

Načrt:

**2 Načrt gradbenih konstrukcij
in drugi gradbeni načrti**

Naziv gradnje:

VEČSTANOVANJSKI OBJEKT

Vrsta gradnje:

**SPREMEMBA NAMEMBNOSTI DELA
OBJEKTA**

Vrsta projektne dokumentacije:

PZI

Investitor:

**Javni stanovanjski sklad Mestne občine
Ljubljana
Zarnikova ulica 3
1000 Ljubljana**

Izdelovalec projektne dokumentacije:

**Enplan, arhitekturni biro, d.o.o.
Zaloška cesta 69
1000 Ljubljana**

Številka projekta:

004/17

Številka načrta:

004/17 - G

Kraj in datum izdelave:

Ljubljana, junij 2020

Številka izvoda:

1 2 3 4

PRILOGA 1B

NASLOVNA STRAN NAČRTA

2 GRADBENE KONSTRUKCIJE IN DRUGI GRADBENI NAČRTI

OSNOVNI PODATKI O GRADNJI

naziv gradnje	VEČSTANOVANJSKI OBJEKT - SPREMEMBA NAMEMBNOSTI DELA OBJEKTA
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kratek opis gradnje	Investitor želi spremeniti namembnost dela objekta v 3 stanovanja. Adaptacija prostorov v stanovanjsko namembnost zahteva reorganizacijo prostorov brez posega v nosilno konstrukcijo.
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VRSTE GRADNJE	SPREMEMBA NAMEMBNOSTI
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DOKUMENTACIJA

vrsta dokumentacije	PZI (projektna dokumentacija za izvedbo gradnje)
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<input type="checkbox"/> sprememba dokumentacije
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številka projekta	004/17
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PODATKI O NAČRTU

strokovno področje načrta	2 GRADBENE KONSTRUKCIJE IN DRUGI GRADBENI NAČRTI
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številka načrta	004/17 - G
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datum izdelave	junij 2020
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PODATKI O IZDELOVALCU NAČRTA

ime in priimek pooblaščenega arhitekta, pooblaščenega inženirja ali druge osebe	Marko KEŠE, dipl.inž.grad.
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identifikacijska številka	IZS G-4595
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podpis pooblaščenega arhitekta, pooblaščenega inženirja ali druge osebe	
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PODATKI O PROJEKTANTU

projektant (naziv družbe)	Enplan, arhitekturni biro, d.o.o.
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sedež družbe	Zaloška cesta 69, 1000 Ljubljana
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vodja projekta	Tanja MODIC, univ.dipl.inž.arh.
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identifikacijska številka	ZAPS 1635 A
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podpis vodje projekta	
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odgovorna oseba projektanta	Jure ŠOSTER
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podpis odgovorne osebe projektanta	
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A. TEHNIČNI OPIS

1. SPLOŠNO

OBSTOJEČE STANJE

V mestni občini Ljubljana, k.o. Dravlje, na zemljiščih s parcelnimi številkami 951/80, 951/81, stoji večstanovanjski objekt s pisarnami. Obstoječi objekt ima AB konstrukcijo in je nadkrit z ravno streho. Predmet obdelave je srednji del pritličja obstoječega objekta, kjer so trenutno pisarne – ID znak 1738-3199-200, k.o. 1738–Dravlje. Vhodi v ta del objekta si iz J strani.

PREDVIDENO STANJE IN OPIS NAMERAVANEGA POSEGA

Investitor želi spremeniti namembnost dela objekta v 3 stanovanja. Adaptacija prostorov v stanovanjsko namembnost zahteva reorganizacijo prostorov brez posega v nosilno konstrukcijo. Adaptacija bo obsegala odstranitev obstoječih tlakov in predelnih sten, montažo novih predelnih sten in tlakov in predelavo instalacij znotraj dela objekta. Nosilna konstrukcija se ohranja v obstoječem stanju. Na fasadi se bodo izvajala vzdrževalna dela.

V sklopu vzdrževalnih del se bodo zamenjale zunanje steklene stene in streha dveh delov objekta – pritličnih izzidkov. Predmetni načrt gradbenih konstrukcij 004/17-G obravnava postavitev konstrukcije izzidka z ravno streho. Ostale steklene stene so znotraj obstoječe AB konstrukcije in ne potrebujejo dodatne podkonstrukcije.

2. ZASNOVA

Obravnavana pritlična izzidka se nahajata med osjo C in D ter med I in J (glej načrt). Konstrukcija izzidka bo znotraj steklene stene in strehe in bo sidrana v obstoječo nosilno AB konstrukcijo.



Pritlični izzidek – na mestu odstranjenih steklenih sten in strehe se bo znotraj nove steklene stene in strehe postavila nova jeklena konstrukcija

3. KONSTRUKCIJA

Konstrukcija izzidka bo jeklena, skeletna. Sestavljena bo iz standardnih škatlastih kvadratnih in pravokotnih profilov ter IPE profilov, ki bodo med sabo varjeni in vijačeni.

Predvidena nosilna konstrukcija bo sestavljena iz enega vzdolžnega okvirja, ki bo z obstoječo AB konstrukcijo povezan z dvema prečkama v prečni smeri, na kateri bodo pritrjeni tudi toplotno izolacijski paneli (npr. Trimoterm FTV – dovoljen razpon za panel $d = 100$ mm in enopoljni nosilec je pri obtežbi $1,25 \text{ kN/m}^2$ cca $4,70$ m, zato dodatne vmesne prečke v prečni smeri niso potrebne). Vzdolžni okvir bo sestavljen iz treh stebrov, ki bodo kvadratnih cevi, profila $50/50/4$ mm in ene prečke, ki bo pravokotna cev, profila $100/50/4$ mm. Okvir v vzdolžni smeri bo v celoti varjen. Predvideni so čelni vari s polno penetracijo V ($a \geq t$), za katere velja, da je njihova projektna nosilnost enaka oz. večja od projektne nosilnosti šibkejšega od stikovanih elementov. Prečki v vzdolžni smeri bosta profila IPE 100 in bosta z okvirjem povezani preko členkastega vijačenega spoja. V ravnini prečk je predvideno tudi diagonalno zavetrovanje s palicami $\phi 10$ z napenjalko.

Jeklena konstrukcija izzidka bo sidrana v obstoječo armiranobetonsko ploščo in steno s pomočjo kemičnih sider HILTI, tip HIT-HY 200 in sidri HIT-V M10 8.8. Predvidena debelina armiranobetonske talne plošče in stene je 20 cm. Obstoječo AB konstrukcijo je potrebno obvezno preveriti pred začetkom izvedbe del.

4. OBTEŽBE

- lastna teža posameznih elementov je upoštevana po specifičnih težah
- stalna obtežba
- koristna obtežba
- obtežba vetra in snega

5. PREDPISI

- SIST EN 1990 Osnove projektiranja
- SIST EN 1991 Vplivi na konstrukcije
- SIST EN 1992 Projektiranje betonskih konstrukcij
- SIST EN 1993 Projektiranje jeklenih konstrukcij

6. MATERIALI

V statičnem izračunu je upoštevana naslednja kvaliteta vgrajenega materiala:

Beton:	C25/30
Jeklo (armatura):	S500-B
Jeklo (konstrukcija):	S235 JR
Vijaki in sidra:	8.8

v Ljubljani, junij 2020

B. STATIČNI IZRAČUN

1. MATERIALI

• Beton

Predvideva se, da je bil uporabljen beton trdnostnega razreda C25/30, z naslednjimi karakterističnimi lastnostmi:

- tlačna trdnost $f_{c,k} = 25,0 \text{ MPa}$,
- natezna trdnost $f_{c,t,m} = 2,6 \text{ MPa}$.

Modul elastičnosti je $E_{c,m} = 31 \text{ GPa}$.

• Armaturno jeklo

Predvideva se, da je bila uporabljena gladka palična in mrežna jeklena armatura trdnostnega razreda S240 (palice) in S400 (mreže), z naslednjimi karakterističnimi lastnostmi:

- trdnost na meji tečenja armature (palice) $f_{y,k} = 240 \text{ MPa}$,
- trdnost na meji tečenja armature (mreže) $f_{y,k} = 400 \text{ MPa}$.

Modul elastičnosti je $E_s = 200 \text{ GPa}$. Srednja vrednost gostote jekla je $\rho = 7850 \text{ kg/m}^3$.

• Konstrukcijsko jeklo

Predvideno je mehko konstrukcijsko jeklo S235 JR, z naslednjimi karakterističnimi lastnostmi:

- nazivna napetost tečenja $f_{y,k} = 235 \text{ MPa}$.

Modul elastičnosti je $E_s = 210 \text{ GPa}$. Srednja vrednost gostote jekla je $\rho = 7850 \text{ kg/m}^3$.

• Varnostni faktorji materiala

Varnostni faktorji materiala zajemajo nezanesljivosti pri kvaliteti materiala. Za dimenzioniranje uporabljamo projektne vrednosti lastnosti materiala, ki jih dobimo tako, da karakteristične vrednosti delimo z delnimi varnostnimi faktorji za material.

Varnostni faktorji materialov - betona, armaturnega jekla, opečnega zidu in lesa.

PROJEKTN SITUACIJA	MEJNO STANJE NOSILNOSTI				MEJNO STANJE UPORABNOSTI			
	BETON – γ_c	JEKLO – γ_s	LES – γ_M	OP. ZID – γ_M	BETON – γ_c	JEKLO – γ_s	LES – γ_M	OP. ZID – γ_M
OSNOVNA	1,50	1,15	1,30	2,2	1,00	1,00	1,00	1,00

Varnostni faktorji konstrukcijskega jekla in veznih sredstev

PROJEKTN SITUACIJA	MEJNO STANJE NOSILNOSTI				MEJNO STANJE UPORABNOSTI			
	γ_{M0}	γ_{M1}	γ_{M2}	$\gamma_{M,ser}$	γ_{M0}	γ_{M1}	γ_{M2}	$\gamma_{M,ser}$
OSNOVNA	1,0	1,0	1,25	/	1,0	/	/	1,0

γ_{M0} (nosilnost prečnih prerezov), γ_{M1} (odpornost elementov na nestabilnost), γ_{M2} (odpornost natežno obremenjenih neto prečnih prerezov na pretrg, vijaki, zvari).

2. OBTEŽBE

2.1. Lastne teže in stalne obtežbe:

• Streha (ravna, nepohodna):	
- hidroizolacija s posipom	0,05 kN/m ²
- toplotna izolacija v naklonu (d = 4-9 cm)	0,05 kN/m ²
- toplotno izolacijski panel - npr. Trimo (d = 10 cm)	0,20 kN/m ²
- jeklena konstrukcija	upošteva program
- toplotna izolacija – kamena volna (d = 14 cm)	0,20 kN/m ²
- mavčnokartonske plošče na podk.	0,25 kN/m ²
$\Sigma g =$	0,75 kN/m ²

2.2. Koristne obtežbe:

- Bivalni prostori $q = 2,0 \text{ kN/m}^2$

2.3. Vpliv snega:

Koeficient izpostavljenosti C_e :

Teren:

$C_e = 1,0$

Toplotni koeficient C_t :

$C_t = 1,0$

Oblikovni koeficient μ :

Naklon strehe:

$\alpha_1 = 2^\circ$

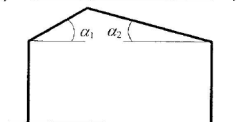
$\alpha_2 =$

$\mu(\alpha_1) = 0,80$

primer (i) $\mu_1(\alpha_1)$ $\mu_1(\alpha_1)$

primer (ii) $0,5\mu_1(\alpha_1)$ $\mu_1(\alpha_1)$

primer (iii) $\mu_1(\alpha_1)$ $0,5\mu$



Slika 5.3: Oblikovni koeficient obtežbe snega pri c
Vrednosti veljajo če lahko sneg zdrsne s strehe. Če so na strehi snegobrani ali druge ovire ali če se nagib strehe zmanjša zaradi parapetov, oblikovni koef. ne sme biti manjši od 0,8.

Ali so na strehi snegobrani?

Ne

$\mu(\alpha_1) = 0,80$

Karakteristična obtežba na tleh na določenem kraju s_k :

Nadmorska višina: m

Snežna cona:

$s_k = 1,53$

Obtežba snega na strehi:

$s = \mu \cdot C_e \cdot C_t \cdot s_k = 1,22 \text{ kN/m}^2$

2.4. Vpliv vetra:

Osnovna hitrost vetra

$$v_b = C_{dir} \cdot C_{season} \cdot v_{b,0} =$$

$$v_{b,0} = 20 \text{ m/s}$$

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

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

20 m/s

Cona 1, pod 800 m

Srednja hitrost vetra

$$v_m(z) = c_r(z) \cdot c_o(z) \cdot v_b =$$

12,12 m/s

$$z = 2,70 \text{ m}$$

$$c_r(z) = 0,61$$

z_0 (m)	z_{min} (m)	z_{max} (m)
0,3	5	200

$$c_r(z) = k_r \cdot \ln(z/z_0)$$

$$k_r = 0,19 \cdot (z_0/z_{0,II})^{0,07}$$

$$c_r(z) = c_r(z_{min})$$

za $z_{min} \leq z \leq z_{max}$

za $z \leq z_{min}$

$$c_o(z) = 1,0$$

Vetrna turbolenca

$$I_v(z) = 0,355$$

$$I_v(z) = \sigma_v/v_m(z) = k_f/c_o(z) \cdot \ln(z/z_0) \text{ za } z_{min} \leq z \leq z_{max}$$

$$k_f = 1,0$$

$$I_v(z) = I_v(z_{min})$$

za $z \leq z_{min}$

Tlak pri največji hitrosti ob sunkih vetra

$$q_p(z) = [1 + 7 \cdot I_v(z)] \cdot 1/2 \cdot \rho \cdot v_m^2(z) = c_e(z) \cdot q_b =$$

0,32 kN/m²

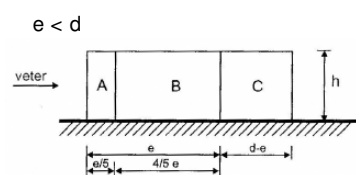
$$\rho = 1,25 \text{ kg/m}^3$$

Tlak vetra na stene

Smer vetra $\theta = 0^\circ$

$$h/d = 0,18$$

Področje	c_{pe}	$q_w = c_{pe} \cdot q_p \text{ [kN/m}^2\text{]}$
E	-0,50	-0,16
D	1,00	0,32
C	-0,70	-0,22
B	-1,00	-0,32
A	-1,40	-0,45



$$d - e = 9,60 \text{ m}$$

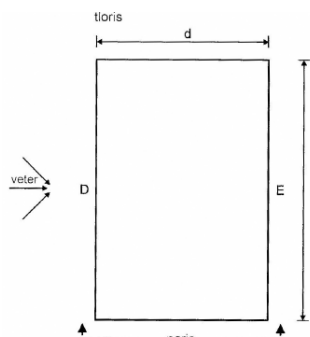
$$e/5 = 1,08 \text{ m}$$

$$4/5 e = 4,32 \text{ m}$$

Smer vetra $\theta = 90^\circ$

$$h/d = 0,03$$

Področje	c_{pe}	$q_w = c_{pe} \cdot q_p \text{ [kN/m}^2\text{]}$
E	-0,50	-0,16
D	1,00	0,32
C	-0,70	-0,22
B	-1,00	-0,32
A	-1,40	-0,45

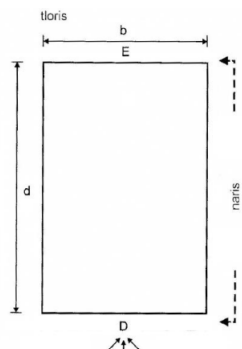


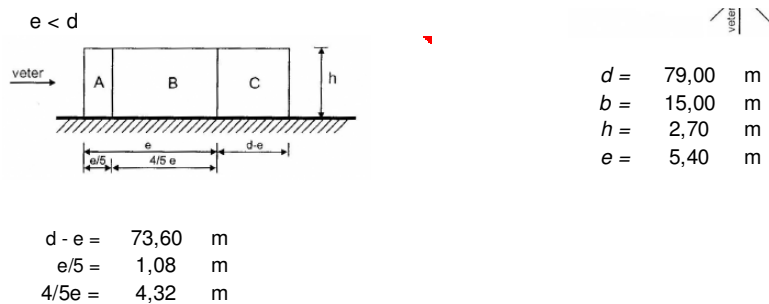
$$d = 15,00 \text{ m}$$

$$b = 79,00 \text{ m}$$

$$h = 2,70 \text{ m}$$

$$e = 5,40 \text{ m}$$





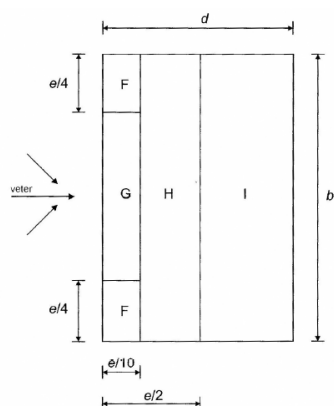
Upoštevam tudi notranje tlake c_{pi} ? ☐ Da ☐ Ne

*Za koeficient c_{pi} se privzame neugodnejša vrednost med +0,2 in -0,3 ($=c_{pe} + c_{pi}$)

Tlak vetra na ravno streho

Vrsta ravne strehe: ☐ Ostri kapni rob ☐ Zaobljeni in mansardni kapni robovi

Področje	c_{pe}	$q_w = c_{pe} \cdot q_p \text{ [kN/m}^2\text{]}$
F	-2,00	-0,64
G	-1,40	-0,45
H	-0,90	-0,29
I	-0,40	-0,13
	0,50	0,16



$$b = 3,20 \text{ m}$$

$$d = 2,00 \text{ m}$$

$$h = 6,70 \text{ m}$$

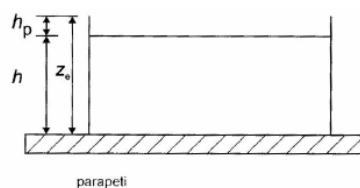
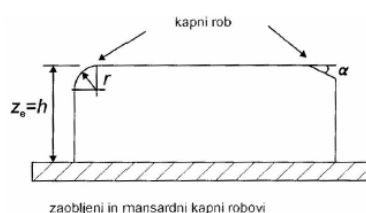
$$e = 3,20 \text{ m}$$

$$e/4 = 0,80 \text{ m}$$

$$e/10 = 0,32 \text{ m}$$

Upoštevam tudi notranje tlake c_{pi} ? ☐ Da ☐ Ne

*Za koeficient c_{pi} se privzame neugodnejša vrednost med +0,2 in -0,3 ($=c_{pe} + c_{pi}$)



2.5. Obtežni varnostni faktorji:

Obtežni varnostni faktorji so odvisni od vrste in kombinacije zunanjih obtežb ter od ugodnega oziroma neugodnega delovanja stalne obtežbe.

