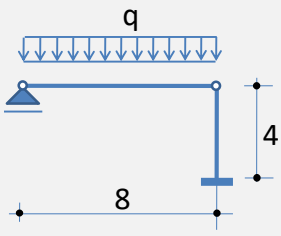
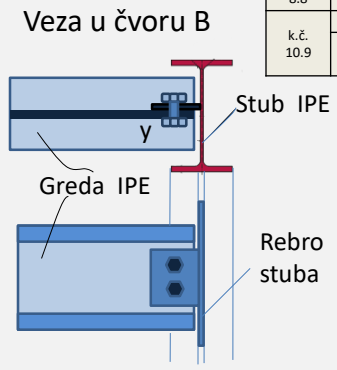
10. Za zadato opterećenje q = 20 kN/m

a) dimenzionisati nosač i stub

b) Konstruisati vezu u čvoru B i nacrtati u razmeri 1:5

Kvalitet čelika: Č0361		
Slučaj opterećenja		
I	II	III
Zavrtnjevi		
k.č. 4.6	neobrađeni	
	obrađeni	
k.č. 5.6	**neobrađeni**	
	obrađeni	
k.č. 8.8	bez sile prednaprezanja	
	sa punom silom prednapr.	
k.č. 10.9	bez sile prednaprezanja	
	sa punom silom prednapr.	

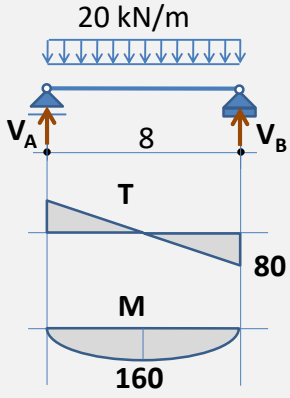




Rešenje zadatka br.10

Greda je sistema proste greda koja svoju reakciju predaje stubu

1. Statički uticaji u gredi



$$1)\ \Sigma V_i = 0;\ V_A - 20\cdot 8 + V_B = 0$$

$$2)\ \Sigma M_A = 0;\ V_B \cdot 8 - 20\cdot 8\cdot 4 = 0$$

Iz 2) $V_B = 80\ kN$

Iz 1) $V_A = 80\ kN$

$$M_{max} = \frac{q\cdot l^2}{8} = \frac{20\cdot 8^2}{8} = 160\ kNm$$

2. Podaci potrebni za proračun

Osnovni materijal Č0361 (I sl.o.) σ_{dop} = 16 kN/cm^2 τ_{dop} = 9 kN/cm^2

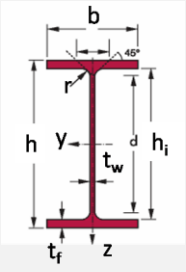
Neobrađeni zavrtnjevi k.č. 5.6 $\sigma_{b,dop}$ = 27 kN/cm^2 τ_{dop} = 14 kN/cm^2

Ugaoni šavovi $\sigma_{w,dop}$ = 12 kN/cm^2

3. Dimenzionisanje nosača

$W_{pot}=M_{max}/\sigma_{doz}$ $W_{pot}=160\cdot10^2/16=1000$ cm^3

Usvaja se valjani profil **IPE 400** sa geometrijskim karakteristikama:



h=400 mm
b= 180 mm
t_w= 8,6 mm
t_f= 13,5 mm
r= 21 mm
d_i=331 mm
$\phi\rightarrow$ M 22

I_y=23130 cm^4
W_y=1156 cm^3
A= 84,5 cm^2
S_y=654 cm^3

3

4. Kontrola napona

Presek nad osloncem: T_{max}=80 kN M=0 kNm

$$\tau_{max}=\frac{T_{max}\cdot S_y}{t_w\cdot I_y}=\frac{80\cdot 654}{23130\cdot 0{,}86}=2{,}63\text{kN/cm}^2<\tau_{dop}=9\text{kN/cm}^2$$

Presek u sredini raspona: T=0 kN M_{max}=160 kNm

$$\sigma_{max}=\frac{M_{max}}{W_y}=\frac{160\cdot 10^2}{1156}=13{,}84\ \text{kN/cm}^2<\sigma_{dop}=16\text{kN/cm}^2$$

