{fr} = c_{fr} \cdot q_p(z) \cdot A_{fr}$ - sila trenja

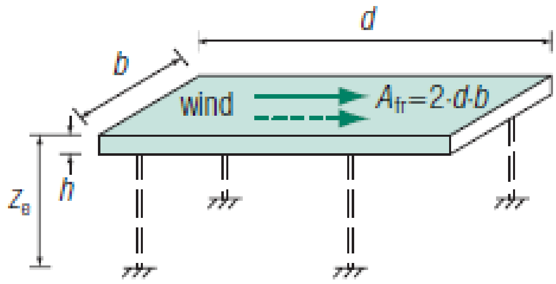
$c_{fr} = 0{,}04$ - koef. trenja za narebreni lim (vjerojatni pokrov)

$q_p(z) = c_e(z) \cdot q_{ref}$ - tlak "vršne" (referentne) brzine

$C_{e(z)}$=2,35- koef. izloženosti

q_{ref} - poredbeni tlak pri srednjoj brzini vjetra

A_{fr} - površina usporedno sa smjerom vjetra



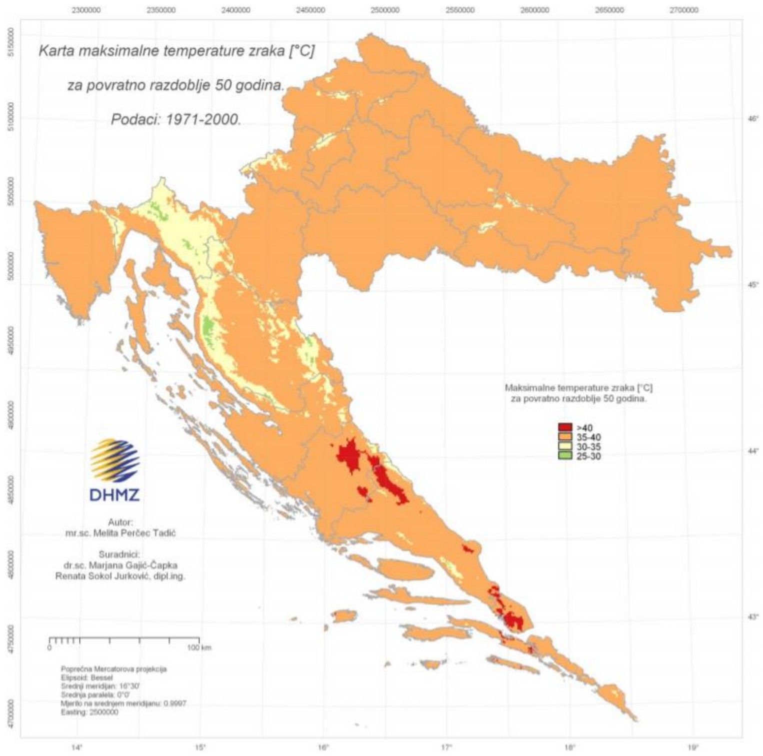
Slika 3.3.5 Trenje vjetra po krovu

Referentna površina:

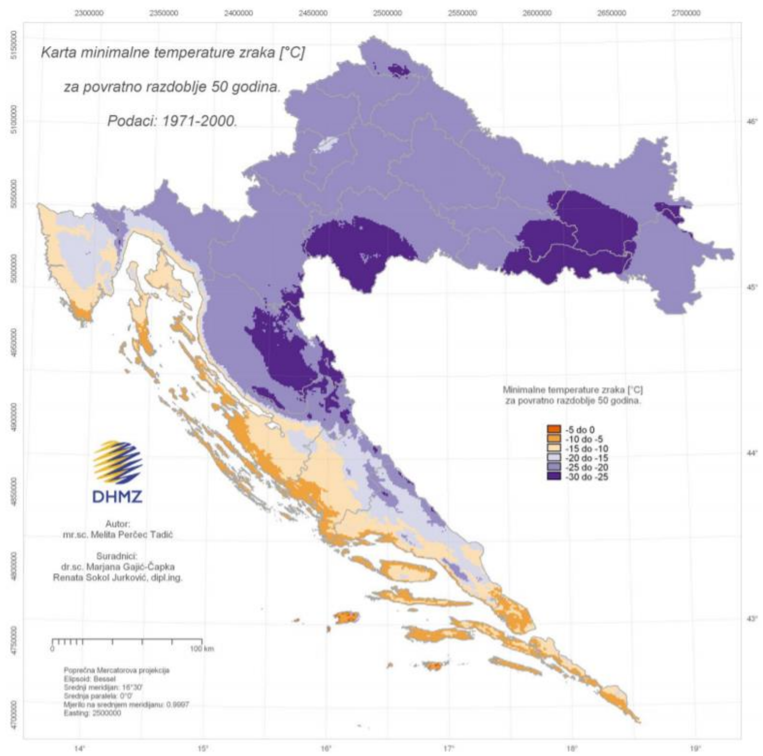
$$A_{fr} = 2 \cdot b \cdot d = 2 \cdot 90 \cdot 33m = 5940 \ \ m^2$$

$$F_{fr} = 0,04 \cdot 2,35 \cdot 0,25 \cdot 5940 = 139,59\,kN$$

3.4. Temperaturno opterećenje



Slika 3.4.1 Karta maksimalne temperature zraka



Slika 3.4.2 Karta minimalne temperature zraka

Proračun temperaturnih djelovanja napravljen je prema Eurocodu 1 [3].

Promatrani objekt nalazi se u zoni Pelješac, područje 1., nadmorske visine 215 m.

Najviša temperatura u hladu: T_{max} = 40 ºC

Najniža temperatura u hladu: T_{min}= -10 ºC

Pretpostavlja se djelovanje jednolike temperature promjene u svim presjecima.

Pretpostavljena temperatura pri montaži konstrukcije T= 15 ºC.

1. Maksimalna pozitivna temperaturna promjena: T_{max} = 40 ºC- 15 ºC=25 ºC.
2. Maksimalna negativna temperaturna promjena: T_{min}= -10 ºC-15 ºC= -25 ºC.

Pri dimenzioniranju elemenata u obzir nije uzeto temperaturno opterećenje, zbog svog zanemarivog učinka na konstrukciju.

4. Rezultati

4.1. Pomaci konstrukcije

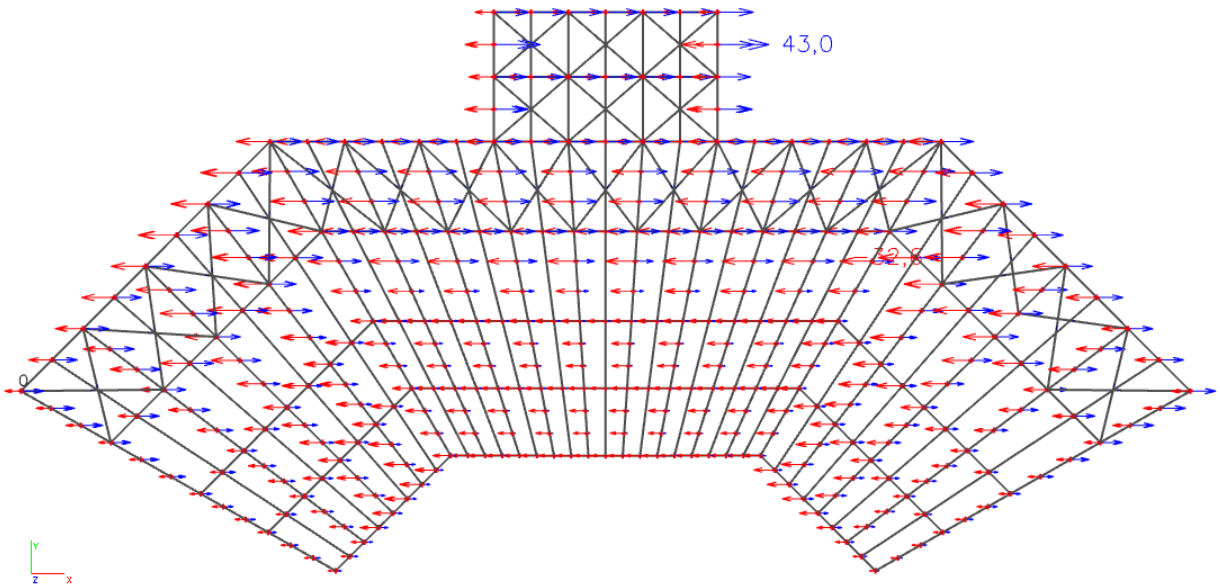
Displacement of nodes

Linear calculation, Extreme : Global
Selection : All
Combinations : SLS-Char (auto)

Node	Case	Ux [mm]	Uy [mm]	Uz [mm]	Fix [mrad]	Fiy [mrad]	Fiz [mrad]
N951	SLS-Char (auto)/7	**-32,6**	-26,0	-25,9	1,2	2,5	-0,1
N1124	SLS-Char (auto)/8	**43,0**	-16,8	2,2	0,1	1,7	-2,4
N909	SLS-Char (auto)/9	21,2	**-42,5**	1,5	-2,0	-1,1	-0,4
N294	SLS-Char (auto)/7	-16,9	**42,7**	-11,7	-1,0	-2,5	0,1
N684	SLS-Char (auto)/7	-18,4	32,8	**-46,8**	0,0	-0,5	0,8
N478	SLS-Char (auto)/10	4,0	19,5	**5,2**	0,5	-0,1	-0,5
N680	SLS-Char (auto)/11	-7,3	15,8	1,6	**-5,9**	3,5	3,6
N579	SLS-Char (auto)/12	7,5	-18,2	-0,1	**3,7**	-0,5	-0,1
N314	SLS-Char (auto)/11	-22,2	38,0	-10,3	2,4	**-5,2**	-0,8
N734	SLS-Char (auto)/13	3,7	1,0	-12,2	2,5	**4,4**	0,2
N568	SLS-Char (auto)/14	8,1	1,5	1,8	0,9	-1,3	**-6,6**
N568	SLS-Char (auto)/15	6,1	-23,1	-1,7	-0,2	0,2	**5,8**

Slika 4.1.1 Pikaz maksimalnih pomaka čvorova

5.1.1 Horizontalni pomak



Slika 4.1.2 Pomak konstrukcije u x smjeru

Horizontalni pomak u_x=43,0mm

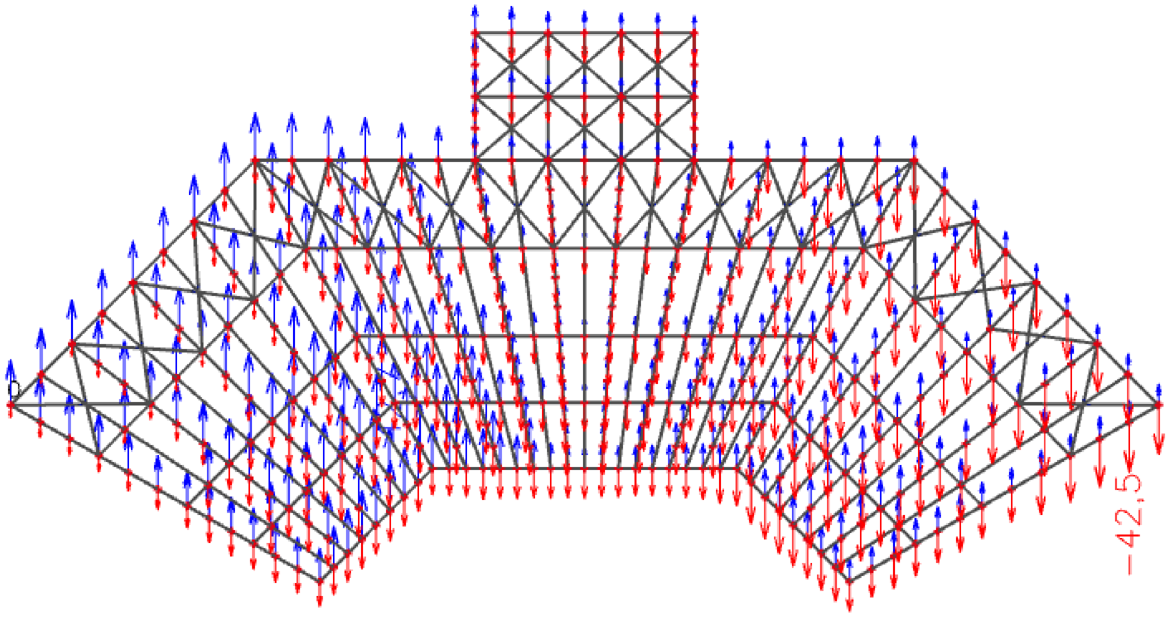
Horizontalni pomak u_y=42,7 mm

Dopušteni horizontalni pomak:

$U_{dop} = \frac{h}{250} = \frac{11500}{250} = 46$ mm

U_{dop} = 46 [mm] > U_x = 43,0 [mm] → Zadovoljava

U_{dop} = 46 [mm] > U_y = 42,7 [mm] → Zadovoljava



Slika 4.1.3 Pomak konstrukcije u y smjeru

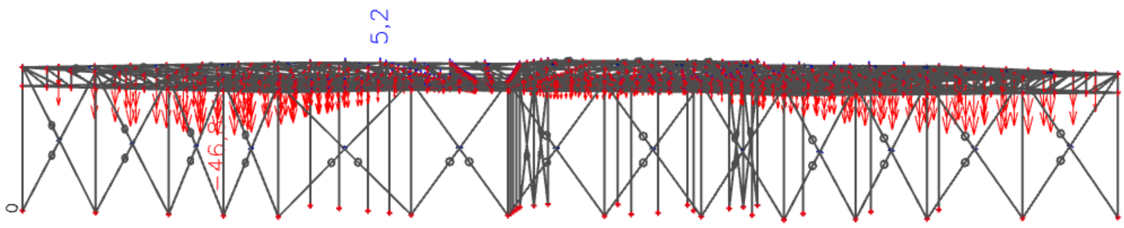
5.1.2. Vertikalni pomak konstrukcije

Vertikalni pomak u_y=46,8 mm

Dopušteni vertikalni pomak:

$U_{dop} = \frac{l}{250} = \frac{27250}{250} = 109$ mm

U_{dop} = 109 [mm] > U_x = 46,8[mm] → Zadovoljava



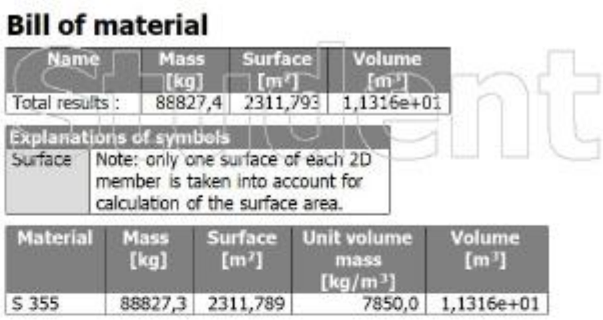
Slika 4.1.4 Pomak konstrukcije u z smjeru

4.2. Težina konstrukcije

Težina konstrukcije izračunata je u programu SCIA Engineer 2018.

Iz slike 5.2.1 vidljivo je da je ukupna masa konstrukcije 88827,4 kg, a ukupna površina konstrukcije 2311,793 m^2. Dijeljenjem mase konstrukcije s tlocrtnom površinom konstrukcije dobivamo kilažu po metru kvadratnom.

$$\frac{88827{,}4}{2311{,}793} = 38{,}42\ [\mathrm{kg/m^2}]$$



Bill of material

Name	Mass [kg]	Surface [m²]	Volume [m³]
Total results :	88827,4	2311,793	1,1316e+01

Explanations of symbols	
Surface	Note: only one surface of each 2D member is taken into account for calculation of the surface area.

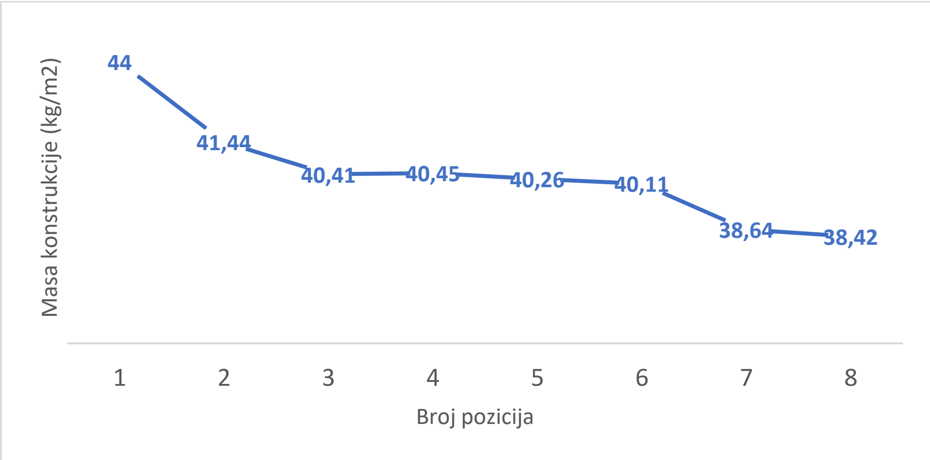
Material	Mass [kg]	Surface [m²]	Unit volume mass [kg/m³]	Volume [m³]
S 355	88827,3	2311,789	7850,0	1,1316e+01

Slika 4.2.1 Iskaz materijala

4.3. Ovisnost težine o broju pozicija

Tablica 4.3-1 Masa konstrukcije i broj pozicija

Masa konstrukcije (kg/m^2)	Broj pozicija
44	8
41,44	9
40,41	10
40,45	11
40,26	12
40,11	13
38,64	14
38,42	15



Slika 4.3.1 Prikaz ovisnosti mase konstrukcije o broju pozicija

Prilikom dimenzioniranja elemenata uvedene su pozicije, kako bi postigli što bolju iskoristivost poprečnih presjeka i što manju težinu same konstrukcije.

4.4. Kontrola naprezanja

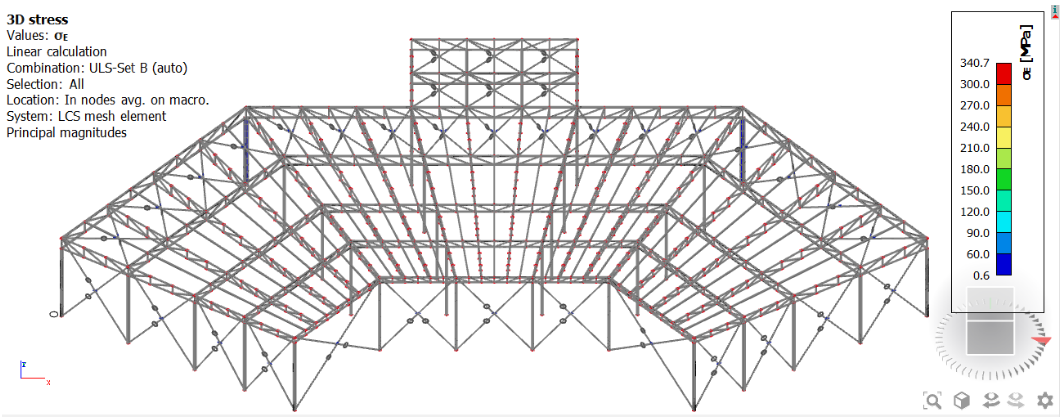
U projektu je odabrana građevinski čelik S 355. S označava Steel, odnosno čelik a 355 je granica popuštanja čelika. Ovisno o debljini elementa t, promatramo sljedeću tablicu.

Tablica 4.4-1 Standardne kvalitete

NOMINALNA KVALITETA EN1993-1-1	NOMINALNA KVALITETA ENV1993-1-1	Debljina elementa t [mm]			
		$t \leq 40$ mm		40 mm $< t \leq 80$ mm	
		fy [N/mm^2]	fu [N/mm^2]	fy [N/mm^2]	fu [N/mm^2]
EN 10025-2					
S 235	Fe-360	235	360	215	360
S 275	Fe-430	275	430	255	410
S 355	Fe-510	355	510	335	470
S 450	---	440	550	410	550

f_y - granica popuštanja čelika,

f_u - čvrstoća čelika.



Slika 4.4.1 Rezultati proračuna naprezanja

3D stress

Linear calculation
Combination: ULS-Set B (auto)
Selection: All
Location: In nodes avg. on macro. System: LCS mesh element
Principal magnitudes
Results on 1D member
Extreme 1D: Global

Name	dx [m]	Fibre	Case	σE [MPa]	σ1 [MPa]	σ2 [MPa]	Txy / Txs [MPa]	Txz / Txs [MPa]
B1365	9,000-	4	ULS-Set B (auto)/1	**0,0**	0,0	0,0	0,0	0,0
B2677	11,180	1	ULS-Set B (auto)/2	**340,7**	340,7	0,0	0,0	0,0

Name	Combination key
ULS-Set B (auto)/1	LC1 + Dodatno stalno + 1.50*3DWind15 + 0.90*temp +
ULS-Set B (auto)/2	LC1 + Dodatno stalno + 1.50*3DWind9 + 0.90*temp +

Slika 4.4.2 Rezultati proračuna naprezanja

5. Dimenzioniranje

5.1. Dimenzioniranje stupova

HEA 550

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS26 - HEA550

EN 1993-1-1 Code Check
National annex: Standard EN

Member B551	0,000 / 10,000 m	HEA550	S 355	ULS-Set B (auto)	0,72 -

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind10 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Rolled	

...::SECTION CHECK::...

The critical check is on position 0,000 m

Internal forces	Calculated	Unit
N_{Ed}	-101,32	kN
$V_{y,Ed}$	-45,98	kN
$V_{z,Ed}$	-53,02	kN
T_{Ed}	0,00	kNm
$M_{y,Ed}$	328,11	kNm
$M_{z,Ed}$	121,13	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	117	24	-1,081e+05	-2,388e+05								
3	SO	117	24	-3,360e+04	9,711e+04	-0,35	0,65	0,74	4,86	9,86	10,95	13,79	1
4	I	438	13	-5,940e+04	6,897e+04	-0,86		0,53	35,04	54,14	62,81	87,30	1
5	SO	117	24	1,176e+05	2,483e+05	0,47	0,49	1,00	4,86	7,32	8,14	11,91	1
7	SO	117	24	4,317e+04	-8,754e+04	-2,03	23,80	0,33	4,86	38,58	42,87	83,35	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	2,1200e-02	m²
$N_{c,Rd}$	7526,00	kN
Unity check	0,01	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	4,6250e-03	m³
$M_{pl,y,Rd}$	1641,88	kNm
Unity check	0,20	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,z}$	1,1083e-03	m³
$M_{pl,z,Rd}$	393,46	kNm
Unity check	0,31	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,4894e-02	m²
$V_{pl,y,Rd}$	3052,61	kN
Unity check	0,02	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	8,3960e-03	m²
$V_{pl,z,Rd}$	1720,84	kN
Unity check	0,03	-

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

$M_{pl,y,Rd}$	1641,88	kNm
α	2,00	
$M_{pl,z,Rd}$	393,46	kNm
β	1,00	

Unity check (6.41) = 0,04 + 0,31 = 0,35 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.
Note: Since the axial force satisfies both criteria (6.33) and (6.34) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the y-y axis is neglected.
Note: Since the axial force satisfies criteria (6.35) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the z-z axis is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 10,000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	117	24	3,743e+03	3,743e+03	1,00	0,43	1,00	4,86	7,32	8,14	11,39	1
3	SO	117	24	3,743e+03	3,743e+03	1,00	0,43	1,00	4,86	7,32	8,14	11,39	1
4	I	438	13	3,743e+03	3,743e+03	1,00		1,00	35,04	22,78	27,66	30,92	4
5	SO	117	24	3,743e+03	3,743e+03	1,00	0,43	1,00	4,86	7,32	8,14	11,39	1
7	SO	117	24	3,743e+03	3,743e+03	1,00	0,43	1,00	4,86	7,32	8,14	11,39	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Student version

Effective section N-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	SO	117	3,550e+05	3,550e+05	1,00	0,43	0,32	1,00	117		
3	SO	117	3,550e+05	3,550e+05	1,00	0,43	0,32	1,00	117		
4	I	438	3,550e+05	3,550e+05	1,00	4,00	0,76	0,94	410	205	205
5	SO	117	3,550e+05	3,550e+05	1,00	0,43	0,32	1,00	117		
7	SO	117	3,550e+05	3,550e+05	1,00	0,43	0,32	1,00	117		

Effective section My+
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	SO	117	-3,550e+05	-3,550e+05							
3	SO	117	-3,550e+05	-3,550e+05							
4	I	438	3,013e+05	-3,013e+05	-1,00	23,90	0,31	1,00	219	88	131
5	SO	117	3,550e+05	3,550e+05	1,00	0,43	0,32	1,00	117		
7	SO	117	3,550e+05	3,550e+05	1,00	0,43	0,32	1,00	117		

Effective section Mz+
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	SO	117	-7,869e+04	-3,550e+05							
3	SO	117	3,550e+05	7,869e+04	0,22	0,53	0,29	1,00	117		
4	I	438	0,000e+00	0,000e+00							
5	SO	117	3,550e+05	7,869e+04	0,22	0,53	0,29	1,00	117		
7	SO	117	-7,869e+04	-3,550e+05							

Effective properties						
Effective area	A_{eff}	2,0829e-02	m²			
Effective second moment of area	$I_{eff,y}$	1,1195e-03	m⁴	$I_{eff,z}$	1,0819e-04	m⁴
Effective section modulus	$W_{eff,y}$	4,1462e-03	m³	$W_{eff,z}$	7,2128e-04	m³

Student version

Effective properties						
Shift of the centroid	$e_{N,y}$	0	mm	$e_{N,z}$	0	mm

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	10,000	10,000	m
Buckling factor k	2,00	0,70	
Buckling length l_{cr}	20,024	7,000	m
Critical Euler load N_{cr}	5789,51	4568,22	kN
Slenderness λ	87,12	98,07	
Relative slenderness λ_{rel}	1,13	1,27	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	

Note: The slenderness or compression force is such that Flexural Buckling effects may be ignored according to EN 1993-1-1 article 6.3.1.2(4).

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: For this I-section the Torsional(-Flexural) buckling resistance is higher than the resistance for Flexural buckling. Therefore Torsional(-Flexural) buckling is not printed on the output.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1 & 6.3.2.3 and formula (6.54)

LTB parameters		
Method for LTB curve	Alternative case	
Effective section modulus $W_{eff,y}$	4,1462e-03	m^3
Elastic critical moment M_{cr}	2172,84	kNm
Relative slenderness $\lambda_{rel,LT}$	0,82	
Limit slenderness $\lambda_{rel,LT,0}$	0,40	

Note: The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4).

Mcr parameters		
LTB length l_{LT}	10,000	m
Influence of load position	no influence	
Correction factor k	1,00	
Correction factor k_w	1,00	
LTB moment factor C_1	2,21	
LTB moment factor C_2	0,12	
LTB moment factor C_3	1,00	
Shear center distance d_z	0	mm
Distance of load application z_g	0	mm
Mono-symmetry constant β_y	0	mm
Mono-symmetry constant z_j	0	mm

Note: C parameters are determined according to ECCS 119 2006 / Galea 2002.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section effective area A_{eff}	2,0829e-02	m^2
Effective section modulus $W_{eff,y}$	4,1462e-03	m^3
Effective section modulus $W_{eff,z}$	7,2128e-04	m^3
Design compression force N_{Ed}	101,32	kN
Design bending moment (maximum) $M_{y,Ed}$	328,11	kNm
Design bending moment (maximum) $M_{z,Ed}$	121,13	kNm
Additional moment $\Delta M_{y,Ed}$	0,00	kNm
Additional moment $\Delta M_{z,Ed}$	0,00	kNm
Characteristic compression resistance N_{Rk}	7394,43	kN
Characteristic moment resistance $M_{y,Rk}$	1471,91	kNm
Characteristic moment resistance $M_{z,Rk}$	256,05	kNm
Reduction factor χ_y	1,00	
Reduction factor χ_z	1,00	
Modified reduction factor $\chi_{LT,mod}$	1,00	
Interaction factor k_{yy}	1,03	
Interaction factor k_{yz}	1,00	
Interaction factor k_{zy}	1,03	
Interaction factor k_{zz}	1,00	

Maximum moment $M_{y,Ed}$ is derived from beam B551 position 0,000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B551 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	5789,51	kN
Critical Euler load $N_{cr,z}$	4568,22	kN
Elastic critical load $N_{cr,T}$	7480,53	kN

Interaction method 1 parameters		
Effective section modulus $W_{eff,y}$	4,1462e-03	m^3
Second moment of area I_y	1,1200e-03	m^4
Second moment of area I_z	1,0800e-04	m^4
Torsional constant I_t	3,5200e-06	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	328,11	kNm
Maximum relative deflection δ_z	-6,7	mm
Equivalent moment factor $C_{my,0}$	0,99	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	121,13	kNm
Maximum relative deflection δ_y	7,4	mm
Equivalent moment factor $C_{mz,0}$	0,98	
Factor μ_y	1,00	
Factor μ_z	1,00	
Factor ε_y	16,27	
Factor a_{LT}	1,00	
Critical moment for uniform bending $M_{cr,0}$	984,85	kNm
Relative slenderness $\lambda_{rel,0}$	1,22	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,29	
Equivalent moment factor C_{my}	1,00	
Equivalent moment factor C_{mz}	0,98	
Equivalent moment factor C_{mLT}	1,01	

Unity check (6.61) = 0,01 + 0,23 + 0,47 = 0,72 -
Unity check (6.62) = 0,01 + 0,23 + 0,47 = 0,72 -

Shear Buckling check
According to EN 1993-1-5 article 5 & 7.1 and formula (5.10) & (7.1)

Shear Buckling parameters		
Buckling field length a	10,000	m
Web	unstiffened	
Web height h_w	492	mm
Web thickness t	13	mm
Material coefficient ε	0,81	
Shear correction factor η	1,20	

Shear Buckling verification	
Web slenderness h_w/t	39,36
Web slenderness limit	48,82

Note: The web slenderness is such that Shear Buckling effects may be ignored according to EN 1993-1-5 article 5.1(2).

The member satisfies the stability check.

HEA 320

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS27 - HEA320

EN 1993-1-1 Code Check
National annex: Standard EN

Member B445	**0,000 / 10,000 m**	**HEA320**	**S 355**	**ULS-Set B (auto)**	**0,52 -**

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind10 + 0.90*Temp -

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Rolled	

...::SECTION CHECK::...