Projektna vrednost vpliva F_d je določena z izrazom:

$$F_d = \gamma_F \cdot F_{rep}$$

kjer sta:

γ_F delni varnostni faktor,
 F_{rep} reprezentativna vrednost vpliva.

Reprezentativne vrednosti obtežb so:

- karakteristična vrednost Q_k ,
- kombinacijska vrednost $\psi_0 \cdot Q_k$,
- pogosta vrednost $\psi_1 \cdot Q_k$,
- navidezno stalna vrednost $\psi_2 \cdot Q_k$.

Kombinacijski faktorji ψ (SIST EN 1990:2004).

VRSTA VPLIVA	ψ_0	ψ_1	ψ_2
KORISTNA OBTEŽBA V STAVBAH – BIVALNI PROSTORI	0,7	0,5	0,3
KORISTNA OBTEŽBA V STAVBAH – STREHA	0,0	0,0	0,0
OBTEŽBA S SNEGOM	0,5	0,2	0,0
OBTEŽBA Z VETROM	0,6	0,2	0,0

Delni varnostni faktorji za obtežbo (SIST EN 1990:2004).

PROJEKTNJA SITUACIJA	MEJNO STANJE NOSILNOSTI MSN		MEJNO STANJE UPORABNOSTI MSU	
	γ_G	γ_Q	γ_G	γ_Q
OSNOVNA				
UGODEN VPLIV	1,0	0	1,0	0
NEUGODEN VPLIV	1,35	1,5	1,0	1,0
NEZGODNA	1,0	1,0	-	-

Mejna stanja, ki se nanašajo na varnost ljudi in varnost konstrukcije upoštevamo kot mejna stanja nosilnosti. Prekoračitev mejnih stanj nosilnosti pomeni odpoved konstrukcije in kasnejšo odstranitev ali rekonstrukcijo. Računske vrednosti zunanjih vplivov se določijo z ustreznim kombiniranjem delujočih obtežb.

Osnovne obtežne kombinacije izračunamo z izrazom:

$$\sum \gamma_{G,j} \cdot G_{k,j} + \gamma_{Q,1} \cdot Q_{k,1} + \sum_{i>1} \gamma_{Q,i} \cdot \psi_{0,i} \cdot Q_{k,i}$$

Nezgodne obtežne kombinacije izračunamo z izrazom:

$$\sum G_{k,j} + A_k + \psi_{1,1} \cdot Q_{k,1} + \sum_{i>1} \psi_{2,i} \cdot Q_{k,i}$$

Mejna stanja, ki se nanašajo na delovanje konstrukcije, udobje ljudi in videz gradbenega objekta, upoštevamo kot mejna stanja uporabnosti.

Upoštevati moramo tri kombinacije vplivov:

- karakteristično obtežno kombinacijo

$$\sum G_{k,j} + Q_{k,1} + \sum_{i>1} \psi_{0,i} \cdot Q_{k,i}$$

- pogosto obtežno kombinacijo

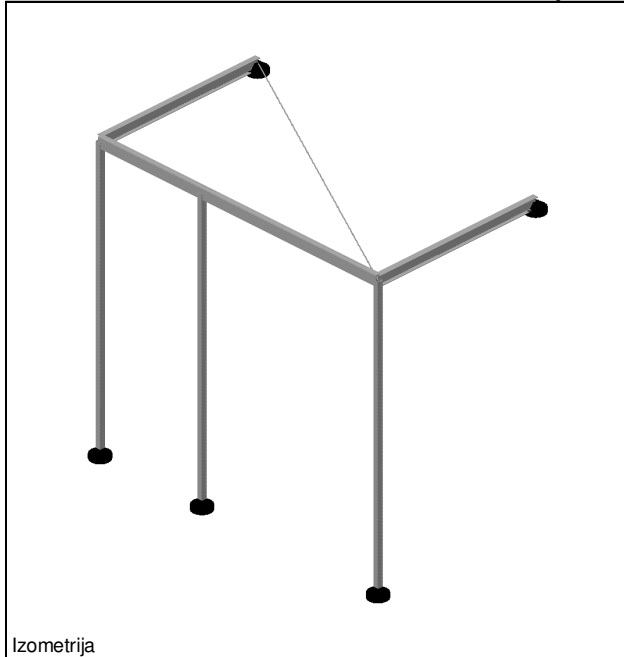
$$\sum G_{k,j} + \psi_{1,1} \cdot Q_{k,1} + \sum_{i>1} \psi_{2,i} \cdot Q_{k,i}$$

- navidezno stalno obtežno kombinacijo

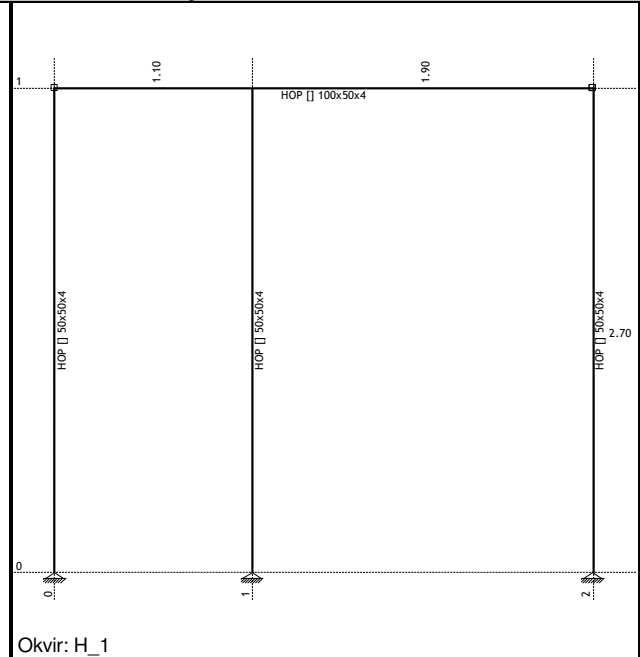
$$\sum G_{k,j} + \sum_{i \geq 1} \psi_{2,i} \cdot Q_{k,i}$$

3. STATIČNI IZRAČUN – izpis rezultatov

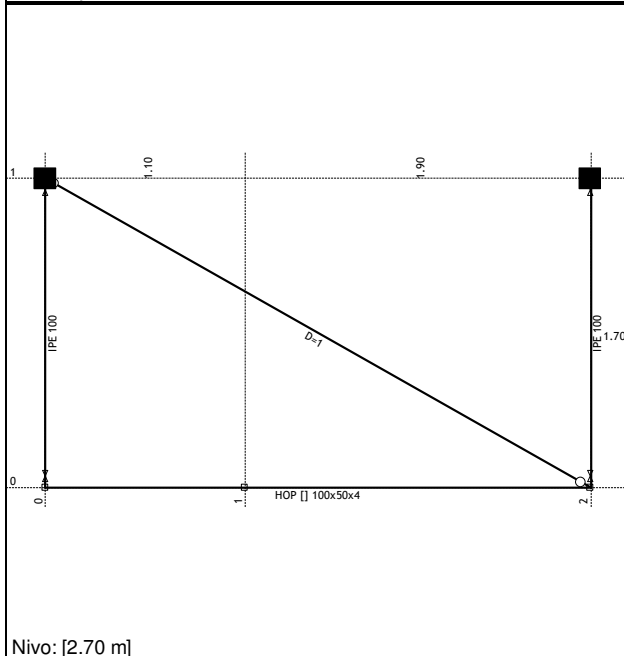
Vhodni podatki - Konstrukcija



Izometrija



Okvir: H_1



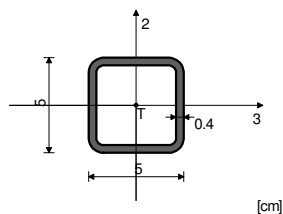
Nivo: [2.70 m]

Tabele materialov

No	Naziv materiala	E[kN/m ²]	μ	γ [kN/m ³]	α [1/C]	Em[kN/m ²]	μ m
1	Jeklo	2.100e+8	0.30	78.50	1.000e-5	2.100e+8	0.30

Seti gred

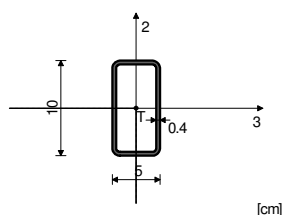
Set: 1 Prerez: HOP [] 50x50x4, Fiktivna ekscentričnost



[cm]

Mat.	A1	A2	A3	I1	I2	I3
1 - Jeklo	6.950e-4	4.000e-4	4.000e-4	4.005e-7	2.374e-7	2.374e-7

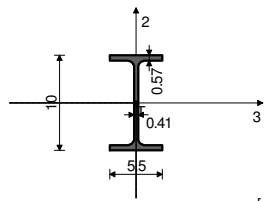
Set: 2 Prerez: HOP [] 100x50x4, Fiktivna ekscentričnost



[cm]

Mat.	A1	A2	A3	I1	I2	I3
1 - Jeklo	1.095e-3	8.000e-4	4.000e-4	1.124e-6	4.490e-7	1.341e-6

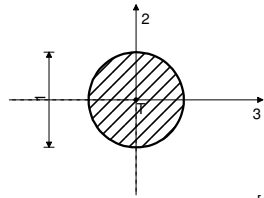
Set: 3 Prerez: IPE 100, Fiktivna ekscentričnost



[cm]

Mat.	A1	A2	A3	I1	I2	I3
1 - Jeklo	1.030e-3	5.062e-4	5.238e-4	1.210e-8	1.590e-7	1.710e-6

Set: 4 Prerez: D=1, Fiktivna ekscentričnost



[cm]

Mat.	A1	A2	A3	I1	I2	I3
1 - Jeklo	7.854e-5	7.069e-5	7.069e-5	9.817e-10	4.909e-10	4.909e-10

Seti: točkovnih podpora

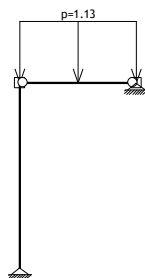
Set	K,R1	K,R2	K,R3	K,M1	K,M2	K,M3
1	1.000e+10	1.000e+10	1.000e+10			

Lista obtežnih primerov

LC	Naziv
1	Stalna + lastna (g)
2	Sneg
3	Veter vzdolžno
4	Veter prečno
5	Komb.: 1.35xI+1.5xII+0.9xIV
6	Komb.: 1.35xI+1.5xII+0.9xIII
7	Komb.: 1.35xI+0.75xII+1.5xIV
8	Komb.: 1.35xI+0.75xII+1.5xIII
9	Komb.: I+1.5xII+0.9xIV
10	Komb.: I+1.5xII+0.9xIII
11	Komb.: I+0.75xII+1.5xIV
12	Komb.: I+0.75xII+1.5xIII
13	Komb.: 1.35xI+1.5xIV

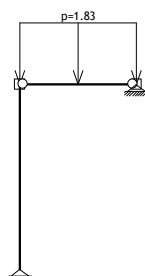
14	Komb.: 1.35xI+1.5xIII
15	Komb.: 1.35xI+1.5xII
16	Komb.: I+1.5xIV
17	Komb.: I+1.5xIII
18	Komb.: I+1.5xII
19	Komb.: 1.35xI
20	Komb.: I+II+III
21	Komb.: I+II+IV
22	Komb.: I+II
23	Komb.: I+III
24	Komb.: I+IV

Obt. 1: Stalna + lastna (g)



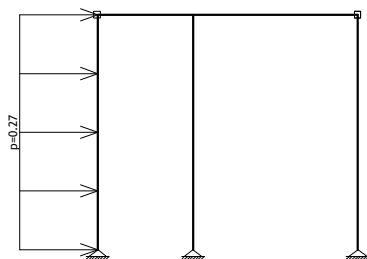
Okvir: V_1

Obt. 2: Sneg



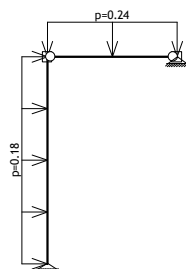
Okvir: V_1

Obt. 3: Veter vzdolžno



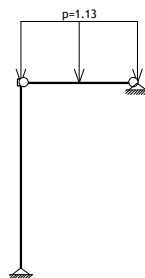
Okvir: H_1

Obt. 4: Veter prečno



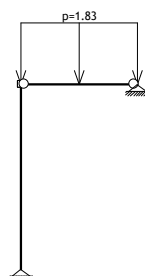
Okvir: V_1

Obt. 1: Stalna + lastna (g)



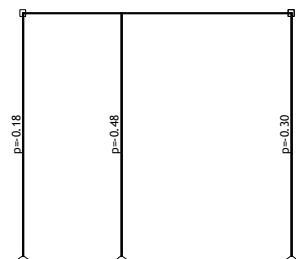
Okvir: V_2

Obt. 2: Sneg



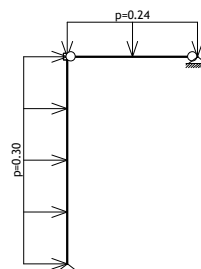
Okvir: V_2

Obt. 4: Veter prečno



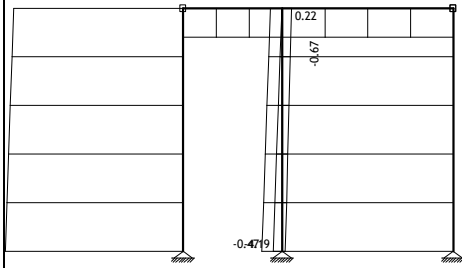
Okvir: H_1

Obt. 4: Veter prečno



Okvir: V_2

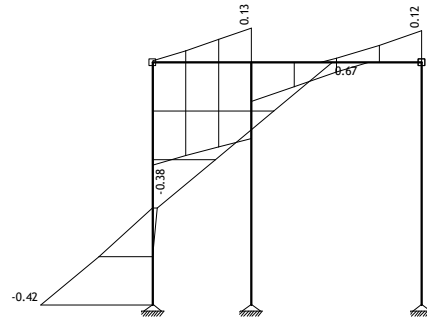
Obt. 25: [MSN] 5-19



Okvir: H_1

Vplivi v gredi: max N1= 0.22 / min N1= -4.19 kN

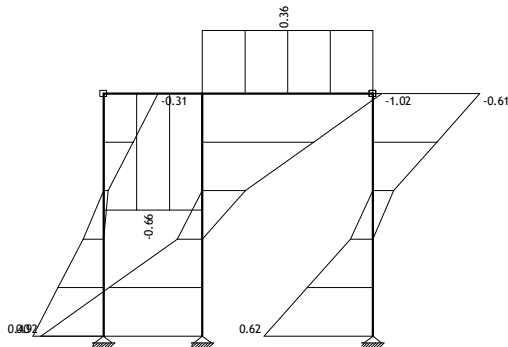
Obt. 25: [MSN] 5-19



Okvir: H_1

Vplivi v gredi: max T2= 0.67 / min T2= -0.42 kN

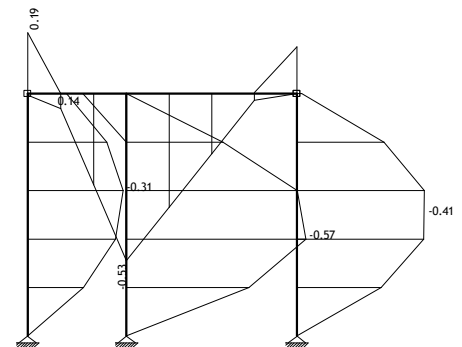
Obt. 25: [MSN] 5-19



Okvir: H_1

Vplivi v gredi: max T3= 0.92 / min T3= -1.02 kN

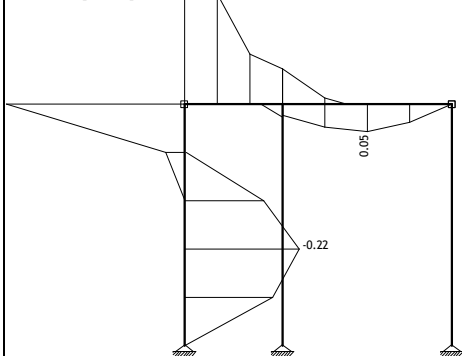
Obt. 25: [MSN] 5-19



Okvir: H_1

Vplivi v gredi: max M2= 0.19 / min M2= -0.57 kNm

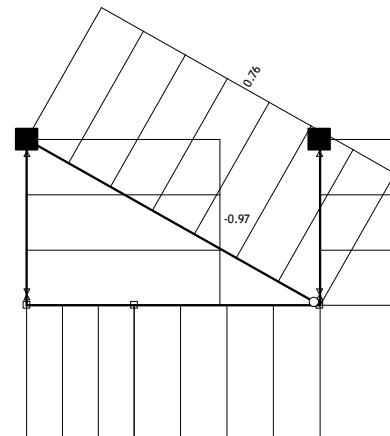
Obt. 25: [MSN] 5-19



Okvir: H_1

Vplivi v gredi: max M3= 0.34 / min M3= -0.34 kNm

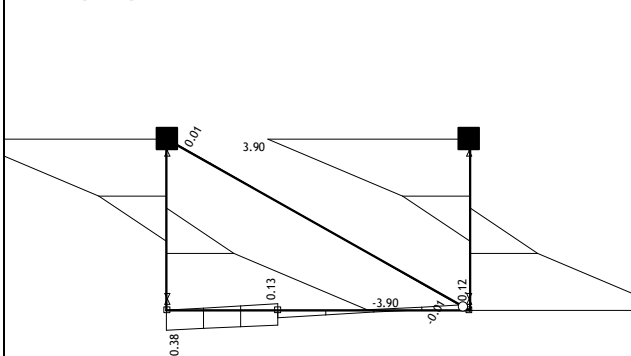
Obt. 25: [MSN] 5-19



Nivo: [2.70 m]