Usvojeni profil IPE 400 zadovoljava

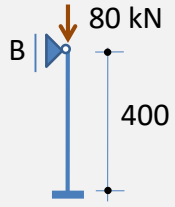
4

5. Dimenzionisanje stuba

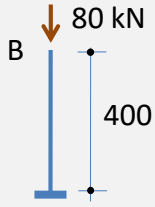
Reakcije proste grede se prenose na stub

V_B=80 kN M=0 kNm

stub u vrhu pridržan gredom

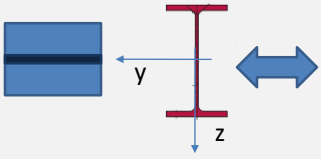


stub u vrhu slobodan



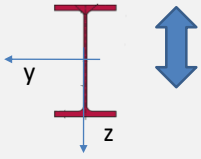
Izvijanje u pravcu grede (oko z-z ose)

$l_{iy}=\beta*l=0,7\cdot400=280$ cm



Izvijanje u drugom pravcu (oko y-y ose)

li=2·400=800 cm



5

Izvijanje u ravni štapa (oko z-z ose)

Pretpostavljen profil IPE 240

A=33,3 cm² i_y=9,97 i_z=2,67

i_z=2,67 cm

Određivanje vitkosti štapa

$$\lambda_z=\frac{l_z}{i_z}=\frac{280}{2,67}=104,86$$

Određivanje relativne vitkosti štapa (λ_V=92,9)

$$\overline{\lambda_z}=\frac{\lambda_z}{\lambda_z}=\frac{104,86}{92,9}=1,13$$ kriva izvijanja B)→ $\chi_z=0,53$

Izvijanje oko y-y ose štapa

i_y=9,97 cm

Određivanje vitkosti štapa

$$\lambda_y=\frac{l_y}{i_y}=\frac{800}{9,97}=80,24 \qquad \overline{\lambda_y}=\frac{\lambda_y}{\lambda_y}=\frac{80,24}{92,9}=0,86$$ (kriva izvijanja C)

$\chi_y=0,62$

Kontrola napona: χ_{min}=min(0,53; 0,62)=0,53

$$\sigma=\frac{N_c}{A}=\frac{280}{33,30}=8,40\ \text{kN/cm}^2<\sigma_{idop}=\chi_{min}\cdot\sigma_{dop}=0,53\cdot16=8,48\ \text{kN/cm}^2$$

Usvojen profil IPE 240 –Č0361

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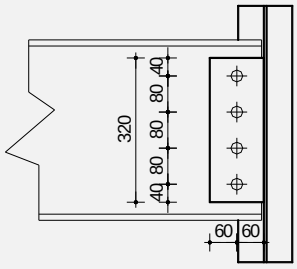
b) Proračun zglobne veze u čvoru B

Pretpostavljena veza kao na slici



Veza priključnog lima za rebro

Predpostavlja se priključni lim # 120 x10 x 320
Pretpostavljaju se minimalni šavovi za vezu
a_w = 4 mm; (lw = h_p =320 mm)

$$M_T = \frac{V(t_p + t_w)}{2} = \frac{80(1,0+0,86)}{2} = 74,4 \text{ kNcm}$$

$$M_e = V \cdot 6,0 = 80 \cdot 6,0 = 480 \text{ kNcm}$$

7

$$n = \frac{M_e}{W_w} = \frac{M_e}{2\frac{a_w \cdot l_w^{\,2}}{6}} = \frac{480 \cdot 3}{0,4 \cdot 32^2} = 3,51 \text{ kN/cm}^2$$

$$V_{II,V} = \frac{V}{A_{w,y}} = \frac{80}{2 \cdot 32 \cdot 0,4} = 3,125 \text{ kN/cm}^2$$

$$V_{II,T} = \frac{M_T}{W_{w,t}} = \frac{M_T}{2(a+t_p)\cdot(h_p+a)\cdot a} = \frac{74,4}{2(0,4+1,0)(32+0,4)\cdot 0,4}$$