The critical check is on position 0,000 m

Internal forces	Calculated	Unit
N_{Ed}	-177,11	kN
$V_{y,Ed}$	-30,34	kN
$V_{z,Ed}$	-18,42	kN
T_{Ed}	0,00	kNm
$M_{y,Ed}$	55,85	kNm
$M_{z,Ed}$	80,32	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Student version

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	118	16	-5,784e+04	-1,941e+05								
3	SO	118	16	1,460e+04	1,508e+05	0,10	0,55	1,00	7,65	7,32	8,14	12,68	2
4	I	225	9	-1,316e+04	4,163e+04	-0,32		0,62	25,00	42,23	49,83	56,90	1
5	SO	118	16	8,631e+04	2,226e+05	0,39	0,50	1,00	7,65	7,32	8,14	12,07	2
7	SO	118	16	1,388e+04	-1,224e+05	-8,82	23,80	0,10	7,65	225,25	250,27	83,35	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 2

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,2400e-02	m²
$N_{c,Rd}$	4402,00	kN
Unity check	0,04	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	1,6292e-03	m³
$M_{pl,y,Rd}$	578,36	kNm
Unity check	0,10	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,z}$	7,0833e-04	m³
$M_{pl,z,Rd}$	251,46	kNm
Unity check	0,32	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	9,6240e-03	m²
$V_{pl,y,Rd}$	1972,53	kN
Unity check	0,02	-

Student version

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	4,0765e-03	m²
$V_{pl,z,Rd}$	835,52	kN
Unity check	0,02	-

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

$M_{pl,y,Rd}$	578,36	kNm
α	2,00	
$M_{pl,z,Rd}$	251,46	kNm
β	1,00	

Unity check (6.41) = 0,01 + 0,32 = 0,33 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.
Note: Since the axial force satisfies both criteria (6.33) and (6.34) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the y-y axis is neglected.
Note: Since the axial force satisfies criteria (6.35) of EN 1993-1-1 article 6.2.9.1(4) its effect on the moment resistance about the z-z axis is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0,000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	118	16	-5,784e+04	-1,941e+05								
3	SO	118	16	1,460e+04	1,508e+05	0,10	0,55	1,00	7,65	7,32	8,14	12,68	2
4	I	225	9	-1,316e+04	4,163e+04	-0,32		0,62	25,00	42,23	49,83	56,90	1
5	SO	118	16	8,631e+04	2,226e+05	0,39	0,50	1,00	7,65	7,32	8,14	12,07	2
7	SO	118	16	1,388e+04	-1,224e+05	-8,82	23,80	0,10	7,65	225,25	250,27	83,35	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 2

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	10,000	10,000	m
Buckling factor k	2,00	0,70	
Buckling length l_{cr}	20,024	7,000	m
Critical Euler load N_{cr}	1183,75	2956,65	kN
Slenderness λ	147,35	93,23	
Relative slenderness λ_{rel}	1,93	1,22	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	b	c	
Imperfection α	0,34	0,49	
Reduction factor χ	0,22	0,42	
Buckling resistance $N_{b,Rd}$	983,59	1867,56	kN

Flexural Buckling verification		
Cross-section area A	1,2400e-02	m²
Buckling resistance $N_{b,Rd}$	983,59	kN
Unity check	0,18	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: For this I-section the Torsional(-Flexural) buckling resistance is higher than the resistance for Flexural buckling. Therefore Torsional(-Flexural) buckling is not printed on the output.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1 & 6.3.2.3 and formula (6.54)

LTB parameters		
Method for LTB curve	Alternative case	
Plastic section modulus $W_{pl,y}$	1,6292e-03	m³
Elastic critical moment M_{cr}	1606,79	kNm
Relative slenderness $\lambda_{rel,LT}$	0,60	
Limit slenderness $\lambda_{rel,LT,0}$	0,40	

Note: The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4).

Mcr parameters		
LTB length l_{LT}	10,000	m
Influence of load position	no influence	
Correction factor k	1,00	
Correction factor k_w	1,00	
LTB moment factor C_1	3,88	
LTB moment factor C_2	0,71	
LTB moment factor C_3	0,41	
Shear center distance d_z	0	mm
Distance of load application z_g	0	mm
Mono-symmetry constant β_y	0	mm
Mono-symmetry constant z_j	0	mm

Note: C parameters are determined according to ECCS 119 2006 / Galea 2002.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	1,2400e-02	m^2
Plastic section modulus $W_{pl,y}$	1,6292e-03	m^3
Plastic section modulus $W_{pl,z}$	7,0833e-04	m^3
Design compression force N_{Ed}	177,11	kN
Design bending moment (maximum) $M_{y,Ed}$	55,85	kNm
Design bending moment (maximum) $M_{z,Ed}$	80,32	kNm
Characteristic compression resistance N_{Rk}	4402,00	kN
Characteristic moment resistance $M_{y,Rk}$	578,36	kNm
Characteristic moment resistance $M_{z,Rk}$	251,46	kNm
Reduction factor χ_y	0,22	
Reduction factor χ_z	0,42	
Modified reduction factor $\chi_{LT,mod}$	1,00	
Interaction factor k_{yy}	1,01	
Interaction factor k_{yz}	0,76	
Interaction factor k_{zy}	0,62	
Interaction factor k_{zz}	1,05	

Maximum moment $M_{y,Ed}$ is derived from beam B445 position 0,000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B445 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	1183,75	kN
Critical Euler load $N_{cr,z}$	2956,65	kN
Elastic critical load $N_{cr,T}$	4919,19	kN
Plastic section modulus $W_{pl,y}$	1,6292e-03	m^3
Elastic section modulus $W_{el,y}$	1,4800e-03	m^3
Plastic section modulus $W_{pl,z}$	7,0833e-04	m^3
Elastic section modulus $W_{el,z}$	4,6600e-04	m^3
Second moment of area I_y	2,2900e-04	m^4
Second moment of area I_z	6,9900e-05	m^4
Torsional constant I_t	1,0800e-06	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	55,85	kNm
Maximum relative deflection δ_z	-1,4	mm
Equivalent moment factor $C_{my,0}$	0,87	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	80,32	kNm
Maximum relative deflection δ_y	7,4	mm
Equivalent moment factor $C_{mz,0}$	0,95	
Factor μ_y	0,88	
Factor μ_z	0,96	
Factor ε_y	2,64	
Factor a_{LT}	1,00	
Critical moment for uniform bending $M_{cr,0}$	414,47	kNm
Relative slenderness $\lambda_{rel,0}$	1,18	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,38	
Equivalent moment factor C_{my}	0,95	
Equivalent moment factor C_{mz}	0,95	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,02	
Factor c_{LT}	0,20	
Factor d_{LT}	0,03	
Factor e_{LT}	0,09	
Factor w_y	1,10	
Factor w_z	1,50	
Factor n_{pl}	0,04	
Maximum relative slenderness $\lambda_{rel,max}$	1,93	
Factor C_{yy}	0,98	
Factor C_{yz}	0,82	
Factor C_{zy}	0,89	
Factor C_{zz}	0,93	

Unity check (6.61) = 0,18 + 0,10 + 0,24 = 0,52 -
Unity check (6.62) = 0,09 + 0,06 + 0,33 = 0,49 -

Shear Buckling check
According to EN 1993-1-5 article 5 & 7.1 and formula (5.10) & (7.1)

Shear Buckling parameters		
Buckling field length a	10,000	m
Web	unstiffened	
Web height h_w	279	mm
Web thickness t	9	mm
Material coefficient ε	0,81	
Shear correction factor η	1,20	

Shear Buckling verification	
Web slenderness h_w/t	31,00
Web slenderness limit	48,82

Note: The web slenderness is such that Shear Buckling effects may be ignored according to EN 1993-1-5 article 5.1(2).

The member satisfies the stability check.

5.2. Dimenzioniranje rešetke

200X100X6

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS6 - CFRHS200X100X6

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1428	0,000 / 2,882 m	CFRHS200X100X6	S 355	ULS-Set B (auto)	0,73 -

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind10 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 0,000 m

Internal forces	Calculated	Unit
N_{Ed}	-472,90	kN
$V_{y,Ed}$	-2,08	kN
$V_{z,Ed}$	4,53	kN
T_{Ed}	0,32	kNm
$M_{y,Ed}$	2,81	kNm
$M_{z,Ed}$	2,76	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	82	6	1,050e+05	1,442e+05	0,73		1,00	13,67	22,78	27,66	34,14	1
3	I	182	6	1,481e+05	1,782e+05	0,83		1,00	30,33	22,78	27,66	32,84	3
5	I	82	6	1,763e+05	1,370e+05	0,78		1,00	13,67	22,78	27,66	33,51	1
7	I	182	6	1,331e+05	1,031e+05	0,77		1,00	30,33	22,78	27,66	33,55	3

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 3

Semi-Comp+ properties		
Material coefficient ε	0,81	
Flange class 2 slenderness limit $\beta_{2,y,f}$	27,66	
Flange class 3 slenderness limit $\beta_{3,y,f}$	30,92	
Web class 2 slenderness limit $\beta_{2,y,w}$	67,53	
Web class 3 slenderness limit $\beta_{3,y,w}$	100,89	
Web class 2 slenderness limit $\beta_{2,z,w}$	27,66	
Web class 3 slenderness limit $\beta_{3,z,w}$	30,92	
Web slenderness ratio c/t_w	30,33	
Flange slenderness ratio c/t_f	13,67	
Reference slenderness ratio $c/t_{ref,y}$	0,00	
Reference slenderness ratio $c/t_{ref,z}$	0,82	
Interpolated section modulus $W_{3,y}$	2,1327e-04	m³
Interpolated section modulus $W_{3,z}$	1,1827e-04	m³

Note: The resistance for this semi-compact section has been calculated according to Semi-Comp+.

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	3,3630e-03	m²
$N_{c,Rd}$	1193,87	kN
Unity check	0,40	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{3,y}$	2,1327e-04	m³

$M_{3,y,Rd}$	75,71	kNm
Unity check	0,04	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{3,z}$	1,1827e-04	m^3
$M_{3,z,Rd}$	41,99	kNm
Unity check	0,07	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,1210e-03	m^2
$V_{pl,y,Rd}$	229,76	kN
Unity check	0,01	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	2,2420e-03	m^2
$V_{pl,z,Rd}$	459,52	kN
Unity check	0,01	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	1,4	MPa
τ_{Rd}	205,0	MPa
Unity check	0,01	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

$M_{N,3,y,Rd}$	45,72	kNm
α	2,02	
$M_{N,3,z,Rd}$	25,36	kNm
β	2,02	

Unity check (6.41) = 0,00 + 0,01 = 0,02 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0,288 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	82	6	1,027e+05	1,335e+05	0,77		1,00	13,67	22,78	27,66	33,61	1
3	I	182	6	1,372e+05	1,794e+05	0,76		1,00	30,33	22,78	27,66	33,67	3
5	I	82	6	1,785e+05	1,477e+05	0,83		1,00	13,67	22,78	27,66	32,89	1
7	I	182	6	1,441e+05	1,018e+05	0,71		1,00	30,33	22,78	27,66	34,42	3

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 3

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	2,882	2,882	m
Buckling factor k	1,00	0,91	
Buckling length l_{cr}	2,882	2,609	m
Critical Euler load N_{cr}	4249,83	1757,18	kN
Slenderness λ	40,50	62,98	
Relative slenderness λ_{rel}	0,53	0,82	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,83	0,65	
Buckling resistance $N_{b,Rd}$	986,20	772,34	kN

Flexural Buckling verification		
Cross-section area A	3,3630e-03	m^2
Buckling resistance $N_{b,Rd}$	772,34	kN
Unity check	0,61	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	3,3630e-03	m^2
Interpolated section modulus $W_{3,y}$	2,1327e-04	m^3
Interpolated section modulus $W_{3,z}$	1,1827e-04	m^3
Design compression force N_{Ed}	472,90	kN
Design bending moment (maximum) $M_{y,Ed}$	5,38	kNm
Design bending moment (maximum) $M_{z,Ed}$	-3,02	kNm
Characteristic compression resistance N_{Rk}	1193,87	kN
Characteristic moment resistance $M_{y,Rk}$	75,71	kNm
Characteristic moment resistance $M_{z,Rk}$	41,99	kNm
Reduction factor χ_y	0,83	
Reduction factor χ_z	0,65	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,10	
Interaction factor k_{yz}	0,59	
Interaction factor k_{zy}	0,75	
Interaction factor k_{zz}	0,94	

Maximum moment $M_{y,Ed}$ is derived from beam B1428 position 1,153 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1428 position 2,882 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	4249,83	kN
Critical Euler load $N_{cr,z}$	1757,18	kN
Elastic critical load $N_{cr,T}$	169904,98	kN
Interpolated section modulus $W_{3,y}$	2,1327e-04	m^3
Elastic section modulus $W_{el,y}$	1,7033e-04	m^3
Interpolated section modulus $W_{3,z}$	1,1827e-04	m^3
Elastic section modulus $W_{el,z}$	1,1538e-04	m^3
Second moment of area I_y	1,7033e-05	m^4
Second moment of area I_z	5,7691e-06	m^4
Torsional constant I_t	1,4170e-05	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	5,38	kNm
Maximum relative deflection δ_z	-1,3	mm
Equivalent moment factor $C_{my,0}$	1,01	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	-3,02	kNm
Maximum relative deflection δ_y	0,4	mm
Equivalent moment factor $C_{mz,0}$	0,78	
Factor μ_y	0,98	
Factor μ_z	0,88	
Factor ε_y	0,22	
Factor a_{LT}	0,17	
Critical moment for uniform bending $M_{cr,0}$	1287,72	kNm
Relative slenderness $\lambda_{rel,0}$	0,24	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,20	
Equivalent moment factor C_{my}	1,01	
Equivalent moment factor C_{mz}	0,78	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,00	
Factor c_{LT}	0,00	
Factor d_{LT}	0,00	
Factor e_{LT}	0,01	
Factor w_y	1,25	
Factor w_z	1,03	
Factor n_{pl}	0,40	
Maximum relative slenderness $\lambda_{rel,max}$	0,82	
Factor C_{yy}	1,01	
Factor C_{yz}	0,97	
Factor C_{zy}	0,89	
Factor C_{zz}	1,01	

Unity check (6.61) = 0,48 + 0,08 + 0,04 = 0,60 -
Unity check (6.62) = 0,61 + 0,05 + 0,07 = 0,73 -

The member satisfies the stability check.

150X50X3

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS7 - CFRHS150X50X3

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1991	**3,020 / 3,020 m**	**CFRHS150X50X3**	**S 355**	**ULS-Set B (auto)**	**0,82 -**

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.50*Snjeg + 1.35*Dodatno stalno + 0.90*3DWind6 + 1.50*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 3,020 m

Internal forces	Calculated	Unit
N_{Ed}	-85,13	kN
$V_{y,Ed}$	-0,09	kN
$V_{z,Ed}$	-0,16	kN
T_{Ed}	0,00	kNm
$M_{y,Ed}$	0,00	kNm
$M_{z,Ed}$	-0,14	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	41	3	8,002e+04	6,924e+04	0,87		1,00	13,67	22,78	27,66	32,43	1
3	I	141	3	6,845e+04	6,845e+04	1,00		1,00	47,00	22,78	27,66	30,92	4
5	I	41	3	6,924e+04	8,002e+04	0,87		1,00	13,67	22,78	27,66	32,43	1
7	I	141	3	8,081e+04	8,081e+04	1,00		1,00	47,00	22,78	27,66	30,92	4

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Effective section N-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	41	3,550e+05	3,550e+05	1,00	4,00	0,30	1,00	41	21	21
3	I	141	3,550e+05	3,550e+05	1,00	4,00	1,02	0,77	109	54	54
5	I	41	3,550e+05	3,550e+05	1,00	4,00	0,30	1,00	41	21	21
7	I	141	3,550e+05	3,550e+05	1,00	4,00	1,02	0,77	109	54	54

Effective section Mz-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	41	3,135e+05	-2,531e+05	-0,81	19,26	0,13	1,00	23	9	14
3	I	141	-2,946e+05	-2,946e+05							
5	I	41	3,135e+05	-2,531e+05	-0,81	19,26	0,13	1,00	23	9	14
7	I	141	3,550e+05	3,550e+05	1,00	4,00	1,02	0,77	109	54	54

Effective properties						
Effective area	A_{eff}	9,4661e-04	m²			
Effective second moment of area	$I_{eff,y}$	2,9849e-06	m⁴	$I_{eff,z}$	4,6776e-07	m⁴
Effective section modulus	$W_{eff,y}$	3,9799e-05	m³	$W_{eff,z}$	1,7206e-05	m³

Effective properties						
Shift of the centroid	$e_{N,y}$	0	mm	$e_{N,z}$	0	mm

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A_{eff}	9,4661e-04	m²
$N_{c,Rd}$	336,05	kN
Unity check	0,25	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.15)

$W_{eff,z,min}$	1,7206e-05	m³
$M_{c,z,Rd}$	6,11	kNm
Unity check	0,02	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	2,8525e-04	m²
$V_{pl,y,Rd}$	58,46	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	8,5575e-04	m²
$V_{pl,z,Rd}$	175,39	kN
Unity check	0,00	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	0,0	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.3 and formula (6.43)

Effective properties		
A_{eff}	9,4661e-04	m²
$e_{N,y}$	0	mm
$e_{N,z}$	0	mm
$W_{eff,y}$	3,9799e-05	m³
$W_{eff,z}$	1,7206e-05	m³

Normal stresses		
$\sigma_{N,Ed}$	89,9	MPa
$\sigma_{My,Ed}$	0,0	MPa
$\sigma_{Mz,Ed}$	8,1	MPa
$\sigma_{tot,Ed}$	98,0	MPa
Unity check	0,28	-

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 3,020 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	41	3	8,002e+04	6,924e+04	0,87		1,00	13,67	22,78	27,66	32,43	1
3	I	141	3	6,845e+04	6,845e+04	1,00		1,00	47,00	22,78	27,66	30,92	4
5	I	41	3	6,924e+04	8,002e+04	0,87		1,00	13,67	22,78	27,66	32,43	1
7	I	141	3	8,081e+04	8,081e+04	1,00		1,00	47,00	22,78	27,66	30,92	4

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	3,020	3,020	m
Buckling factor k	1,00	0,90	
Buckling length l_{cr}	3,020	2,714	m
Critical Euler load N_{cr}	678,63	148,18	kN
Slenderness λ	59,03	126,33	
Relative slenderness λ_{rel}	0,70	1,51	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,72	0,31	
Buckling resistance $N_{b,Rd}$	242,76	105,05	kN

Flexural Buckling verification		
Cross-section effective area A_{eff}	9,4661e-04	m^2
Buckling resistance $N_{b,Rd}$	105,05	kN
Unity check	0,81	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section effective area A_{eff}	9,4661e-04	m^2
Effective section modulus $W_{eff,y}$	3,9799e-05	m^3
Effective section modulus $W_{eff,z}$	1,7206e-05	m^3
Design compression force N_{Ed}	85,13	kN
Design bending moment (maximum) $M_{y,Ed}$	0,12	kNm
Design bending moment (maximum) $M_{z,Ed}$	-0,14	kNm
Additional moment $\Delta M_{y,Ed}$	0,00	kNm
Additional moment $\Delta M_{z,Ed}$	0,00	kNm
Characteristic compression resistance N_{Rk}	336,05	kN
Characteristic moment resistance $M_{y,Rk}$	14,13	kNm
Characteristic moment resistance $M_{z,Rk}$	6,11	kNm
Reduction factor χ_y	0,72	
Reduction factor χ_z	0,31	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,10	
Interaction factor k_{yz}	0,69	
Interaction factor k_{zy}	0,60	
Interaction factor k_{zz}	0,37	

Maximum moment $M_{y,Ed}$ is derived from beam B1991 position 1,510 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1991 position 3,020 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	678,63	kN
Critical Euler load $N_{cr,z}$	148,18	kN
Elastic critical load $N_{cr,T}$	39522,78	kN
Effective section modulus $W_{eff,y}$	3,9799e-05	m^3
Second moment of area I_y	2,9855e-06	m^4
Second moment of area I_z	5,2650e-07	m^4
Torsional constant I_t	1,5022e-06	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 4 (Line load)	
Equivalent moment factor $C_{my,0}$	1,00	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 1 (Linear)	
Ratio of end moments ψ_z	-1,00	
Equivalent moment factor $C_{mz,0}$	0,31	
Factor μ_y	0,96	
Factor μ_z	0,52	
Factor ε_y	0,03	
Factor a_{LT}	0,50	
Critical moment for uniform bending $M_{cr,0}$	120,66	kNm
Relative slenderness $\lambda_{rel,0}$	0,34	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,17	
Equivalent moment factor C_{my}	1,00	
Equivalent moment factor C_{mz}	0,31	
Equivalent moment factor C_{mLT}	1,00	

Unity check (6.61) = 0,35 + 0,01 + 0,02 = 0,38 -
Unity check (6.62) = 0,81 + 0,01 + 0,01 = 0,82 -

The member satisfies the stability check.

180x100x5

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS14 - CFRHS180X100X5

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1661	2,437 / 2,437 m	CFRHS180X100X5	S 355	ULS-Set B (auto)	0,86 -

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind10 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 2,437 m

Internal forces	Calculated	Unit
N_{Ed}	-319,88	kN
$V_{y,Ed}$	0,46	kN
$V_{z,Ed}$	4,24	kN
T_{Ed}	0,63	kNm
$M_{y,Ed}$	1,24	kNm
$M_{z,Ed}$	0,06	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	85	5	1,111e+05	1,124e+05	0,99		1,00	17,00	22,78	27,66	31,03	1
3	I	165	5	1,130e+05	1,311e+05	0,86		1,00	33,00	22,78	27,66	32,48	4
5	I	85	5	1,316e+05	1,304e+05	0,99		1,00	17,00	22,78	27,66	31,02	1
7	I	165	5	1,298e+05	1,116e+05	0,86		1,00	33,00	22,78	27,66	32,50	4

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Effective section N-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	85	3,550e+05	3,550e+05	1,00	4,00	0,37	1,00	85	42	42
3	I	165	3,550e+05	3,550e+05	1,00	4,00	0,71	0,97	160	80	80
5	I	85	3,550e+05	3,550e+05	1,00	4,00	0,37	1,00	85	42	42
7	I	165	3,550e+05	3,550e+05	1,00	4,00	0,71	0,97	160	80	80

Effective section My+
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	85	-3,550e+05	-3,550e+05							
3	I	165	3,347e+05	-3,347e+05	-1,00	23,90	0,29	1,00	82	33	49
5	I	85	3,550e+05	3,550e+05	1,00	4,00	0,37	1,00	85	42	42
7	I	165	3,347e+05	-3,347e+05	-1,00	23,90	0,29	1,00	82	33	49

Effective section Mz+
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	85	3,180e+05	-3,111e+05	-0,98	23,32	0,15	1,00	43	17	26
3	I	165	3,550e+05	3,550e+05	1,00	4,00	0,71	0,97	160	80	80
5	I	85	3,180e+05	-3,111e+05	-0,98	23,32	0,15	1,00	43	17	26
7	I	165	-3,481e+05	-3,481e+05							

Effective properties						
Effective area	A_{eff}	2,5841e-03	m²			
Effective second moment of area	$I_{eff,y}$	1,1240e-05	m⁴	$I_{eff,z}$	4,4586e-06	m⁴
Effective section modulus	$W_{eff,y}$	1,2489e-04	m³	$W_{eff,z}$	8,8348e-05	m³
Shift of the centroid	$e_{N,y}$	0	mm	$e_{N,z}$	0	mm

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A_{eff}	2,5841e-03	m²
$N_{c,Rd}$	917,35	kN
Unity check	0,35	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.15)

$W_{eff,y,min}$	1,2489e-04	m³
$M_{c,y,Rd}$	44,33	kNm
Unity check	0,03	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.15)

$W_{eff,z,min}$	8,8348e-05	m³
$M_{c,z,Rd}$	31,36	kNm
Unity check	0,00	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	9,4143e-04	m²
$V_{pl,y,Rd}$	192,95	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,6946e-03	m²
$V_{pl,z,Rd}$	347,32	kN
Unity check	0,01	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	3,8	MPa
τ_{Rd}	205,0	MPa
Unity check	0,02	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.3 and formula (6.43)

Effective properties		
A_{eff}	2,5841e-03	m²
$e_{N,y}$	0	mm
$e_{N,z}$	0	mm
$W_{eff,y}$	1,2489e-04	m³
$W_{eff,z}$	8,8348e-05	m³

Normal stresses		
$\sigma_{N,Ed}$	123,8	MPa
$\sigma_{My,Ed}$	9,9	MPa
$\sigma_{Mz,Ed}$	0,7	MPa
$\sigma_{tot,Ed}$	134,4	MPa
Unity check	0,38	-

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 2,437 m

Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	85	5	1,111e+05	1,124e+05	0,99		1,00	17,00	22,78	27,66	31,03	1
3	I	165	5	1,130e+05	1,311e+05	0,86		1,00	33,00	22,78	27,66	32,48	4
5	I	85	5	1,316e+05	1,304e+05	0,99		1,00	17,00	22,78	27,66	31,02	1
7	I	165	5	1,298e+05	1,116e+05	0,86		1,00	33,00	22,78	27,66	32,50	4

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	2,437	4,874	m
Buckling factor k	1,00	0,65	
Buckling length l_{cr}	2,437	3,180	m
Critical Euler load N_{cr}	3924,09	925,98	kN
Slenderness λ	37,31	76,81	
Relative slenderness λ_{rel}	0,48	1,00	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,85	0,54	
Buckling resistance $N_{b,Rd}$	781,74	497,80	kN

Flexural Buckling verification		
Cross-section effective area A_{eff}	2,5841e-03	m²
Buckling resistance $N_{b,Rd}$	497,80	kN
Unity check	0,64	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section effective area A_{eff}	2,5841e-03	m²
Effective section modulus $W_{eff,y}$	1,2489e-04	m³
Effective section modulus $W_{eff,z}$	8,8348e-05	m³
Design compression force N_{Ed}	319,88	kN
Design bending moment (maximum) $M_{y,Ed}$	-9,91	kNm
Design bending moment (maximum) $M_{z,Ed}$	-1,07	kNm
Additional moment $\Delta M_{y,Ed}$	0,00	kNm
Additional moment $\Delta M_{z,Ed}$	0,00	kNm
Characteristic compression resistance N_{Rk}	917,35	kN
Characteristic moment resistance $M_{y,Rk}$	44,33	kNm
Characteristic moment resistance $M_{z,Rk}$	31,36	kNm
Reduction factor χ_y	0,85	
Reduction factor χ_z	0,54	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,03	
Interaction factor k_{yz}	1,09	
Interaction factor k_{zy}	0,84	
Interaction factor k_{zz}	0,89	

Maximum moment $M_{y,Ed}$ is derived from beam B1661 position 0,000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1661 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	3924,09	kN
Critical Euler load $N_{cr,z}$	925,98	kN
Elastic critical load $N_{cr,T}$	141423,11	kN
Effective section modulus $W_{eff,y}$	1,2489e-04	m³
Second moment of area I_y	1,1242e-05	m⁴
Second moment of area I_z	4,5177e-06	m⁴
Torsional constant I_t	1,0448e-05	m⁴
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	-9,91	kNm
Maximum relative deflection δ_z	1,4	mm

Interaction method 1 parameters		
Equivalent moment factor $C_{my,0}$	0,96	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	-1,07	kNm
Maximum relative deflection δ_y	0,5	mm
Equivalent moment factor $C_{mz,0}$	0,72	
Factor μ_y	0,99	
Factor μ_z	0,81	
Factor ε_y	0,64	
Factor a_{LT}	0,07	
Critical moment for uniform bending $M_{cr,0}$	577,35	kNm
Relative slenderness $\lambda_{rel,0}$	0,28	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,32	
Equivalent moment factor C_{my}	0,96	
Equivalent moment factor C_{mz}	0,72	
Equivalent moment factor C_{mLT}	1,00	

Unity check (6.61) = 0,41 + 0,23 + 0,04 = 0,68 -
Unity check (6.62) = 0,64 + 0,19 + 0,03 = 0,86 -

The member satisfies the stability check.

120x40x6

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS16 - CFRHS120X40X6

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1709	0,000 / 2,739 m	CFRHS120X40X6	S 355	ULS-Set B (auto)	0,94 -

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind10 + 0.90*Temp -

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 0,000 m

Internal forces	Calculated	Unit
N_{Ed}	-83,47	kN
$V_{y,Ed}$	0,21	kN
$V_{z,Ed}$	-0,45	kN
T_{Ed}	-0,01	kNm
$M_{y,Ed}$	0,71	kNm
$M_{z,Ed}$	0,00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	22	6	3,338e+04	3,338e+04	1,00		1,00	3,67	22,78	27,66	30,92	1
3	I	102	6	3,508e+04	6,412e+04	0,55		1,00	17,00	22,78	27,66	36,68	1
5	I	22	6	6,583e+04	6,583e+04	1,00		1,00	3,67	22,78	27,66	30,92	1
7	I	102	6	6,412e+04	3,508e+04	0,55		1,00	17,00	22,78	27,66	36,68	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,6830e-03	m²
$N_{c,Rd}$	597,47	kN
Unity check	0,14	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	5,6890e-05	m³
$M_{pl,y,Rd}$	20,20	kNm
Unity check	0,04	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	4,2075e-04	m²
$V_{pl,y,Rd}$	86,24	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,2622e-03	m²
$V_{pl,z,Rd}$	258,71	kN
Unity check	0,00	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	0,1	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.31)

$M_{N,y,Rd}$	20,20	kNm
Unity check	0,04	-

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0,000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	22	6	3,338e+04	3,338e+04	1,00		1,00	3,67	22,78	27,66	30,92	1
3	I	102	6	3,508e+04	6,412e+04	0,55		1,00	17,00	22,78	27,66	36,68	1
5	I	22	6	6,583e+04	6,583e+04	1,00		1,00	3,67	22,78	27,66	30,92	1
7	I	102	6	6,412e+04	3,508e+04	0,55		1,00	17,00	22,78	27,66	36,68	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	2,739	2,739	m
Buckling factor k	1,00	1,00	
Buckling length l_{cr}	2,739	2,739	m
Critical Euler load N_{cr}	690,76	113,22	kN
Slenderness λ	71,06	175,52	
Relative slenderness λ_{rel}	0,93	2,30	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,58	0,15	
Buckling resistance $N_{b,Rd}$	347,43	92,04	kN

Flexural Buckling verification		
Cross-section area A	1,6830e-03	m²
Buckling resistance $N_{b,Rd}$	92,04	kN
Unity check	0,91	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	1,6830e-03	m²
Plastic section modulus $W_{pl,y}$	5,6890e-05	m³
Plastic section modulus $W_{pl,z}$	2,5080e-05	m³
Design compression force N_{Ed}	83,47	kN
Design bending moment (maximum) $M_{y,Ed}$	0,71	kNm
Design bending moment (maximum) $M_{z,Ed}$	0,15	kNm
Characteristic compression resistance N_{Rk}	597,47	kN
Characteristic moment resistance $M_{y,Rk}$	20,20	kNm
Characteristic moment resistance $M_{z,Rk}$	8,90	kNm
Reduction factor χ_y	0,58	

Bending and axial compression check parameters		
Reduction factor χ_z	0,15	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	0,82	
Interaction factor k_{yz}	4,50	
Interaction factor k_{zy}	0,20	
Interaction factor k_{zz}	1,41	

Maximum moment $M_{y,Ed}$ is derived from beam B1709 position 0,000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1709 position 1,369 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	690,76	kN
Critical Euler load $N_{cr,z}$	113,22	kN
Elastic critical load $N_{cr,T}$	59003,73	kN
Plastic section modulus $W_{pl,y}$	5,6890e-05	m^3
Elastic section modulus $W_{el,y}$	4,1660e-05	m^3
Plastic section modulus $W_{pl,z}$	2,5080e-05	m^3
Elastic section modulus $W_{el,z}$	2,0490e-05	m^3
Second moment of area I_y	2,4997e-06	m^4
Second moment of area I_z	4,0970e-07	m^4
Torsional constant I_t	1,2597e-06	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 1 (Linear)	
Ratio of end moments ψ_y	-0,74	
Equivalent moment factor $C_{my,0}$	0,59	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 4 (Line load)	
Equivalent moment factor $C_{mz,0}$	1,02	
Factor μ_y	0,95	
Factor μ_z	0,30	
Factor ε_y	0,34	
Factor a_{LT}	0,50	
Critical moment for uniform bending $M_{cr,0}$	107,46	kNm
Relative slenderness $\lambda_{rel,0}$	0,43	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,23	
Equivalent moment factor C_{my}	0,68	
Equivalent moment factor C_{mz}	1,02	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,00	
Factor c_{LT}	0,00	
Factor d_{LT}	0,00	
Factor e_{LT}	0,00	
Factor w_y	1,37	
Factor w_z	1,22	
Factor n_{pl}	0,14	
Maximum relative slenderness $\lambda_{rel,max}$	2,30	
Factor C_{yy}	0,89	
Factor C_{yz}	0,46	
Factor C_{zy}	0,73	
Factor C_{zz}	0,82	

Unity check (6.61) = 0,24 + 0,03 + 0,07 = 0,34 -
Unity check (6.62) = 0,91 + 0,01 + 0,02 = 0,94 -

The member satisfies the stability check.