Vplivi v gredi: max N1= 0.76 / min N1= -0.98 kN

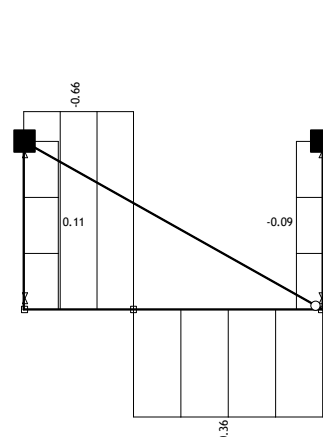
Obt. 25: [MSN] 5-19



Nivo: [2.70 m]

Vplivi v gredi: max T2= 3.90 / min T2= -3.90 kN

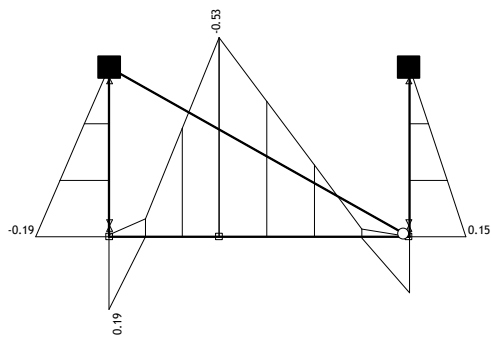
Obt. 25: [MSN] 5-19



Nivo: [2.70 m]

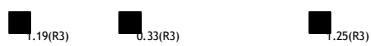
Vplivi v gredi: max T3= 0.36 / min T3= -0.66 kN

Obt. 25: [MSN] 5-19



Nivo: [2.70 m]
Vplivi v gredi: max M2= 0.19 / min M2= -0.53 kNm

Obt. 1: Stalna + lastna (g)



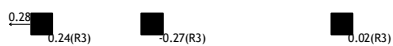
Nivo: [0.00 m]
Reakcije podpor

Obt. 2: Sneg



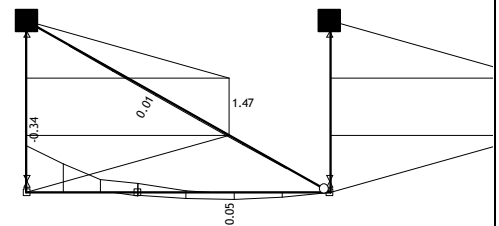
Nivo: [0.00 m]
Reakcije podpor

Obt. 3: Veter vzdolžno



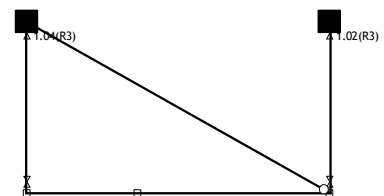
Nivo: [0.00 m]
Reakcije podpor

Obt. 25: [MSN] 5-19



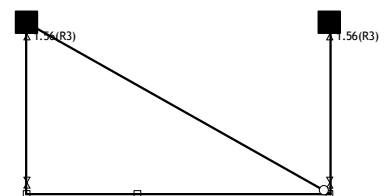
Nivo: [2.70 m]
Vplivi v gredi: max M3= 1.47 / min M3= -0.34 kNm

Obt. 1: Stalna + lastna (g)



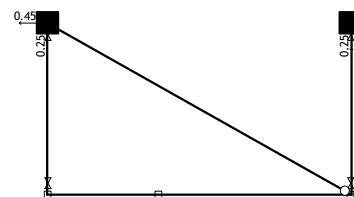
Nivo: [2.70 m]
Reakcije podpor

Obt. 2: Sneg



Nivo: [2.70 m]
Reakcije podpor

Obt. 3: Veter vzdolžno



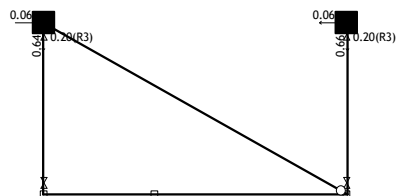
Nivo: [2.70 m]
Reakcije podpor

Obt. 4: Vetur prečno



Nivo: [0.00 m]
Reakcije podpor

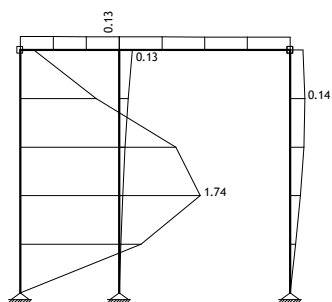
Obt. 4: Vetur prečno



Nivo: [2.70 m]
Reakcije podpor

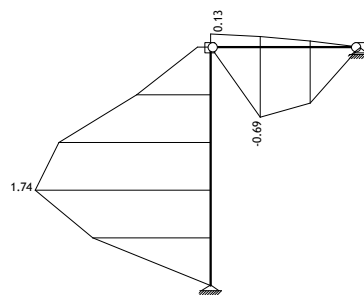
Kontrola pomikov:

Obt. 26: [MSU] 20-24



Okvir: H_1
Vplivi v gredi: max Xp= 1.74 / min Xp= -0.00 m / 1000

Obt. 26: [MSU] 20-24



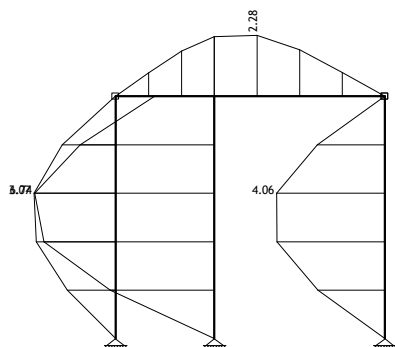
Okvir: V_1
Vplivi v gredi: max Xp= 1.74 / min Xp= -0.69 m / 1000

- Horizontalni pomiki (vzdolžna smer):

$$\delta = 0,17cm \leq \frac{L}{300} = \frac{270}{300} = 0,9cm$$

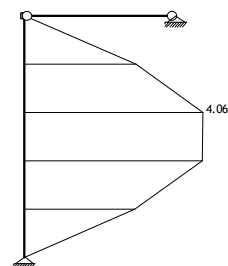
OK

Obt. 26: [MSU] 20-24



Okvir: H_1
Vplivi v gredi: max Yp= 6.74 / min Yp= -0.00 m / 1000

Obt. 26: [MSU] 20-24



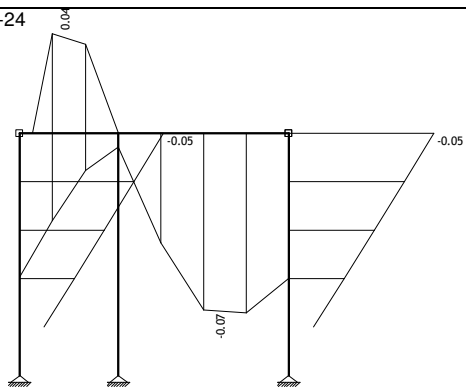
Okvir: V_2
Vplivi v gredi: max Yp= 4.06 / min Yp= -0.00 m / 1000

- Horizontalni pomiki (prečna smer):

$$\delta = 0,41cm \leq \frac{L}{300} = \frac{270}{300} = 0,9cm$$

OK

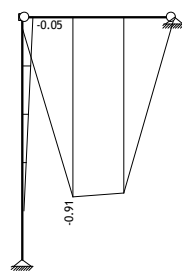
Obt. 26: [MSU] 20-24



Okvir: H_1

Vplivi v gredi: max Zp= 0.04 / min Zp= -0.07 m / 1000

Obt. 26: [MSU] 20-24



Okvir: V_2

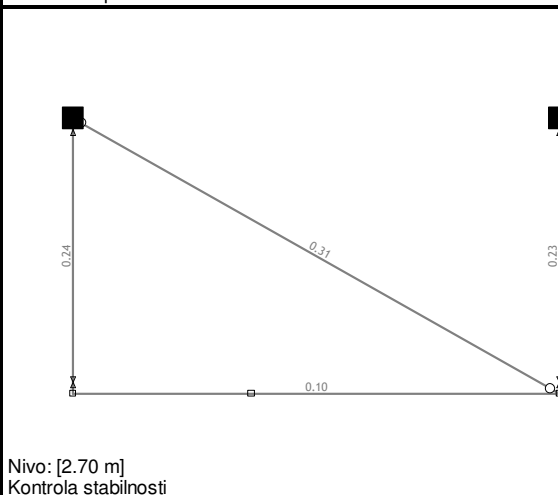
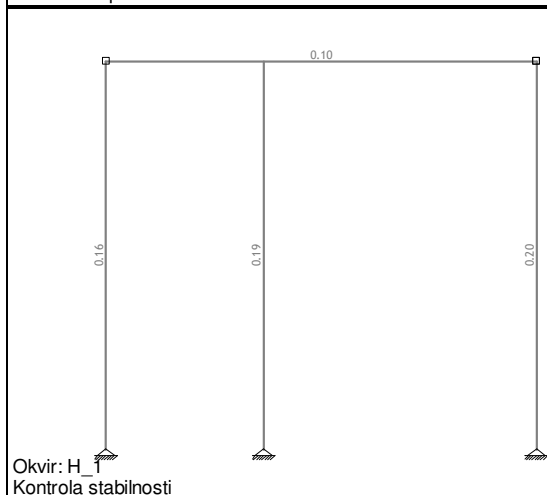
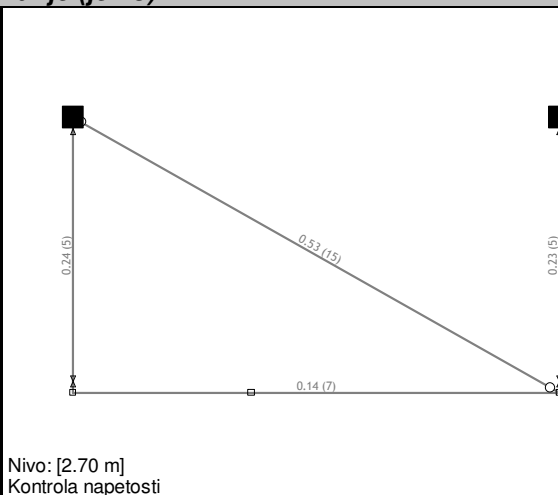
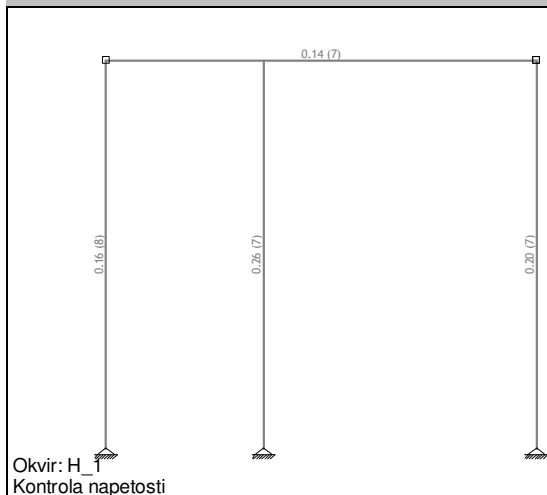
Vplivi v gredi: max Zp= -0.00 / min Zp= -0.91 m / 1000

- Vertikalni pomiki:

$$\delta = 0,09cm \leq \frac{L}{300} = \frac{170}{300} = 0,57cm$$

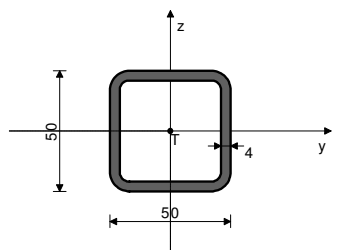
OK

Dimenzioniranje (jeklo)



PALICA 4-7
PREČNI PREREZ: HOP [50x50x4 [S 235] [Set: 1]
EUROCODE 3 (EN 1993-1-1:2005)

GEOMETRIJSKE KARAKTERISTIKE prereza



Ax =	6.950	cm ²
Ay =	3.475	cm ²
Az =	3.475	cm ²
Ix =	40.047	cm ⁴
Iy =	23.740	cm ⁴
Iz =	23.740	cm ⁴
Wy =	9.496	cm ³
Wz =	9.496	cm ³
Wy,pl =	12.728	cm ³
Wz,pl =	12.728	cm ³
yM0 =	1.000	
yM1 =	1.000	
yM2 =	1.250	
Anet/A =	0.900	

(fy = 23.5 kN/cm², fu = 36.0 kN/cm²)

FAKTORJI IZKORIŠČENOSTI PO KOMBINACIJAH OBTEŽB

7. γ=0.20	11. γ=0.19	13. γ=0.17
5. γ=0.17	16. γ=0.16	9. γ=0.16
21. γ=0.15	24. γ=0.12	15. γ=0.08
6. γ=0.08	10. γ=0.07	18. γ=0.07
8. γ=0.06	20. γ=0.06	22. γ=0.06
12. γ=0.05	14. γ=0.04	19. γ=0.03
23. γ=0.03	17. γ=0.03	

PALICA IZPOSTAVLJENA PRITISKU IN UPOGIBU
(obtežni primer 7, na 115.7 cm od začetka palice)

Računska osna sila	NEd =	-3.036	kN
Prečna sila v y smeri	VEd,y =	-0.082	kN
Upogibni moment okoli z osi	MEd,z =	0.407	kNm
Sistemska dolžina palice	L =	270.00	cm

5.5 KLASIFIKACIJA PREČNIH PREREZOV
Razred prereza 1

6.2 NOSILNOST PREČNIH PREREZOV

6.2.4 Tlak
Računska nosilnost na tlak
Pogoj 6.9: NEd ≤ Nc,Rd (3.04 ≤ 163.33)

Nc,Rd = 163.33 kN

6.2.5 Upogib z-z
Plastični odpornostni moment
Računska nosilnost na upogib
Pogoj 6.12: MEd,z ≤ Mc,Rd,z (0.41 ≤ 2.99)

Wz,pl = 12.728 cm³
Mc,Rd = 2.991 kNm

6.2.6 Strig

Računska strižna nosilnost
Računska strižna nosilnost
Pogoj 6.17: VEd,y ≤ Vc,Rd,y (0.08 ≤ 47.15)

Vpl,Rd,y = 47.148 kN
Vc,Rd,y = 47.148 kN

6.2.10 Upogib z osno in prečno silo
Ni potrebno zmanjšanje upogibne nosilnosti
Pogoj: VEd,y ≤ 50%Vpl,Rd,y

6.2.9 Upogib in osna sila
Razmerje NEd / Npl,Rd
Zmanjšana plast.upogibna nosilnost
Koeficient
Razmerje (Mz,Ed / MN,z,Rd)β
Pogoj 6.41: (0.14 ≤ 1)

MN,z,Rd = 0.019
2.991 kNm
β = 1.000
0.136

6.3 NOSILNOST ELEMENTA NA UKLON

6.3.1.1 Nosilnost na uklon
Uklonska dolžina y-y
Relativna vitkost y-y
Uklonska krivulja za os y-y: C
Elastična kritična sila
Koeficient nepopolnosti
Računska uklonska nosilnost
Pogoj 6.46: NEd ≤ Nb,Rd,y (3.04 ≤ 48.54)

ly,y = 270.00 cm
λy = 1.556
α = 0.490
Ncr,y = 67.495 kN
χy = 0.297
Nb,Rd,y = 48.538 kN

Uklonska dolžina z-z
Relativna vitkost z-z
Uklonska krivulja za os z-z: C
Koeficient nepopolnosti
Računska uklonska nosilnost
Pogoj 6.46: NEd ≤ Nb,Rd,z (3.04 ≤ 48.54)

lz,z = 270.00 cm
λz = 1.556
α = 0.490
χz = 0.297
Nb,Rd,z = 48.538 kN

6.3.3. Elementi konstantnega prečnega prereza obremenjeni z upogibom in osnim tlakom
Preračun koeficienta interakcije je izvršen z alternativno metodo št.2 (Aneks B)

Koeficient oblike momenta
Koeficient oblike momenta
Koeficient oblike momenta
Koeficient interakcije
Koeficient interakcije
Koeficient interakcije

Cmy = 1.000
Cmz = 0.952
CmLT = 1.000
kyy = 1.050
kyz = 0.600
kzy = 0.630
kzz = 0.999

Koeficient nepopolnosti
NEd / (χy NRk / yM1)
kyz * (Mz,Ed + ΔMz,Ed) / ...
Pogoj 6.61: (0.14 ≤ 1)

χy = 0.297
0.063
0.082

Koeficient nepopolnosti
NEd / (χz NRk / yM1)
kzz * (Mz,Ed + ΔMz,Ed) / ...
Pogoj 6.62: (0.20 ≤ 1)

χz = 0.297
0.063
0.136

KONTROLA STRIŽNE NOSILNOSTI

(obtežni primer 7, konec palice)

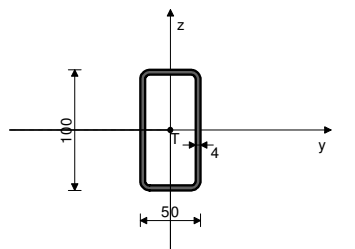
Računska osna sila	NEd =	-3.149 kN
Prečna sila v y smeri	VEd,y =	0.621 kN
Sistemska dolžina palice	L =	270.00 cm

6.2 NOSILNOST PREČNIH PREREZOV

PALICA 7-3

PREČNI PREREZ: HOP [100x50x4 [S 235] [Set: 2]
EUROCODE 3 (EN 1993-1-1:2005)

GEOMETRIJSKE KARAKTERISTIKE prereza



Ax =	10.950 cm ²
Ay =	3.650 cm ²
Az =	7.300 cm ²
Ix =	112.41 cm ⁴
Iy =	134.14 cm ⁴
Iz =	44.900 cm ⁴
Wy =	26.828 cm ³
Wz =	17.960 cm ³
Wy,pl =	36.128 cm ³
Wz,pl =	21.928 cm ³
yM0 =	1.000
yM1 =	1.000
yM2 =	1.250
Anet/A =	0.900

(fy = 23.5 kN/cm², fu = 36.0 kN/cm²)

FAKTORJI IZKORIŠČENOSTI PO KOMBINACIJAH OBTEŽB

7. γ=0.10	11. γ=0.10	13. γ=0.10
16. γ=0.10	21. γ=0.07	24. γ=0.07
9. γ=0.06	5. γ=0.06	14. γ=0.04
17. γ=0.04	8. γ=0.04	12. γ=0.04
23. γ=0.03	20. γ=0.03	6. γ=0.03
10. γ=0.03	15. γ=0.01	18. γ=0.01
19. γ=0.01	22. γ=0.01	

PALICA IZPOSTAVLJENA PRITISKU IN UPOGIBU (obtežni primer 7, na 110.0 cm od začetka palice)