$$V_{II,T} = 2,05 \text{ kN/cm}^2$$

$$\sigma_u = \sqrt{n^2 + 3(V_{II,V} + V_{II,T})^2} = \sqrt{3,51^2 + 3(3,125+2,05)^2} =$$

$$\sigma_u = 9,63 \text{ kN/cm}^2 > \sigma_{w,dop} = 12 \text{kN/cm}^2$$

8

Kontrola napona u priključnom limu

$$M_e = V \cdot 6{,}0 = 80 \cdot 6 = 480 \text{ kNcm}$$

$$\sigma_{max} = \frac{M_e}{W_p} = \frac{M_e}{\frac{t_p \cdot h_p^{\,2}}{6}} = \frac{480 \cdot 6}{1{,}0 \cdot 32^2} = 2{,}81 \text{ kN/cm}^2$$

$$\tau_v = \frac{V}{t_p \cdot h_p} = \frac{80}{1{,}0 \cdot 32} = 2{,}5 \text{ kN/cm}^2$$

$$\tau_T = \frac{M_T}{W_T} = \frac{74{,}4}{h_p \cdot t_p^{\,2}/3} = \frac{74{,}4 \cdot 3}{32 \cdot 1{,}0^2} = 6{,}97 \text{ kN/cm}^2$$

$$\sigma_u = \sqrt{\sigma^2 + 3(\tau_V + V_T)^2} = \sqrt{2{,}81^2 + 3(2{,}5 + 6{,}97)^2} =$$

$$\sigma_u = 16{,}64 \text{ kN/cm}^2 \approx \sigma_{dop} = 16 \text{ kN/cm}^2$$

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Veza priključnog lima za rebro nosača

Proračun nosivosti zavrtnjeva

Usv. M20.....5.6

$$d = \sqrt{5 \cdot t_{s,min}} - 0{,}2 = \sqrt{5 \cdot 0{,}86} - 0{,}2 = 1{,}87$$

$$F_v = \frac{2^2 \pi}{4} \cdot 14{,}0 = 43{,}98 \text{kN}$$

$$F_b = 0{,}86 \cdot 2 \cdot 27 = 46{,}44 \text{ kN}$$

$$F_{dop} = 43{,}98 \text{kN}$$

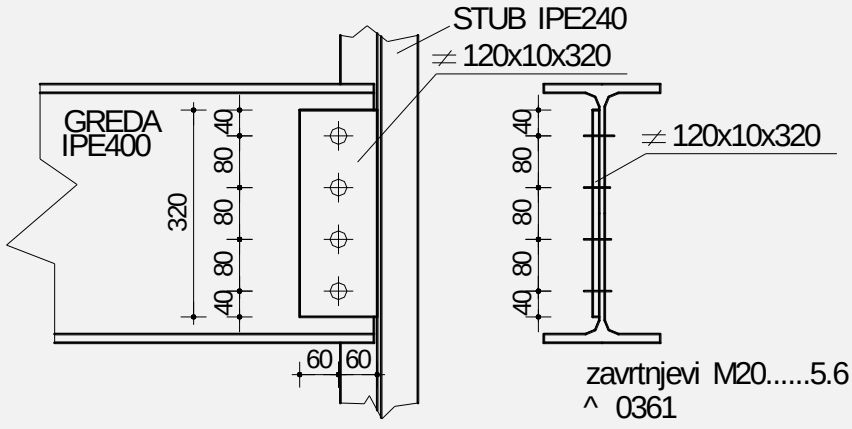
Proračun potrebnog broja zavrtnjeva

$$n = \frac{1}{F_{dop}} \sqrt{V^2 + \left(\frac{6 \cdot M_e}{h}\right)^2} = \frac{1}{43{,}98} \sqrt{80^2 + \left(\frac{6 \cdot 480}{32}\right)^2} = 2{,}74$$

Usvojeno 4M20 .....5.6

$$F_v = \frac{V}{n} = \frac{80}{4} = 20 \text{ kN}$$

10


STUB IPE240
≠ 120x10x320
GREDA
IPE400
40
80
80
80
40
320
60
60
40
80
80
80
40
≠ 120x10x320
zavrtnjevi M20.....5.6
^ 0361

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