120x80x3

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS15 - CFRHS120X80X3

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1313	0,000 / 1,994 m	CFRHS120X80X3	S 355	ULS-Set B (auto)	0,57 -

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind14 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 0,000 m

Internal forces	Calculated	Unit
N_{Ed}	-76,58	kN
$V_{y,Ed}$	0,21	kN
$V_{z,Ed}$	0,49	kN
T_{Ed}	-0,05	kNm
$M_{y,Ed}$	-0,83	kNm
$M_{z,Ed}$	-0,10	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	71	3	9,121e+04	8,526e+04	0,93		1,00	23,67	22,78	27,66	31,63	2
3	I	111	3	8,393e+04	4,389e+04	0,52		1,00	37,00	22,78	27,66	37,05	3
5	I	71	3	4,306e+04	4,901e+04	0,88		1,00	23,67	22,78	27,66	32,28	2
7	I	111	3	5,034e+04	9,038e+04	0,56		1,00	37,00	22,78	27,66	36,53	4

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Effective section N-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	71	3,550e+05	3,550e+05	1,00	4,00	0,51	1,00	71	36	36
3	I	111	3,550e+05	3,550e+05	1,00	4,00	0,80	0,91	101	50	50
5	I	71	3,550e+05	3,550e+05	1,00	4,00	0,51	1,00	71	36	36
7	I	111	3,550e+05	3,550e+05	1,00	4,00	0,80	0,91	101	50	50

Effective section My-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	71	3,550e+05	3,550e+05	1,00	4,00	0,51	1,00	71	36	36
3	I	111	3,368e+05	-3,368e+05	-1,00	23,90	0,33	1,00	56	22	33
5	I	71	-3,550e+05	-3,550e+05							
7	I	111	3,368e+05	-3,368e+05	-1,00	23,90	0,33	1,00	56	22	33

Effective section Mz-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	71	3,281e+05	-3,086e+05	-0,94	22,38	0,22	1,00	37	15	22
3	I	111	-3,355e+05	-3,355e+05							
5	I	71	3,281e+05	-3,086e+05	-0,94	22,38	0,22	1,00	37	15	22
7	I	111	3,550e+05	3,550e+05	1,00	4,00	0,80	0,91	101	50	50

Effective properties						
Effective area	A_{eff}	1,0780e-03	m²			
Effective second moment of area	$I_{eff,y}$	2,3016e-06	m⁴	$I_{eff,z}$	1,1864e-06	m⁴
Effective section modulus	$W_{eff,y}$	3,8360e-05	m³	$W_{eff,z}$	2,8873e-05	m³
Shift of the centroid	$e_{N,y}$	0	mm	$e_{N,z}$	0	mm

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A_{eff}	1,0780e-03	m²
$N_{c,Rd}$	382,68	kN
Unity check	0,20	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.15)

$W_{eff,y,min}$	3,8360e-05	m³
$M_{c,y,Rd}$	13,62	kNm
Unity check	0,06	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.15)

$W_{eff,z,min}$	2,8873e-05	m³
$M_{c,z,Rd}$	10,25	kNm
Unity check	0,01	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	4,5640e-04	m²
$V_{pl,y,Rd}$	93,54	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	6,8460e-04	m²
$V_{pl,z,Rd}$	140,32	kN
Unity check	0,00	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	1,0	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.3 and formula (6.43)

Effective properties		
A_{eff}	1,0780e-03	m²
$e_{N,y}$	0	mm
$e_{N,z}$	0	mm
$W_{eff,y}$	3,8360e-05	m³
$W_{eff,z}$	2,8873e-05	m³

Normal stresses		
$\sigma_{N,Ed}$	71,0	MPa
$\sigma_{My,Ed}$	21,6	MPa
$\sigma_{Mz,Ed}$	3,6	MPa
$\sigma_{tot,Ed}$	96,3	MPa
Unity check	0,27	-

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0,000 m

Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	71	3	9,121e+04	8,526e+04	0,93		1,00	23,67	22,78	27,66	31,63	2
3	I	111	3	8,393e+04	4,389e+04	0,52		1,00	37,00	22,78	27,66	37,05	3
5	I	71	3	4,306e+04	4,901e+04	0,88		1,00	23,67	22,78	27,66	32,28	2
7	I	111	3	5,034e+04	9,038e+04	0,56		1,00	37,00	22,78	27,66	36,53	4

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	1,994	3,987	m
Buckling factor k	1,00	0,80	
Buckling length l_{cr}	1,994	3,205	m
Critical Euler load N_{cr}	1200,42	249,09	kN
Slenderness λ	44,38	97,44	
Relative slenderness λ_{rel}	0,56	1,24	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,81	0,42	
Buckling resistance $N_{b,Rd}$	308,50	158,95	kN

Flexural Buckling verification		
Cross-section effective area A_{eff}	1,0780e-03	m²
Buckling resistance $N_{b,Rd}$	158,95	kN
Unity check	0,48	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section effective area A_{eff}	1,0780e-03	m²
Effective section modulus $W_{eff,y}$	3,8360e-05	m³
Effective section modulus $W_{eff,z}$	2,8873e-05	m³
Design compression force N_{Ed}	76,58	kN
Design bending moment (maximum) $M_{y,Ed}$	-0,83	kNm
Design bending moment (maximum) $M_{z,Ed}$	0,35	kNm
Additional moment $\Delta M_{y,Ed}$	0,00	kNm
Additional moment $\Delta M_{z,Ed}$	0,00	kNm
Characteristic compression resistance N_{Rk}	382,68	kN
Characteristic moment resistance $M_{y,Rk}$	13,62	kNm
Characteristic moment resistance $M_{z,Rk}$	10,25	kNm
Reduction factor χ_y	0,81	
Reduction factor χ_z	0,42	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,03	
Interaction factor k_{yz}	1,25	
Interaction factor k_{zy}	0,83	
Interaction factor k_{zz}	1,00	

Maximum moment $M_{y,Ed}$ is derived from beam B1313 position 0,000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1314 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	1200,42	kN
Critical Euler load $N_{cr,z}$	249,09	kN
Elastic critical load $N_{cr,T}$	66673,63	kN
Effective section modulus $W_{eff,y}$	3,8360e-05	m³
Second moment of area I_y	2,3020e-06	m⁴
Second moment of area I_z	1,2343e-06	m⁴
Torsional constant I_t	2,5547e-06	m⁴
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	-0,83	kNm
Maximum relative deflection δ_z	0,4	mm

Interaction method 1 parameters		
Equivalent moment factor $C_{my,0}$	0,98	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	0,35	kNm
Maximum relative deflection δ_y	-1,3	mm
Equivalent moment factor $C_{mz,0}$	0,88	
Factor μ_y	0,99	
Factor μ_z	0,79	
Factor ε_y	0,30	
Factor a_{LT}	0,00	
Critical moment for uniform bending $M_{cr,0}$	182,35	kNm
Relative slenderness $\lambda_{rel,0}$	0,27	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,31	
Equivalent moment factor C_{my}	0,98	
Equivalent moment factor C_{mz}	0,88	
Equivalent moment factor C_{mLT}	1,00	

Unity check (6.61) = 0,25 + 0,06 + 0,04 = 0,35 -
Unity check (6.62) = 0,48 + 0,05 + 0,03 = 0,57 -

The member satisfies the stability check.

50x50x3

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS17 - CFRHS50X50X3

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1218	**0,000 / 2,230 m**	**CFRHS50X50X3**	**S 355**	**ULS-Set B (auto)**	**0,72 -**

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind14 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 0,000 m

Internal forces	Calculated	Unit
N_{Ed}	-40,78	kN
$V_{y,Ed}$	0,06	kN
$V_{z,Ed}$	0,01	kN
T_{Ed}	0,00	kNm
$M_{y,Ed}$	0,01	kNm
$M_{z,Ed}$	0,00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	41	3	7,472e+04	7,472e+04	1,00		1,00	13,67	22,78	27,66	30,92	1
3	I	41	3	7,481e+04	7,603e+04	0,98		1,00	13,67	22,78	27,66	31,09	1
5	I	41	3	7,612e+04	7,612e+04	1,00		1,00	13,67	22,78	27,66	30,92	1
7	I	41	3	7,603e+04	7,481e+04	0,98		1,00	13,67	22,78	27,66	31,09	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	5,4100e-04	m²
$N_{c,Rd}$	192,06	kN
Unity check	0,21	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	9,3900e-06	m³
$M_{pl,y,Rd}$	3,33	kNm
Unity check	0,00	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	2,7050e-04	m²
$V_{pl,y,Rd}$	55,44	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	2,7050e-04	m²
$V_{pl,z,Rd}$	55,44	kN
Unity check	0,00	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	0,0	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.31)

$M_{N,y,Rd}$	3,33	kNm
Unity check	0,00	-

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 1,338 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	41	3	7,036e+04	7,668e+04	0,92		1,00	13,67	22,78	27,66	31,83	1
3	I	41	3	7,738e+04	8,059e+04	0,96		1,00	13,67	22,78	27,66	31,35	1
5	I	41	3	8,036e+04	7,404e+04	0,92		1,00	13,67	22,78	27,66	31,79	1
7	I	41	3	7,334e+04	7,013e+04	0,96		1,00	13,67	22,78	27,66	31,39	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	2,230	2,230	m
Buckling factor k	1,00	1,00	
Buckling length l_{cr}	2,230	2,230	m
Critical Euler load N_{cr}	81,12	81,12	kN
Slenderness λ	117,57	117,57	
Relative slenderness λ_{rel}	1,54	1,54	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,30	0,30	
Buckling resistance $N_{b,Rd}$	58,06	58,06	kN

Flexural Buckling verification		
Cross-section area A	5,4100e-04	m²
Buckling resistance $N_{b,Rd}$	58,06	kN
Unity check	0,70	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	5,4100e-04	m²
Plastic section modulus $W_{pl,y}$	9,3900e-06	m³
Plastic section modulus $W_{pl,z}$	9,3900e-06	m³
Design compression force N_{Ed}	40,78	kN
Design bending moment (maximum) $M_{y,Ed}$	0,02	kNm
Design bending moment (maximum) $M_{z,Ed}$	0,03	kNm
Characteristic compression resistance N_{Rk}	192,06	kN
Characteristic moment resistance $M_{y,Rk}$	3,33	kNm
Characteristic moment resistance $M_{z,Rk}$	3,33	kNm
Reduction factor χ_y	0,30	

Bending and axial compression check parameters		
Reduction factor χ_z	0,30	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,06	
Interaction factor k_{yz}	1,43	
Interaction factor k_{zy}	0,86	
Interaction factor k_{zz}	1,40	

Maximum moment $M_{y,Ed}$ is derived from beam B1218 position 2,230 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1218 position 1,115 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	81,12	kN
Critical Euler load $N_{cr,z}$	81,12	kN
Elastic critical load $N_{cr,T}$	36099,60	kN
Plastic section modulus $W_{pl,y}$	9,3900e-06	m^3
Elastic section modulus $W_{el,y}$	7,7900e-06	m^3
Plastic section modulus $W_{pl,z}$	9,3900e-06	m^3
Elastic section modulus $W_{el,z}$	7,7900e-06	m^3
Second moment of area I_y	1,9470e-07	m^4
Second moment of area I_z	1,9470e-07	m^4
Torsional constant I_t	3,2130e-07	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 1 (Linear)	
Ratio of end moments ψ_y	0,27	
Equivalent moment factor $C_{my,0}$	0,84	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 4 (Line load)	
Equivalent moment factor $C_{mz,0}$	1,02	
Factor μ_y	0,59	
Factor μ_z	0,59	
Factor ε_y	0,04	
Factor a_{LT}	0,00	
Critical moment for uniform bending $M_{cr,0}$	45,91	kNm
Relative slenderness $\lambda_{rel,0}$	0,27	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,21	
Equivalent moment factor C_{my}	0,84	
Equivalent moment factor C_{mz}	1,02	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,00	
Factor c_{LT}	0,00	
Factor d_{LT}	0,00	
Factor e_{LT}	0,00	
Factor w_y	1,21	
Factor w_z	1,21	
Factor n_{pl}	0,21	
Maximum relative slenderness $\lambda_{rel,max}$	1,54	
Factor C_{yy}	0,93	
Factor C_{yz}	0,50	
Factor C_{zy}	0,69	
Factor C_{zz}	0,85	

Unity check (6.61) = 0,70 + 0,01 + 0,01 = 0,72 -
Unity check (6.62) = 0,70 + 0,01 + 0,01 = 0,72 -

The member satisfies the stability check.

120x80x5

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS19 - CFRHS120X80X5

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1129	2,877 / 2,877 m	CFRHS120X80X5	S 355	ULS-Set B (auto)	0,66 -

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.50*Snjeg + 1.35*Dodatno stalno + 0.90*3DWind1 + 1.50*Temp -

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 2,877 m

Internal forces	Calculated	Unit
N_{Ed}	-19,16	kN
$V_{y,Ed}$	0,01	kN
$V_{z,Ed}$	-0,91	kN
T_{Ed}	0,03	kNm
$M_{y,Ed}$	-2,02	kNm
$M_{z,Ed}$	-0,04	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	65	5	4,404e+04	4,273e+04	0,97		1,00	13,00	22,78	27,66	31,24	1
3	I	105	5	3,976e+04	-2,040e+04	-0,51		0,66	21,00	38,90	46,13	65,09	1
5	I	65	5	-2,316e+04	-2,185e+04								
7	I	105	5	-1,888e+04	4,128e+04	-0,46		0,69	21,00	36,96	43,95	62,55	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,8360e-03	m²
$N_{c,Rd}$	651,78	kN
Unity check	0,03	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	7,2450e-05	m³
$M_{pl,y,Rd}$	25,72	kNm
Unity check	0,08	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,z}$	5,4740e-05	m³
$M_{pl,z,Rd}$	19,43	kNm
Unity check	0,00	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	7,3440e-04	m²
$V_{pl,y,Rd}$	150,52	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,1016e-03	m²
$V_{pl,z,Rd}$	225,78	kN
Unity check	0,00	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	0,3	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

$M_{N,y,Rd}$	25,72	kNm
α	1,66	
$M_{N,z,Rd}$	19,43	kNm
β	1,66	

Unity check (6.41) = 0,01 + 0,00 = 0,01 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 2,877 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	65	5	4,404e+04	4,273e+04	0,97		1,00	13,00	22,78	27,66	31,24	1
3	I	105	5	3,976e+04	-2,040e+04	-0,51		0,66	21,00	38,90	46,13	65,09	1
5	I	65	5	-2,316e+04	-2,185e+04								
7	I	105	5	-1,888e+04	4,128e+04	-0,46		0,69	21,00	36,96	43,95	62,55	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	2,877	17,263	m
Buckling factor k	1,00	0,61	
Buckling length l_{cr}	2,877	10,560	m
Critical Euler load N_{cr}	884,13	34,90	kN
Slenderness λ	65,61	330,19	
Relative slenderness λ_{rel}	0,86	4,32	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,63	0,05	
Buckling resistance $N_{b,Rd}$	407,66	31,34	kN

Flexural Buckling verification		
Cross-section area A	1,8360e-03	m²
Buckling resistance $N_{b,Rd}$	31,34	kN
Unity check	0,61	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	1,8360e-03	m^2
Plastic section modulus $W_{pl,y}$	7,2450e-05	m^3
Plastic section modulus $W_{pl,z}$	5,4740e-05	m^3
Design compression force N_{Ed}	19,16	kN
Design bending moment (maximum) $M_{y,Ed}$	-2,02	kNm
Design bending moment (maximum) $M_{z,Ed}$	0,18	kNm
Characteristic compression resistance N_{Rk}	651,78	kN
Characteristic moment resistance $M_{y,Rk}$	25,72	kNm
Characteristic moment resistance $M_{z,Rk}$	19,43	kNm
Reduction factor χ_y	0,63	
Reduction factor χ_z	0,05	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,23	
Interaction factor k_{yz}	0,92	
Interaction factor k_{zy}	0,58	
Interaction factor k_{zz}	0,62	

Maximum moment $M_{y,Ed}$ is derived from beam B1129 position 2,877 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1135 position 2,877 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	884,13	kN
Critical Euler load $N_{cr,z}$	34,90	kN
Elastic critical load $N_{cr,T}$	110290,71	kN
Plastic section modulus $W_{pl,y}$	7,2450e-05	m^3
Elastic section modulus $W_{el,y}$	5,8860e-05	m^3
Plastic section modulus $W_{pl,z}$	5,4740e-05	m^3
Elastic section modulus $W_{el,z}$	4,6940e-05	m^3
Second moment of area I_y	3,5314e-06	m^4
Second moment of area I_z	1,8778e-06	m^4
Torsional constant I_t	4,0227e-06	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	-2,02	kNm
Maximum relative deflection δ_z	1,3	mm
Equivalent moment factor $C_{my,0}$	0,99	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	0,18	kNm
Maximum relative deflection δ_y	3,3	mm
Equivalent moment factor $C_{mz,0}$	0,58	
Factor μ_y	0,99	
Factor μ_z	0,46	
Factor ε_y	3,29	
Factor a_{LT}	0,00	
Critical moment for uniform bending $M_{cr,0}$	65,14	kNm
Relative slenderness $\lambda_{rel,0}$	0,63	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,19	
Equivalent moment factor C_{my}	0,99	
Equivalent moment factor C_{mz}	0,58	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,00	
Factor c_{LT}	0,00	
Factor d_{LT}	0,00	
Factor e_{LT}	0,00	
Factor w_y	1,23	
Factor w_z	1,17	
Factor n_{pl}	0,03	
Maximum relative slenderness $\lambda_{rel,max}$	4,32	
Factor C_{yy}	0,81	
Factor C_{yz}	0,81	
Factor C_{zy}	0,50	
Factor C_{zz}	0,96	

Unity check (6.61) = 0,05 + 0,10 + 0,01 = 0,15 -
Unity check (6.62) = 0,61 + 0,05 + 0,01 = 0,66 -

The member satisfies the stability check.

50x50x2

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS18 - CFRHS50X50X3

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1133	**0,000 / 3,245 m**	**CFRHS50X50X3**	**S 355**	**ULS-Set B (auto)**	**0,71 -**

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 1.50*Snjeg + 1.35*Dodatno stalno + 0.90*3DWind6 + 1.50*Temp -

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 0,000 m

Internal forces	Calculated	Unit
N_{Ed}	-20,87	kN
$V_{y,Ed}$	0,08	kN
$V_{z,Ed}$	0,00	kN
T_{Ed}	-0,02	kNm
$M_{y,Ed}$	0,01	kNm
$M_{z,Ed}$	0,00	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	41	3	3,715e+04	3,715e+04	1,00		1,00	13,67	22,78	27,66	30,92	1
3	I	41	3	3,734e+04	3,984e+04	0,94		1,00	13,67	22,78	27,66	31,61	1
5	I	41	3	4,003e+04	4,003e+04	1,00		1,00	13,67	22,78	27,66	30,92	1
7	I	41	3	3,984e+04	3,734e+04	0,94		1,00	13,67	22,78	27,66	31,61	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	5,4100e-04	m²
$N_{c,Rd}$	192,06	kN
Unity check	0,11	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	9,3900e-06	m³
$M_{pl,y,Rd}$	3,33	kNm
Unity check	0,00	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	2,7050e-04	m²
$V_{pl,y,Rd}$	55,44	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	2,7050e-04	m²
$V_{pl,z,Rd}$	55,44	kN
Unity check	0,00	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	1,5	MPa
τ_{Rd}	205,0	MPa
Unity check	0,01	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.31)

$M_{N,y,Rd}$	3,33	kNm
Unity check	0,00	-

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 1,622 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	41	3	2,948e+04	4,331e+04	0,68		1,00	13,67	22,78	27,66	34,77	1
3	I	41	3	4,459e+04	4,828e+04	0,92		1,00	13,67	22,78	27,66	31,76	1
5	I	41	3	4,754e+04	3,372e+04	0,71		1,00	13,67	22,78	27,66	34,39	1
7	I	41	3	3,243e+04	2,874e+04	0,89		1,00	13,67	22,78	27,66	32,19	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	3,245	3,245	m
Buckling factor k	1,00	1,00	
Buckling length l_{cr}	3,245	3,245	m
Critical Euler load N_{cr}	38,33	38,33	kN
Slenderness λ	171,04	171,04	
Relative slenderness λ_{rel}	2,24	2,24	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,16	0,16	
Buckling resistance $N_{b,Rd}$	30,97	30,97	kN

Flexural Buckling verification		
Cross-section area A	5,4100e-04	m²
Buckling resistance $N_{b,Rd}$	30,97	kN
Unity check	0,67	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	5,4100e-04	m²
Plastic section modulus $W_{pl,y}$	9,3900e-06	m³
Plastic section modulus $W_{pl,z}$	9,3900e-06	m³
Design compression force N_{Ed}	20,87	kN
Design bending moment (maximum) $M_{y,Ed}$	0,02	kNm
Design bending moment (maximum) $M_{z,Ed}$	0,07	kNm
Characteristic compression resistance N_{Rk}	192,06	kN
Characteristic moment resistance $M_{y,Rk}$	3,33	kNm
Characteristic moment resistance $M_{z,Rk}$	3,33	kNm
Reduction factor χ_y	0,16	

Bending and axial compression check parameters	
Reduction factor χ_z	0,16
Reduction factor χ_{LT}	1,00
Interaction factor k_{yy}	1,19
Interaction factor k_{yz}	1,34
Interaction factor k_{zy}	1,21
Interaction factor k_{zz}	1,34

Maximum moment $M_{y,Ed}$ is derived from beam B1133 position 3,245 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1133 position 1,622 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	38,33	kN
Critical Euler load $N_{cr,z}$	38,33	kN
Elastic critical load $N_{cr,T}$	36075,74	kN
Plastic section modulus $W_{pl,y}$	9,3900e-06	m^3
Elastic section modulus $W_{el,y}$	7,7900e-06	m^3
Plastic section modulus $W_{pl,z}$	9,3900e-06	m^3
Elastic section modulus $W_{el,z}$	7,7900e-06	m^3
Second moment of area I_y	1,9470e-07	m^4
Second moment of area I_z	1,9470e-07	m^4
Torsional constant I_t	3,2130e-07	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 1 (Linear)	
Ratio of end moments ψ_y	0,51	
Equivalent moment factor $C_{my,0}$	0,93	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 4 (Line load)	
Equivalent moment factor $C_{mz,0}$	1,02	
Factor μ_y	0,50	
Factor μ_z	0,50	
Factor ε_y	0,08	
Factor a_{LT}	0,00	
Critical moment for uniform bending $M_{cr,0}$	31,55	kNm
Relative slenderness $\lambda_{rel,0}$	0,33	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,19	
Equivalent moment factor C_{my}	0,93	
Equivalent moment factor C_{mz}	1,02	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,00	
Factor c_{LT}	0,00	
Factor d_{LT}	0,00	
Factor e_{LT}	0,00	
Factor w_y	1,21	
Factor w_z	1,21	
Factor n_{pl}	0,11	
Maximum relative slenderness $\lambda_{rel,max}$	2,24	
Factor C_{yy}	0,86	
Factor C_{yz}	0,50	
Factor C_{zy}	0,51	
Factor C_{zz}	0,83	

Unity check (6.61) = 0,67 + 0,01 + 0,03 = 0,71 -
Unity check (6.62) = 0,67 + 0,01 + 0,03 = 0,71 -

The member satisfies the stability check.

200x80x5

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS21 - CFRHS200X80X5

EN 1993-1-1 Code Check
National annex: Standard EN

Member B1538	**2,668 / 2,668 m**	**CFRHS200X80X5**	**S 355**	**ULS-Set B (auto)**	**0,59 -**

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind10 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 2,668 m

Internal forces	Calculated	Unit
N_{Ed}	-126,01	kN
$V_{y,Ed}$	-0,21	kN
$V_{z,Ed}$	-5,47	kN
T_{Ed}	-0,07	kNm
$M_{y,Ed}$	-1,73	kNm
$M_{z,Ed}$	0,32	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	65	5	5,768e+04	6,457e+04	0,89		1,00	13,00	22,78	27,66	32,11	1
3	I	185	5	6,442e+04	3,916e+04	0,61		1,00	37,00	22,78	27,66	35,79	4
5	I	65	5	3,795e+04	3,106e+04	0,82		1,00	13,00	22,78	27,66	33,00	1
7	I	185	5	3,121e+04	5,647e+04	0,55		1,00	37,00	22,78	27,66	36,60	4

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Effective section N-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	65	3,550e+05	3,550e+05	1,00	4,00	0,28	1,00	65	33	33
3	I	185	3,550e+05	3,550e+05	1,00	4,00	0,80	0,91	168	84	84
5	I	65	3,550e+05	3,550e+05	1,00	4,00	0,28	1,00	65	33	33
7	I	185	3,550e+05	3,550e+05	1,00	4,00	0,80	0,91	168	84	84

Effective section My-
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	65	3,550e+05	3,550e+05	1,00	4,00	0,28	1,00	65	33	33
3	I	185	3,368e+05	-3,368e+05	-1,00	23,90	0,33	1,00	93	37	56
5	I	65	-3,550e+05	-3,550e+05							
7	I	185	3,368e+05	-3,368e+05	-1,00	23,90	0,33	1,00	93	37	56

Effective section Mz+
Effective width calculation
According to EN 1993-1-5 article 4.4

Id	Type	b_p [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	ψ [-]	k_σ [-]	λ_p [-]	ρ [-]	b_e [mm]	b_{e1} [mm]	b_{e2} [mm]
1	I	65	3,092e+05	-2,858e+05	-0,92	21,97	0,12	1,00	34	14	20
3	I	185	3,550e+05	3,550e+05	1,00	4,00	0,80	0,91	168	84	84
5	I	65	3,092e+05	-2,858e+05	-0,92	21,97	0,12	1,00	34	14	20
7	I	185	-3,315e+05	-3,315e+05							

Effective properties						
Effective area	A_{eff}	2,4611e-03	m^2			
Effective second moment of area	$I_{eff,y}$	1,2688e-05	m^4	$I_{eff,z}$	2,8771e-06	m^4
Effective section modulus	$W_{eff,y}$	1,2688e-04	m^3	$W_{eff,z}$	6,9693e-05	m^3
Shift of the centroid	$e_{N,y}$	0	mm	$e_{N,z}$	0	mm

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A_{eff}	2,4611e-03	m^2
$N_{c,Rd}$	873,68	kN
Unity check	0,14	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.15)

$W_{eff,y,min}$	1,2688e-04	m^3
$M_{c,y,Rd}$	45,04	kNm
Unity check	0,04	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.15)

$W_{eff,z,min}$	6,9693e-05	m^3
$M_{c,z,Rd}$	24,74	kNm
Unity check	0,01	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	7,5314e-04	m^2
$V_{pl,y,Rd}$	154,36	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,8829e-03	m^2
$V_{pl,z,Rd}$	385,91	kN
Unity check	0,01	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	0,5	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.3 and formula (6.43)

Effective properties		
A_{eff}	2,4611e-03	m^2
$e_{N,y}$	0	mm
$e_{N,z}$	0	mm
$W_{eff,y}$	1,2688e-04	m^3
$W_{eff,z}$	6,9693e-05	m^3

Normal stresses		
$\sigma_{N,Ed}$	51,2	MPa
$\sigma_{My,Ed}$	13,7	MPa
$\sigma_{Mz,Ed}$	4,6	MPa
$\sigma_{tot,Ed}$	69,4	MPa
Unity check	0,20	-

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 1,868 m

Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	65	5	2,880e+04	3,916e+04	0,74		1,00	13,00	22,78	27,66	34,04	1
3	I	185	5	4,067e+04	6,688e+04	0,61		1,00	37,00	22,78	27,66	35,78	4
5	I	65	5	6,679e+04	5,642e+04	0,84		1,00	13,00	22,78	27,66	32,68	1
7	I	185	5	5,492e+04	2,871e+04	0,52		1,00	37,00	22,78	27,66	37,05	3

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 4

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	2,668	8,004	m
Buckling factor k	1,00	0,53	
Buckling length l_{cr}	2,668	4,220	m
Critical Euler load N_{cr}	3695,30	349,69	kN
Slenderness λ	38,45	124,99	
Relative slenderness λ_{rel}	0,49	1,58	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,85	0,29	
Buckling resistance $N_{b,Rd}$	743,20	253,17	kN

Flexural Buckling verification		
Cross-section effective area A_{eff}	2,4611e-03	m²
Buckling resistance $N_{b,Rd}$	253,17	kN
Unity check	0,50	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section effective area A_{eff}	2,4611e-03	m²
Effective section modulus $W_{eff,y}$	1,2688e-04	m³
Effective section modulus $W_{eff,z}$	6,9693e-05	m³
Design compression force N_{Ed}	126,01	kN
Design bending moment (maximum) $M_{y,Ed}$	3,93	kNm
Design bending moment (maximum) $M_{z,Ed}$	0,82	kNm
Additional moment $\Delta M_{y,Ed}$	0,00	kNm
Additional moment $\Delta M_{z,Ed}$	0,00	kNm
Characteristic compression resistance N_{Rk}	873,68	kN
Characteristic moment resistance $M_{y,Rk}$	45,04	kNm
Characteristic moment resistance $M_{z,Rk}$	24,74	kNm
Reduction factor χ_y	0,85	
Reduction factor χ_z	0,29	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,03	
Interaction factor k_{yz}	1,13	
Interaction factor k_{zy}	0,74	
Interaction factor k_{zz}	0,81	

Maximum moment $M_{y,Ed}$ is derived from beam B1538 position 0,534 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1538 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	3695,30	kN
Critical Euler load $N_{cr,z}$	349,69	kN
Elastic critical load $N_{cr,T}$	109738,38	kN
Effective section modulus $W_{eff,y}$	1,2688e-04	m³
Second moment of area I_y	1,2691e-05	m⁴
Second moment of area I_z	3,0044e-06	m⁴
Torsional constant I_t	8,0838e-06	m⁴
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	3,93	kNm
Maximum relative deflection δ_z	-1,0	mm

Interaction method 1 parameters		
Equivalent moment factor $C_{my,0}$	1,00	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	0,82	kNm
Maximum relative deflection δ_y	-2,1	mm
Equivalent moment factor $C_{mz,0}$	0,73	
Factor μ_y	0,99	
Factor μ_z	0,71	
Factor ε_y	0,60	
Factor a_{LT}	0,36	
Critical moment for uniform bending $M_{cr,0}$	252,02	kNm
Relative slenderness $\lambda_{rel,0}$	0,42	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,29	
Equivalent moment factor C_{my}	1,00	
Equivalent moment factor C_{mz}	0,73	
Equivalent moment factor C_{mLT}	1,00	

Unity check (6.61) = 0,17 + 0,09 + 0,04 = 0,30 -
Unity check (6.62) = 0,50 + 0,06 + 0,03 = 0,59 -

The member satisfies the stability check.