Računska osna sila	NEd =	-0.114 kN
Prečna sila v y smeri	VEd,y =	-0.663 kN
Prečna sila v z smeri	VEd,z =	0.120 kN
Upogibni moment okoli y osi	MEd,y =	-0.059 kNm
Upogibni moment okoli z osi	MEd,z =	0.535 kNm
Moment torzije	Mt =	0.124 kNm
Sistemska dolžina palice	L =	300.00 cm

5.5 KLASIFIKACIJA PREČNIH PREREZOV Razred prereza 1

6.2 NOSILNOST PREČNIH PREREZOV

6.2.4 Tlak

Računska nosilnost na tlak	Nc,Rd =	257.32 kN
----------------------------	---------	-----------

Pogoj 6.9: NEd <= Nc,Rd (0.11 <= 257.32)

6.2.5 Upogib y-y

Plastični odpornostni moment	Wy,pl =	36.128 cm ³
Računska nosilnost na upogib	Mc,Rd =	8.490 kNm

Pogoj 6.12: MEd,y <= Mc,Rd,y (0.06 <= 8.49)

6.2.5 Upogib z-z

Plastični odpornostni moment	Wz,pl =	21.928 cm ³
Računska nosilnost na upogib	Mc,Rd =	5.153 kNm

Pogoj 6.12: MEd,z <= Mc,Rd,z (0.53 <= 5.15)

6.2.6 Strig

Računska strižna nosilnost	Vpl,Rd,z =	99.044 kN
Računska strižna nosilnost	Vc,Rd,z =	99.044 kN

Pogoj 6.17: VEd,z <= Vc,Rd,z (0.12 <= 99.04)

Računska strižna nosilnost	Vpl,Rd,y =	49.522 kN
Računska strižna nosilnost	Vc,Rd,y =	49.522 kN

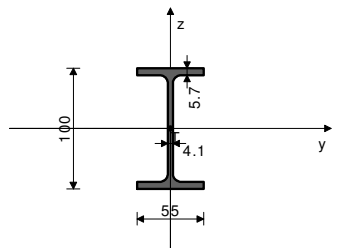
Pogoj 6.17: VEd,y <= Vc,Rd,y (0.66 <= 49.52)

6.2.10 Upogib z osno in prečno silo

PALICA 6-3

PREČNI PREREZ: IPE 100 [S 235] [Set: 3]
EUROCODE 3 (EN 1993-1-1:2005)

GEOMETRIJSKE KARAKTERISTIKE prereza



Ax =	10.300 cm ²
Ay =	5.238 cm ²
Az =	5.062 cm ²
Ix =	1.210 cm ⁴
Iy =	171.00 cm ⁴
Iz =	15.900 cm ⁴
Wy =	34.200 cm ³
Wz =	5.782 cm ³
Wy,pl =	38.825 cm ³
Wz,pl =	8.621 cm ³
yM0 =	1.000
yM1 =	1.000
yM2 =	1.250
Anet/A =	0.900

(fy = 23.5 kN/cm², fu = 36.0 kN/cm²)

FAKTORJI IZKORIŠČENOSTI PO KOMBINACIJAH OBTEŽB

5. γ=0.23	9. γ=0.22	6. γ=0.21
15. γ=0.21	7. γ=0.20	10. γ=0.19
18. γ=0.19	11. γ=0.18	21. γ=0.18

6.2.6 Strig

Računska strižna nosilnost	Vpl,Rd,y =	47.148 kN
Računska strižna nosilnost	Vc,Rd,y =	47.148 kN

Pogoj 6.17: VEd,y <= Vc,Rd,y (0.62 <= 47.15)

Ni potrebno zmanjšanje upogibne nosilnosti

Pogoj: VEd,z <= 50%Vpl,Rd,z ; VEd,y <= 50%Vpl,Rd,y

6.2.9 Upogib in osna sila

Razmerje NEd / Npl,Rd		0.000
Zmanjšana plast.upogibna nosilnost	MN,z,Rd =	5.153 kNm
Koeficient	β =	1.660
Razmerje (Mz,Ed / MN,z,Rd) ^β		0.023

Pogoj 6.41: (0.02 <= 1)

6.3 NOSILNOST ELEMENTA NA UKLON

6.3.1.1 Nosilnost na uklon

Uklonska dolžina y-y	ly =	300.00 cm
Relativna vitkost y-y	λ_y =	0.913
Uklonska krivulja za os y-y: C	α =	0.490
Elastična kritična sila	Ncr,y =	308.91 kN
Koeficient nepopolnosti	χ_y =	0.592
Računska uklonska nosilnost	Nb,Rd,y =	152.35 kN

Pogoj 6.46: NEd <= Nb,Rd,y (0.11 <= 152.35)

Uklonska dolžina z-z	lz =	300.00 cm
Relativna vitkost z-z	λ_z =	1.578
Uklonska krivulja za os z-z: C	α =	0.490
Koeficient nepopolnosti	χ_z =	0.291
Računska uklonska nosilnost	Nb,Rd,z =	74.799 kN

Pogoj 6.46: NEd <= Nb,Rd,z (0.11 <= 74.80)

6.3.2.1 Nosilnost na bočno-torzijski uklon

Koeficient	C1 =	1.285
Koeficient	C2 =	1.562
Koeficient	C3 =	0.753
Koef. ukl.dolžine za uklon	k =	1.000
Koef. ukl.dolžine za vbočenje	kw =	1.000
Koordinata	zg =	0.000 cm
Koordinata	zj =	0.000 cm
Razmak med bočnimi	L =	300.00 cm

podporami

Sektorski vztrajnostni moment	Iw =	0.000 cm ⁶
Krit.moment bočne zvrnitve	Mcr =	124.51 kNm
Ustrezni odpornostni moment	Wy =	36.128 cm ³
Koeficient imperf.	αLT =	0.760
Brezdimenz.vitkost	λLT =	0.261
Koeficient zmanjšanja (6.3.2.2.)	χLT =	0.953
Računska uklonska nosilnost	Mb,Rd =	8.088 kNm

Pogoj 6.54: MEd,y <= Mb,Rd (0.06 <= 8.09)

6.3.3. Elementi konstantnega prečnega prereza obremenjeni z

upogibom in osnim tlakom

Preračun koeficienta interakcije je izvršen z alternativno

metodo št.2 (Aneks B)

Koeficient oblike momenta	Cmy =	0.948
Koeficient oblike momenta	Cmz =	0.864
Koeficient oblike momenta	CmLT =	0.948
Koeficient interakcije	kyy =	0.948
Koeficient interakcije	kyy =	0.519
Koeficient interakcije	kzy =	0.569
Koeficient interakcije	kzz =	0.865

Koeficient nepopolnosti	xy =	0.592
NEd / (xy NRk / yM1)		0.001
kyy * (MyEd + ΔMyEd) / ...		0.007
kyy * (MyEd + ΔMyEd) / ...		0.054

Pogoj 6.61: (0.06 <= 1)

Koeficient nepopolnosti	xz =	0.291
NEd / (xz NRk / yM1)		0.002
kzy * (MyEd + ΔMyEd) / ...		0.004
kzy * (MyEd + ΔMyEd) / ...		0.090

Pogoj 6.62: (0.10 <= 1)

20. γ=0.15	22. γ=0.15	8. γ=0.15
13. γ=0.14	16. γ=0.14	12. γ=0.13
24. γ=0.10	14. γ=0.08	19. γ=0.08
23. γ=0.06	17. γ=0.06	

PALICA IZPOSTAVLJENA PRITISKU IN UPOGIBU (obtežni primer 5, na 63.7 cm od začetka palice)

Računska osna sila	NEd =	-0.584 kN
Prečna sila v y smeri	VEd,y =	0.069 kN
Prečna sila v z smeri	VEd,z =	-0.975 kN
Upogibni moment okoli y osi	MEd,y =	1.474 kNm
Upogibni moment okoli z osi	MEd,z =	0.073 kNm
Sistemska dolžina palice	L =	170.00 cm

5.5 KLASIFIKACIJA PREČNIH PREREZOV

Razred prereza 1

6.2 NOSILNOST PREČNIH PREREZOV

6.2.4 Tlak

Računska nosilnost na tlak	Nc,Rd =	242.05 kN
----------------------------	---------	-----------

Pogoj 6.9: NEd <= Nc,Rd (0.58 <= 242.05)

6.2.5 Upogib y-y

Upoštevajo se tudi luknje za vezna sredstva.

Efektivni odpornostni moment	Wy,eff =	27.820 cm ³
Računska nosilnost na upogib	Mc,Rd =	6.538 kNm

Pogoj 6.12: MEd,y <= Mc,Rd,y (1.47 <= 6.54)

6.2.5 Upogib z-z

Upoštevajo se tudi luknje za vezna sredstva.
Efektivni odpornostni moment
Računska nosilnost na upogib
Pogoj 6.12: $M_{Ed,z} \leq M_{c,Rd,z}$ (0.07 <= 1.21)

$W_{z,eff} = 5.133 \text{ cm}^3$
 $M_{c,Rd} = 1.206 \text{ kNm}$

6.2.6 Strig
Računska strižna nosilnost
Računska strižna nosilnost

$V_{pl,Rd,z} = 49.286 \text{ kN}$
 $V_{c,Rd,z} = 49.286 \text{ kN}$

Pogoj 6.17: $V_{Ed,z} \leq V_{c,Rd,z}$ (0.98 <= 49.29)

Računska strižna nosilnost
Računska strižna nosilnost

$V_{pl,Rd,y} = 84.758 \text{ kN}$
 $V_{c,Rd,y} = 84.758 \text{ kN}$

Pogoj 6.17: $V_{Ed,y} \leq V_{c,Rd,y}$ (0.07 <= 84.76)

6.2.10 Upogib z osno in prečno silo

Ni potrebno zmanjšanje upogibne nosilnosti

Pogoj: $V_{Ed,z} \leq 50\% V_{pl,Rd,z}$; $V_{Ed,y} \leq 50\% V_{pl,Rd,y}$

6.2.9 Upogib in osna sila

Razmerje $N_{Ed} / N_{pl,Rd}$

Zmanjšana plast.upogibna

nosilnost

Koeficient

Razmerje $(M_{y,Ed} / M_{N,y,Rd})^\alpha$

Zmanjšana plast.upogibna

nosilnost

Koeficient

Razmerje $(M_{z,Ed} / M_{N,z,Rd})^\beta$

Pogoj 6.41: (0.06 <= 1)

$M_{N,y,Rd} = 0.002$
 9.124 kNm

$\alpha = 2.000$

0.026

$M_{N,z,Rd} = 2.026 \text{ kNm}$

$\beta = 1.000$

0.036

6.3 NOSILNOST ELEMENTA NA UKLON

6.3.1.1 Nosilnost na uklon

Uklonska dolžina y-y

Relativna vitkost y-y

Uklonska krivulja za os y-y: A

Elastična kritična sila

Koeficient nepopolnosti

Računska uklonska nosilnost

Pogoj 6.46: $N_{Ed} \leq N_{b,Rd,y}$ (0.58 <= 227.71)

$l_{y,y} = 170.00 \text{ cm}$

$\lambda_{y,y} = 0.444$

$\alpha = 0.210$

$N_{cr,y} = 1226.4 \text{ kN}$

$\chi_{y,y} = 0.941$

$N_{b,Rd,y} = 227.71 \text{ kN}$

Uklonska dolžina z-z

Relativna vitkost z-z

Uklonska krivulja za os z-z: B

Koeficient nepopolnosti

Računska uklonska nosilnost

Pogoj 6.46: $N_{Ed} \leq N_{b,Rd,z}$ (0.58 <= 86.79)

$l_{z,z} = 170.00 \text{ cm}$

$\lambda_{z,z} = 1.457$

$\alpha = 0.340$

$\chi_{z,z} = 0.359$

$N_{b,Rd,z} = 86.789 \text{ kN}$

6.3.2.1 Nosilnost na bočno-torzijski uklon

Koeficient

Koeficient

Koeficient

Koef.ukl.dolžine za uklon

Koef.ukl.dolžine za vbočenje

Koordinata

Koordinata

Razmak med bočnimi

podporami

$C1 = 1.132$

$C2 = 0.459$

$C3 = 0.525$

$k = 1.000$

$k_w = 1.000$

$z_g = 0.000 \text{ cm}$

$z_j = 0.000 \text{ cm}$

$L = 170.00 \text{ cm}$

Sektorski vztrajnostni moment

$I_w = 351.38 \text{ cm}^6$

Krit.moment bočne zvrnitve

$M_{cr} = 13.402 \text{ kNm}$

Ustrezni odpornostni moment

$W_y = 38.825 \text{ cm}^3$

Koeficient imperf.

$\alpha_{LT} = 0.210$

Brezdimenz.vitkost

$\lambda_{LT} = 0.825$

Koeficient zmanjšanja (6.3.2.2.)

$\chi_{LT} = 0.781$

Računska uklonska nosilnost

$M_{b,Rd} = 7.126 \text{ kNm}$

Pogoj 6.54: $M_{Ed,y} \leq M_{b,Rd}$ (1.47 <= 7.13)

6.3.3. Elementi konstantnega prečnega prereza obremenjeni z

upogibom in osnim tlakom

Preračun koeficienta interakcije je izvršen z alternativno

metodo št.2 (Aneks B)

Koeficient oblike momenta

$C_{my} = 0.950$

Koeficient oblike momenta

$C_{mz} = 0.600$

Koeficient oblike momenta

$C_{mLT} = 0.950$

Koeficient interakcije

$k_{yy} = 0.951$

Koeficient interakcije

$k_{yz} = 0.363$

Koeficient interakcije

$k_{zy} = 0.999$

Koeficient interakcije

$k_{zz} = 0.606$

Koeficient nepopolnosti

$\chi_y = 0.941$

$N_{Ed} / (\chi_y N_{Rk} / \gamma_{M1})$

0.003

$k_{yy} * (M_{y,Ed} + \Delta M_{y,Ed}) / \dots$

0.197

$k_{yz} * (M_{z,Ed} + \Delta M_{z,Ed}) / \dots$

0.013

Pogoj 6.61: (0.21 <= 1)

Koeficient nepopolnosti

$\chi_z = 0.359$

$N_{Ed} / (\chi_z N_{Rk} / \gamma_{M1})$

0.007

$k_{zy} * (M_{y,Ed} + \Delta M_{y,Ed}) / \dots$

0.207

$k_{zz} * (M_{z,Ed} + \Delta M_{z,Ed}) / \dots$

0.022

Pogoj 6.62: (0.24 <= 1)

KONTROLA STRIŽNE NOSILNOSTI

(obtežni primer 5, na 21.2 cm od začetka palice)

Računska osna sila

$N_{Ed} = -0.584 \text{ kN}$

Prečna sila v y smeri

$V_{Ed,y} = 0.069 \text{ kN}$

Prečna sila v z smeri

$V_{Ed,z} = -2.925 \text{ kN}$

Upogibni moment okoli y osi

$M_{Ed,y} = 0.553 \text{ kNm}$

Upogibni moment okoli z osi

$M_{Ed,z} = 0.102 \text{ kNm}$

Sistemska dolžina palice

$L = 170.00 \text{ cm}$

6.2 NOSILNOST PREČNIH PREREZOV

6.2.6 Strig

Računska strižna nosilnost

$V_{pl,Rd,z} = 49.286 \text{ kN}$

Računska strižna nosilnost

$V_{c,Rd,z} = 49.286 \text{ kN}$

Pogoj 6.17: $V_{Ed,z} \leq V_{c,Rd,z}$ (2.93 <= 49.29)

Računska strižna nosilnost

$V_{pl,Rd,y} = 84.758 \text{ kN}$

Računska strižna nosilnost

$V_{c,Rd,y} = 84.758 \text{ kN}$

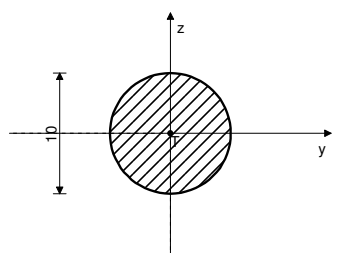
Pogoj 6.17: $V_{Ed,y} \leq V_{c,Rd,y}$ (0.07 <= 84.76)

PALICA 6-7

PREČNI PREREZ: Krožni [S 235] [Set: 4]

EUROCODE 3 (EN 1993-1-1:2005)

GEOMETRIJSKE KARAKTERISTIKE prereza



($f_y = 23.5 \text{ kN/cm}^2$, $f_u = 36.0 \text{ kN/cm}^2$)

$A_x = 0.785 \text{ cm}^2$

$A_y = 0.707 \text{ cm}^2$

$A_z = 0.707 \text{ cm}^2$

$I_x = 0.098 \text{ cm}^4$

$I_y = 0.049 \text{ cm}^4$

$I_z = 0.049 \text{ cm}^4$

$W_y = 0.098 \text{ cm}^3$

$W_z = 0.098 \text{ cm}^3$

$W_{y,pl} = 0.167 \text{ cm}^3$

$W_{z,pl} = 0.167 \text{ cm}^3$

$\gamma_{M0} = 1.000$

$\gamma_{M1} = 1.000$

$\gamma_{M2} = 1.250$

$A_{net}/A = 0.900$

FAKTORJI IZKORIŠČENOSTI PO KOMBINACIJAH OBEŽB

5. $\gamma = 0.31$

6. $\gamma = 0.31$

7. $\gamma = 0.31$

8. $\gamma = 0.31$

13. $\gamma = 0.31$

14. $\gamma = 0.31$

15. $\gamma = 0.31$

19. $\gamma = 0.31$

17. $\gamma = 0.04$

22. $\gamma = 0.04$

20. $\gamma = 0.03$

23. $\gamma = 0.03$

10. $\gamma = 0.03$

18. $\gamma = 0.00$

11. $\gamma = 0.00$

16. $\gamma = 0.00$

21. $\gamma = 0.00$

22. $\gamma = 0.00$

9. $\gamma = 0.00$

24. $\gamma = 0.00$

PALICA IZPOSTAVLJENA NATEGU IN UPOGIBU

(obtežni primer 8, na 162.3 cm od začetka palice)

Računska osna sila

$N_{Ed} = 0.766 \text{ kN}$

Upogibni moment okoli y osi

$M_{Ed,y} = 0.012 \text{ kNm}$

Sistemska dolžina palice

$L = 344.82 \text{ cm}$

5.5 KLASIFIKACIJA PREČNIH PREREZOV

Razred prereza 1

6.2 NOSILNOST PREČNIH PREREZOV

6.2.3 Nateg

Plast.rač.nosilnost bruto prereza

$N_{pl,Rd} = 18.457 \text{ kN}$

Mejna rač.nosilnost neto

$N_{u,Rd} = 18.322 \text{ kN}$

prereza

Računska nos. na nateg

$N_{t,Rd} = 18.322 \text{ kN}$

Pogoj 6.5: $N_{Ed} \leq N_{t,Rd}$ (0.77 <= 18.32)

6.2.5 Upogib y-y

Plastični odpornostni moment

$W_{y,pl} = 0.167 \text{ cm}^3$

Računska nosilnost na upogib

$M_{c,Rd} = 0.039 \text{ kNm}$

Pogoj 6.12: $M_{Ed,y} \leq M_{c,Rd,y}$ (0.01 <= 0.04)

6.2.9 Upogib in osna sila

Razmerje $N_{Ed} / N_{pl,Rd}$

0.041

Zmanjšana plast.upogibna

nosilnost

$M_{N,y,Rd} = 0.039 \text{ kNm}$

Razmerje $M_{Ed,y} / M_{N,y,Rd}$

0.310

Pogoj 6.41: (0.31 <= 1)

KONTROLA STRIŽNE NOSILNOSTI

(obtežni primer 8, začetek palice)

Računska osna sila

$N_{Ed} = 0.766 \text{ kN}$

Prečna sila v z smeri

$V_{Ed,z} = 0.014 \text{ kN}$

Sistemska dolžina palice

$L = 344.82 \text{ cm}$

6.2 NOSILNOST PREČNIH PREREZOV

6.2.6 Strig

Računska strižna nosilnost

$V_{pl,Rd,z} = 9.590 \text{ kN}$

Računska strižna nosilnost

$V_{c,Rd,z} = 9.590 \text{ kN}$

Pogoj 6.17: $V_{Ed,z} \leq V_{c,Rd,z}$ (0.01 <= 9.59)

Specifier's comments:

1 Input data

Anchor type and size:

HIT-HY 200 + HIT-V (8.8) M10

Effective embedment depth:

 $h_{ef,act} = 70 \text{ mm}$ ($h_{ef,limit} = - \text{ mm}$)

Material:

8.8

Approval No.:

ETA 11/0493

Issued | Valid:

28. 07. 2017 | -

Proof:

Design method ETAG BOND (EOTA TR 029)

Stand-off installation:

 $e_b = 0 \text{ mm}$ (no stand-off); $t = 10 \text{ mm}$

Baseplate:

 $l_x \times l_y \times t = 150 \text{ mm} \times 150 \text{ mm} \times 10 \text{ mm}$; (Recommended plate thickness: not calculated)

Profile:

Square hollow; ($L \times W \times T$) = $50 \text{ mm} \times 50 \text{ mm} \times 4 \text{ mm}$

Base material:

cracked concrete, C20/25, $f_{c,cube} = 25,00 \text{ N/mm}^2$; $h = 200 \text{ mm}$, Temp. short/long: 40/24 °C

Installation:

hammer drilled hole, Installation condition: Dry

Reinforcement:

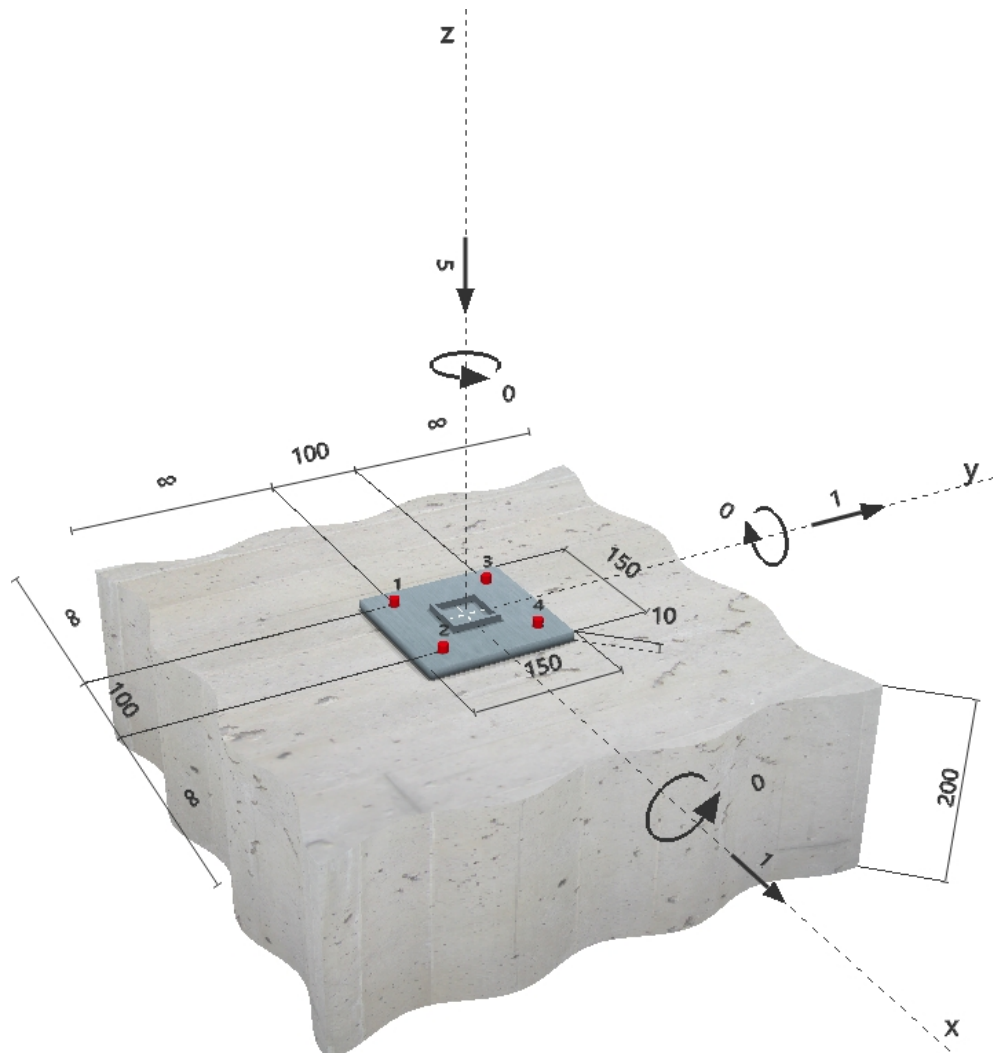
No reinforcement or Reinforcement spacing $\geq 150 \text{ mm}$ (any \emptyset) or $\geq 100 \text{ mm}$ ($\emptyset \leq 10 \text{ mm}$)

no longitudinal edge reinforcement

Reinforcement to control splitting according to EOTA TR 029, 5.2.2.6 present.



Geometry [mm] & Loading [kN, kNm]



Company:
 Specifier:
 Address:
 Phone | Fax: |
 E-Mail:

Page: 2
 Project:
 Fastening Point:
 Date: 17. 06. 2020

1.1 Load combination

Case	Description	Forces [kN] / Moments [kNm]	Seismic	Fire	Max. Util. [%]
1	Combination 1	$V_x = 1,000; V_y = 1,000; N = -5,000;$ $M_x = 0,000; M_y = 0,000; M_z = 0,000;$	no	no	3
2	Combination 2	$V_x = 1,000; V_y = 1,000; N = 1,000;$ $M_x = 0,000; M_y = 0,000; M_z = 0,000;$	no	no	4

* The detailed results (Combination 1, shown in the following) do not represent the decisive load combination Combination 2

2 Load case/Resulting anchor forces

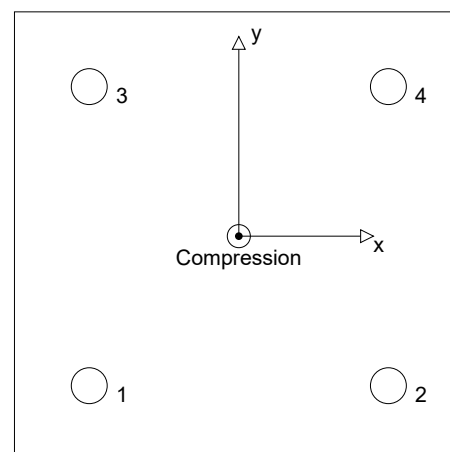
Load case: Design loads

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0,000	0,354	0,250	0,250
2	0,000	0,354	0,250	0,250
3	0,000	0,354	0,250	0,250
4	0,000	0,354	0,250	0,250

max. concrete compressive strain: 0,01 [%]
 max. concrete compressive stress: 0,22 [N/mm²]
 resulting tension force in (x/y)=(0/0): 0,000 [kN]
 resulting compression force in (x/y)=(0/0): 5,000 [kN]



3 Tension load (EOTA TR 029, Section 5.2.2)

	Load [kN]	Capacity [kN]	Utilisation β_N [%]	Status
Steel failure*	N/A	N/A	N/A	N/A
Combined pullout-concrete cone failure**	N/A	N/A	N/A	N/A
Concrete cone failure**	N/A	N/A	N/A	N/A
Splitting failure**	N/A	N/A	N/A	N/A

* most unfavourable anchor **anchor group (anchors in tension)

Company:

Specifier:

Address:

Phone | Fax:

E-Mail:

Page:

Project:

Fastening Point:

Date:

3

17. 06. 2020

4 Shear load (EOTA TR 029, Section 5.2.3)

	Load [kN]	Capacity [kN]	Utilisation β_v [%]	Status
Steel failure (without lever arm)*	0,354	18,400	2	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	1,414	52,553	3	OK
Concrete edge failure in direction **	N/A	N/A	N/A	N/A

* most unfavourable anchor ** anchor group (relevant anchors)

4.1 Steel failure (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
23,000	1,250	18,400	0,354

4.2 Pryout failure (bond relevant)

$A_{p,N}$ [mm ²]	$A_{p,N}^0$ [mm ²]	$\tau_{Rk,ucr,25}$ [N/mm ²]	$c_{cr,Np}$ [mm]	$s_{cr,Np}$ [mm]	c_{min} [mm]
96.100	44.100	18,00	105	210	∞
ψ_c	$\tau_{Rk,cr}$ [N/mm ²]	k	$\psi_{g,Np}^0$	$\psi_{g,Np}$	k-factor
1,000	7,50	2,300	1,312	1,097	2,000
$e_{c1,v}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,v}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$
0	1,000	0	1,000	1,000	1,000
$N_{Rk,p}^0$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,op}$ [kN]	V_{Sd} [kN]	
16,493	39,414	1,500	52,553	1,414	

5 Displacements (highest loaded anchor)

Short term loading:

N_{Sk}	=	0,000 [kN]	δ_N	=	0,000 [mm]
V_{Sk}	=	0,262 [kN]	δ_V	=	0,016 [mm]
			δ_{NV}	=	0,016 [mm]

Long term loading:

N_{Sk}	=	0,000 [kN]	δ_N	=	0,000 [mm]
V_{Sk}	=	0,262 [kN]	δ_V	=	0,021 [mm]
			δ_{NV}	=	0,021 [mm]

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the baseplate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

Company:
Specifier:
Address:
Phone | Fax: |
E-Mail:

Page: 4
Project:
Fastening Point:
Date: 17. 06. 2020

6 Warnings

- The anchor design methods in PROFIS Anchor require rigid anchor plates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Checking the transfer of loads into the base material is required in accordance with EOTA TR 029, Section 7!
- The design is only valid if the clearance hole in the fixture is not larger than the value given in Table 4.1 of EOTA TR029! For larger diameters of the clearance hole see Chapter 1.1. of EOTA TR029!
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- Drilled hole cleaning must be performed according to instructions for use (blow twice with oil-free compressed air (min. 6 bar), brush twice, blow twice with oil-free compressed air (min. 6 bar)).
- Characteristic bond resistances depend on short- and long-term temperatures.
- Please contact Hilti to check feasibility of HIT-V rod supply.
- Edge reinforcement is not required to avoid splitting failure

Fastening meets the design criteria!

Company:
 Specifier:
 Address:
 Phone | Fax: |
 E-Mail:

Page: 5
 Project:
 Fastening Point:
 Date: 17. 06. 2020

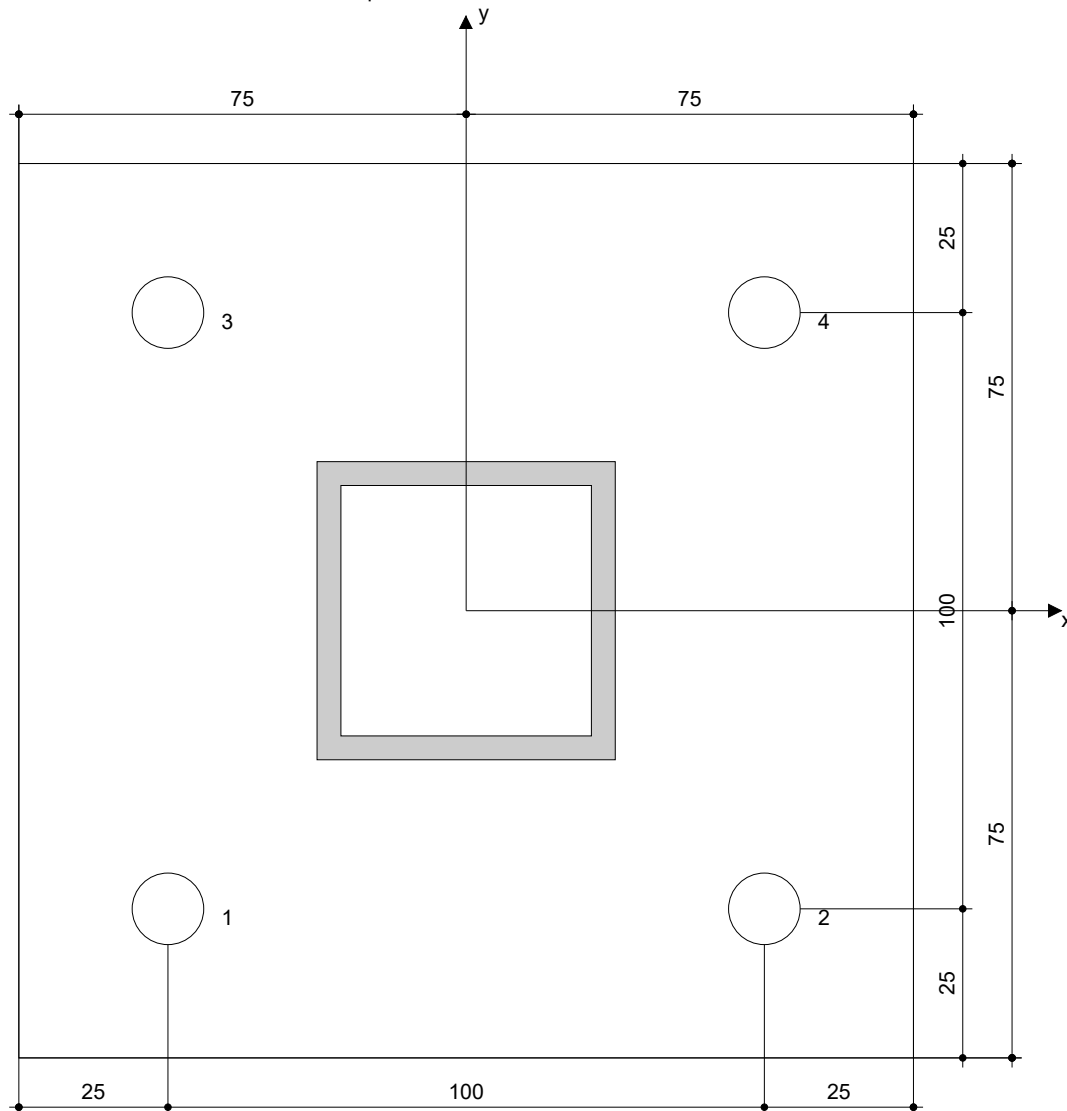
7 Installation data

Baseplate, steel: -
 Profile: Square hollow; 50 x 50 x 4 mm
 Hole diameter in the fixture: $d_f = 12$ mm
 Plate thickness (input): 10 mm
 Recommended plate thickness: not calculated
 Drilling method: Hammer drilled
 Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and size: HIT-HY 200 + HIT-V (8.8) M10
 Installation torque: 0,020 kNm
 Hole diameter in the base material: 12 mm
 Hole depth in the base material: 70 mm
 Minimum thickness of the base material: 100 mm

7.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> Suitable Rotary Hammer Properly sized drill bit 	<ul style="list-style-type: none"> Compressed air with required accessories to blow from the bottom of the hole Proper diameter wire brush 	<ul style="list-style-type: none"> Dispenser including cassette and mixer Torque wrench



Coordinates Anchor [mm]

Anchor	x	y	C _{-x}	C _{+x}	C _{-y}	C _{+y}
1	-50	-50	-	-	-	-
2	50	-50	-	-	-	-
3	-50	50	-	-	-	-
4	50	50	-	-	-	-

Company:
Specifier:
Address:
Phone | Fax: |
E-Mail:

Page: 6
Project:
Fastening Point:
Date: 17. 06. 2020

8 Remarks; Your Cooperation Duties

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Specifier's comments:

1 Input data

Anchor type and size: HIT-HY 200 + HIT-V-F (8.8) M10

Seismic/Filling set or any suitable annular gap filling solution

Effective embedment depth: $h_{ef,act} = 70 \text{ mm}$ ($h_{ef,limit} = - \text{ mm}$)

Material: 8.8

Approval No.: ETA 11/0493

Issued | Valid: 28. 07. 2017 | -

Proof: SOFA design method + fib (07/2011) - after ETAG BOND testing

Stand-off installation: $e_b = 0 \text{ mm}$ (no stand-off); $t = 10 \text{ mm}$

Baseplate: $l_x \times l_y \times t = 240 \text{ mm} \times 100 \text{ mm} \times 10 \text{ mm}$; (Recommended plate thickness: not calculated)