140x60x5

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS22 - CFRHS140X60X5

EN 1993-1-1 Code Check
National annex: Standard EN

Member B2307	**2,575 / 2,575 m**	**CFRHS140X60X5**	**S 355**	**ULS-Set B (auto)**	**0,79 -**

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind5 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 2,575 m

Internal forces	Calculated	Unit
N_{Ed}	-46,41	kN
$V_{y,Ed}$	0,00	kN
$V_{z,Ed}$	-3,06	kN
T_{Ed}	0,01	kNm
$M_{y,Ed}$	-1,15	kNm
$M_{z,Ed}$	0,11	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	45	5	4,136e+04	4,568e+04	0,91		1,00	9,00	22,78	27,66	31,97	1
3	I	125	5	4,481e+04	1,104e+04	0,25		1,00	25,00	22,78	27,66	41,86	2
5	I	45	5	9,214e+03	4,892e+03	0,53		1,00	9,00	22,78	27,66	36,93	1
7	I	125	5	5,763e+03	3,953e+04	0,15		1,00	25,00	22,78	27,66	43,94	2

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 2

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,8360e-03	m²
$N_{c,Rd}$	651,78	kN
Unity check	0,07	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	7,8300e-05	m³
$M_{pl,y,Rd}$	27,80	kNm
Unity check	0,04	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,z}$	4,2880e-05	m³
$M_{pl,z,Rd}$	15,22	kNm
Unity check	0,01	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	5,5080e-04	m²
$V_{pl,y,Rd}$	112,89	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,2852e-03	m^2
$V_{pl,z,Rd}$	263,41	kN
Unity check	0,01	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	0,2	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

$M_{N,y,Rd}$	27,80	kNm
α	1,67	
$M_{N,z,Rd}$	15,22	kNm
β	1,67	

Unity check (6.41) = 0,00 + 0,00 = 0,01 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0,000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	45	5	4,465e+04	4,906e+04	0,91		1,00	9,00	22,78	27,66	31,91	1
3	I	125	5	4,795e+04	7,792e+03	0,16		1,00	25,00	22,78	27,66	43,58	2
5	I	45	5	5,695e+03	1,286e+03	0,23		1,00	9,00	22,78	27,66	42,27	1
7	I	125	5	2,402e+03	4,256e+04	0,06		1,00	25,00	22,78	27,66	45,97	2

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 2

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	2,575	7,725	m
Buckling factor k	1,00	0,73	
Buckling length l_{cr}	2,575	5,659	m
Critical Euler load N_{cr}	1331,41	71,94	kN
Slenderness λ	53,46	229,99	
Relative slenderness λ_{rel}	0,70	3,01	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,72	0,09	
Buckling resistance $N_{b,Rd}$	472,47	61,60	kN

Flexural Buckling verification		
Cross-section area A	1,8360e-03	m^2
Buckling resistance $N_{b,Rd}$	61,60	kN
Unity check	0,75	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	1,8360e-03	m^2
Plastic section modulus $W_{pl,y}$	7,8300e-05	m^3
Plastic section modulus $W_{pl,z}$	4,2880e-05	m^3
Design compression force N_{Ed}	46,41	kN
Design bending moment (maximum) $M_{y,Ed}$	-1,37	kNm
Design bending moment (maximum) $M_{z,Ed}$	-0,29	kNm
Characteristic compression resistance N_{Rk}	651,78	kN
Characteristic moment resistance $M_{y,Rk}$	27,80	kNm
Characteristic moment resistance $M_{z,Rk}$	15,22	kNm
Reduction factor χ_y	0,72	
Reduction factor χ_z	0,09	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,30	
Interaction factor k_{yz}	0,92	
Interaction factor k_{zy}	0,50	
Interaction factor k_{zz}	0,54	

Maximum moment $M_{y,Ed}$ is derived from beam B2307 position 0,000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1559 position 2,575 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	1331,41	kN
Critical Euler load $N_{cr,z}$	71,94	kN
Elastic critical load $N_{cr,T}$	82311,53	kN
Plastic section modulus $W_{pl,y}$	7,8300e-05	m^3
Elastic section modulus $W_{el,y}$	6,0840e-05	m^3
Plastic section modulus $W_{pl,z}$	4,2880e-05	m^3
Elastic section modulus $W_{el,z}$	3,7050e-05	m^3
Second moment of area I_y	4,2589e-06	m^4
Second moment of area I_z	1,1116e-06	m^4
Torsional constant I_t	2,9797e-06	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	-1,37	kNm
Maximum relative deflection δ_z	-0,4	mm
Equivalent moment factor $C_{my,0}$	0,98	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	-0,29	kNm
Maximum relative deflection δ_y	-1,6	mm
Equivalent moment factor $C_{mz,0}$	0,50	
Factor μ_y	0,99	
Factor μ_z	0,38	
Factor ε_y	0,89	
Factor a_{LT}	0,30	
Critical moment for uniform bending $M_{cr,0}$	96,42	kNm
Relative slenderness $\lambda_{rel,0}$	0,54	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,20	
Equivalent moment factor C_{my}	0,98	
Equivalent moment factor C_{mz}	0,50	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,00	
Factor c_{LT}	0,00	
Factor d_{LT}	0,00	
Factor e_{LT}	0,00	
Factor w_y	1,29	
Factor w_z	1,16	
Factor n_{pl}	0,07	
Maximum relative slenderness $\lambda_{rel,max}$	3,01	
Factor C_{yy}	0,78	
Factor C_{yz}	0,85	
Factor C_{zy}	0,49	
Factor C_{zz}	0,98	

Unity check (6.61) = 0,10 + 0,06 + 0,02 = 0,18 -
Unity check (6.62) = 0,75 + 0,02 + 0,01 = 0,79 -

The member satisfies the stability check.

140x70x4

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS23 - CFRHS140X70X4

EN 1993-1-1 Code Check
National annex: Standard EN

Member B2210	**2,575 / 2,575 m**	**CFRHS140X70X4**	**S 355**	**ULS-Set B (auto)**	**0,84 -**

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind10 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 2,575 m

Internal forces	Calculated	Unit
N_{Ed}	-88,90	kN
$V_{y,Ed}$	-0,03	kN
$V_{z,Ed}$	-4,68	kN
T_{Ed}	-0,02	kNm
$M_{y,Ed}$	-1,52	kNm
$M_{z,Ed}$	-0,03	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	58	4	8,342e+04	8,200e+04	0,98		1,00	14,50	22,78	27,66	31,10	1
3	I	128	4	8,036e+04	3,094e+04	0,39		1,00	32,00	22,78	27,66	39,31	3
5	I	58	4	2,949e+04	3,091e+04	0,95		1,00	14,50	22,78	27,66	31,42	1
7	I	128	4	3,255e+04	8,198e+04	0,40		1,00	32,00	22,78	27,66	39,10	3

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 3

Semi-Comp+ properties		
Material coefficient ε	0,81	
Flange class 2 slenderness limit $\beta_{2,y,f}$	27,66	
Flange class 3 slenderness limit $\beta_{3,y,f}$	30,92	
Web class 2 slenderness limit $\beta_{2,y,w}$	67,53	
Web class 3 slenderness limit $\beta_{3,y,w}$	100,89	
Web class 2 slenderness limit $\beta_{2,z,w}$	27,66	
Web class 3 slenderness limit $\beta_{3,z,w}$	30,92	
Web slenderness ratio c/t_w	32,00	
Flange slenderness ratio c/t_f	14,50	
Reference slenderness ratio $c/t_{ref,y}$	0,00	
Reference slenderness ratio $c/t_{ref,z}$	1,00	
Interpolated section modulus $W_{3,y}$	7,0070e-05	m³
Interpolated section modulus $W_{3,z}$	3,8050e-05	m³

Note: The resistance for this semi-compact section has been calculated according to Semi-Comp+.

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,5750e-03	m²
$N_{c,Rd}$	559,13	kN
Unity check	0,16	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{3,y}$	7,0070e-05	m³

$M_{3,y,Rd}$	24,87	kNm
Unity check	0,06	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{3,z}$	3,8050e-05	m^3
$M_{3,z,Rd}$	13,51	kNm
Unity check	0,00	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	5,2500e-04	m^2
$V_{pl,y,Rd}$	107,60	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,0500e-03	m^2
$V_{pl,z,Rd}$	215,21	kN
Unity check	0,02	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	0,3	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

$M_{N,3,y,Rd}$	20,92	kNm
α	1,71	
$M_{N,3,z,Rd}$	11,36	kNm
β	1,71	

Unity check (6.41) = 0,01 + 0,00 = 0,01 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 2,575 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	58	4	8,342e+04	8,200e+04	0,98		1,00	14,50	22,78	27,66	31,10	1
3	I	128	4	8,036e+04	3,094e+04	0,39		1,00	32,00	22,78	27,66	39,31	3
5	I	58	4	2,949e+04	3,091e+04	0,95		1,00	14,50	22,78	27,66	31,42	1
7	I	128	4	3,255e+04	8,198e+04	0,40		1,00	32,00	22,78	27,66	39,10	3

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 3

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	2,575	7,725	m
Buckling factor k	1,00	0,57	
Buckling length l_{cr}	2,575	4,403	m
Critical Euler load N_{cr}	1227,34	142,40	kN
Slenderness λ	51,57	151,41	
Relative slenderness λ_{rel}	0,67	1,98	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,74	0,20	
Buckling resistance $N_{b,Rd}$	413,83	111,45	kN

Flexural Buckling verification		
Cross-section area A	1,5750e-03	m^2
Buckling resistance $N_{b,Rd}$	111,45	kN
Unity check	0,80	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	1,5750e-03	m^2
Interpolated section modulus $W_{3,y}$	7,0070e-05	m^3
Interpolated section modulus $W_{3,z}$	3,8050e-05	m^3
Design compression force N_{Ed}	88,90	kN
Design bending moment (maximum) $M_{y,Ed}$	-1,52	kNm
Design bending moment (maximum) $M_{z,Ed}$	-0,07	kNm
Characteristic compression resistance N_{Rk}	559,13	kN
Characteristic moment resistance $M_{y,Rk}$	24,87	kNm
Characteristic moment resistance $M_{z,Rk}$	13,51	kNm
Reduction factor χ_y	0,74	
Reduction factor χ_z	0,20	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	1,31	
Interaction factor k_{yz}	0,62	
Interaction factor k_{zy}	0,57	
Interaction factor k_{zz}	0,50	

Maximum moment $M_{y,Ed}$ is derived from beam B2210 position 2,575 m.
Maximum moment $M_{z,Ed}$ is derived from beam B1520 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	1227,34	kN
Critical Euler load $N_{cr,z}$	142,40	kN
Elastic critical load $N_{cr,T}$	78914,94	kN
Interpolated section modulus $W_{3,y}$	7,0070e-05	m^3
Elastic section modulus $W_{el,y}$	5,6090e-05	m^3
Interpolated section modulus $W_{3,z}$	3,8050e-05	m^3
Elastic section modulus $W_{el,z}$	3,8050e-05	m^3
Second moment of area I_y	3,9260e-06	m^4
Second moment of area I_z	1,3318e-06	m^4
Torsional constant I_t	3,2602e-06	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	-1,52	kNm
Maximum relative deflection δ_z	-1,1	mm
Equivalent moment factor $C_{my,0}$	0,99	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	-0,07	kNm
Maximum relative deflection δ_y	-0,2	mm
Equivalent moment factor $C_{mz,0}$	0,44	
Factor μ_y	0,98	
Factor μ_z	0,43	
Factor ε_y	0,48	
Factor a_{LT}	0,17	
Critical moment for uniform bending $M_{cr,0}$	110,39	kNm
Relative slenderness $\lambda_{rel,0}$	0,47	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,22	
Equivalent moment factor C_{my}	0,99	
Equivalent moment factor C_{mz}	0,44	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,00	
Factor c_{LT}	0,00	
Factor d_{LT}	0,00	
Factor e_{LT}	0,00	
Factor w_y	1,25	
Factor w_z	1,00	
Factor n_{pl}	0,16	
Maximum relative slenderness $\lambda_{rel,max}$	1,98	
Factor C_{yy}	0,80	
Factor C_{yz}	1,00	
Factor C_{zy}	0,54	
Factor C_{zz}	1,00	

Unity check (6.61) = 0,21 + 0,08 + 0,00 = 0,30 -
Unity check (6.62) = 0,80 + 0,03 + 0,00 = 0,84 -

The member satisfies the stability check.

60x60x4

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS28 - CFRHS60X60X4

EN 1993-1-1 Code Check
National annex: Standard EN

Member B470	0,000 / 1,500 m	CFRHS60X60X4	S 355	ULS-Set B (auto)	0,92 -

Note: EN 1993-1-3 article 1.1(3) specifies that this part does not apply to cold formed CHS and RHS sections.
The default EN 1993-1-1 code check is executed instead of the EN 1993-1-3 code check.

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind10 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Cold formed	

...::SECTION CHECK::...

The critical check is on position 0,000 m

Internal forces	Calculated	Unit
N_{Ed}	-126,59	kN
$V_{y,Ed}$	-1,31	kN
$V_{z,Ed}$	4,32	kN
T_{Ed}	-0,12	kNm
$M_{y,Ed}$	-1,02	kNm
$M_{z,Ed}$	0,90	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	48	4	1,637e+05	2,634e+05	0,62		1,00	12,00	22,78	27,66	35,59	1
3	I	48	4	2,623e+05	1,502e+05	0,57		1,00	12,00	22,78	27,66	36,30	1
5	I	48	4	1,325e+05	3,288e+04	0,25		1,00	12,00	22,78	27,66	41,83	1
7	I	48	4	3,392e+04	1,461e+05	0,23		1,00	12,00	22,78	27,66	42,15	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	8,5500e-04	m²
$N_{c,Rd}$	303,52	kN
Unity check	0,42	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,y}$	1,7640e-05	m³
$M_{pl,y,Rd}$	6,26	kNm
Unity check	0,16	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{pl,z}$	1,7640e-05	m³
$M_{pl,z,Rd}$	6,26	kNm
Unity check	0,14	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	4,2750e-04	m²
$V_{pl,y,Rd}$	87,62	kN
Unity check	0,01	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	4,2750e-04	m^2
$V_{pl,z,Rd}$	87,62	kN
Unity check	0,05	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	1	
τ_{Ed}	5,0	MPa
τ_{Rd}	205,0	MPa
Unity check	0,02	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

$M_{N,y,Rd}$	4,68	kNm
α	2,07	
$M_{N,z,Rd}$	4,68	kNm
β	2,07	

Unity check (6.41) = 0,04 + 0,03 = 0,08 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 0,000 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	I	48	4	1,637e+05	2,634e+05	0,62		1,00	12,00	22,78	27,66	35,59	1
3	I	48	4	2,623e+05	1,502e+05	0,57		1,00	12,00	22,78	27,66	36,30	1
5	I	48	4	1,325e+05	3,288e+04	0,25		1,00	12,00	22,78	27,66	41,83	1
7	I	48	4	3,392e+04	1,461e+05	0,23		1,00	12,00	22,78	27,66	42,15	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 1

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	1,500	1,500	m
Buckling factor k	1,00	0,52	
Buckling length l_{cr}	1,500	0,784	m
Critical Euler load N_{cr}	401,17	1469,04	kN
Slenderness λ	66,46	34,73	
Relative slenderness λ_{rel}	0,87	0,45	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	c	c	
Imperfection α	0,49	0,49	
Reduction factor χ	0,62	0,87	
Buckling resistance $N_{b,Rd}$	187,72	263,48	kN

Flexural Buckling verification		
Cross-section area A	8,5500e-04	m^2
Buckling resistance $N_{b,Rd}$	187,72	kN
Unity check	0,67	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: The cross-section concerns a RHS section which is not susceptible to Torsional(-Flexural) Buckling.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1
Note: The cross-section concerns an RHS section with 'h / b < 10 / $\lambda_{rel,z}$'.
This section is thus not susceptible to Lateral Torsional Buckling.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	8,5500e-04	m^2
Plastic section modulus $W_{pl,y}$	1,7640e-05	m^3
Plastic section modulus $W_{pl,z}$	1,7640e-05	m^3
Design compression force N_{Ed}	126,59	kN
Design bending moment (maximum) $M_{y,Ed}$	-1,02	kNm
Design bending moment (maximum) $M_{z,Ed}$	0,90	kNm
Characteristic compression resistance N_{Rk}	303,52	kN
Characteristic moment resistance $M_{y,Rk}$	6,26	kNm
Characteristic moment resistance $M_{z,Rk}$	6,26	kNm
Reduction factor χ_y	0,62	
Reduction factor χ_z	0,87	
Reduction factor χ_{LT}	1,00	
Interaction factor k_{yy}	0,98	
Interaction factor k_{yz}	0,60	
Interaction factor k_{zy}	0,77	
Interaction factor k_{zz}	0,99	

Maximum moment $M_{y,Ed}$ is derived from beam B470 position 0,000 m.
Maximum moment $M_{z,Ed}$ is derived from beam B470 position 0,000 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	401,17	kN
Critical Euler load $N_{cr,z}$	1469,04	kN
Elastic critical load $N_{cr,T}$	57827,38	kN
Plastic section modulus $W_{pl,y}$	1,7640e-05	m^3
Elastic section modulus $W_{el,y}$	1,4520e-05	m^3
Plastic section modulus $W_{pl,z}$	1,7640e-05	m^3
Elastic section modulus $W_{el,z}$	1,4520e-05	m^3
Second moment of area I_y	4,3550e-07	m^4
Second moment of area I_z	4,3550e-07	m^4
Torsional constant I_t	7,2640e-07	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	-1,02	kNm
Maximum relative deflection δ_z	-1,2	mm
Equivalent moment factor $C_{my,0}$	0,83	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{z,Ed}$	0,90	kNm
Maximum relative deflection δ_y	0,4	mm
Equivalent moment factor $C_{mz,0}$	0,93	
Factor μ_y	0,85	
Factor μ_z	0,99	
Factor ε_y	0,47	
Factor a_{LT}	0,00	
Critical moment for uniform bending $M_{cr,0}$	153,73	kNm
Relative slenderness $\lambda_{rel,0}$	0,20	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,28	
Equivalent moment factor C_{my}	0,83	
Equivalent moment factor C_{mz}	0,93	
Equivalent moment factor C_{mLT}	1,00	
Factor b_{LT}	0,00	
Factor c_{LT}	0,00	
Factor d_{LT}	0,00	
Factor e_{LT}	0,00	
Factor w_y	1,21	
Factor w_z	1,21	
Factor n_{pl}	0,42	
Maximum relative slenderness $\lambda_{rel,max}$	0,87	
Factor C_{yy}	1,05	
Factor C_{yz}	0,87	
Factor C_{zy}	0,93	
Factor C_{zz}	1,01	

Unity check (6.61) = 0,67 + 0,16 + 0,09 = 0,92 -
Unity check (6.62) = 0,48 + 0,12 + 0,14 = 0,75 -

The member satisfies the stability check.

5.3. Dimenzioniranje podrožnice

IPE160A

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)
Coordinate system: Principal
Extreme 1D: Global
Selection: All
Filter: Cross-section = CS9 - IPE160A

EN 1993-1-1 Code Check
National annex: Standard EN

Member B2581	**7,883 / 7,883 m**	**IPE160A**	**S 355**	**ULS-Set B (auto)**	**0,80 -**

Combination key
ULS-Set B (auto) / 1.35*LC1 + 0.90*Snjeg + 1.35*Dodatno stalno + 1.50*3DWind14 + 0.90*temp +

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Rolled	

...::SECTION CHECK::...

The critical check is on position 7,883 m

Internal forces	Calculated	Unit
N_{Ed}	-19,96	kN
$V_{y,Ed}$	-0,02	kN
$V_{z,Ed}$	-0,83	kN
T_{Ed}	0,00	kNm
$M_{y,Ed}$	-1,25	kNm
$M_{z,Ed}$	-0,09	kNm

Classification for cross-section design
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m²]	σ_2 [kN/m²]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	30	6	2,787e+04	3,274e+04	0,85	0,44	1,00	5,08	7,32	8,14	11,36	1
3	SO	30	6	2,430e+04	1,943e+04	0,80	0,51	1,00	5,08	7,32	8,14	12,17	1
4	I	127	4	2,391e+04	7,612e+02	0,03		1,00	31,80	22,78	27,66	46,56	3
5	SO	30	6	-3,199e+03	-8,067e+03								
7	SO	30	6	3,715e+02	5,240e+03	0,07	0,56	1,00	5,08	7,32	8,14	12,73	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 3

Semi-Comp+ properties		
Material coefficient ε	0,81	
Flange class 2 slenderness limit $\beta_{2,y,f}$	8,14	
Flange class 3 slenderness limit $\beta_{3,y,f}$	11,39	
Web class 2 slenderness limit $\beta_{2,y,w}$	67,53	
Web class 3 slenderness limit $\beta_{3,y,w}$	100,89	
Flange class 2 slenderness limit $\beta_{2,z,f}$	8,14	
Flange class 3 slenderness limit $\beta_{3,z,f}$	13,02	
Web slenderness ratio c/t_w	31,80	
Flange slenderness ratio c/t_f	5,08	
Reference slenderness ratio $c/t_{ref,y}$	0,00	
Reference slenderness ratio $c/t_{ref,z}$	0,00	
Interpolated section modulus $W_{3,y}$	9,9100e-05	m³
Interpolated section modulus $W_{3,z}$	2,0700e-05	m³

Note: The resistance for this semi-compact section has been calculated according to Semi-Comp+.

Compression check
According to EN 1993-1-1 article 6.2.4 and formula (6.9)

A	1,6200e-03	m²
$N_{c,Rd}$	575,10	kN
Unity check	0,03	-

Bending moment check for M_y
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{3,y}$	9,9100e-05	m³
$M_{3,y,Rd}$	35,18	kNm
Unity check	0,04	-

Bending moment check for M_z
According to EN 1993-1-1 article 6.2.5 and formula (6.12),(6.13)

$W_{3,z}$	2,0700e-05	m^3
$M_{3,z,Rd}$	7,35	kNm
Unity check	0,01	-

Shear check for V_y
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	1,0196e-03	m^2
$V_{pl,y,Rd}$	208,98	kN
Unity check	0,00	-

Shear check for V_z
According to EN 1993-1-1 article 6.2.6 and formula (6.17)

η	1,20	
A_v	7,8220e-04	m^2
$V_{pl,z,Rd}$	160,32	kN
Unity check	0,01	-

Torsion check
According to EN 1993-1-1 article 6.2.7 and formula (6.23)

Fibre	2	
τ_{Ed}	0,0	MPa
τ_{Rd}	205,0	MPa
Unity check	0,00	-

Note: The unity check for torsion is lower than the limit value of 0,05. Therefore torsion is considered as insignificant and is ignored in the combined checks.

Combined bending, axial force and shear force check
According to EN 1993-1-1 article 6.2.9.1 and formula (6.41)

$M_{N,3,y,Rd}$	33,96	kNm
α	2,00	
$M_{N,3,z,Rd}$	7,34	kNm
β	1,00	

Unity check (6.41) = 0,00 + 0,01 = 0,01 -

Note: Since the shear forces are less than half the plastic shear resistances their effect on the moment resistances is neglected.

The member satisfies the section check.

...::STABILITY CHECK::...

Classification for member buckling design
Decisive position for stability classification: 7,883 m
Classification according to EN 1993-1-1 article 5.5.2
Classification of Internal and Outstand parts according to EN 1993-1-1 Table 5.2 Sheet 1 & 2

Id	Type	c [mm]	t [mm]	σ_1 [kN/m^2]	σ_2 [kN/m^2]	Ψ [-]	k_σ [-]	α [-]	c/t [-]	Class 1 Limit [-]	Class 2 Limit [-]	Class 3 Limit [-]	Class
1	SO	30	6	2,787e+04	3,274e+04	0,85	0,44	1,00	5,08	7,32	8,14	11,36	1
3	SO	30	6	2,430e+04	1,943e+04	0,80	0,51	1,00	5,08	7,32	8,14	12,17	1
4	I	127	4	2,391e+04	7,612e+02	0,03		1,00	31,80	22,78	27,66	46,56	3
5	SO	30	6	-3,199e+03	-8,067e+03								
7	SO	30	6	3,715e+02	5,240e+03	0,07	0,56	1,00	5,08	7,32	8,14	12,73	1

Note: The Classification limits have been set according to Semi-Comp+.
The cross-section is classified as Class 3

Flexural Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)

Buckling parameters	yy	zz	
Sway type	sway	non-sway	
System length L	7,883	7,883	m
Buckling factor k	1,00	0,81	
Buckling length l_{cr}	7,883	6,366	m
Critical Euler load N_{cr}	229,81	27,82	kN
Slenderness λ	120,87	347,41	
Relative slenderness λ_{rel}	1,58	4,55	
Limit slenderness $\lambda_{rel,0}$	0,20	0,20	
Buckling curve	a	b	
Imperfection α	0,21	0,34	
Reduction factor χ	0,34	0,05	
Buckling resistance $N_{b,Rd}$	195,47	25,88	kN

Flexural Buckling verification		
Cross-section area A	1,6200e-03	m^2
Buckling resistance $N_{b,Rd}$	25,88	kN
Unity check	0,77	-

Torsional(-Flexural) Buckling check
According to EN 1993-1-1 article 6.3.1.1 and formula (6.46)
Note: For this I-section the Torsional(-Flexural) buckling resistance is higher than the resistance for Flexural buckling. Therefore Torsional(-Flexural) buckling is not printed on the output.

Lateral Torsional Buckling check
According to EN 1993-1-1 article 6.3.2.1 & 6.3.2.3 and formula (6.54)

LTB parameters		
Method for LTB curve	Alternative case	
Interpolated section modulus $W_{3,y}$	9,9100e-05	m^3
Elastic critical moment M_{cr}	10,96	kNm
Relative slenderness $\lambda_{rel,LT}$	1,79	
Limit slenderness $\lambda_{rel,LT,0}$	0,40	

Note: The slenderness or bending moment is such that Lateral Torsional Buckling effects may be ignored according to EN 1993-1-1 article 6.3.2.2(4).

Mcr parameters		
LTB length l_{LT}	7,883	m
Influence of load position	no influence	
Correction factor k	1,00	
Correction factor k_w	1,00	
LTB moment factor C_1	1,98	
LTB moment factor C_2	0,81	
LTB moment factor C_3	0,41	
Shear center distance d_z	0	mm
Distance of load application z_g	0	mm
Mono-symmetry constant β_y	0	mm
Mono-symmetry constant z_j	0	mm

Note: C parameters are determined according to ECCS 119 2006 / Galea 2002.

Bending and axial compression check
According to EN 1993-1-1 article 6.3.3 and formula (6.61),(6.62)

Bending and axial compression check parameters		
Interaction method	alternative method 1	
Cross-section area A	1,6200e-03	m^2
Interpolated section modulus $W_{3,y}$	9,9100e-05	m^3
Interpolated section modulus $W_{3,z}$	2,0700e-05	m^3
Design compression force N_{Ed}	19,96	kN
Design bending moment (maximum) $M_{y,Ed}$	-1,25	kNm
Design bending moment (maximum) $M_{z,Ed}$	-0,09	kNm
Characteristic compression resistance N_{Rk}	575,10	kN
Characteristic moment resistance $M_{y,Rk}$	35,18	kNm
Characteristic moment resistance $M_{z,Rk}$	7,35	kNm
Reduction factor χ_y	0,34	
Reduction factor χ_z	0,05	
Modified reduction factor $\chi_{LT,mod}$	1,00	
Interaction factor k_{yy}	2,11	
Interaction factor k_{yz}	0,71	
Interaction factor k_{zy}	0,65	
Interaction factor k_{zz}	0,31	

Maximum moment $M_{y,Ed}$ is derived from beam B2581 position 7,883 m.
Maximum moment $M_{z,Ed}$ is derived from beam B2581 position 7,883 m.

Interaction method 1 parameters		
Critical Euler load $N_{cr,y}$	229,81	kN
Critical Euler load $N_{cr,z}$	27,82	kN
Elastic critical load $N_{cr,T}$	367,44	kN
Interpolated section modulus $W_{3,y}$	9,9100e-05	m^3
Elastic section modulus $W_{el,y}$	8,7800e-05	m^3
Interpolated section modulus $W_{3,z}$	2,0700e-05	m^3
Elastic section modulus $W_{el,z}$	1,3300e-05	m^3
Second moment of area I_y	6,8900e-06	m^4
Second moment of area I_z	5,4400e-07	m^4
Torsional constant I_t	1,9600e-08	m^4
Method for equivalent moment factor $C_{my,0}$	Table A.2 Line 2 (General)	
Design bending moment (maximum) $M_{y,Ed}$	-1,25	kNm
Maximum relative deflection δ_z	-2,7	mm
Equivalent moment factor $C_{my,0}$	0,96	
Method for equivalent moment factor $C_{mz,0}$	Table A.2 Line 1 (Linear)	
Ratio of end moments ψ_z	-0,86	
Equivalent moment factor $C_{mz,0}$	0,30	
Factor μ_y	0,94	
Factor μ_z	0,29	

Interaction method 1 parameters		
Factor ε_y	1,16	
Factor a_{LT}	1,00	
Critical moment for uniform bending $M_{cr,0}$	5,53	kNm
Relative slenderness $\lambda_{rel,0}$	2,52	
Limit relative slenderness $\lambda_{rel,0,lim}$	0,20	
Equivalent moment factor C_{my}	0,98	
Equivalent moment factor C_{mz}	0,30	
Equivalent moment factor C_{mLT}	1,85	
Factor b_{LT}	0,00	
Factor c_{LT}	0,01	
Factor d_{LT}	0,00	
Factor e_{LT}	0,00	
Factor w_y	1,13	
Factor w_z	1,50	
Factor n_{pl}	0,03	
Maximum relative slenderness $\lambda_{rel,max}$	4,55	
Factor C_{yy}	0,89	
Factor C_{yz}	0,97	
Factor C_{zy}	0,46	
Factor C_{zz}	0,99	

Unity check (6.61) = 0,10 + 0,08 + 0,01 = 0,19 -
Unity check (6.62) = 0,77 + 0,02 + 0,00 = 0,80 -

Shear Buckling check
According to EN 1993-1-5 article 5 & 7.1 and formula (5.10) & (7.1)

Shear Buckling parameters		
Buckling field length a	7,883	m
Web	unstiffened	
Web height h_w	145	mm
Web thickness t	4	mm
Material coefficient ε	0,81	
Shear correction factor η	1,20	

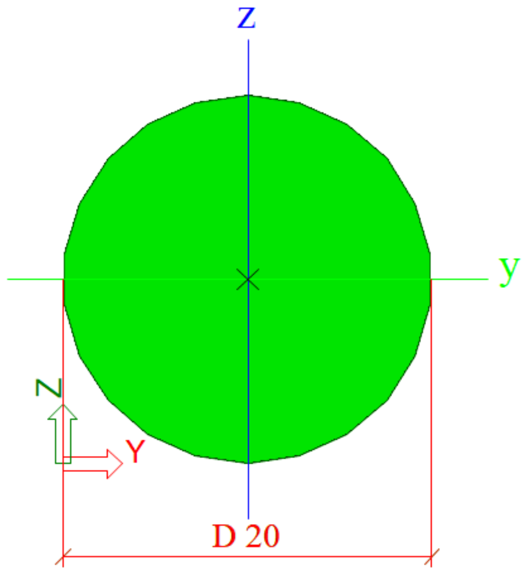
Shear Buckling verification	
Web slenderness h_w/t	36,30
Web slenderness limit	48,82

Note: The web slenderness is such that Shear Buckling effects may be ignored according to EN 1993-1-5 article 5.1(2).

The member satisfies the stability check.

5.4. Dimenzioniranje sprega

Spreg je zbog nemogućnosti dimenzioniranja nelinearnim proračunom proračunat na način da je izvršena provjera na najveću vlačnu silu.

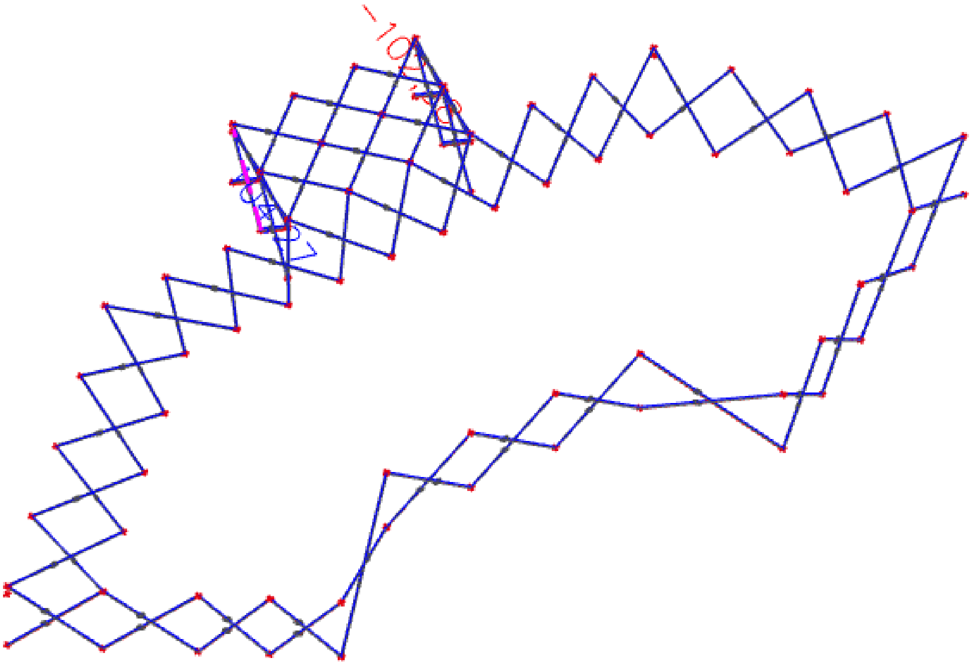


Slika 5.4.1 Poprečni presjek sprega

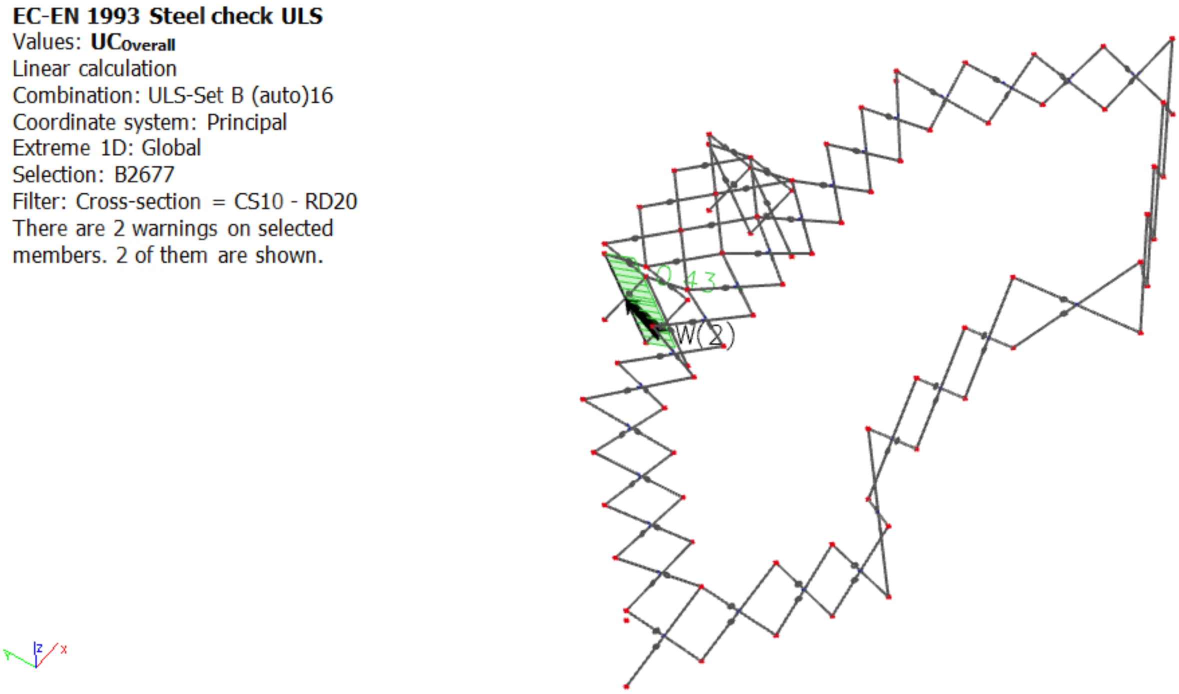
Internal forces on member

Linear calculation, Extreme : Global, System : Principal
Selection : All
Combinations : ULS-Set B (auto)
Cross-section : CS10 - RD20

Member	css	dx [m]	Case	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
B2702	CS10 - RD20	11,180	ULS-Set B (auto)/16	**-102,38**	0,00	0,00	0,00	0,00	0,00
B2677	CS10 - RD20	11,180	ULS-Set B (auto)/17	**104,27**	0,00	0,00	0,00	0,00	0,00
B2615	CS10 - RD20	0,000	ULS-Set B (auto)/18	-1,86	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**



Slika 5.4.2 Maksimalna uzdužna sila u spregu



Slika 5.4.3 Iskorištenost sprega

EC-EN 1993 Steel check ULS

Linear calculation
Combination: ULS-Set B (auto)16
Coordinate system: Principal
Extreme 1D: Global
Selection: B2677
Filter: Cross-section = CS10 - RD20

EN 1993-1-1 Code Check
National annex: Standard EN

Member B2677	**11,180 / 11,180 m**	**RD20**	**S 355**	**ULS-Set B (auto)16**	**0,43 -**

Combination key
ULS-Set B (auto)16 / 1.35*LC1 + 1.35*Dodatno stalno + 0.90*3DWind9

Partial safety factors	
γ_{M0} for resistance of cross-sections	1,00
γ_{M1} for resistance to instability	1,00
γ_{M2} for resistance of net sections	1,25

Material		
Yield strength f_y	355,0	MPa
Ultimate strength f_u	490,0	MPa
Fabrication	Rolled	

Warning: Strength reduction in function of the thickness is not supported for this type of cross-section.

...::SECTION CHECK::...

The critical check is on position 11,180 m

Internal forces	Calculated	Unit
N_{Ed}	48,07	kN
$V_{y,Ed}$	0,00	kN
$V_{z,Ed}$	0,00	kN
T_{Ed}	0,00	kNm
$M_{y,Ed}$	0,00	kNm
$M_{z,Ed}$	0,00	kNm

Classification for cross-section design
Warning: Classification is not supported for this type of cross-section.
The section is checked as elastic, class 3.

Tension check
According to EN 1993-1-1 article 6.2.3 and formula (6.5)

A	3,1400e-04	m^2
$N_{pl,Rd}$	111,47	kN
$N_{u,Rd}$	110,78	kN
$N_{t,Rd}$	110,78	kN
Unity check	0,43	-

The member satisfies the section check.

6. Spojevi

6.1. Spoj stup temelj

Steel connection

Name	Conn
Node	N393
Connection type	Frame bolted
Connection geometry	Column base
Calculation type	Internal forces
Lc/Combi	ULS-Set B (auto)

Connected beams

Name	Cross-section	Material	Length [m]	Beg. node	End node	Type
B660	CS26 - HEA550	S 355	10,000	N393	N392	column (100)

Parts of connection

Bolts

M30 - 5.6 (ISO 4014, ISO 4032, ISO 7089)			
Name		Bolt pattern	2 bolts/row
Internal bolts distance [mm]	200	External bolts distance [mm]	
Length [mm]	1340	Reference	Bottom of the end plate
1.Location [mm]	775	2.Location [mm]	606
7.Location [mm]	234	8.Location [mm]	65

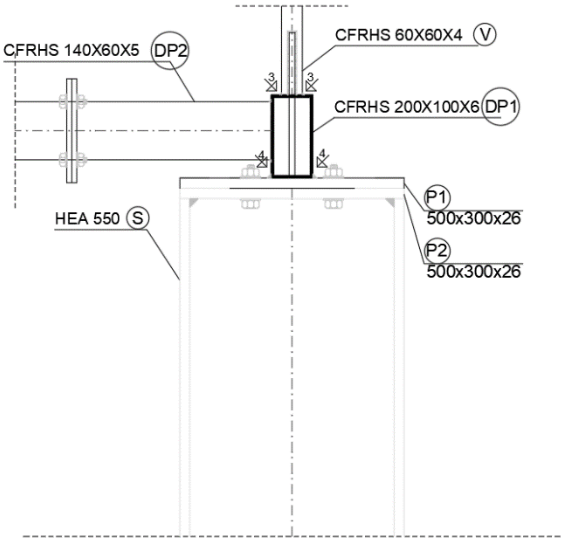
End-plate

EP			
Material	S 355	Left extension [mm]	200
Thickness[mm]	25	Right extension [mm]	200
Input	Top/Bottom/Left/Right	Total width [mm]	700
Top extension [mm]	150	Total height [mm]	840
Bottom extension [mm]	150		

Connection analysis: Side [B660]

According to EN 1993-1-8
National annex: Standard EN

Partial safety factors	
Gamma M0	1.00
Gamma M1	1.00
Gamma M2	1.25
Gamma M3	1.25
Gamma c	1.50



1. Internal forces

ULS-Set B (auto)		
NEd	-65.00	kN
Vz,Ed	-54.38	kN
My,Ed	341.69	kNm

Left side in Compression, Right side in Tension.

...::STRONG-AXIS CALCULATION::..

2. T-stub in compression
According to EN 1993-1-8 Article 6.2.5

Bearing width data		
α	1.50	-
βj	0.60	-
fcd	16.67	MPa
fj	15.00	MPa
c	70.22	mm

3. Design moment resistance Mj,y,Rd
3.1. Design resistance of basic components
3.1.1. Column flange and web in compression - Left side
According to EN 1993-1-8 Article 6.2.6.7

Fc,fb,Rd data		
Section class	1	
Mc,Rd	1641.88	kNm
hb-tfb	516.00	mm
Fc,fb,Rd	3181.93	kN

3.1.2. Concrete in compression under the left column flange
According to EN 1993-1-8 Article 6.2.6.9

Fc,pl,Rd data		
beff	164.44	mm
leff	440.44	mm
Aeff	72423.43	mm²
Fc,pl,Rd	1086.35	kN

3.1.3. Design tension resistance of anchor row
(effective lengths in mm, resistance in kN)

Ft,Rd data		
fub	500.00	MPa
As	561.00	mm²
k2	0.90	-
Beta	0.85	-
Ft,Rd	171.67	kN
Lb	311.80	mm

Note: The bolt-rows are numbered starting from the bolt-row farthest from the centre of compression as given by EN 1993-1-8 Article 6.2.7.2 (1).

Note: The Alternative method for FT,1,Rd according to EN 1993-1-8 Article 6.2.4, Table 6.2 is used.

3.1.4. Base plate under the right column flange
According to EN 1993-1-8 Article 6.2.6.11, 6.2.6.8
(effective lengths in mm, resistance in kN)

row	m2U	m2L	limit	near flange U	near flange L	Classification
2	44.16	-	497.77	✓	-	Bolt-row adjacent to beam flange
1	-	-	-	-	-	Bolt-row outside of beam

row	p (p1+p2)	e	ex	m	mx	n	λ1U	λ2U	αU	λ1L	λ2L	αL
2	0.00+186.00	250.00	-	84.70	-	105.87	0.25	0.13	8.00	-	-	-
1	0.00+0.00	250.00	64.80	-	69.36	64.80	-	-	-	-	-	-

row	leff,cp,i	leff,nc,i
2	532.18	677.59
1	347.50	279.22

For individual anchor row:

row	leff,1	leff,2	Lb*	Prying forces	FT,1,Rd	FT,2,Rd	FT,3,Rd	Ft,ep,Rd,i
2	532.18	677.59	361.57	✓	1583.57	585.18	343.33	343.33
1	279.22	279.22	378.45	✓	1068.13	396.72	343.33	343.33

row	beff,t,wb	Ft,wb,Rd,i
2	532.18	2361.55
1	-	-

3.1.4.1. Base plate in bending under the right column flange

row	Ft,pl,Rd,i	Ft,pl,Rd,g	Ft,pl,Rd,r
2	343.33	-	343.33
1	343.33	-	343.33

Ft,pl,Rd = 686.66 kN

3.1.4.2. Column web in tension under the right column flange

row	Ft,wc,Rd,i	Ft,wc,Rd,g	Ft,wc,Rd,r
2	2361.55	-	2361.55
1	-	-	-

Ft,wc,Rd = 2361.55 kN

3.2. Determination of Mj,y,Rd
According to EN 1993-1-8 Article 6.2.8.3 Table 6.7

Mj,Rd data		
FC,l,Rd	1086.35	kN
zC,l	258.00	mm
FT,r,Rd	686.66	kN
zT,r	270.60	mm
z	528.60	mm
e	5257.15	mm

Mj,y,Rd = 381.70 kNm

4. Design shear resistance VRd

Vz,Rd data		
Vz,Rd	628.32	kN
Fv,Rd	78.54	kN
e1,ep	64.80	mm
p1	169.20	mm
Alfa_d plate	0.65	
Alfa_b plate	0.65	

Vz,Rd data		
Fb,ep,Rd	481.09	kN
Alfa_b (6.2) plate	0.35	
F1,vb,Rd	134.64	kN
F2,vb,Rd	78.54	kN

5. Stiffness calculation

5.1. Design rotational stiffness

According to EN 1993-1-8 Article 6.3.4
Bolt-rows under the right column flange

row	k15[mm]	k16[mm]	keff[mm]
2	11.63	2.88	2.31
1	11.11	2.88	2.29

Sj data		
kC,l	20.82	mm
zC,l	258.00	mm
kT,r	4.59	mm
zT,r	270.60	mm
z	528.60	mm
ek	-162.54	mm
e	5257.15	mm
Sj,ini	227.61	MNm/rad
mu	2.22	
Sj	102.71	MNm/rad

5.2. Stiffness classification

According to EN 1993-1-8 Article 5.2.2.5 (2)

Stiffness data		
frame type	braced	
E	210000.00	MPa
Ic	1120000000.00	mm^4
Lc	10000.00	mm
λ0,rel	0.57	-
Sj,ini limit	22.85	MNm/rad

System RIGID

5.3. Ductility classification

In the endplate we have the following :
t > 0.53 sqrt(fub/fy) d
This results in a non-ductile classification for ductility : class 3.

6. Design Calculations.

6.1. Anchorage length

According to EN 1992-1-1 Article 8.4

Anchorage data		
fctd	1.20	MPa
good bond condition	no	-
μ1	0.70	-
μ2	1.00	-
fbd	1.89	MPa
Ft,bolt	171.67	kN
As,prov	561.00	mm^2
As,req	572.22	mm^2
σ,sd	306.00	MPa
lb,rqd	1217.35	mm
bar shape	Straight	-
α1	1.00	-
lbd	1217.35	mm

Anchorage data - straight		
d	30.00	mm
lbd,c	966.15	mm

Anchorage data		
lbd	1217.35	mm
lbd,c	966.15	mm
lb,min	365.20	mm
lbd	1217.35	mm

6.2. Calculation weldsize

6.2.1. Calculation af

data		
Mj,y,Rd	146.79	kNm
α	1.40	
h	516.00	mm
FRd	398.27	kN

data		
Nt,Rd	2556.00	kN
fu	490.00	MPa
β_w	0.90	
minimum af	13.83	mm
af	14.00	mm

6.2.2. Calculation aw

data		
Ft	686.66	kN
Fv	13.74	kN
lw	1075.89	mm
fu	490.00	MPa
β_w	0.90	
minimum aw (a2)	7.20	mm
aw	8.00	mm

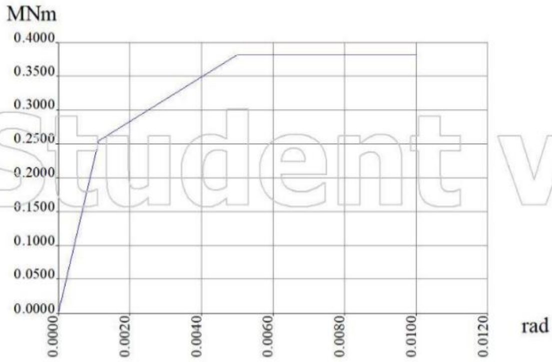
...::RESULTS::...

7. Unity checks

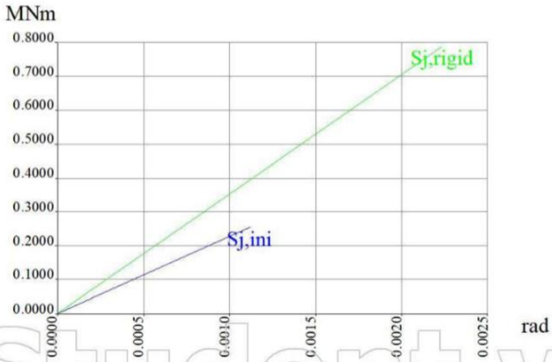
Unity checks	
My,Ed/Mj,y,Rd	0.90
Vz,Ed/Vz,Rd	0.09

The connection satisfies.

Moment-rotation diagram: Side [B660] - Strong axis



Stiffness classification: Side [B660] - Strong axis



6.2 Vlačni nastavak rešetke

Project:
Project no:
Author:

IDEA StatiCa®
Calculate yesterday's estimates

Project data

Project name	
Project number	
Author	
Description	
Date	27.6.2019.
Design code	EN

Material

Steel	S 355

1 / 7

Project:
Project no:
Author:

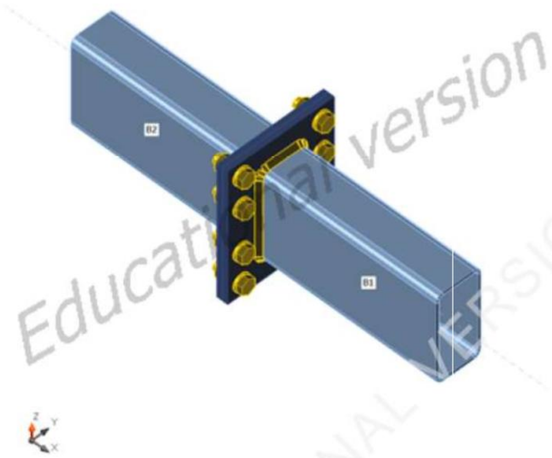
Project item CON1

Design

Name	CON1
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	1 - RHSCF200/100/6.0	0,0	0,0	0,0	0	0	0	Node
B2	2 - RHSCF200/100/6.0	180,0	0,0	0,0	0	0	0	Node



Cross-sections

Name	Material
1 - RHSCF200/100/6.0	S 355
2 - RHSCF200/100/6.0	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm²]
M20 6.8	M20 6.8	20	600,0	314

2 / 7

Project:
Project no:
Author:

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	354,6	0,4	1,3	-0,3	5,2	-1,0
	B2	354,6	0,4	-1,3	-0,3	5,2	1,0

Check

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	1,1 < 5%	OK
Bolts	92,7 < 100%	OK
Welds	98,2 < 100%	OK
Buckling	Not calculated	

Plates

Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Status
B1	6,0	LE1	325,0	1,1	OK
B2	6,0	LE1	325,0	1,1	OK
PP1a	12,0	LE1	324,0	0,6	OK
PP1b	12,0	LE1	324,0	0,6	OK

Design data

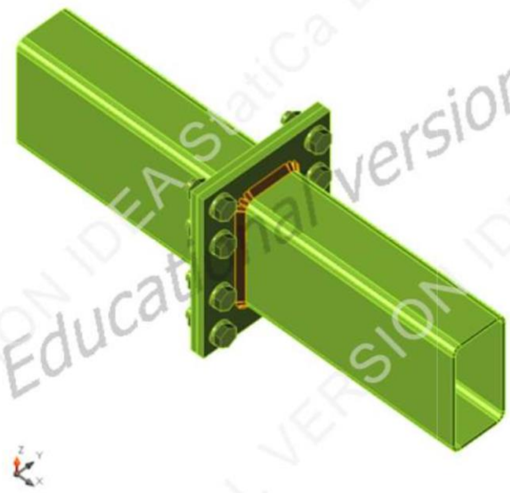
Material	f_y [MPa]	ε_{lim} [%]
S 355	355,0	5,0

Symbol explanation

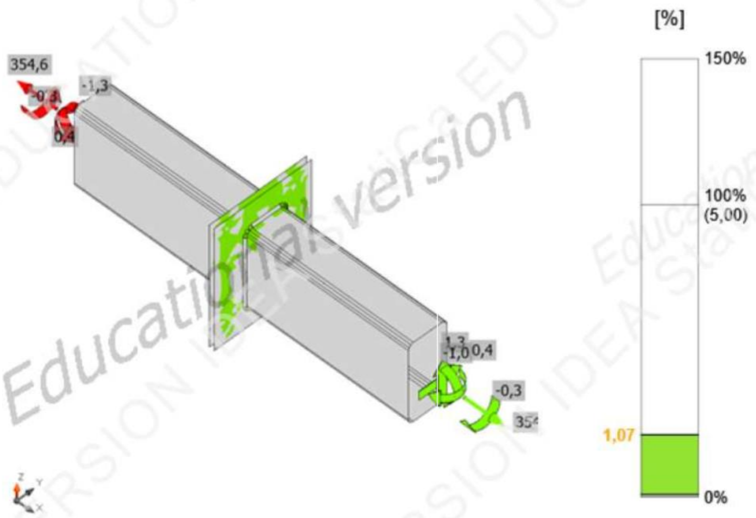
ε_{Pl}	Strain
σ_{Ed}	Eq. stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

3 / 7

Project:
Project no:
Author:



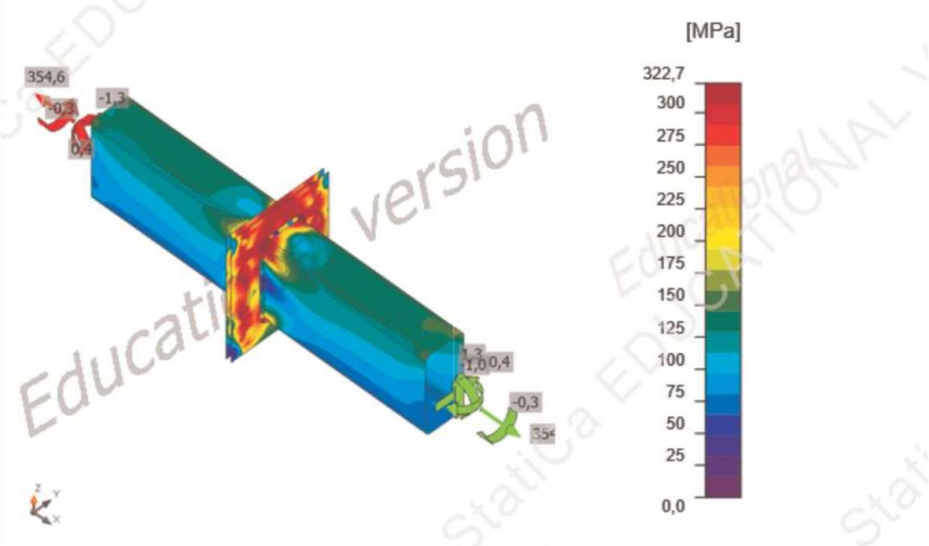
Overall check, LE1



Strain check, LE1

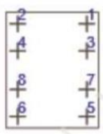
4 / 7

Project:
Project no:
Author:



Equivalent stress, LE1

Bolts

	Name	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	LE1	89,6	0,3	84,6	95,1	0,3	60,8	OK
	B2	LE1	89,1	0,5	84,1	141,9	0,5	60,6	OK
	B3	LE1	98,2	0,1	92,7	110,8	0,1	66,4	OK
	B4	LE1	96,3	0,3	90,9	234,1	0,3	65,3	OK
	B5	LE1	75,1	0,2	70,9	100,3	0,2	50,9	OK
	B6	LE1	66,4	0,5	62,7	118,5	0,6	45,4	OK
	B7	LE1	91,9	0,0	86,9	228,5	0,0	62,1	OK
	B8	LE1	90,1	0,3	85,2	161,6	0,4	61,2	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M20 6.8 - 1	105,8	297,2	90,4

5 / 7

Project:
Project no:
Author:

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Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear EN 1993-1-8 table 3.4

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_\perp$ [MPa]	$\tau_{\|\|}$ [MPa]	$\tau_\perp$ [MPa]	Ut [%]	Ut_c [%]	Status
PP1a	B1	◢7,0	555	LE1	427,5	0,4	338,6	56,8	-139,6	98,2	44,0	OK
PP1b	B2	◢7,0	555	LE1	427,5	0,4	338,5	-57,5	-139,3	98,2	43,9	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 355	0,90	435,6	352,8

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_\perp$	Perpendicular stress
$\tau_{\|\|}$	Shear stress parallel to weld axis
$\tau_\perp$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
γ_{M0}	1,10	-	EN 1993-1-1: 6.1
γ_{M1}	1,00	-	EN 1993-1-1: 6.1
γ_{M2}	1,25	-	EN 1993-1-1: 6.1
γ_{M3}	1,25	-	EN 1993-1-8: 2.2
γ_C	1,50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1,20	-	ETAG 001-C: 3.2.1

6 / 7

Project:
Project no:
Author:

Item	Value	Unit	Reference
Joint coefficient βj	0,67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0,10	-	
Friction coefficient - concrete	0,25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0,30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0,05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2,20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1,20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance	Yes		ETAG 001-C
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0,03	-	CIDECT DG 1, 3 - 1.1

6.3 Tlačni nastavak rešetke

Project:
Project no:
Author:

Project data

Project name	
Project number	
Author	
Description	
Date	27.6.2019.
Design code	EN

Material

Steel	S 355

Project:
Project no:
Author:

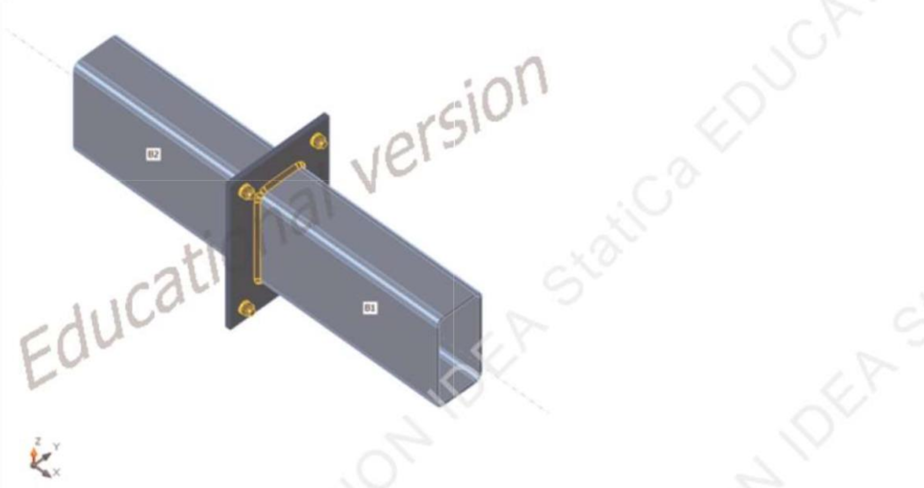
Project item Spoj resetke

Design

Name	Spoj resetke
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1	1 - RHSCF200/100/6.0	0,0	0,0	0,0	0	0	0	Node
B2	1 - RHSCF200/100/6.0	180,0	0,0	0,0	0	0	0	Node



Cross-sections

Name	Material
1 - RHSCF200/100/6.0	S 355

Bolts

Name	Bolt assembly	Diameter [mm]	fu [MPa]	Gross area [mm^2]
M12 5.6	M12 5.6	12	500,0	113