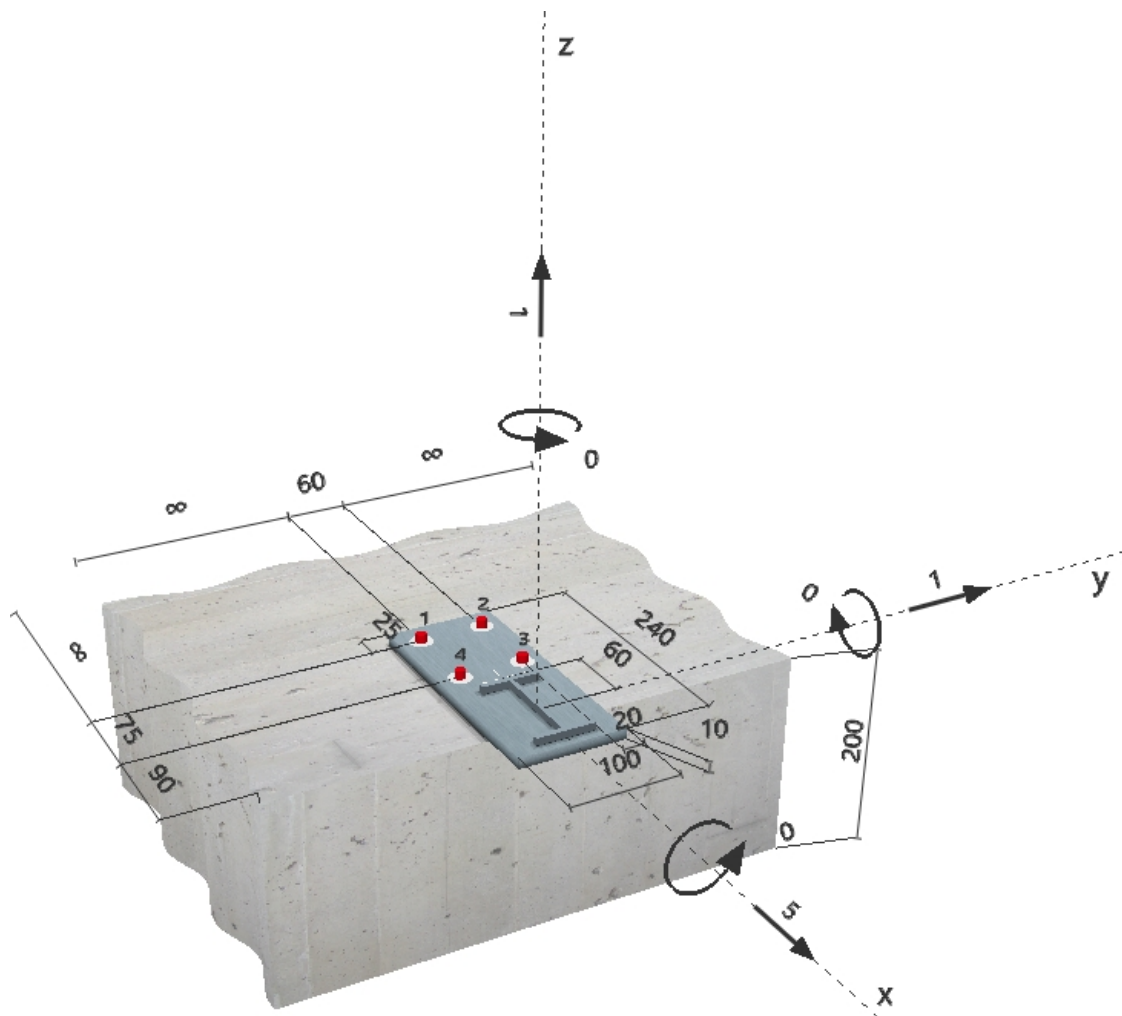
Profile: IPE; ($L \times W \times T \times FT$) = $100 \text{ mm} \times 55 \text{ mm} \times 4 \text{ mm} \times 6 \text{ mm}$

Base material: cracked concrete, $C20/25$, $f_{c,cyl} = 20,00 \text{ N/mm}^2$; $h = 200 \text{ mm}$, Temp. short/long: $40/24 \text{ }^\circ\text{C}$
Installation: **hammer drilled hole, Installation condition: Dry**

Reinforcement: No reinforcement or Reinforcement spacing $\geq 150 \text{ mm}$ (any \varnothing) or $\geq 100 \text{ mm}$ ($\varnothing \leq 10 \text{ mm}$)

no longitudinal edge reinforcement

Reinforcement to control splitting according to fib (07/2011), 16.1.5 present


Geometry [mm] & Loading [kN, kNm]


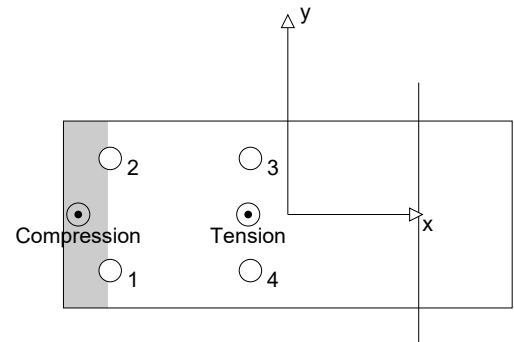
2 Load case/Resulting anchor forces

Load case: Design loads

Anchor reactions [kN]

Tension force: (+Tension, -Compression)

Anchor	Tension force	Shear force	Shear force x	Shear force y
1	0,015	1,648	1,632	-0,228
2	0,015	0,897	0,868	-0,228
3	0,932	1,133	0,868	0,728
4	0,932	1,787	1,632	0,728



max. concrete compressive strain: 0,03 [%]
max. concrete compressive stress: 0,75 [N/mm²]
resulting tension force in (x/y)=(-21/0): 1,893 [kN]
resulting compression force in (x/y)=(-112/0): 0,893 [kN]

3 Tension load SOFA (fib (07/2011), section 16.2.1)

	Load [kN]	Capacity [kN]	Utilisation β_N [%]	Status
Steel failure*	0,932	30,667	4	OK
Combined pullout-concrete cone failure**	1,893	14,385	14	OK
Concrete cone failure**	1,893	15,806	12	OK
Splitting failure**	N/A	N/A	N/A	N/A

* most unfavourable anchor **anchor group (anchors in tension)

3.1 Steel failure

$N_{Rk,s}$ [kN]	$\gamma_{M,s}$	$N_{Rd,s}$ [kN]	N_{Sd} [kN]
46,000	1,500	30,667	0,932

3.2 Combined pullout-concrete cone failure

$A_{p,N}$ [mm ²]	$A_{p,N}^0$ [mm ²]	$\psi_{A,Np}$	$\tau_{Rk,ucr,25}$ [N/mm ²]	$s_{cr,Np}$ [mm]	$c_{cr,Np}$ [mm]	c_{min} [mm]
72.900	44.100	1,653	18,00	210	105	90
ψ_c	$\tau_{Rk,cr}$ [N/mm ²]	$\max \tau_{Rk,cr}$ [N/mm ²]	$\psi_{g,Np}^0$	$\psi_{g,Np}$		
1,000	7,50	9,17	1,260	1,113		
$e_{c1,N}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,N}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$	
36	0,743	0	1,000	0,957	1,000	
$N_{Rk,p}^0$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{M,p}$	$N_{Rd,p}$ [kN]	N_{Sd} [kN]		
16,493	21,577	1,500	14,385	1,893		

3.3 Concrete cone failure

$A_{c,N}$ [mm ²]	$A_{c,N}^0$ [mm ²]	$\psi_{A,N}$	$c_{cr,N}$ [mm]	$s_{cr,N}$ [mm]		
72.900	44.100	1,653	105	210		
$e_{c1,N}$ [mm]	$\psi_{ec1,N}$	$e_{c2,N}$ [mm]	$\psi_{ec2,N}$	$\psi_{s,N}$	$\psi_{re,N}$	
36	0,743	0	1,000	0,957	1,000	
k_1	$N_{Rk,c}^0$ [kN]	$\gamma_{M,c}$	$N_{Rd,c}$ [kN]	N_{Sd} [kN]		
7,700	20,168	1,500	15,806	1,893		

Company:
 Specifier:
 Address:
 Phone | Fax:
 E-Mail:

Page: 3
 Project:
 Fastening Point:
 Date: 17. 06. 2020

4 Shear load SOFA (fib (07/2011), section 16.2.2)

	Load [kN]	Capacity [kN]	Utilisation β_v [%]	Status
Steel failure (without lever arm)*	1,787	18,400	10	OK
Steel failure (with lever arm)*	N/A	N/A	N/A	N/A
Pryout failure**	5,099	30,547	17	OK
Concrete edge failure in direction x+**	2,893	7,829	37	OK

* most unfavourable anchor **anchor group (relevant anchors)

4.1 Steel failure (without lever arm)

$V_{Rk,s}$ [kN]	$\gamma_{M,s}$	$V_{Rd,s}$ [kN]	V_{Sd} [kN]
23,000	1,250	18,400	1,787

4.2 Pryout failure (bond relevant)

$A_{p,N}$ [mm ²]	$A_{p,N}^0$ [mm ²]	$\psi_{A,Np}$	$\tau_{Rk,ucr,25}$ [N/mm ²]	$c_{cr,Np}$ [mm]	$s_{cr,Np}$ [mm]	c_{min} [mm]
72.900	44.100	1,653	18,00	105	210	90
ψ_c	$\tau_{Rk,cr}$ [N/mm ²]	$\max \tau_{Rk,cr}$ [N/mm ²]	$\psi_{g,Np}^0$	$\psi_{g,Np}$	k_4	
1,000	7,50	9,17	1,260	1,113	2,000	
$e_{c1,V}$ [mm]	$\psi_{ec1,Np}$	$e_{c2,V}$ [mm]	$\psi_{ec2,Np}$	$\psi_{s,Np}$	$\psi_{re,Np}$	
5	0,959	23	0,823	0,957	1,000	
$N_{Rk,p}^0$ [kN]	$N_{Rk,p}$ [kN]	$\gamma_{M,c,p}$	$V_{Rd,op}$ [kN]	V_{Sd} [kN]		
16,493	22,910	1,500	30,547	5,099		

4.3 Concrete edge failure in direction x+

l_f [mm]	d_{nom} [mm]	k_v	α	β		
70	10,0	1,700	0,065	0,057		
c_1 [mm]	$A_{c,V}$ [mm ²]	$A_{c,V}^0$ [mm ²]	$\psi_{A,V}$			
165	111.000	122.513	0,906			
$\psi_{s,V}$	$\psi_{h,V}$	$\psi_{a,V}$	$e_{c,V}$ [mm]	$\psi_{ec,V}$	$\psi_{re,V}$	$\psi_{90^\circ,V}$
1,000	1,112	1,012	9	0,965	1,000	2,000
$V_{Rk,c}^0$ [kN]	n_1	$\gamma_{M,c}$	$V_{Rd,c}$ [kN]	V_{Sd} [kN]		
23,859	2	1,500	7,829	2,893		

Note: Resistance limit acc. to fib (07/2011) Eq. (10.2-6) is governing

5 Combined tension and shear loads SOFA (fib (07/2011), section 10.3)

	β_N	β_V	α	Utilisation $\beta_{N,V}$ [%]	Status
steel	0,030	0,097	2,000	2	OK
concrete	0,132	0,370	1,500	28	OK

$$\beta_N^\alpha + \beta_V^\alpha \leq 1$$

Company:
Specifier:
Address:
Phone | Fax: |
E-Mail:

Page: 4
Project:
Fastening Point:
Date: 17. 06. 2020

6 Displacements (highest loaded anchor)

Short term loading:

N_{Sk}	=	0,690 [kN]	δ_N	=	0,022 [mm]
V_{Sk}	=	1,860 [kN]	δ_V	=	0,112 [mm]
			δ_{NV}	=	0,114 [mm]

Long term loading:

N_{Sk}	=	0,690 [kN]	δ_N	=	0,050 [mm]
V_{Sk}	=	1,860 [kN]	δ_V	=	0,149 [mm]
			δ_{NV}	=	0,157 [mm]

Comments: Tension displacements are valid with half of the required installation torque moment for uncracked concrete! Shear displacements are valid without friction between the concrete and the baseplate! The gap due to the drilled hole and clearance hole tolerances are not included in this calculation!

The acceptable anchor displacements depend on the fastened construction and must be defined by the designer!

7 Warnings

- The anchor design methods in PROFIS Anchor require rigid anchor plates per current regulations (ETAG 001/Annex C, EOTA TR029, etc.). This means load re-distribution on the anchors due to elastic deformations of the anchor plate are not considered - the anchor plate is assumed to be sufficiently stiff, in order not to be deformed when subjected to the design loading. PROFIS Anchor calculates the minimum required anchor plate thickness with FEM to limit the stress of the anchor plate based on the assumptions explained above. The proof if the rigid base plate assumption is valid is not carried out by PROFIS Anchor. Input data and results must be checked for agreement with the existing conditions and for plausibility!
- Your design has selected filled holes. Please ensure that there is a proper method to fill the annular gap between the fixture and HIT-HY 200 + HIT-V-F (8.8) M10, and contact Hilti in case of any questions.
- The accessory list in this report is for the information of the user only. In any case, the instructions for use provided with the product have to be followed to ensure a proper installation.
- Drilled hole cleaning must be performed according to instructions for use (blow twice with oil-free compressed air (min. 6 bar), brush twice, blow twice with oil-free compressed air (min. 6 bar)).
- Characteristic bond resistances depend on short- and long-term temperatures.
- Please contact Hilti to check feasibility of HIT-V rod supply.
- The design method fib (07/2011) assumes that no hole clearance between the anchors and the fixture is present. This can be achieved by filling the gap with mortar of sufficient compressive strength (e.g. by using the HILTI Seismic/Filling set) or by other suitable means
- The compliance with current standards (e.g. EC3) is the responsibility of the user
- The baseplate overlaps the concrete plate edges. A local concrete spalling due to compression has to be checked separately!
- Checking the transfer of loads into the base material is required in accordance with fib (07/2011)!

Fastening meets the design criteria!

Company:
 Specifier:
 Address:
 Phone | Fax: |
 E-Mail:

Page: 5
 Project:
 Fastening Point:
 Date: 17. 06. 2020

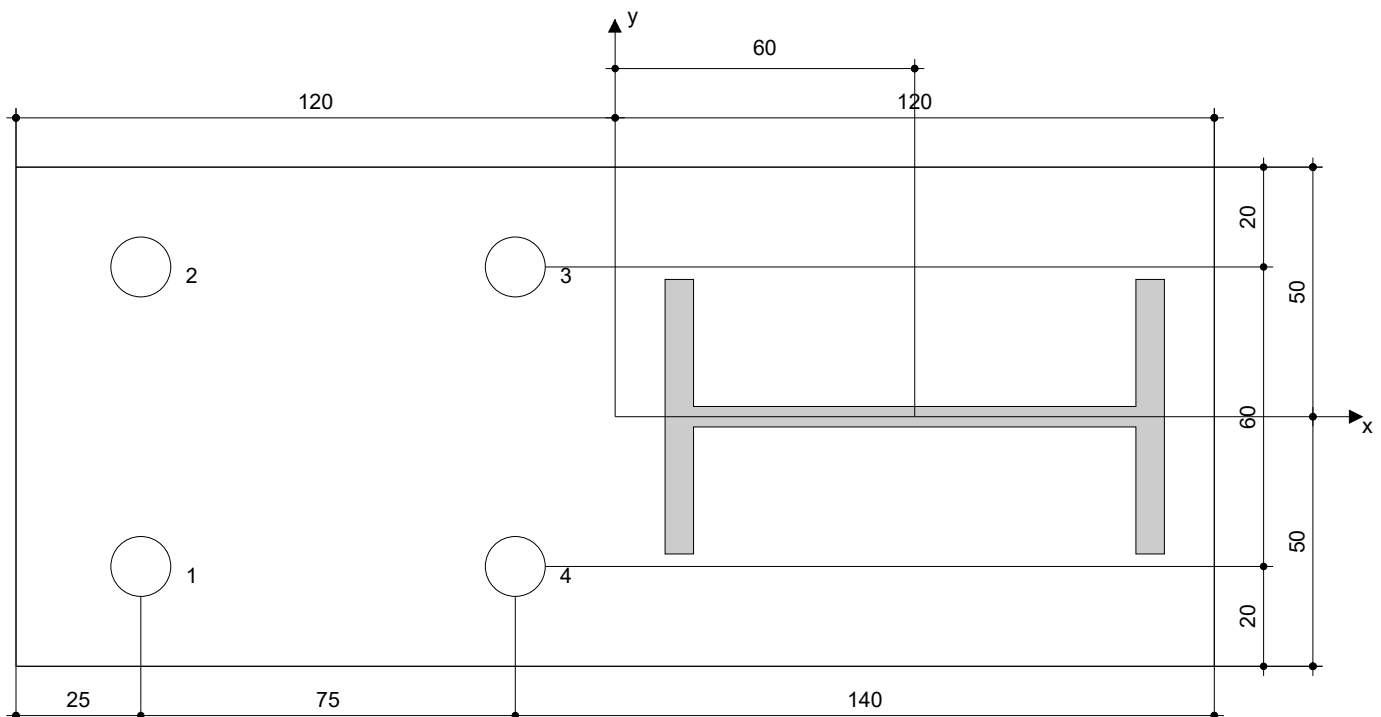
8 Installation data

Baseplate, steel: -
 Profile: IPE; 100 x 55 x 4 x 6 mm
 Hole diameter in the fixture: $d_f = 12$ mm
 Plate thickness (input): 10 mm
 Recommended plate thickness: not calculated
 Drilling method: Hammer drilled
 Cleaning: Compressed air cleaning of the drilled hole according to instructions for use is required

Anchor type and size: HIT-HY 200 + HIT-V-F (8.8) M10
 Installation torque: 0,020 kNm
 Hole diameter in the base material: 12 mm
 Hole depth in the base material: 70 mm
 Minimum thickness of the base material: 100 mm

8.1 Recommended accessories

Drilling	Cleaning	Setting
<ul style="list-style-type: none"> Suitable Rotary Hammer Properly sized drill bit 	<ul style="list-style-type: none"> Compressed air with required accessories to blow from the bottom of the hole Proper diameter wire brush 	<ul style="list-style-type: none"> Dispenser including cassette and mixer Seismic/Filling set Torque wrench



Coordinates Anchor [mm]

Anchor	x	y	c _{-x}	c _{+x}	c _{-y}	c _{+y}
1	-95	-30	-	165	-	-
2	-95	30	-	165	-	-
3	-20	30	-	90	-	-
4	-20	-30	-	90	-	-

Company:
Specifier:
Address:
Phone | Fax: |
E-Mail:

Page: 6
Project:
Fastening Point:
Date: 17. 06. 2020

9 Remarks; Your Cooperation Duties

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Project:

Project no:

Author:

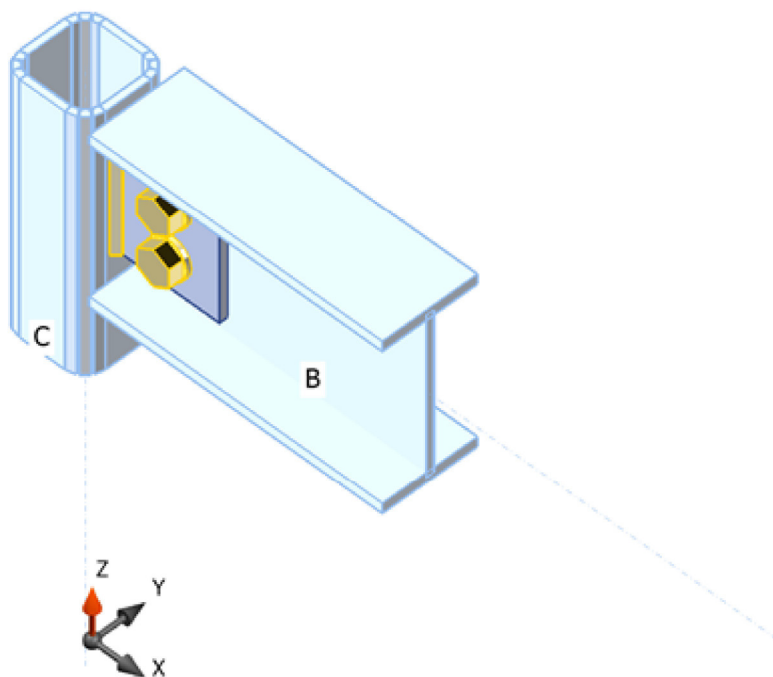
Project item Spoj D2

Design

Name Spoj D2
Description
Analysis Stress, strain/ simplified loading

Beams and columns

Name	Cross-section	β - Direction [°]	γ - Pitch [°]	α - Rotation [°]	Offset ex [mm]	Offset ey [mm]	Offset ez [mm]
C	3 - VHP50/50x4.0	0,0	90,0	0,0	0	0	0
B	2 - CON1(IPE100)	0,0	0,0	0,0	0	0	-50



Cross-sections

Name	Material
3 - VHP50/50x4.0	S 235
2 - CON1(IPE100)	S 235

Bolts

Name	Bolt assembly	Diameter [mm]	f_u [MPa]	Gross area [mm ²]
M12 8.8	M12 8.8	12	800,0	113

Project:

Project no:

Author:

Load effects (equilibrium not required)

Name	Member	Pos.	X [mm]	N [kN]	Vy [kN]	Vz [kN]	Mx [kNm]	My [kNm]	Mz [kNm]
LE1	B	End	0	0,0	0,0	-4,0	0,0	0,0	0,0

Check

Summary

Name	Value	Check status
Analysis	100,0%	OK
Plates	0,0 < 5%	OK
Bolts	33,1 < 100%	OK
Welds	16,9 < 100%	OK
Buckling	Not calculated	

Plates

Name	Thickness [mm]	Loads	σ_{Ed} [MPa]	ϵ_{Pl} [1e-4]	Check status
C	4,0	LE1	73,3	0,0	OK
B-bfl 1	5,7	LE1	28,5	0,0	OK
B-tfl 1	5,7	LE1	29,9	0,0	OK
B-w 1	4,1	LE1	138,7	0,0	OK
FP1	5,0	LE1	138,7	0,0	OK

Design data

Material	f_y [MPa]	ϵ_{lim} [1e-4]
S 235	235,0	500,0

Symbol explanation

ϵ_{Pl}

Strain

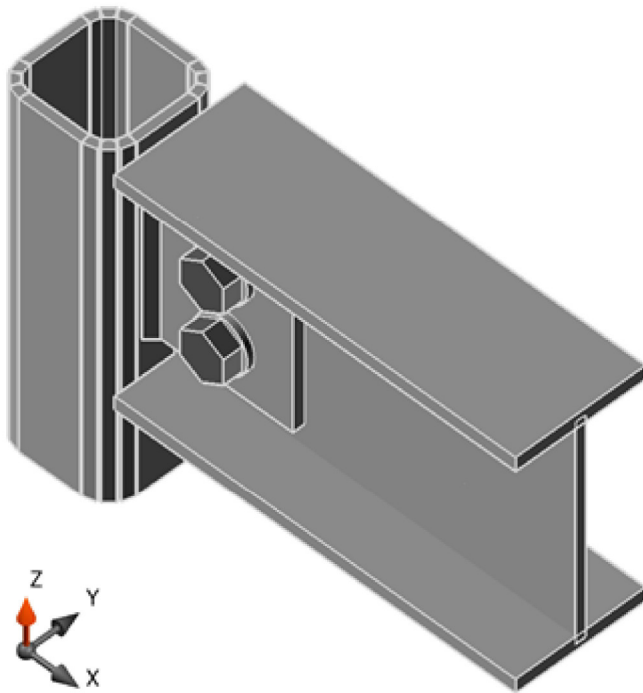
σ_{Ed}

Eq. stress

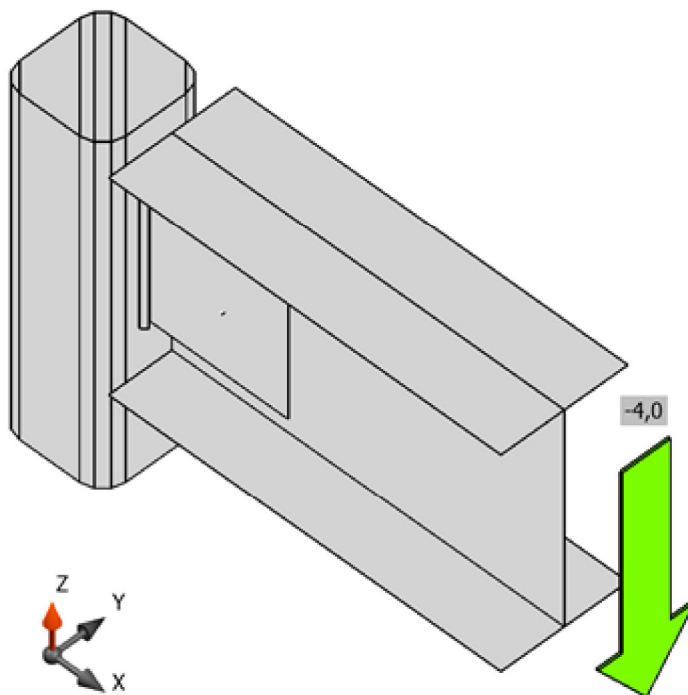
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Project no:

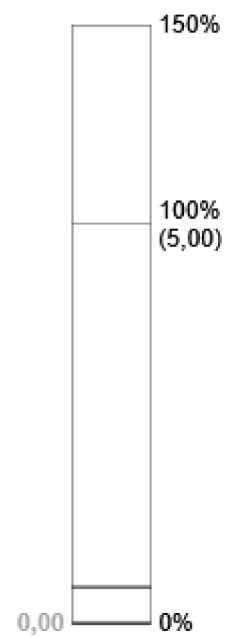
Author:



Overall check, LE1



Strain check
[%]

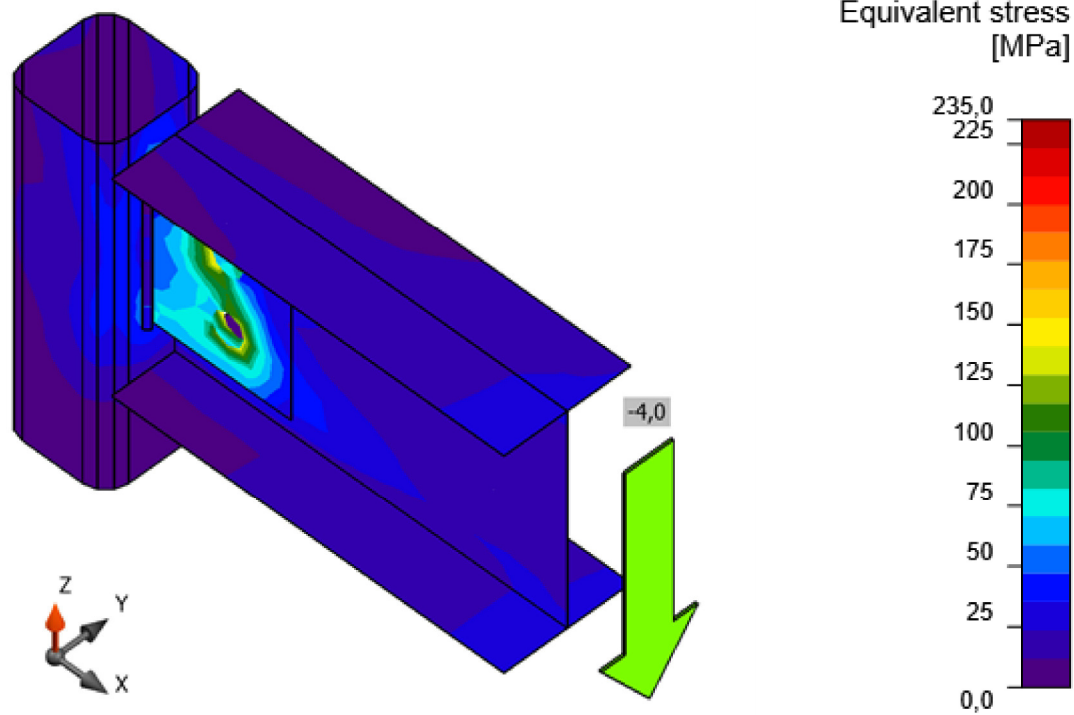


Strain check, LE1

Project:

Project no:

Author:



Equivalent stress, LE1

Bolts

	Name	Loads	$F_{t,Ed}$ [kN]	V [kN]	U_{t_t} [%]	$F_{b,Rd}$ [kN]	U_{t_s} [%]	$U_{t_{ts}}$ [%]	Status
	B1	LE1	1,2	7,9	2,8	33,6	24,6	26,4	OK
	B2	LE1	0,8	7,9	1,9	24,0	33,1	25,8	OK

Design data

Name	$F_{t,Rd}$ [kN]	$B_{p,Rd}$ [kN]	$F_{v,Rd}$ [kN]
M12 8.8 - 1	48,4	44,5	32,3

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 V_y , V_z 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

Project:

Project no:

Author:

U_t Utilization in tension

U_{ts} Utilization in shear

U_{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} [%]	σ_{\perp} [MPa]	τ_{\parallel} [MPa]	τ_{\perp} [MPa]	U_t [%]	U_{tc} [%]	Status
C-w 3	FP1	▲3,0▲	70	LE1	32,0	0,0	9,2	-11,1	13,8	8,9	6,2	OK
		▲3,0▲	70	LE1	60,9	0,0	33,8	-0,3	-29,2	16,9	11,9	OK

Design data

	β_w [-]	$\sigma_{w,Rd}$ [MPa]	0.9σ [MPa]
S 235	0,80	360,0	259,2

Symbol explanation

ϵ_{Pl} Strain

$\sigma_{w,Ed}$ Equivalent stress

$\sigma_{w,Rd}$ Equivalent stress resistance

σ_{\perp} Perpendicular stress

τ_{\parallel} Shear stress parallel to weld axis

τ_{\perp} Shear stress perpendicular to weld axis

0.9σ Perpendicular stress resistance - $0.9 \cdot f_u / \gamma_{M2}$

β_w Correlation factor EN 1993-1-8 tab. 4.1

U_t Utilization

U_{tc} 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 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		

Project:

Project no:

Author:

Item	Value	Unit	Reference
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 cone breakout resistance	Yes		ETAG 001-C
Use calculated a_b in bearing check.	Yes		EN 1993-1-8: tab 3.4

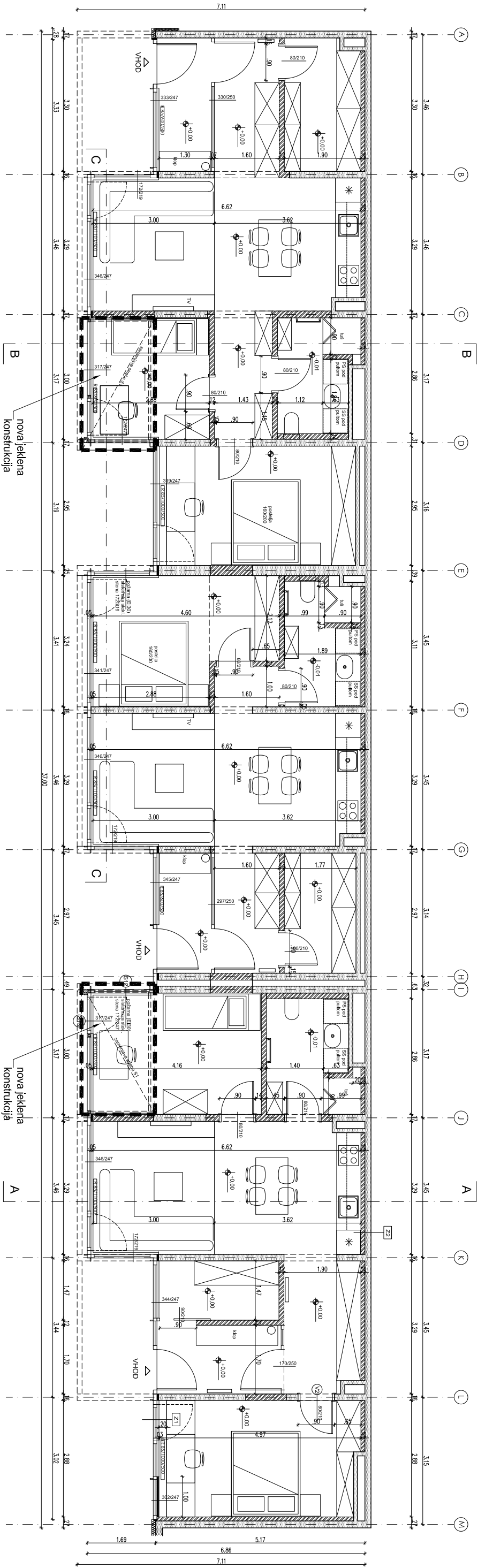
	TEHNIČNI PRIKAZI
--	-------------------------

VSEBINA

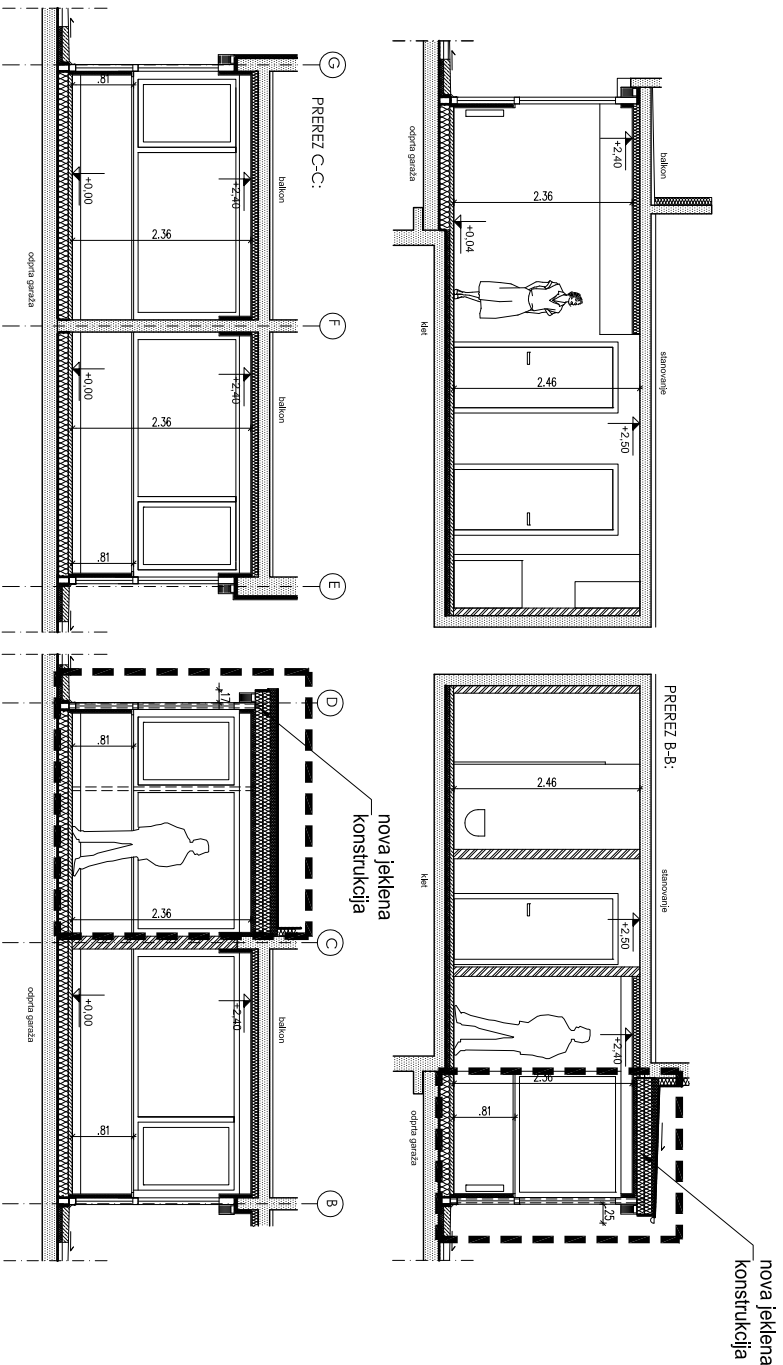
01	Situacija – tloris pritličja in prerezi	M 1:100
02	Jeklena konstrukcija – pozicijski načrt in detajli	M 1:10, 1:50

Situacija (M 1:100)