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B1	-472,9	-2,1	-7,0	0,3	5,4	-3,0
	B2	-472,9	-2,1	7,0	0,3	5,4	3,0

2 / 7

Project:
Project no:
Author:

Check

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	0,0 < 5%	OK
Bolts	11,2 < 100%	OK
Welds	92,3 < 100%	OK
Buckling	Not calculated	

Plates

Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Status
B1	6,0	LE1	256,5	0,0	OK
B2	6,0	LE1	278,4	0,0	OK
PP1a	5,0	LE1	37,4	0,0	OK
PP1b	5,0	LE1	37,2	0,0	OK

Design data

Material	f_y [MPa]	ε_{lim} [%]
S 355	355,0	5,0

Symbol explanation

ε_{Pl}	Strain
σ_{Ed}	Eq. stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

Project:
Project no:
Author:

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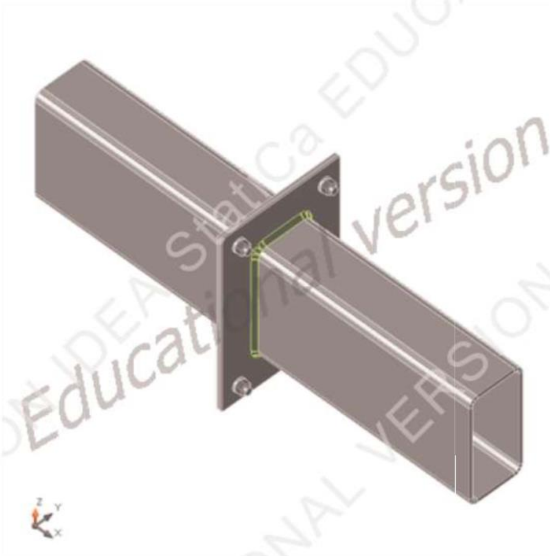
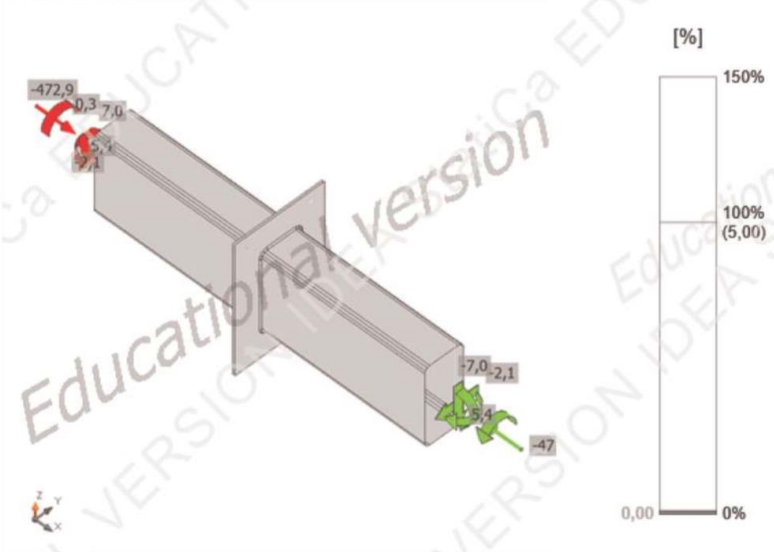


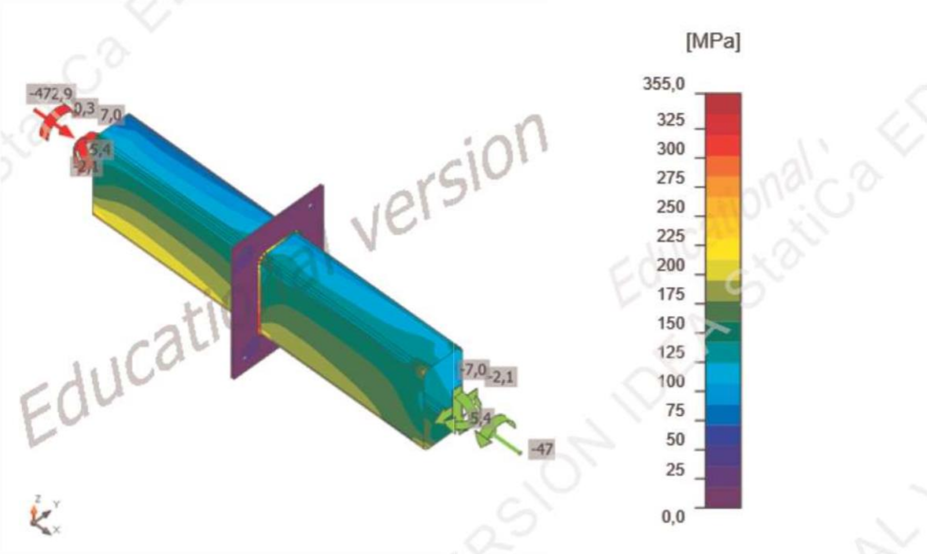
Overall check, LE1



Strain check, LE1

4 / 7

Project:
Project no:
Author:



Equivalent stress, LE1

Bolts

	Name	Loads	$F_{t,Ed}$ [kN]	V [kN]	Ut_t [%]	$F_{b,Rd}$ [kN]	Ut_s [%]	Ut_{ts} [%]	Status
	B1	LE1	0,1	2,2	0,3	50,0	11,0	11,2	OK
	B2	LE1	0,1	1,8	0,2	54,2	8,6	8,8	OK
	B3	LE1	0,1	2,0	0,4	45,3	9,9	10,2	OK
	B4	LE1	0,1	1,5	0,3	45,3	7,2	7,4	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M12 5.6 - 1	30,6	72,0	20,4

Symbol explanation

$F_{t,Rd}$	Bolt tension resistance EN 1993-1-8 tab. 3.4
$F_{t,Ed}$	Tension force
$B_{p,Rd}$	Punching shear resistance
V	Resultant of shear forces Vy, Vz in bolt
$F_{v,Rd}$	Bolt shear resistance EN_1993-1-8 table 3.4
$F_{b,Rd}$	Plate bearing resistance EN 1993-1-8 tab. 3.4
Ut_t	Utilization in tension
Ut_s	Utilization in shear
Ut_{ts}	Utilization in tension and shear EN 1993-1-8 table 3.4

5 / 7

Project:
Project no:
Author:

IDEA StatiCa®

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\parallel}$ [MPa]	$\tau_{\perp}$ [MPa]	Ut [%]	Ut_c [%]	Status
PP1a	B2	◢5,0	555	LE1	402,2	0,0	-230,8	-14,3	189,6	92,3	55,4	OK
PP1b	B1	◢5,0	555	LE1	400,6	0,0	-227,1	24,6	188,9	92,0	55,3	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 355	0,90	435,6	352,8

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\parallel}$	Shear stress parallel to weld axis
$\tau_{\perp}$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
γ_{M0}	1,00	-	EN 1993-1-1: 6.1
γ_{M1}	1,00	-	EN 1993-1-1: 6.1
γ_{M2}	1,25	-	EN 1993-1-1: 6.1
γ_{M3}	1,25	-	EN 1993-1-8: 2.2
γ_{C}	1,50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1,20	-	ETAG 001-C: 3.2.1
Joint coefficient βj	0,67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0,10	-	
Friction coefficient - concrete	0,25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0,30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0,05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2,20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1,20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance	Yes		ETAG 001-C
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4

6 / 7

Project:
Project no:
Author:

Item	Value	Unit	Reference
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0,03	-	CIDECT DG 1, 3 - 1.1

6.4. Spoj ispuna donji pojas

Project:
Project no:
Author:

Project data

Project name	
Project number	
Author	
Description	
Date	4.7.2019.
Design code	EN

Material

Steel	S 355

1 / 12

Project:
Project no:
Author:

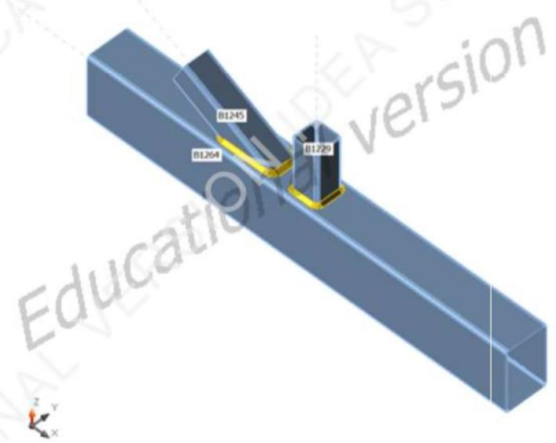
Project item Con N624

Design

Name	Con N624
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1229	1 - CFRHS50X50X3(RHS50x50)	0,0	-90,0	0,0	0	0	0	Position
B1245	1 - CFRHS50X50X3(RHS50x50)	180,0	-27,8	0,0	0	0	0	Position
B1264	2 - CFRHS120X80X3(RHS120x80)	0,0	0,0	0,0	0	0	0	Position



Cross-sections

Name	Material
1 - CFRHS50X50X3(RHS50x50)	S 355
2 - CFRHS120X80X3(RHS120x80)	S 355

2 / 12

Project:
Project no:
Author:

Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
ULS-Set(1)	B1229	-1,2	0,0	-0,6	0,0	0,2	0,0
	B1245	2,5	0,0	0,1	0,0	-0,1	0,0
	B1264	4,9	-0,4	-0,1	0,1	-0,1	-0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(2)	B1229	-9,8	0,0	0,1	0,0	0,0	0,0
	B1245	20,4	0,0	0,0	0,0	0,0	0,0
	B1264	28,3	-0,1	-0,2	-0,1	-0,2	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(3)	B1229	-6,9	0,0	0,1	0,0	0,0	0,0
	B1245	14,5	0,0	0,0	0,0	0,0	0,0
	B1264	2,3	0,1	-0,1	-0,1	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(4)	B1229	-1,4	0,0	-0,6	0,0	0,2	0,0
	B1245	2,8	0,0	0,1	0,0	-0,1	0,0
	B1264	33,0	-0,5	-0,1	0,1	-0,2	-0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(5)	B1229	-8,7	0,0	0,9	0,0	-0,2	0,0
	B1245	17,8	0,0	-0,1	0,0	0,0	0,0
	B1264	-58,9	0,3	-0,1	-0,2	-0,1	0,3
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(6)	B1229	-4,3	0,0	-0,3	0,0	0,1	0,0
	B1245	9,4	0,0	0,1	0,0	0,0	0,0
	B1264	58,3	0,0	-0,2	0,0	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(7)	B1229	-5,0	0,0	-0,2	0,0	0,1	0,0
	B1245	10,1	0,0	0,0	0,0	0,0	0,0
	B1264	5,7	-0,2	-0,1	0,0	-0,2	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(8)	B1229	-5,1	0,0	0,8	0,0	-0,2	0,0
	B1245	10,3	0,0	-0,1	0,0	0,0	0,0
	B1264	-33,2	0,2	0,0	-0,1	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(9)	B1229	-1,8	0,0	-0,6	0,0	0,2	0,0
	B1245	3,6	0,0	0,1	0,0	-0,1	0,0
	B1264	34,1	-0,5	-0,1	0,0	-0,2	-0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(10)	B1229	-7,5	0,0	-0,2	0,0	0,1	0,0
	B1245	15,9	0,0	0,1	0,0	0,0	0,0
	B1264	30,9	0,1	-0,2	0,0	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(11)	B1229	-4,9	0,0	0,8	0,0	-0,2	0,0
	B1245	10,0	0,0	-0,1	0,0	0,1	0,0

3 / 12

Project:
Project no:
Author:

IDEA StatiCa
Calculate yesterday's estimates

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1264	-61,2	0,3	0,0	-0,1	0,0	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(12)	B1229	-5,1	0,0	-0,5	0,0	0,2	0,0
	B1245	10,5	0,0	0,1	0,0	-0,1	0,0
	B1264	35,3	-0,5	-0,1	0,0	-0,2	-0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(13)	B1229	-8,8	0,0	-0,2	0,0	0,1	0,0
	B1245	18,7	0,0	0,1	0,0	-0,1	0,0
	B1264	20,6	-0,2	-0,2	0,0	-0,1	-0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(14)	B1229	-9,7	0,0	0,0	0,0	0,0	0,0
	B1245	20,5	0,0	0,0	0,0	-0,1	0,0
	B1264	28,9	-0,1	-0,2	-0,1	-0,1	-0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(15)	B1229	-5,4	0,0	0,8	0,0	-0,2	0,0
	B1245	11,0	0,0	-0,1	0,0	0,0	0,0
	B1264	-60,1	0,3	0,0	-0,2	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(16)	B1229	-8,9	0,0	0,9	0,0	-0,2	0,0
	B1245	18,1	0,0	-0,1	0,0	0,0	0,0
	B1264	-30,8	0,3	-0,1	-0,2	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(17)	B1229	-9,8	0,0	0,6	0,0	-0,2	0,0
	B1245	20,1	0,0	0,0	0,0	0,0	0,0
	B1264	-1,9	0,2	-0,1	-0,1	-0,2	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(18)	B1229	-1,3	0,0	-0,3	0,0	0,1	0,0
	B1245	2,4	0,0	0,0	0,0	0,0	0,0
	B1264	3,4	-0,3	-0,1	0,0	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(19)	B1229	-5,1	0,0	0,1	0,0	0,0	0,0
	B1245	10,7	0,0	0,0	0,0	0,0	0,0
	B1264	1,7	0,0	-0,1	0,0	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(20)	B1229	-4,9	0,0	-0,5	0,0	0,2	0,0
	B1245	10,2	0,0	0,1	0,0	-0,1	0,0
	B1264	7,2	-0,4	-0,1	0,0	-0,1	-0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(21)	B1229	-5,7	0,0	-0,3	0,0	0,1	0,0
	B1245	12,2	0,0	0,1	0,0	0,0	0,0
	B1264	30,3	0,1	-0,2	0,0	0,0	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(22)	B1229	-6,9	0,0	0,8	0,0	-0,2	0,0
	B1245	14,1	0,0	-0,1	0,0	0,0	0,0

4 / 12

Project:
Project no:
Author:

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1264	-32,6	0,2	-0,1	-0,1	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(23)	B1229	-5,0	0,0	0,5	0,0	-0,1	0,0
	B1245	10,5	0,0	0,0	0,0	0,0	0,0
	B1264	-32,0	0,1	-0,1	-0,1	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(24)	B1229	-7,6	0,0	0,1	0,0	0,0	0,0
	B1245	16,1	0,0	0,0	0,0	0,0	0,0
	B1264	30,1	0,3	-0,2	-0,1	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(25)	B1229	-4,3	0,0	0,0	0,0	0,0	0,0
	B1245	9,3	0,0	0,0	0,0	0,0	0,0
	B1264	28,9	0,2	-0,2	0,0	0,0	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(26)	B1229	-8,7	0,0	0,0	0,0	0,0	0,0
	B1245	18,5	0,0	0,1	0,0	0,0	0,0
	B1264	5,1	0,1	-0,2	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(27)	B1229	-8,8	0,0	0,1	0,0	0,0	0,0
	B1245	18,6	0,0	0,0	0,0	0,0	0,0
	B1264	4,6	0,2	-0,2	-0,1	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(28)	B1229	-9,4	0,0	0,6	0,0	-0,2	0,0
	B1245	19,6	0,0	0,0	0,0	0,0	0,0
	B1264	-48,7	0,3	-0,2	-0,1	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(29)	B1229	-1,5	0,0	-0,3	0,0	0,1	0,0
	B1245	2,7	0,0	0,0	0,0	0,0	0,0
	B1264	31,5	-0,3	0,0	0,0	-0,2	-0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(30)	B1229	-8,2	0,0	0,9	0,0	-0,2	0,0
	B1245	16,9	0,0	-0,1	0,0	0,0	0,0
	B1264	-60,0	0,3	-0,1	-0,2	-0,1	0,3
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(31)	B1229	-4,1	0,0	-0,3	0,0	0,1	0,0
	B1245	9,1	0,0	0,1	0,0	0,0	0,0
	B1264	30,2	0,1	-0,2	0,0	0,0	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(32)	B1229	-4,9	0,0	-0,2	0,0	0,1	0,0
	B1245	10,7	0,0	0,0	0,0	-0,1	0,0
	B1264	-10,0	-0,2	-0,1	0,0	0,0	-0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(33)	B1229	-4,8	0,0	-0,2	0,0	0,1	0,0
	B1245	9,5	0,0	0,0	0,0	0,0	0,0

Project:
Project no:
Author:

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1264	32,7	-0,3	-0,1	0,0	-0,2	-0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(34)	B1229	-5,2	0,0	-0,2	0,0	0,1	0,0
	B1245	10,4	0,0	0,0	0,0	0,0	0,0
	B1264	33,8	-0,3	-0,1	0,0	-0,2	-0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(35)	B1229	-9,4	0,0	0,4	0,0	-0,1	0,0
	B1245	19,7	0,0	0,0	0,0	0,0	0,0
	B1264	-48,1	0,2	-0,2	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(36)	B1229	-5,1	0,0	0,4	0,0	-0,1	0,0
	B1245	10,8	0,0	0,0	0,0	0,0	0,0
	B1264	-49,6	0,1	-0,1	-0,1	0,0	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(37)	B1229	-4,9	0,0	-0,1	0,0	0,0	0,0
	B1245	10,6	0,0	0,0	0,0	0,0	0,0
	B1264	-20,3	-0,1	-0,1	0,0	0,0	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(38)	B1229	-4,2	0,0	-0,3	0,0	0,1	0,0
	B1245	9,1	0,0	0,1	0,0	0,0	0,0
	B1264	29,7	0,1	-0,2	0,0	0,0	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(39)	B1229	-4,4	0,0	0,0	0,0	0,0	0,0
	B1245	9,3	0,0	0,0	0,0	0,0	0,0
	B1264	28,4	0,2	-0,2	-0,1	0,0	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(40)	B1229	-5,9	0,0	0,1	0,0	0,0	0,0
	B1245	12,4	0,0	0,0	0,0	0,0	0,0
	B1264	29,0	0,3	-0,2	-0,1	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(41)	B1229	-7,7	0,0	0,1	0,0	0,0	0,0
	B1245	16,1	0,0	0,0	0,0	0,0	0,0
	B1264	29,6	0,3	-0,2	-0,1	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(42)	B1229	-8,4	0,0	0,8	0,0	-0,2	0,0
	B1245	17,2	0,0	-0,1	0,0	0,0	0,0
	B1264	-32,0	0,3	-0,1	-0,2	-0,1	0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(43)	B1229	-8,3	0,0	0,5	0,0	-0,1	0,0
	B1245	17,3	0,0	0,0	0,0	0,0	0,0
	B1264	-30,8	0,1	-0,1	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(44)	B1229	-6,8	0,0	0,5	0,0	-0,1	0,0
	B1245	14,2	0,0	0,0	0,0	0,0	0,0

6 / 12

Project:
Project no:
Author:

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1264	-31,4	0,1	-0,1	-0,1	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(45)	B1229	-5,1	0,0	-0,2	0,0	0,1	0,0
	B1245	11,0	0,0	0,0	0,0	-0,1	0,0
	B1264	18,1	-0,3	-0,1	0,0	-0,1	-0,2
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(46)	B1229	-4,5	0,0	0,0	0,0	0,0	0,0
	B1245	9,5	0,0	0,0	0,0	0,0	0,0
	B1264	57,0	0,2	-0,1	0,0	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(47)	B1229	-8,1	0,0	0,5	0,0	-0,2	0,0
	B1245	17,0	0,0	0,0	0,0	0,0	0,0
	B1264	-58,9	0,2	-0,1	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(48)	B1229	-6,1	0,0	0,0	0,0	0,0	0,0
	B1245	12,7	0,0	0,0	0,0	0,0	0,0
	B1264	57,1	0,2	-0,2	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(49)	B1229	-4,6	0,0	0,0	0,0	0,0	0,0
	B1245	9,6	0,0	0,0	0,0	0,0	0,0
	B1264	56,5	0,2	-0,1	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(50)	B1229	-6,6	0,0	0,5	0,0	-0,1	0,0
	B1245	13,9	0,0	0,0	0,0	0,0	0,0
	B1264	-59,5	0,2	-0,1	-0,1	0,0	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(51)	B1229	-7,9	0,0	0,1	0,0	0,0	0,0
	B1245	16,4	0,0	0,0	0,0	0,0	0,0
	B1264	57,7	0,2	-0,2	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(52)	B1229	-6,4	0,0	0,1	0,0	0,0	0,0
	B1245	13,3	0,0	0,0	0,0	0,0	0,0
	B1264	57,1	0,2	-0,2	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(53)	B1229	-4,4	0,0	-0,3	0,0	0,1	0,0
	B1245	9,4	0,0	0,1	0,0	0,0	0,0
	B1264	57,8	0,0	-0,2	0,0	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(54)	B1229	-4,8	0,0	0,5	0,0	-0,1	0,0
	B1245	10,2	0,0	0,0	0,0	0,0	0,0
	B1264	-60,1	0,1	-0,1	-0,1	0,0	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(55)	B1229	-6,3	0,0	0,5	0,0	-0,1	0,0
	B1245	13,3	0,0	0,0	0,0	0,0	0,0

7 / 12

Project:
Project no:
Author:

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1264	-59,5	0,1	-0,1	-0,1	0,0	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(56)	B1229	-7,6	0,0	-0,2	0,0	0,1	0,0
	B1245	16,2	0,0	0,1	0,0	0,0	0,0
	B1264	59,5	0,1	-0,2	0,0	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(57)	B1229	-7,4	0,0	-0,2	0,0	0,1	0,0
	B1245	15,9	0,0	0,1	0,0	0,0	0,0
	B1264	31,4	0,1	-0,2	0,0	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(58)	B1229	-5,6	0,0	-0,3	0,0	0,1	0,0
	B1245	12,2	0,0	0,1	0,0	0,0	0,0
	B1264	30,8	0,1	-0,2	0,0	0,0	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(59)	B1229	-7,6	0,0	-0,1	0,0	0,0	0,0
	B1245	15,5	0,0	0,0	0,0	0,0	0,0
	B1264	36,8	-0,2	-0,1	-0,1	-0,2	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(60)	B1229	-9,1	0,0	0,1	0,0	0,0	0,0
	B1245	19,1	0,0	0,0	0,0	0,0	0,0
	B1264	51,4	0,1	-0,2	-0,1	-0,2	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(61)	B1229	-4,8	0,0	0,3	0,0	-0,1	0,0
	B1245	10,2	0,0	0,0	0,0	0,0	0,0
	B1264	-50,3	0,1	-0,1	-0,1	0,0	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(62)	B1229	-2,8	0,0	-0,3	0,0	0,1	0,0
	B1245	5,5	0,0	0,0	0,0	0,0	0,0
	B1264	4,0	-0,3	-0,1	0,0	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(63)	B1229	-6,1	0,0	-0,2	0,0	0,1	0,0
	B1245	13,1	0,0	0,1	0,0	0,0	0,0
	B1264	58,9	0,0	-0,2	0,0	-0,1	0,0
	B1264	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(64)	B1229	-7,8	0,0	0,1	0,0	0,0	0,0
	B1245	16,4	0,0	0,0	0,0	0,0	0,0
	B1264	58,2	0,2	-0,2	-0,1	-0,1	0,1
	B1264	0,0	0,0	0,0	0,0	0,0	0,0

Project:
Project no:
Author:

Check

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	0,0 < 5%	OK
Welds	76,6 < 100%	OK
Buckling	Not calculated	

Plates

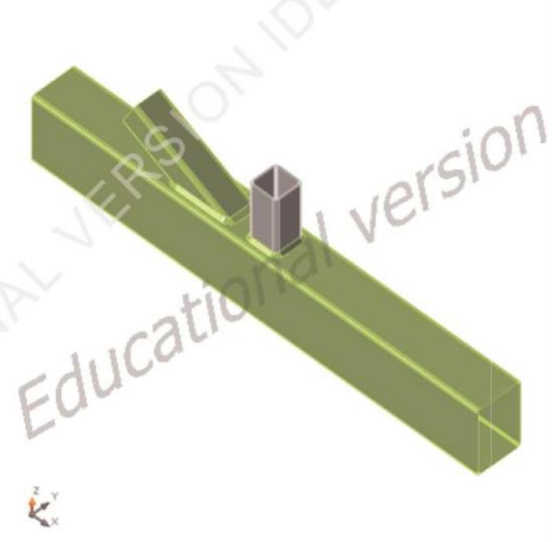
Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Status
B1229	3,0	ULS-Set(16)	242,7	0,0	OK
B1245	3,0	ULS-Set(14)	261,5	0,0	OK
B1264	3,0	ULS-Set(5)	311,0	0,0	OK

Design data

Material	f_y [MPa]	ε_{lim} [%]
S 355	355,0	5,0

Symbol explanation

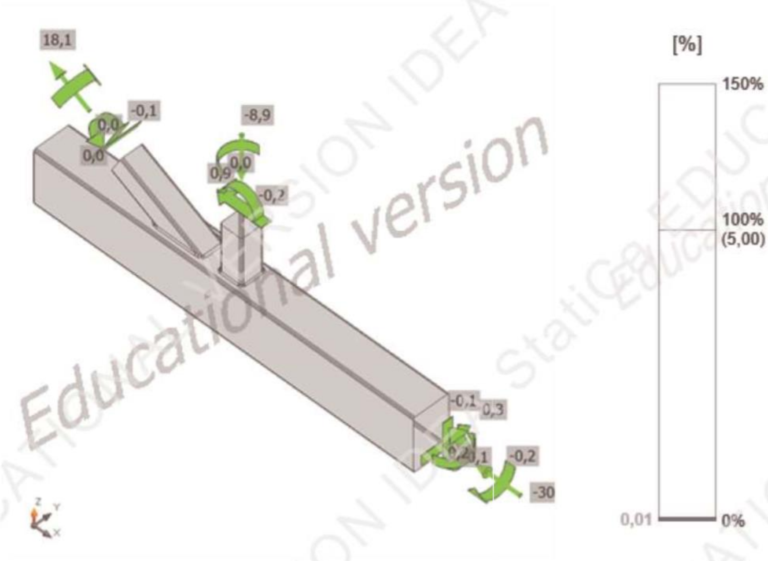
ε_{Pl}	Strain
σ_{Ed}	Eq. stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain



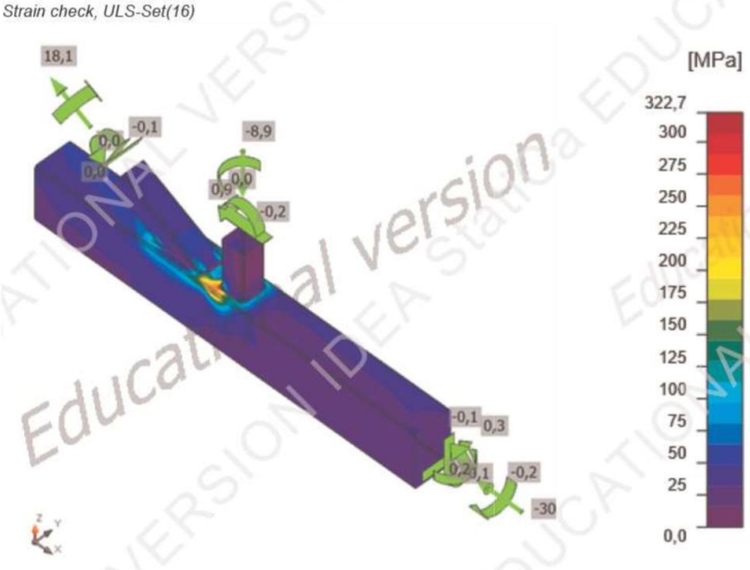
Overall check, ULS-Set(16)

9 / 12

Project:
Project no:
Author:



Strain check, ULS-Set(16)



Equivalent stress, ULS-Set(16)

10 / 12

Project:
Project no:
Author:

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_{\perp}$ [MPa]	$\tau_{\|\|}$ [MPa]	$\tau_{\perp}$ [MPa]	Ut [%]	Ut_c [%]	Status
B1264-w 3	B1229	◢4,0	180	ULS-Set(16)	315,6	0,0	-268,6	43,8	85,1	76,1	12,4	OK
B1264-w 3	B1245	◢4,0	285	ULS-Set(14)	333,8	0,0	96,5	183,8	15,9	76,6	9,1	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 355	0,90	435,6	352,8

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_{\perp}$	Perpendicular stress
$\tau_{\|\|}$	Shear stress parallel to weld axis
$\tau_{\perp}$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
γ_{M0}	1,10	-	EN 1993-1-1: 6.1
γ_{M1}	1,00	-	EN 1993-1-1: 6.1
γ_{M2}	1,25	-	EN 1993-1-1: 6.1
γ_{M3}	1,25	-	EN 1993-1-8: 2.2
γ_{C}	1,50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1,20	-	ETAG 001-C: 3.2.1
Joint coefficient βj	0,67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0,10	-	
Friction coefficient - concrete	0,25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0,30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0,05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2,20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1,20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance	Yes		ETAG 001-C
Use calculated αb in bearing check.	Yes		EN 1993-1-8: tab 3.4

11 / 12

Project:
Project no:
Author:

Item	Value	Unit	Reference
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0,03	-	CIDECT DG 1, 3 - 1.1

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Project no:
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Project data

Project name	
Project number	
Author	
Description	
Date	1.7.2019.
Design code	EN

Material

Steel	S 355

Project:
Project no:
Author:

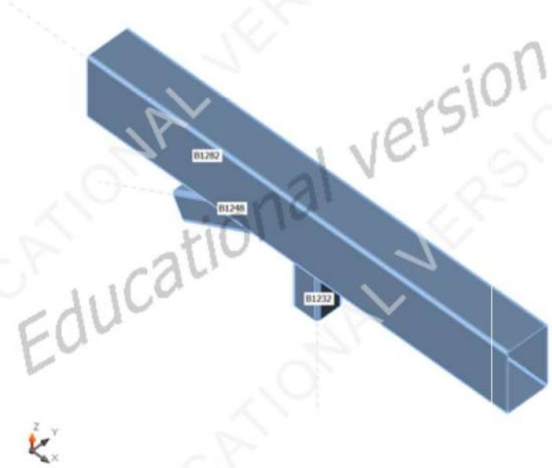
Project item Con N629

Design

Name	Con N629
Description	
Analysis	Stress, strain/ loads in equilibrium

Beams and columns

Name	Cross-section	β – Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]	Forces in
B1232	1 - CFRHS50X50X3(RHS50x50)	0,0	90,0	0,0	0	0	0	Position
B1248	1 - CFRHS50X50X3(RHS50x50)	180,0	27,8	0,0	0	0	0	Position
B1282	2 - CFRHS120X80X2.5(RHS120x80)	0,0	0,0	0,0	0	0	0	Position



Cross-sections

Name	Material
1 - CFRHS50X50X3(RHS50x50)	S 355
2 - CFRHS120X80X2.5(RHS120x80)	S 355

2 / 12

Project:
Project no:
Author:

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Load effects (forces in equilibrium)

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
ULS-Set(1)	B1232	-2,7	0,0	0,1	0,0	0,0	0,0
	B1248	4,0	0,0	0,0	0,0	0,0	0,0
	B1282	19,0	1,3	0,2	0,0	-0,1	0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(2)	B1232	-11,8	0,0	0,3	0,0	-0,1	0,0
	B1248	9,5	0,0	-0,1	0,0	0,1	0,0
	B1282	8,0	1,5	-0,5	0,0	-0,2	0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(3)	B1232	-5,6	0,0	0,2	0,0	-0,1	0,0
	B1248	2,0	0,0	0,0	0,0	0,0	0,0
	B1282	-11,0	-0,1	-0,3	0,0	-0,1	-0,1
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(4)	B1232	-3,1	0,0	0,1	0,0	0,0	0,0
	B1248	5,0	0,0	0,0	0,0	0,0	0,0
	B1282	45,5	1,4	0,3	0,0	-0,1	0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(5)	B1232	-11,5	0,0	0,3	0,0	-0,1	0,0
	B1248	8,6	0,0	-0,1	0,0	0,1	0,0
	B1282	-16,0	1,5	-0,6	0,0	-0,1	0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(6)	B1232	-8,6	0,0	0,2	0,0	-0,1	0,0
	B1248	1,2	0,0	0,1	0,0	0,0	0,0
	B1282	-65,9	-3,3	-0,6	0,1	0,0	-1,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(7)	B1232	-9,8	0,0	0,3	0,0	-0,1	0,0
	B1248	8,3	0,0	-0,1	0,0	0,1	0,0
	B1282	-13,2	3,2	-0,3	0,0	-0,1	0,9
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(8)	B1232	-7,5	0,0	0,2	0,0	-0,1	0,0
	B1248	8,5	0,0	-0,1	0,0	0,1	0,0
	B1282	-10,6	3,2	-0,1	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(9)	B1232	-3,0	0,0	0,1	0,0	0,0	0,0
	B1248	5,0	0,0	0,0	0,0	0,0	0,0
	B1282	43,0	1,4	0,3	0,0	-0,1	0,6
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(10)	B1232	-4,8	0,0	0,1	0,0	0,0	0,0
	B1248	5,1	0,0	0,0	0,0	0,0	0,0
	B1282	42,0	-0,3	0,1	0,0	-0,2	-0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(11)	B1232	-5,0	0,0	0,1	0,0	0,0	0,0
	B1248	1,7	0,0	0,1	0,0	0,0	0,0

3 / 12

Project:
Project no:
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Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1282	-36,3	-3,1	-0,2	0,0	0,0	-1,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(12)	B1232	-7,4	0,0	0,2	0,0	-0,1	0,0
	B1248	1,6	0,0	0,1	0,0	0,0	0,0
	B1282	-39,0	-3,2	-0,5	0,1	-0,1	-1,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(13)	B1232	-10,5	0,0	0,3	0,0	-0,1	0,0
	B1248	5,9	0,0	-0,1	0,0	0,1	0,0
	B1282	-29,5	0,8	-0,6	0,0	-0,1	0,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(14)	B1232	-2,7	0,0	0,1	0,0	0,0	0,0
	B1248	0,9	0,0	-0,1	0,0	0,0	0,0
	B1282	-16,7	2,9	-0,1	0,0	0,0	0,9
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(15)	B1232	-2,8	0,0	0,1	0,0	0,0	0,0
	B1248	4,0	0,0	0,0	0,0	0,0	0,0
	B1282	21,4	1,3	0,2	0,0	-0,1	0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(16)	B1232	-3,0	0,0	0,1	0,0	0,0	0,0
	B1248	0,4	0,0	0,0	0,0	0,0	0,0
	B1282	-57,7	-1,5	-0,1	0,0	0,0	-0,6
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(17)	B1232	-3,7	0,0	0,2	0,0	-0,1	0,0
	B1248	0,4	0,0	-0,1	0,0	0,0	0,0
	B1282	-17,1	2,9	-0,2	0,0	-0,1	0,9
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(18)	B1232	-10,8	0,0	0,3	0,0	-0,1	0,0
	B1248	10,1	0,0	-0,1	0,0	0,1	0,0
	B1282	8,1	1,6	-0,3	0,0	-0,1	0,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(19)	B1232	-4,0	0,0	0,1	0,0	-0,1	0,0
	B1248	-0,1	0,0	0,0	0,0	0,0	0,0
	B1282	-57,8	-1,5	-0,3	0,0	0,0	-0,7
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(20)	B1232	-4,2	0,0	0,1	0,0	-0,1	0,0
	B1248	1,5	0,0	0,0	0,0	0,0	0,0
	B1282	-8,2	-0,1	-0,2	0,0	-0,1	-0,1
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(21)	B1232	-6,0	0,0	0,1	0,0	-0,1	0,0
	B1248	1,2	0,0	0,1	0,0	0,0	0,0
	B1282	-36,5	-3,1	-0,4	0,1	0,0	-1,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(22)	B1232	-8,9	0,0	0,3	0,0	-0,1	0,0
	B1248	8,9	0,0	-0,1	0,0	0,1	0,0

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Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1282	-13,2	3,2	-0,1	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(23)	B1232	-6,3	0,0	0,2	0,0	-0,1	0,0
	B1248	8,9	0,0	-0,1	0,0	0,1	0,0
	B1282	16,3	3,3	0,1	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(24)	B1232	-7,7	0,0	0,2	0,0	-0,1	0,0
	B1248	9,3	0,0	-0,1	0,0	0,1	0,0
	B1282	13,8	3,3	0,0	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(25)	B1232	-7,2	0,0	0,2	0,0	-0,1	0,0
	B1248	0,8	0,0	0,1	0,0	0,0	0,0
	B1282	-63,4	-3,2	-0,5	0,1	0,0	-1,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(26)	B1232	-9,2	0,0	0,3	0,0	-0,1	0,0
	B1248	9,9	0,0	-0,1	0,0	0,1	0,0
	B1282	10,9	3,3	-0,1	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(27)	B1232	-7,6	0,0	0,2	0,0	-0,1	0,0
	B1248	6,0	0,0	0,0	0,0	0,0	0,0
	B1282	36,6	-0,4	-0,1	0,1	-0,2	-0,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(28)	B1232	-5,7	0,0	0,1	0,0	-0,1	0,0
	B1248	0,3	0,0	0,1	0,0	0,0	0,0
	B1282	-60,5	-3,2	-0,5	0,1	0,0	-1,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(29)	B1232	-7,8	0,0	0,2	0,0	-0,1	0,0
	B1248	2,6	0,0	0,1	0,0	0,0	0,0
	B1282	-41,7	-3,1	-0,4	0,1	-0,1	-1,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(30)	B1232	-6,6	0,0	0,3	0,0	-0,1	0,0
	B1248	1,3	0,0	-0,1	0,0	0,0	0,0
	B1282	-22,5	2,8	-0,4	0,0	-0,1	0,8
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(31)	B1232	-8,3	0,0	0,3	0,0	-0,1	0,0
	B1248	1,6	0,0	0,0	0,0	0,0	0,0
	B1282	-25,6	1,2	-0,6	0,1	-0,1	0,1
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(32)	B1232	-3,3	0,0	0,1	0,0	0,0	0,0
	B1248	1,4	0,0	0,0	0,0	0,0	0,0
	B1282	-33,6	-1,4	0,0	0,0	0,0	-0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(33)	B1232	-7,5	0,0	0,2	0,0	-0,1	0,0
	B1248	6,0	0,0	0,0	0,0	0,0	0,0

Project:
Project no:
Author:

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1282	34,1	-0,3	-0,1	0,0	-0,2	-0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(34)	B1232	-3,9	0,0	0,1	0,0	-0,1	0,0
	B1248	0,0	0,0	0,0	0,0	0,0	0,0
	B1282	-50,8	-1,0	-0,3	0,0	0,0	-0,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(35)	B1232	-6,0	0,0	0,2	0,0	-0,1	0,0
	B1248	8,0	0,0	-0,1	0,0	0,1	0,0
	B1282	-7,8	3,3	0,0	0,0	0,0	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(36)	B1232	-8,9	0,0	0,2	0,0	-0,1	0,0
	B1248	2,1	0,0	0,1	0,0	0,0	0,0
	B1282	-41,8	-3,2	-0,6	0,1	-0,1	-1,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(37)	B1232	-5,7	0,0	0,2	0,0	-0,1	0,0
	B1248	5,0	0,0	0,0	0,0	0,0	0,0
	B1282	16,1	1,2	0,1	0,0	-0,1	0,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(38)	B1232	-7,5	0,0	0,3	0,0	-0,1	0,0
	B1248	1,5	0,0	0,0	0,0	0,0	0,0
	B1282	-33,4	1,6	-0,5	0,0	-0,1	0,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(39)	B1232	-8,6	0,0	0,3	0,0	-0,1	0,0
	B1248	2,6	0,0	0,0	0,0	0,0	0,0
	B1282	-1,5	1,2	-0,6	0,1	-0,2	0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(40)	B1232	-9,0	0,0	0,3	0,0	-0,1	0,0
	B1248	3,3	0,0	0,0	0,0	0,0	0,0
	B1282	4,8	0,7	-0,5	0,1	-0,2	0,1
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(41)	B1232	-8,4	0,0	0,2	0,0	-0,1	0,0
	B1248	5,3	0,0	0,0	0,0	0,0	0,0
	B1282	26,2	-0,2	-0,2	0,1	-0,2	-0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(42)	B1232	-8,9	0,0	0,2	0,0	-0,1	0,0
	B1248	8,6	0,0	-0,1	0,0	0,1	0,0
	B1282	13,4	1,6	-0,3	0,0	-0,1	0,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(43)	B1232	-8,0	0,0	0,2	0,0	-0,1	0,0
	B1248	9,2	0,0	-0,1	0,0	0,1	0,0
	B1282	13,5	1,7	-0,2	0,0	-0,1	0,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(44)	B1232	-8,7	0,0	0,3	0,0	-0,1	0,0
	B1248	8,9	0,0	-0,1	0,0	0,1	0,0

6 / 12

Project:
Project no:
Author:

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1282	13,4	3,3	-0,2	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(45)	B1232	-10,1	0,0	0,3	0,0	-0,1	0,0
	B1248	9,3	0,0	-0,1	0,0	0,1	0,0
	B1282	10,8	3,2	-0,3	0,0	-0,1	0,9
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(46)	B1232	-7,1	0,0	0,2	0,0	-0,1	0,0
	B1248	0,7	0,0	0,1	0,0	0,0	0,0
	B1282	-63,1	-3,2	-0,6	0,1	0,0	-1,4
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(47)	B1232	-4,7	0,0	0,1	0,0	0,0	0,0
	B1248	0,8	0,0	0,1	0,0	0,0	0,0
	B1282	-60,4	-3,1	-0,3	0,0	0,0	-1,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(48)	B1232	-3,0	0,0	0,1	0,0	0,0	0,0
	B1248	1,8	0,0	-0,1	0,0	0,0	0,0
	B1282	7,4	3,0	0,0	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(49)	B1232	-7,5	0,0	0,2	0,0	-0,1	0,0
	B1248	1,7	0,0	0,1	0,0	0,0	0,0
	B1282	-65,8	-3,2	-0,4	0,1	0,0	-1,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(50)	B1232	-5,8	0,0	0,2	0,0	-0,1	0,0
	B1248	1,3	0,0	0,0	0,0	0,0	0,0
	B1282	-63,1	-1,5	-0,2	0,0	0,0	-0,6
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(51)	B1232	-5,6	0,0	0,2	0,0	-0,1	0,0
	B1248	1,8	0,0	-0,1	0,0	0,0	0,0
	B1282	-22,1	2,9	-0,2	0,0	-0,1	0,9
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(52)	B1232	-6,9	0,0	0,2	0,0	-0,1	0,0
	B1248	0,8	0,0	0,0	0,0	0,0	0,0
	B1282	-63,2	-1,6	-0,4	0,0	0,0	-0,7
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(53)	B1232	-8,4	0,0	0,2	0,0	-0,1	0,0
	B1248	5,3	0,0	0,0	0,0	0,0	0,0
	B1282	27,7	-0,3	-0,2	0,1	-0,2	-0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(54)	B1232	-4,6	0,0	0,1	0,0	0,0	0,0
	B1248	5,5	0,0	0,0	0,0	0,0	0,0
	B1282	42,7	1,3	0,2	0,0	-0,2	0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(55)	B1232	-8,7	0,0	0,3	0,0	-0,1	0,0
	B1248	1,4	0,0	0,0	0,0	0,0	0,0

Project:
Project no:
Author:

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1282	-59,5	-2,1	-0,6	0,1	-0,1	-0,9
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(56)	B1232	-6,0	0,0	0,1	0,0	-0,1	0,0
	B1248	5,9	0,0	0,0	0,0	0,0	0,0
	B1282	40,1	1,3	0,1	0,0	-0,2	0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(57)	B1232	-7,3	0,0	0,2	0,0	-0,1	0,0
	B1248	5,0	0,0	0,0	0,0	0,0	0,0
	B1282	12,5	-0,4	-0,1	0,1	-0,1	-0,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(58)	B1232	-7,3	0,0	0,2	0,0	-0,1	0,0
	B1248	8,3	0,0	-0,1	0,0	0,1	0,0
	B1282	16,2	3,3	-0,1	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(59)	B1232	-9,2	0,0	0,2	0,0	-0,1	0,0
	B1248	3,0	0,0	0,0	0,0	0,0	0,0
	B1282	-19,4	-2,0	-0,5	0,1	-0,2	-0,9
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(60)	B1232	-4,3	0,0	0,1	0,0	-0,1	0,0
	B1248	0,9	0,0	0,0	0,0	0,0	0,0
	B1282	-33,8	-1,5	-0,2	0,0	0,0	-0,6
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(61)	B1232	-10,5	0,0	0,3	0,0	-0,1	0,0
	B1248	9,1	0,0	-0,1	0,0	0,1	0,0
	B1282	-16,0	1,5	-0,4	0,0	-0,1	0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(62)	B1232	-10,9	0,0	0,3	0,0	-0,1	0,0
	B1248	7,4	0,0	-0,1	0,0	0,1	0,0
	B1282	10,6	0,9	-0,5	0,1	-0,2	0,1
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(63)	B1232	-8,0	0,0	0,3	0,0	-0,1	0,0
	B1248	3,1	0,0	0,0	0,0	0,0	0,0
	B1282	6,7	1,7	-0,4	0,0	-0,2	0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(64)	B1232	-6,1	0,0	0,1	0,0	-0,1	0,0
	B1248	1,2	0,0	0,1	0,0	0,0	0,0
	B1282	-62,9	-3,2	-0,4	0,1	0,0	-1,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(65)	B1232	-7,8	0,0	0,2	0,0	-0,1	0,0
	B1248	9,4	0,0	-0,1	0,0	0,1	0,0
	B1282	13,4	3,3	0,0	0,0	-0,1	1,0
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(66)	B1232	-7,7	0,0	0,2	0,0	-0,1	0,0
	B1248	8,2	0,0	-0,1	0,0	0,1	0,0

Project:
Project no:
Author:

Name	Member	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
	B1282	-10,6	1,6	-0,2	0,0	0,0	0,3
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(67)	B1232	-6,8	0,0	0,3	0,0	-0,1	0,0
	B1248	2,2	0,0	-0,1	0,0	0,0	0,0
	B1282	1,6	2,9	-0,3	0,0	-0,2	0,9
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(68)	B1232	-10,0	0,0	0,3	0,0	-0,1	0,0
	B1248	8,0	0,0	-0,1	0,0	0,1	0,0
	B1282	-13,2	1,5	-0,5	0,0	-0,1	0,2
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(69)	B1232	-8,2	0,0	0,2	0,0	-0,1	0,0
	B1248	2,8	0,0	0,0	0,0	0,0	0,0
	B1282	-17,7	-1,0	-0,4	0,1	-0,1	-0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(70)	B1232	-7,7	0,0	0,2	0,0	-0,1	0,0
	B1248	1,2	0,0	0,0	0,0	0,0	0,0
	B1282	-57,8	-1,1	-0,5	0,0	-0,1	-0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0
ULS-Set(71)	B1232	-5,5	0,0	0,2	0,0	-0,1	0,0
	B1248	4,9	0,0	0,0	0,0	0,0	0,0
	B1282	13,6	1,3	0,1	0,0	-0,1	0,5
	B1282	0,0	0,0	0,0	0,0	0,0	0,0

Check

Summary

Name	Value	Status
Analysis	100,0%	OK
Plates	0,1 < 5%	OK
Welds	98,5 < 100%	OK
Buckling	Not calculated	

Plates

Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ε_{Pl} [%]	Status
B1232	3,0	ULS-Set(2)	282,4	0,0	OK
B1248	3,0	ULS-Set(26)	160,8	0,0	OK
B1282	2,5	ULS-Set(2)	355,2	0,1	OK

Design data

Material	f_y [MPa]	ε_{lim} [%]
S 355	355,0	5,0

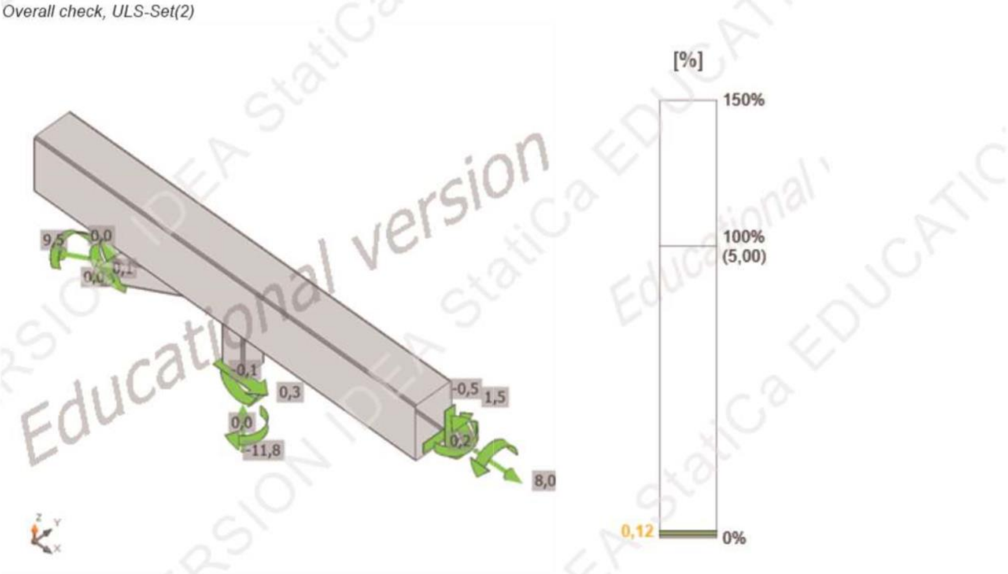
9 / 12

Project:
Project no:
Author:

Symbol explanation

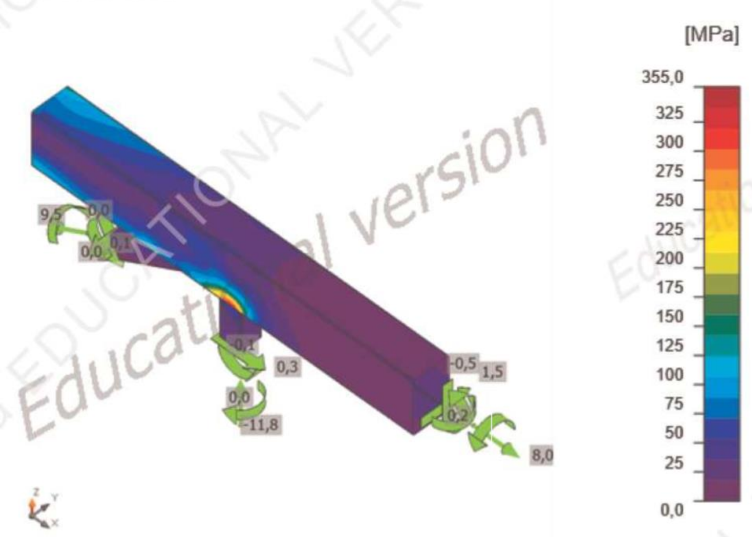
ε_{Pl}	Strain
σ_{Ed}	Eq. stress
f_y	Yield strength
ε_{lim}	Limit of plastic strain

Overall check, ULS-Set(2)



Project:
Project no:
Author:

Strain check, ULS-Set(2)



Equivalent stress, ULS-Set(2)

Welds (Plastic redistribution)

Item	Edge	Throat th. [mm]	Length [mm]	Loads	$\sigma_{w,Ed}$ [MPa]	ε_{Pl} [%]	$\sigma_\perp$ [MPa]	$\tau_{\|\|}$ [MPa]	$\tau_\perp$ [MPa]	Ut [%]	Ut_c [%]	Status
B1282-w 1	B1232	◢2,5	180	ULS-Set(2)	429,1	1,3	-55,6	4,4	245,6	98,5	35,8	OK
B1282-w 1	B1248	◢2,5	285	ULS-Set(27)	296,2	0,0	43,7	50,8	-161,4	68,0	6,2	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9 σ [MPa]
S 355	0,90	435,6	352,8

Symbol explanation

ε_{Pl}	Strain
$\sigma_{w,Ed}$	Equivalent stress
$\sigma_{w,Rd}$	Equivalent stress resistance
$\sigma_\perp$	Perpendicular stress
$\tau_{\|\|}$	Shear stress parallel to weld axis
$\tau_\perp$	Shear stress perpendicular to weld axis
0.9 σ	Perpendicular stress resistance - 0.9*fu/γM2
β_w	Corelation factor EN 1993-1-8 tab. 4.1
Ut	Utilization
Utc	Weld capacity utilization

Project:
Project no:
Author:

Buckling

Buckling analysis was not calculated.

Code settings

Item	Value	Unit	Reference
γ_{M0}	1,00	-	EN 1993-1-1: 6.1
γ_{M1}	1,00	-	EN 1993-1-1: 6.1
γ_{M2}	1,25	-	EN 1993-1-1: 6.1
γ_{M3}	1,25	-	EN 1993-1-8: 2.2
γ_{C}	1,50	-	EN 1992-1-1: 2.4.2.4
γ_{Inst}	1,20	-	ETAG 001-C: 3.2.1
Joint coefficient β_j	0,67	-	EN 1993-1-8: 6.2.5
Effective area - influence of mesh size	0,10	-	
Friction coefficient - concrete	0,25	-	EN 1993-1-8
Friction coefficient in slip-resistance	0,30	-	EN 1993-1-8 tab 3.7
Limit plastic strain	0,05	-	EN 1993-1-5
Weld stress evaluation	Plastic redistribution		
Detailing	No		
Distance between bolts [d]	2,20	-	EN 1993-1-8: tab 3.3
Distance between bolts and edge [d]	1,20	-	EN 1993-1-8: tab 3.3
Concrete breakout resistance	Yes		ETAG 001-C
Use calculated α_b in bearing check.	Yes		EN 1993-1-8: tab 3.4
Cracked concrete	Yes		
Local deformation check	No		
Local deformation limit	0,03	-	CIDECT DG 1, 3 - 1.1

6.6. Spoj stup rešetka

1) Osnovni materijal:

Čelik S355

$f_y = 355 \text{ N/mm}^2$

$E = 210 \,\text{GPa}$

2) Kontrola vara

- dužina vara pojasnice:

$l_p = O = 2 \cdot 250 + 100 = 600 \ (mm)$

- max debljina vara s obzirom na debljinu stijenke nosača

$\mathrm{a}_{\max} = 0.7 \cdot \mathrm{t}_{\min}$

$t_{\min} = 4,2 \ (mm)$

$\Rightarrow a_{\max} = 0.7 \cdot t_{\min} = 0.7 \cdot 6 = 4,2 \ (mm)$

$a_{odabrano} = 4 \ (mm)$

Za pretpostavljeni var a=4(mm):

- uzdužna sila: $F_{w,Rd} = \dfrac{F_{w,Rk}}{1.25} \cdot \dfrac{L}{100} = \dfrac{130,9}{1.25} \cdot \dfrac{600}{100} = 628,32 \ (kN)$

uvjet nosivosti:

$N = F_{w,Sd} \leq F_{w,Rd}$

$104,14 \ (kN) \leq 628,32 \ (kN)$

Var a=4 mm zadovoljava.

3) Proračun vijaka

Pretpostavljeni vijci: M 16, k.v.5.6, n=4 vijka

- udaljenost c_{min} vijaka od ruba pojasnice:

$$c_{\min} = 2 \cdot d + a \cdot \sqrt{2} = 2 \cdot 16 + 4 \cdot \sqrt{2} = 37,66\ (mm)$$

Usvojeno c=40 mm.

- otpornost vijaka na vlak:

$$F_{t,Rd} = \frac{F_{t,Rk}}{\gamma_{M1}} = \frac{70,7}{1.25} = 56,56\ (kN)$$

uvjet nosivosti

$$F_{t,Rd} > F_{t,Sd} / 2$$

$$56,56\ kN > 104,14 / 4 = 26,035\ (kN)$$

- otpornost vijaka na posmik:

$$F_{v,Rd} = \frac{F_{v,Rk}}{\gamma_{M1}} = \frac{47,1}{1,25} = 37,68\ (kN)$$

uvjet nosivosti

$$\mathrm{F_{v,Rd}} > \mathrm{F_{v,Sd}}$$

$$37,68\ kN > F_{v,Sd} = V_{Sd} / 4 = 31,33 / 4 = 7,83\ (kN)$$

- interakcija uzdužne i odrezne sile na vijak:

$$\frac{\mathrm{F_{V,Sd}}}{\mathrm{F_{V,Rd}}} + \frac{\mathrm{F_{t,Sd}}}{1,4 \cdot \mathrm{F_{t,Rd}}} \le 1$$

$$\frac{7,83}{37,68} + \frac{26,035}{1,4 \cdot 56,56} = 0.53 \le 1$$

→ Vijci zadovoljavaju.

4) Proračun ploče

- proračun dimenzija ploče:

$$b_{pl,\min} = b + 2 \cdot a \cdot \sqrt{2} + 20\ mm = 250 + 2 \cdot 4 \cdot \sqrt{2} + 20 = 281,31\ (mm)$$

Odabrane dimenzije ploče: 500x300 mm

Proračun debljine ploče:

- pritisak po omotaču rupe osnovnog materijala:

$$F_{V,Sd} = \frac{V_{Sd}}{2} = 15,66\ (kN) \equiv F_{b,Sd}$$

$$F_{b,Rd} = \frac{F_{b,Rk}}{1,25} \cdot \frac{t_{pl}}{10} = \frac{162,9}{1,25} \cdot \frac{t_{pl}}{10} = F_{b,Sd} = 15,66\ (kN)$$

$$\Rightarrow t_{pl}^{\min} = 1,20\ (mm)$$

- savijanje ploče od vlačnih vijaka:

$$M_{Sd} = F_{t,Sd} \cdot c = 104,14 \cdot 2 \cdot 0,05 = 10,414\ (kNm)$$

$$\mathrm{M_{Sd}} \le \frac{\mathrm{W_{min}} \cdot \mathrm{f_y}}{1,1} \Rightarrow \mathrm{W_{min}} = \frac{1.1 \cdot \mathrm{M_{Sd}}}{\mathrm{f_y}} = \frac{\mathrm{b_{pl}} \cdot \mathrm{t^2{}_{pl}}^{\min}}{6}$$

$$t_{pl}^{\min} = \sqrt{\frac{1,1 \cdot M_{Sd} \cdot 6}{b_{pl} \cdot f_y}} = \sqrt{\frac{1,1 \cdot 10,41 \cdot 100 \cdot 6}{30 \cdot 35.5}} = 2,53\ (cm)$$

$$t_{pl} \ge 2,53\ (cm) \rightarrow t_{pl,odabrano} = 26\ (mm)$$

Usvojene dimenzije ploče: 500x300x26 mm

7. Temelj

Proračun temelja izvršen je u programu Aspalathos kalkulator, gdje je temelj dimenzioniran na najveći moment koji se javlja pri graničnom stanju nosivosti.