Toris



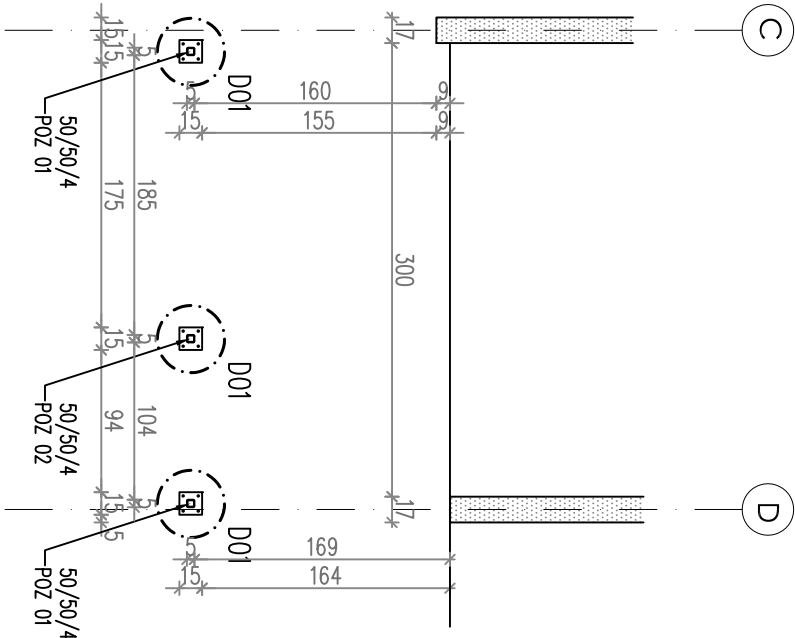
Prerezi



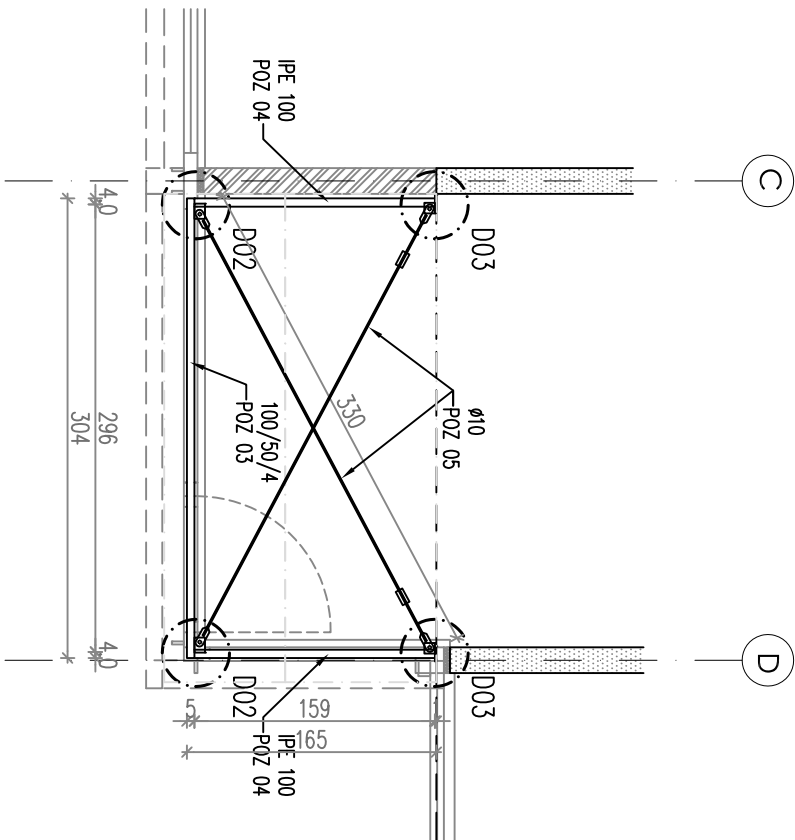
Enplan arhitekturni biro		Vrsta projekta: PZI	
Projektno področje:		Enplan, arhitekturni biro d.o.o.	
Odgovorni projektant:		Marko Keše, dipl.inž.grad., IZS PI G-4595	
Odgovorni vodja projekta:		Tanja Modic univ.dipl.inž.arh., ZAPS A-1635	
Izdalek:			
Vsebinska risba:		Številka projekta: 004/17	
Situacija - tloris pritličja in prerezi		Številka načrta: 004/17-G	
Investitor:		Številka risbe: 01	
Javni stanovanjski sklad Mestne občine Ljubljana Zemljakova ulica 3, 1000 Ljubljana		Datum: Junij 2020	
Naziv objekta: VEČSTANOVAJSKI OBJEKT - SPREMEMBA NAMEMBNOSTI DELA OBJEKTA		Merilo: 1:100	

Pozicijski načrt jeklene konstrukcije (M 1:50)

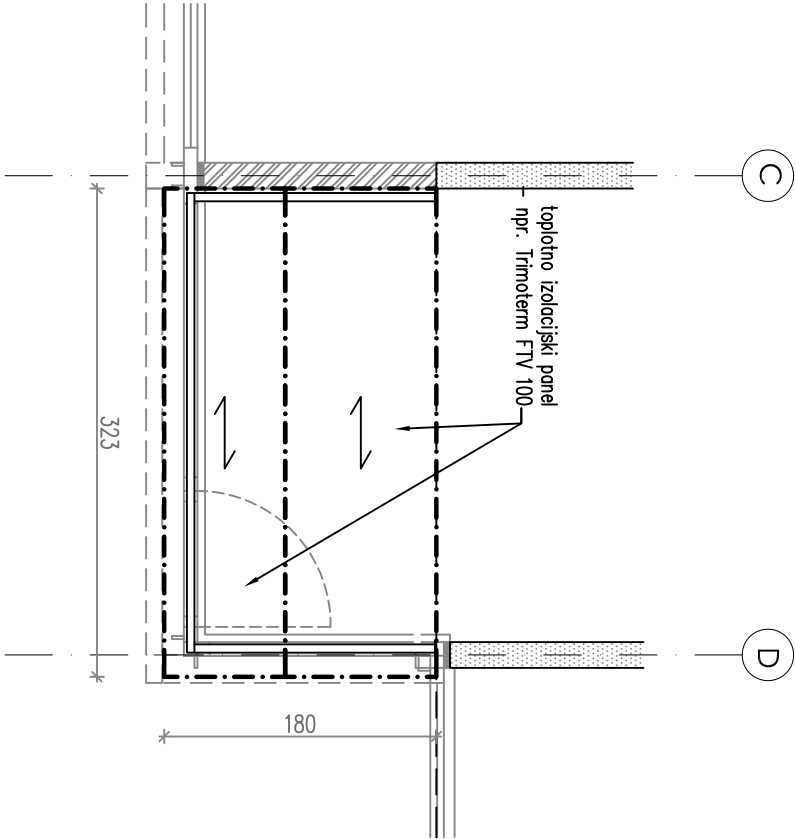
Tloris stebrov



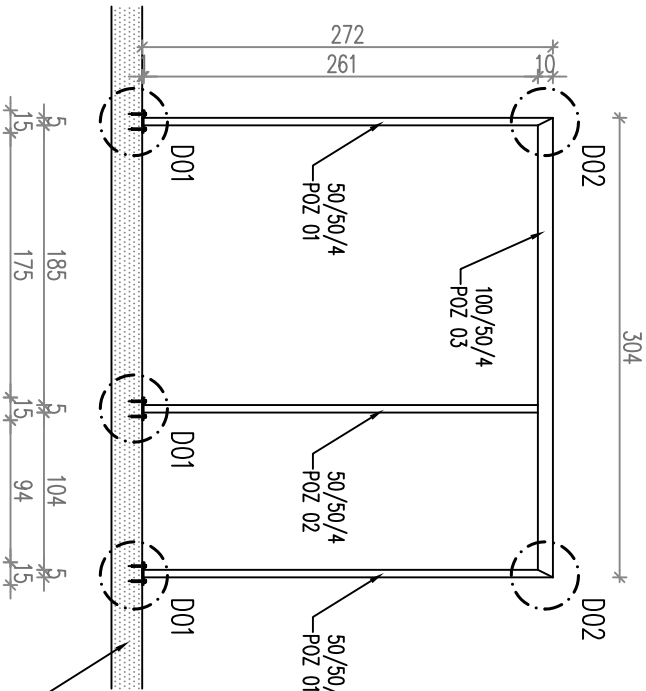
Tloris strešne konstrukcije



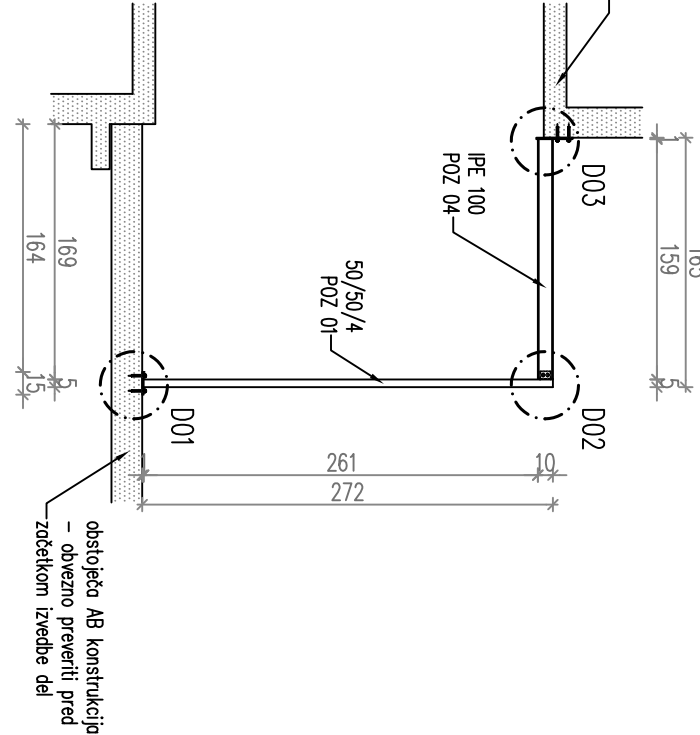
Tloris (polaganje) toplotno izolacijskih panelov



Pogled – vzdolžna konstrukcija



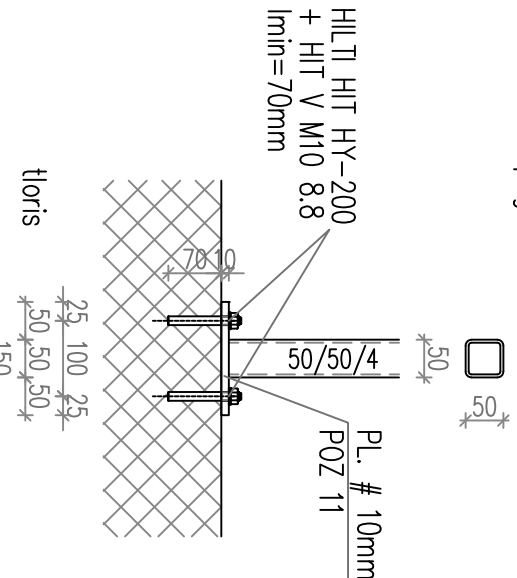
Pogled – prečna konstrukcija



Detalji (M 1:10)

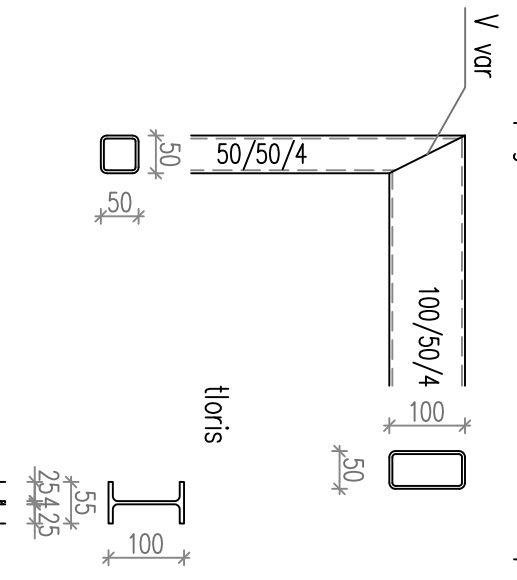
Detalj "D01"

pogled

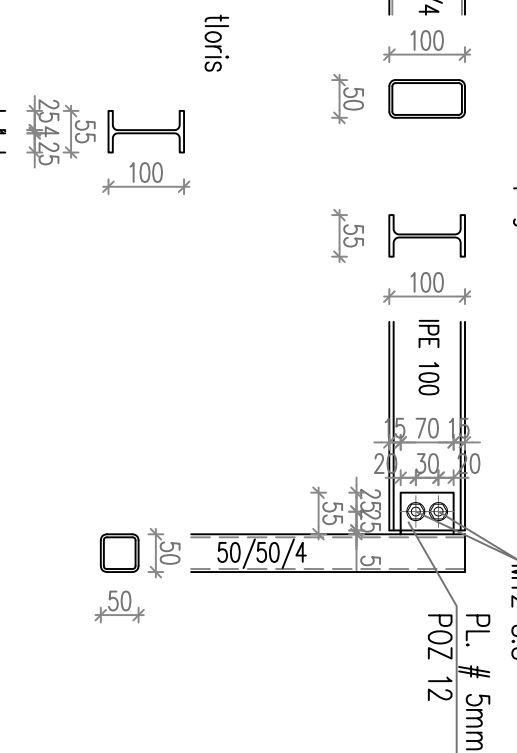


Detalj "D02"

pogled 1

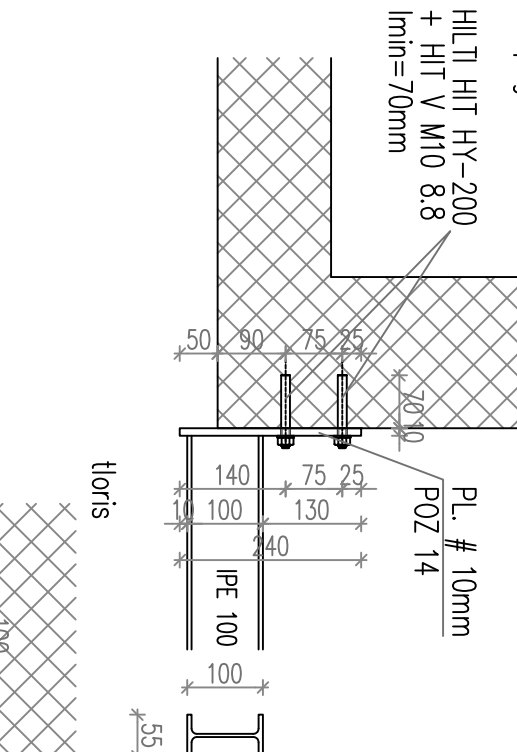


pogled 2

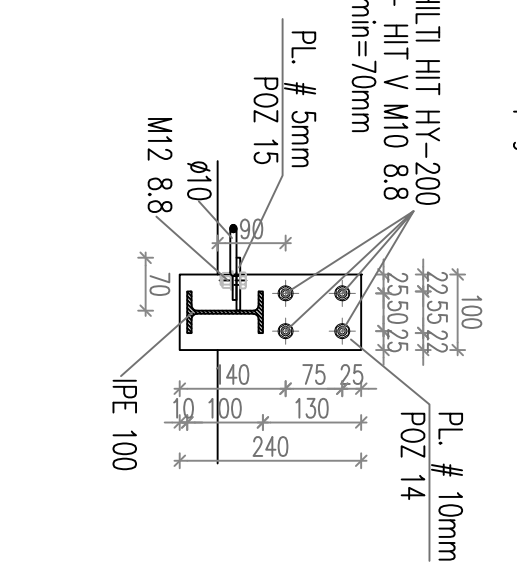


Detalj "D03"

pogled 1



pogled 2



KOSOVNICA

PROFIL					
POZICIJA	PLOČEVINA (bl/h)	MATERIAL	TEŽA (kg/m)	DOLŽINA (mm)	TEŽA (kg)
01.	□ 50/50/4	S235JR	5,46	2710	14,80
02.	□ 50/50/4	S235JR	5,46	2610	14,25
03.	□ 100/50/4	S235JR	8,60	3040	26,14
04.	□ IPE 100	S235JR	8,09	1585	12,82
05.	• Ø10 (z napenjanjem)	S235JR	0,62	3300	2,05
SKUPAJ:					99,71
PLOČEVINE					
POZICIJA	PLOČEVINA (bl/h)	MATERIAL	TEŽA (kg/m)	DIMENZIJE (mm)	TEŽA (kg)
11.	150/150/10 mm	S235JR	78,50	150 1150 1,77	3
12.	70/55/5 mm	S235JR	39,25	70 155 0,15	2
13.	100/70/5 mm	S235JR	39,25	100 170 0,27	2
14.	240/100/10 mm	S235JR	78,50	240 100 1,88	2
15.	70/70/5 mm	S235JR	39,25	70 70 0,19	2
SKUPAJ:					10,30
SKUPAJ (+3% za spojna sredstva):					113,33

*Opomba: kosovnica je približna in zgolj informativna. Točno kosovnico izdela izvajalec jeklene konstrukcije!

OPOMBA:

Materijal: jeklo S235 JR sidro in vijaki 8.8

Izvedbeni razred: EXC 2

Pri izdelavi zvarov upoštevati:

Vsi vori so varjeni neprekinjeno in zoključeni

Vsi čelni zvari so izvedeni s preventivno korena zvara

Za izvedbene primere zvarov velja – neoznačeni zvari v načrtih:

KOTNI ZVARI

Za a < 10

dvoglini kotni zvar

X=0,6 pri materialu S235

X=0,7 pri materialu S355

enoglini kotni zvar

preklopni spoj

Kotni zvar a = 0,7 * min

Pred pričetkom del mora izvajalec del preveriti dimenzije v navedene načrtih

O morebitnih napakah in neskladjih obvezno obvestiti projektanta konstrukcije

Za vse manjkajoče kote glej načrt arhitekture



Projektno podjetje:	Enplan, arhitekturno biro d.o.o.	Vrsta projekta:	PZI
Odgovorni projektant:	Marko Keše, diplomirani inženir, ZAPS A-1635		
Odgovorni strok. projektant:	Tanja Modic univ.dipl.inž. arh., ZAPS A-1635		
Iskalnik:			
Vsebinska ršba:	Jeklena konstrukcija	Številka projekta:	004/17
	- pozicijski načrt in detajli	Številka nacrta:	004/17-G
Investitor:	Javni stanovniški sklad Mestne občine Ljubljana	Številka risbe:	02
	Zemljekovarska ulica 3, 1000 Ljubljana	Datum:	Junij 2020
Naziv objekta:	VEČSTANOVNIŠKI OBJEKT - SPREMENBA	Metric:	1:50, 1:10
	MEMBRANOSTI DELA OBJEKTA		