BETON

C 25/30

$\gamma_b = 24$ kN/m^3

ARMATURA

B 500/550

$f_{yk} = 500$ N/mm^2

$\gamma_s = 1{,}15$

$f_{yd} = f_{yk} / \gamma_s = 434{,}8$ N/mm^2

TLO

$f_{tla,dop} = 0{,}4$ MN/m^2

REZNE SILE

$N = -124{,}28$ kN

$M_z = 347{,}39$ kN

SILE

$$A = b_x \cdot b_y = 9 \text{ m}^2$$

$$W_x = \frac{b_x \cdot b_y^2}{6} = 4{,}5 \text{ m}^2$$

$$W_y = \frac{b_y \cdot b_x^2}{6} = 4{,}5 \text{ m}^2$$

$$N_{sd} = N - \gamma_b \cdot b_x \cdot b_y \cdot d = -448{,}28 \text{ kN}$$

$$M_{sd,x} = M_x + N \cdot c_y = 0 \text{ kNm}$$

$$M_{sd,y} = M_y + N \cdot c_x = 347{,}39 \text{ kNm}$$

$$e_x = \frac{M_{sd,y}}{N_{sd}} = -77{,}49 \text{ cm}$$

$$e_y = \frac{M_{sd,x}}{N_{sd}} = 0 \text{ cm}$$

NAPREZANJA U TLU

$\sigma_1 = 0{,}00$ MN/m^2

$\sigma_2 = 0{,}13739$ MN/m^2

$\sigma_3 = 0{,}13739$ MN/m^2

$\sigma_4 = 0{,}00$ MN/m^2

ARMATURA

$M_{1\text{-}1} = 2{,}1$ kNm

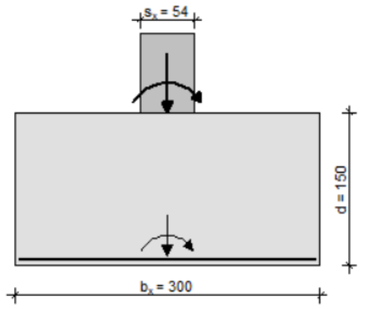
$M_{2\text{-}2} = 253{,}02$ kNm

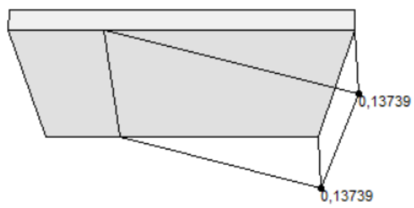
$M_{3\text{-}3} = 32{,}9$ kNm

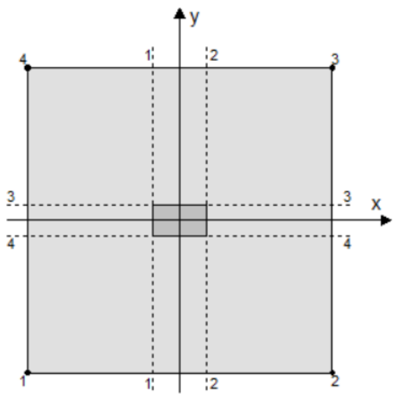
$M_{4\text{-}4} = 32{,}9$ kNm

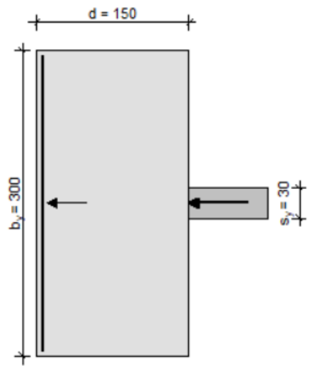
$$A_{sx} = \frac{M_{2\text{-}2}}{0.9 \cdot d \cdot f_{yd}} = \mathbf{4{,}46} \text{ cm}^2$$

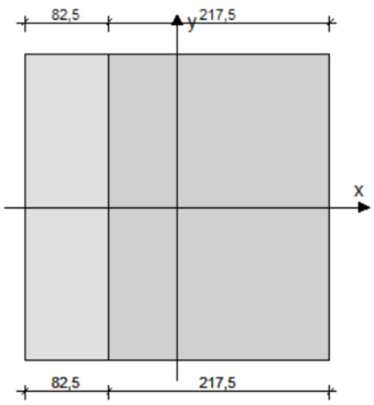
$$A_{sy} = \frac{M_{3\text{-}3}}{0.9 \cdot d \cdot f_{yd}} = \mathbf{0{,}58} \text{ cm}^2$$











8. Nacrti

9. Reference

[1] HRN EN 1991-1-3 : DJELOVANJA NA KONSTRUKCIJE – OPTEREĆENJE SNIJEGOM

[2] HRN EN 1991-1-4 : DJELOVANJA NA KONSTRUKCIJE – OPTEREĆENJE VJETROM

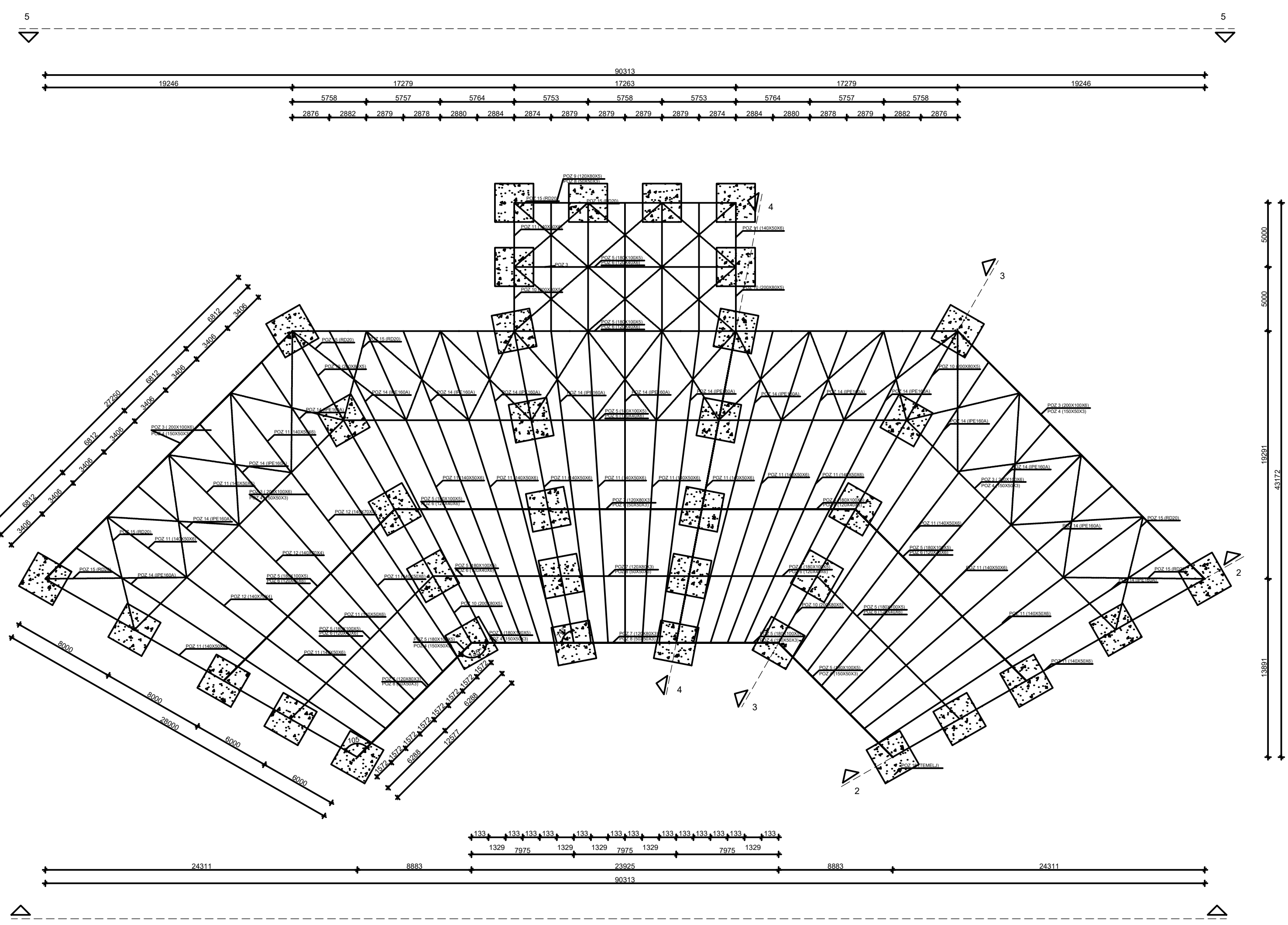
[3] HRN EN 1991-1-5 : DJELOVANJA NA KONSTRUKCIJE – TOPLINSKA DJELOVANJA

http://klima.hr/k1/k1_9/SLnormY7100p50_detaljno.pdf - Snijeg

http://klima.hr/k1/k1_9/obvY9201p50_detaljno.pdf -Vjetar

http://www.kartografija.hr/tl_files/Hkd/dogadjaji/Svjetski%20dan%20GISa/prezentcije/03_2012_Svjetski%20dan%20GIS_temperature_MPTadic_web.pdf -Temperatura

TLOCRT



PLAN POZICIJA NOSIVE KONSTRUKCIJE

M 1:100

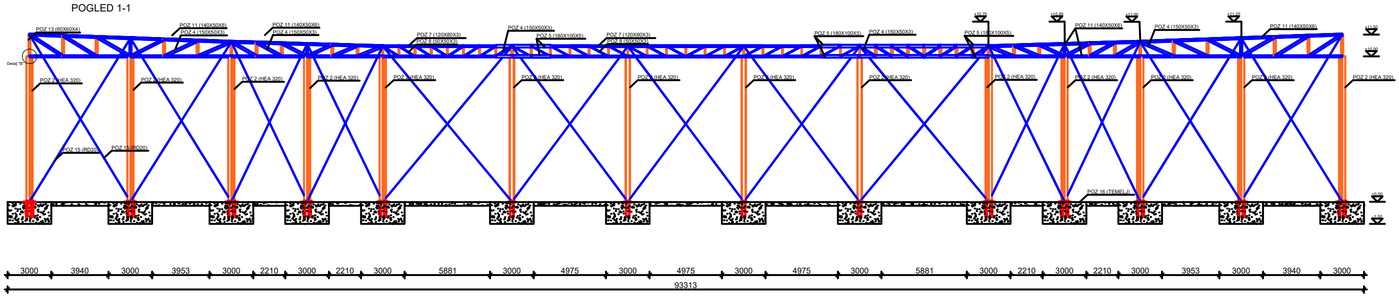
ČELIK S355

BETON C 25/30

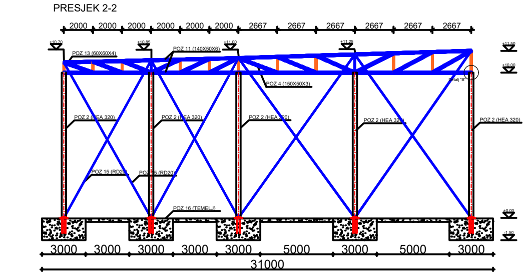
DIPLOMSKI RAD		
PROGRAM:	KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU	
STUDENT: Loris Bulić, 687	MENTOR dr.sc. N.Torić	
SADRŽAJ	PLAN POZICIJA KONSTRUKCIJE	MJERILO 1:100
DATUM	2018./2019	PRILOG 1

FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

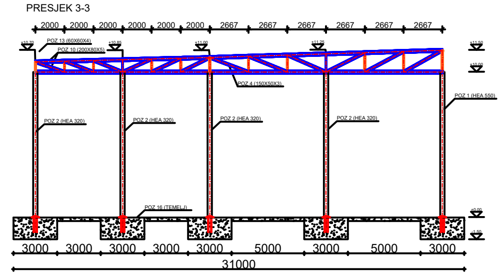
POGLED 1-1



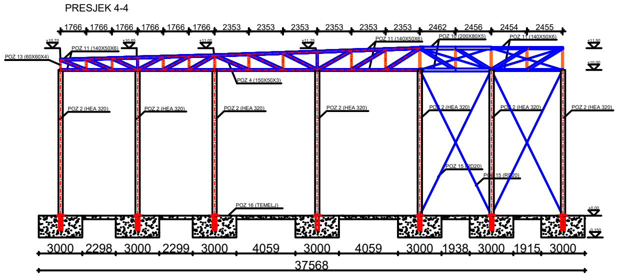
PRESJEK 2-2



PRESJEK 3-3



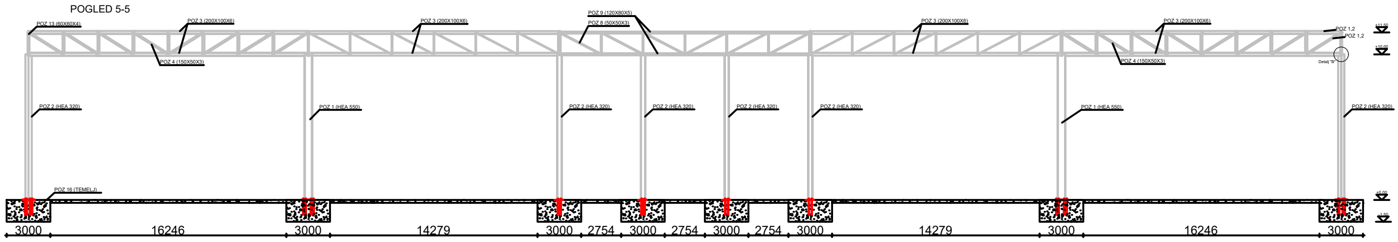
PRESJEK 4-4



PRIKAZ I OPIS POZICIJA		
POZICIJA	PROFIL	NAZIV
POZ 1	HEA 550	Stup 1
POZ 2	HEA 320	Stup 2
POZ 3	CFRHS 200X100X6	Gornji i donji pojas rešetke
POZ 4	CFRHS 150X50X3	Dijagonala rešetke
POZ 5	CFRHS 180X100X5	Gornji i donji pojas rešetke
POZ 6	CFRHS 120X40X6	Dijagonala rešetke
POZ 7	CFRHS 120X80X3	Gornji i donji pojas rešetke
POZ 8	CFRHS 50x50X3	Dijagonala rešetke
POZ 9	CFRHS 120X80X5	Gornji i donji pojas rešetke
POZ 10	CFRHS 200X80X5	Gornji i donji pojas rešetke
POZ 11	CFRHS 140X50X6	Gornji i donji pojas rešetke
POZ 12	CFRHS 140X70X4	Gornji i donji pojas rešetke
POZ 13	CFRHS 60X60X4	Vertikale
POZ 14	IPE 160A	Podrožnica
POZ 15	RD 20	Spregovi
POZ 16	TEMELJ	Temelj stupa

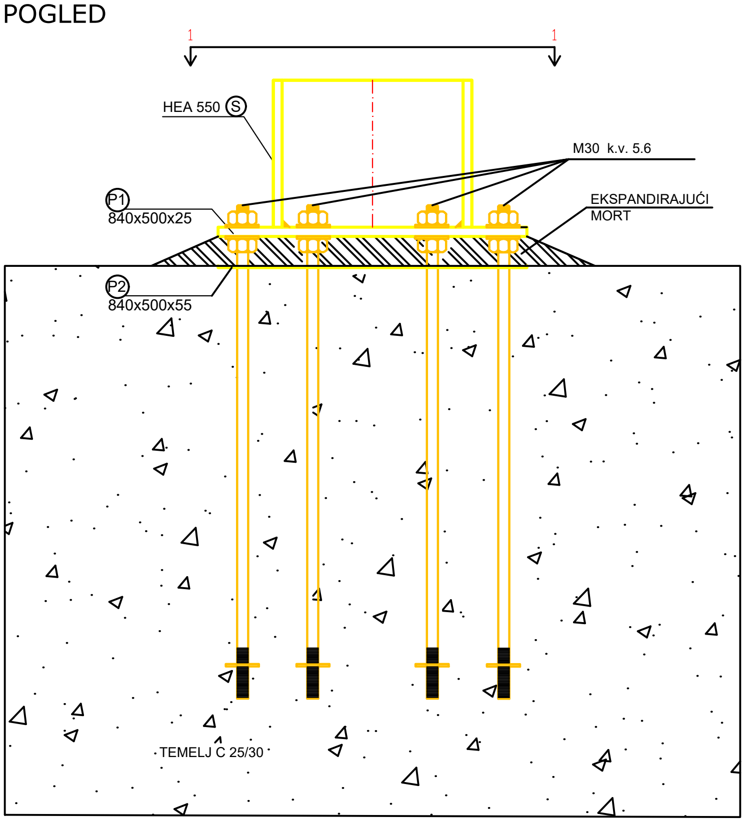
PLAN POZICIJA NOSIVE KONSTRUKCIJE
M 1:100
ČELIK S355
BETON C 25/30

POGLED 5-5



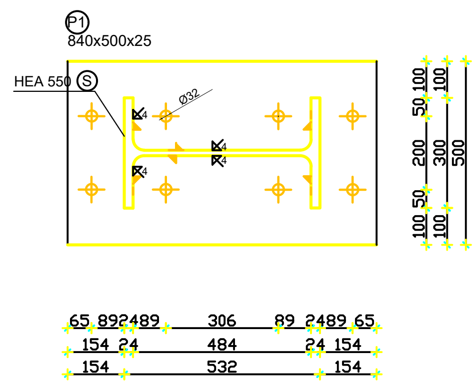
FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE 21000 SPLIT, MATICE HRVATSKE 15	DIPLOMSKI RAD		
	PROGRAM: KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU		
	STUDENT: Loris Bulić, 687	MENTOR dr.sc. N.Torić	
	SADRŽAJ PLAN POZICIJA KONSTRUKCIJE	MJERILO 1:100	
	DATUM 2018./2019	PRILOG 2	

POGLED



DETALJ "A"
SPOJ STUP-TEMELJ
M 1:10

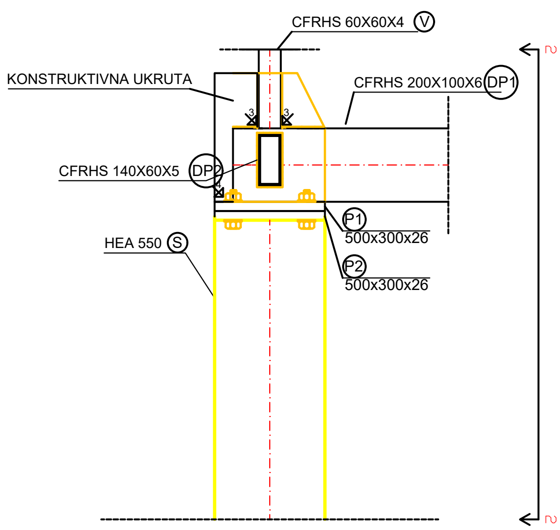
PRESJEK 1-1



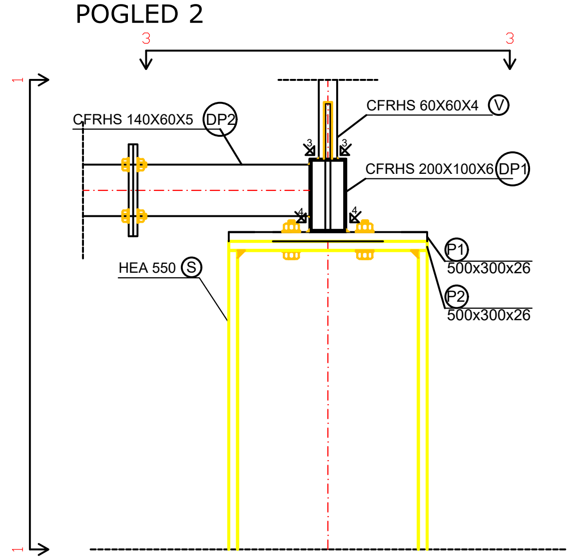
DIPLOMSKI RAD			
PROGRAM: KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU			
STUDENT: Loris Bulić, 687		MENTOR: dr.sc. N.Torić	
SADRŽAJ	SPOJ STUP TEMELJ	MJERILO	1:10
DATUM	2018./2019	PRILOG	3

FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

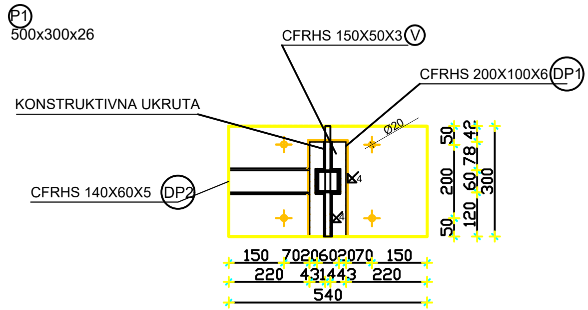
POGLED 1



POGLED 2



PRESJEK 3-3



7.4 DETALJ "B"

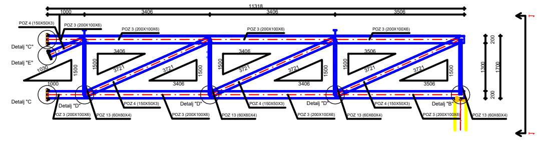
SPOJ STUP-REŠETKA

M 1:10

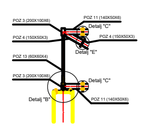
FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

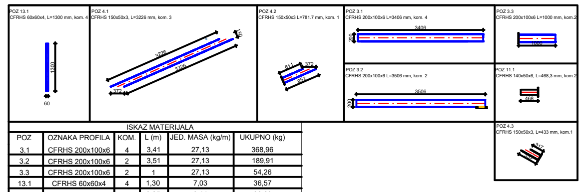
DIPLOMSKI RAD			
PROGRAM: KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU			
STUDENT: Loris Bulić, 687		MENTOR: dr.sc. N.Torić	
SADRŽAJ	DETALJ SPOJA STUP REŠETKA	MJERILO	1:10
DATUM	2018./2019	PRILOG	4

POGLED



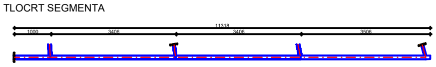
PRESJEK A-A



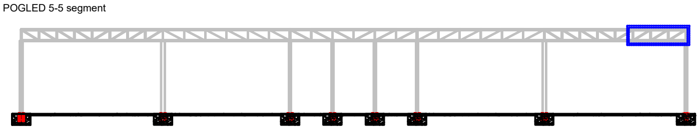


ISKAZ MATERIJALA					
POZ	OZNAKA PROFILA	KOM.	L (m)	JED. MASA (kg/m)	UKUPNO (kg)
3.1	CFRHS 200x100x6	4	3,41	27,13	368,96
3.2	CFRHS 200x100x6	2	3,51	27,13	189,91
3.3	CFRHS 200x100x6	2	1	27,13	54,26
13.1	CFRHS 60x60x4	4	1,30	7,03	36,57
4.1	CFRHS 150x50x3	3	3,25	9,14	88,63
4.2	CFRHS 150x50x3	1	0,78	9,14	7,31
11.1	CFRHS 140x50x6	2	0,47	16,77	15,76
11.1	CFRHS 150x50x3	1	0,43	9,14	3,93
DODATAK NA SPOJNE ELEMENTE I DODATNI MATERIJAL 10%				Σ	765,33+76,53=841,86

TLOCRT SEGMENTA



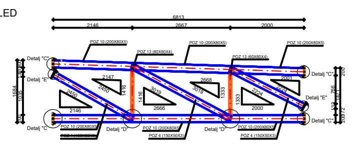
POGLED 5-5 segment



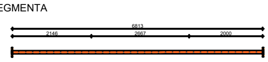
RADIONIČKI NACRT SEGMENTA 1
MJ 1:50

FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE 21000 SPLIT, MATICE HRVATSKE 15	DIPLOMSKI RAD	
	PROGRAM: KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU	
	STUDENT: Loris Bulić, 687	MENTOR: dr.sc. N.Torić
	SADRŽAJ RADIONIČKI NACRT SEGM. 1	MJERILO 1:50
	DATUM 2018./2019	PRILOG 5

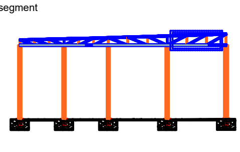
POGLED

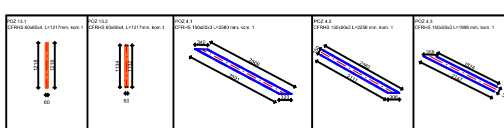


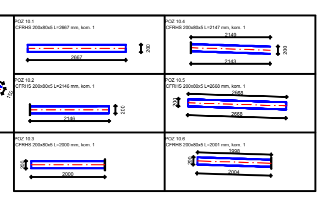
TLOCRT SEGMENTA



POGLED 3-3 segment







ISKAZ MATERIJALA					
POZ	OZNAKA PROFILA	KOM.	L (m)	JED. MASA (kg/m)	UKUPNO (kg)
10.1	CFRHS 200x80x5	1	2,67	21,2	56,60
10.2	CFRHS 200x80x5	1	2,12	21,2	44,94
10.3	CFRHS 200x80x5	1	2	21,2	42,4
10.4	CFRHS 200x80x5	1	2,15	21,2	45,58
10.5	CFRHS 200x80x5	1	2,67	21,2	56,60
10.6	CFRHS 200x80x5	1	2	21,2	42,4
4.1	CFRHS 150x50x3	1	2,58	9,14	23,58
4.2	CFRHS 150x50x3	1	2,26	9,14	20,66
4.3	CFRHS 150x50x3	1	1,99	9,14	18,28
13.1	CFRHS 60x60x4	2	1,22	7,03	17,15
DODATAK NA SPOJNE ELEMENTE I DODATNI MATERIJAL 10%				Σ	367,19+36,72=403,91

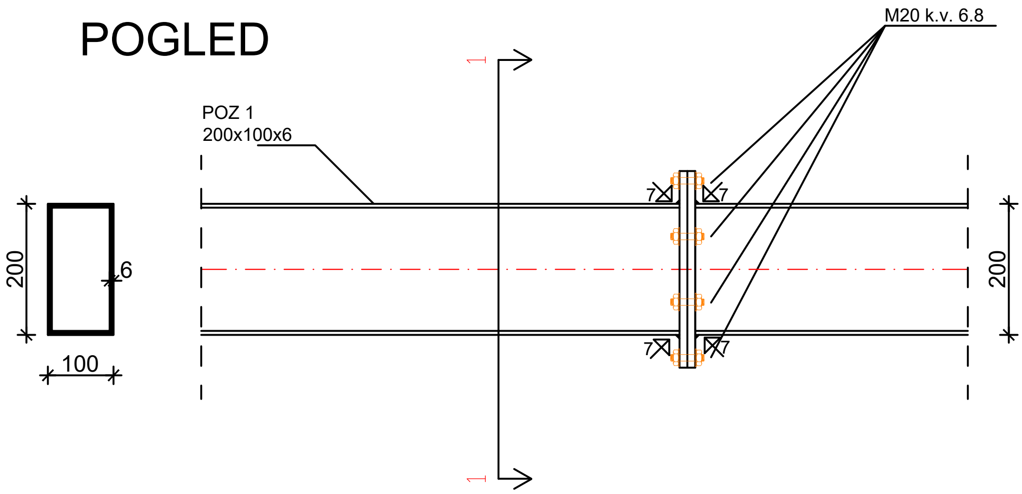
RADIONIČKI NACRT SEGMENTA 2
MJ 1:50

DIPLOMSKI RAD			
PROGRAM:	KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU		
STUDENT: Loris Bulić, 687		MENTOR: dr.sc. N.Torić	
SADRŽAJ	RADIONIČKI NACRT SEGM. 2	MJERILO	1:50
DATUM	2018./2019	PRILOG	6

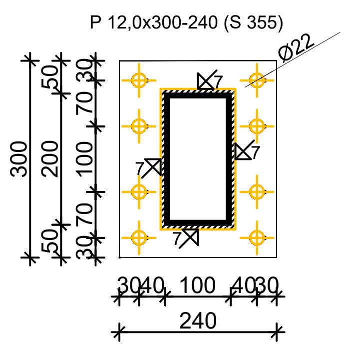
FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

DETALJ "C"
MONTAŽNI NASTAVAK REŠETKE
M 1:10

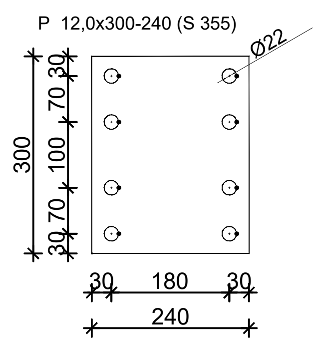
POGLED



PRESJEK 1-1



PLOČICA



FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

DIPLOMSKI RAD

PROGRAM: KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU

STUDENT: Loris Bulić,687

MENTOR: dr.sc. N.Torić

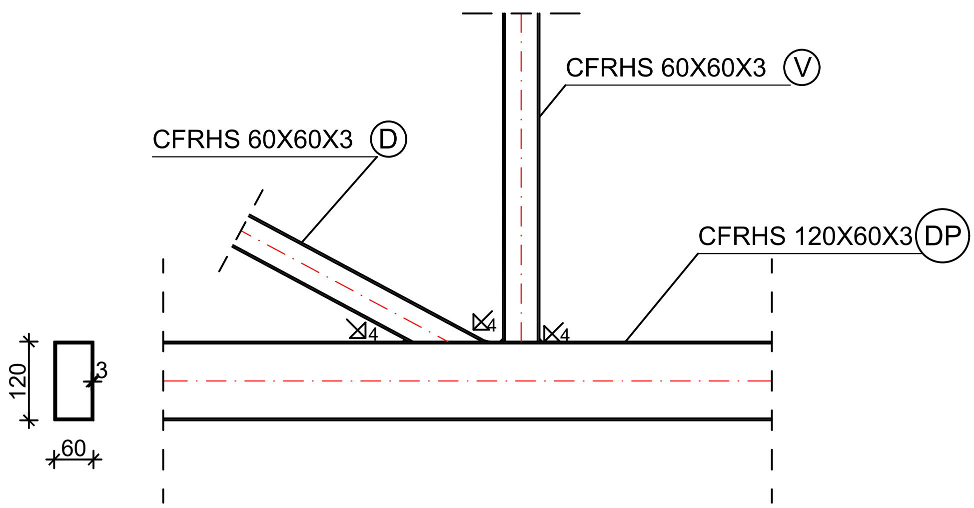
SADRŽAJ: MONTAŽNI NASTAVAK REŠETKE

MJERILO 1:10

DATUM 2018./2019

PRILOG 7

DETALJ "D"
VAR ISPUNE NA GLAVNI POJAS
M 1:10

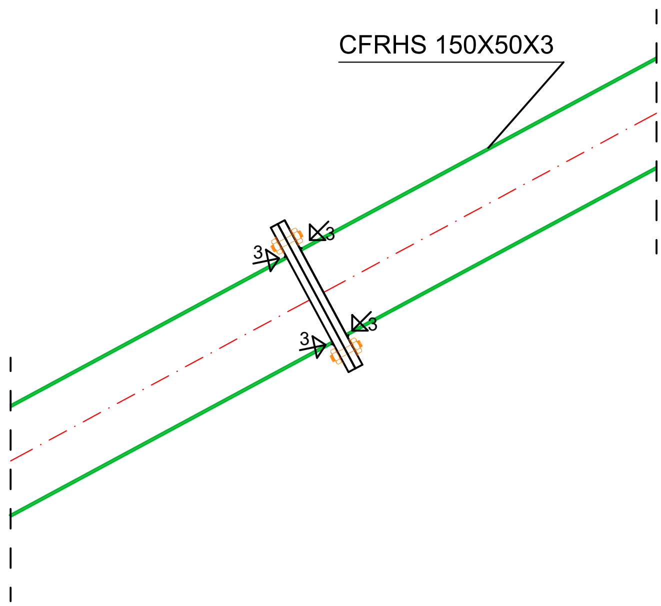


FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE 21000 SPLIT, MATICE HRVATSKE 15	DIPLOMSKI RAD		
	PROGRAM: KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU		
	STUDENT: Loris Bulić,687	MENTOR: dr.sc. N.Torić	
	SADRŽAJ: DETALJ VARA ISPUNE NA GL.POJAS	MJERILO	1:10
	DATUM: 2018./2019	PRILOG	8

DETALJ "E"

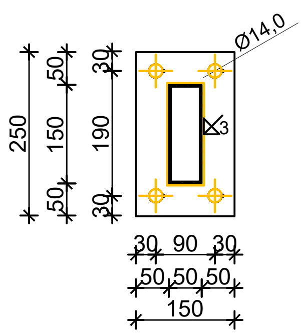
MONTAŽNI NASTAVAK DIJAGONALE REŠETKE

M 1:10



PRESJEK 1-1

P 10,0x250-150 (S 355)



PLOČICA

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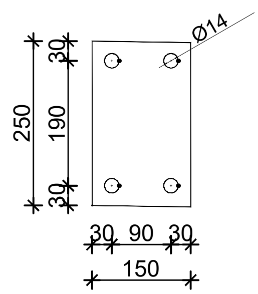

FAKULTET GRAĐEVINARSTVA, ARHITEKTURE I GEODEZIJE
KATEDRA ZA METALNE I DRVENE KONSTRUKCIJE
21000 SPLIT, MATICE HRVATSKE 15

DIPLOMSKI RAD

PROGRAM: KONSTRUKCIJA IZLOŽBENOG PAVILJONA NA PELJEŠCU

STUDENT: Loris Bulić,687

MENTOR: dr.sc. N.Torić

SADRŽAJ: MONTAŽNI NASTAVAK DIJAGONALE REŠETKE

MJERILO: 1:10

DATUM: 2018./2019

PRILOG: 9