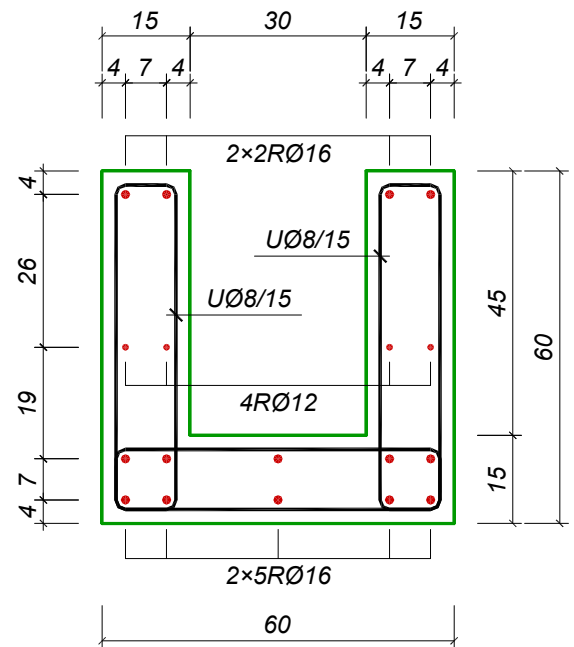


15 Nosač sistema proste grede, raspona $L = 6\text{ m}$, armiran kao na skici, opterećen je stalnim opterećenjem $g = 30\text{ kN/m}$. Odrediti veličinu jednako raspodeljenog povremenog opterećenja koju nosač može prihvatiti uz zadovoljenje propisanih koeficijenata sigurnosti. Prilikom proračuna nosivosti preseka uzeti u obzir i poprečnu (GA 240/360) i podužnu (RA 400/500) armaturu. Beton MB 30.



Nosivost u odnosu na momente savijanja

Zadati presek je u proračunskom smislu pravougaoni, širine $b = 2 \times 15 = 30\text{ cm}$. Pošto nije eksplicitno zahtevano, proračun je sproveden uz zanemarenje nosivosti pritisnute armature.

$$A_{a1} = 20.10\text{ cm}^2 \quad (2 \times 5 = 10R\text{Ø}16)$$

$$a_1 = \frac{5 \times 4 + 5 \times 11}{10} = 7.5\text{ cm} \Rightarrow h = 60 - 7.5 = 52.5\text{ cm}$$

$$\mu_1 = \frac{20.10 \times 40}{30 \times 52.5 \times 2.05} = 24.909\% \xrightarrow{\text{TABLICE}} \begin{cases} k = 2.144 \\ \varepsilon_b / \varepsilon_a = 3.5 / 7.85\% \end{cases}$$

$$M_{au} = \left(\frac{52.5}{2.144} \right)^2 \times 30 \times 2.05 \times 10^{-2} = 368.8\text{ kNm} = M_u \quad (N_u = 0)$$

$$M_g = \frac{30 \times 6.0^2}{8} = 135\text{ kNm} \Rightarrow M_p = \frac{368.8 - 1.6 \times 135}{1.8} = 84.9\text{ kNm}$$

$$p_1 \leq \frac{8 \times M_p}{L^2} = \frac{8 \times 84.9}{6.0^2} = 18.87 \frac{\text{kN}}{\text{m}}$$

Nosivost u odnosu na transverzalne sile

$$\tau_{u,u} = \frac{m \times a_u^{(1)}}{b \times e_u} \times \sigma_v = \frac{2 \times 2 \times 0.503}{2 \times 15 \times 15} \times 24 = 0.107 \frac{\text{kN}}{\text{cm}^2} = 1.07\text{ MPa}$$

$$\tau_n = \frac{2}{3} \times \tau_{Ru} + \tau_r = \frac{2}{3} \times 1.07 + 1.1 = 1.81\text{ MPa} = 0.181 \frac{\text{kN}}{\text{cm}^2}$$

$$\tau_n = \frac{T_u}{b \times 0.9 \times h} \Rightarrow T_u = 0.181 \times 2 \times 15 \times 0.9 \times 52.5 = 257.3\text{ kN}$$

$$T_g = \frac{30 \times 6.0}{2} = 90\text{ kN} \Rightarrow T_p = \frac{257.3 - 1.6 \times 90}{1.8} = 62.9\text{ kN}$$

$$p_2 \leq \frac{2 \times T_p}{L} = \frac{2 \times 62.9}{6.0} = 20.97 \frac{\text{kN}}{\text{m}}$$

Merodavno je manje od dva sračunata opterećenja, dakle $p = p_1 = 18.87\text{ kN/m}$.

16

Sračunati napone u betonu i armaturi, srednje rastojanje i karakterističnu širinu prslina ($t=0$) za presek iz prethodnog zadatka samo usled stalnog opterećenja.

Pritisnuta je gornja ivica, pa je oblik pritisnute zone preseka pravougaoni, širine 30 cm.

$$MB\ 30 \Rightarrow E_b = 31.5\ \text{GPa} \text{ (čl. 52. BAB 87)} \Rightarrow n = \frac{E_a}{E_b} = \frac{210}{31.5} = 6.67$$

$$a_1 = 7.5\ \text{cm} \Rightarrow h = 60 - 7.5 = 52.5\ \text{cm}$$

Zanemarenjem pritisnute armature sledi:

$$A_{a1} = 10R\emptyset 16 \Rightarrow \mu_1 = \frac{20.10}{30 \times 52.5} = 0.0128 = 1.28\% ; \mu_2 = 0$$

$$s^2 + 2 \times 6.67 \times 0.0128 \times s - 2 \times 6.67 \times 0.0128 = 0 \Rightarrow s = 0.336$$

$$J_{ilb} = \frac{s^2}{2} \times \left(1 - \frac{s}{3}\right) = \frac{0.336^2}{2} \times \left(1 - \frac{0.336}{3}\right) = 0.050$$

$$M_a = M_g = 135\ \text{kNm}$$

$$\sigma_b = \frac{M_a}{b \times h^2} \times \frac{s}{J_{ilb}} = \frac{135 \times 10^2}{30 \times 52.5^2} \times \frac{0.336}{0.050} = 1.09 \frac{\text{kN}}{\text{cm}^2} = 10.9\ \text{MPa}$$

$$\sigma_{a1} = 6.67 \times 10.9 \times \frac{1 - 0.336}{0.336} = 144.0\ \text{MPa} \Rightarrow \varepsilon_{a1} = \frac{144.0}{210 \times 10^3} = 0.686\text{‰}$$

ODREĐIVANJE ŠIRINE PRSLINA

$$MB\ 30 \Rightarrow f_{bzm} = 2.4\ \text{MPa} \text{ (član 51. PBAB 87)}$$

$$d = 60\ \text{cm} = 0.6\ \text{m} \Rightarrow f_{bzs} = 0.7 \times 0.24 \times \left(0.6 + \frac{0.4}{\sqrt[4]{0.6}}\right) = 0.177 \frac{\text{kN}}{\text{cm}^2}$$

$$W_{b1} \approx \frac{30 \times 60^2}{6} = 18000\ \text{cm}^3 \Rightarrow M_r = 0.177 \times 18000 = 3190\ \text{kNcm}$$

$$M_r = 31.9\ \text{kNm} < M = M_g = 135\ \text{kNm} \Rightarrow \text{presek sa prslinom}$$

$$a_0 = a' - \emptyset/2 = 4.0 - 1.6/2 = 3.2\ \text{cm}$$

$$\emptyset = 16\ \text{mm} = 1.6\ \text{cm}$$

$$e_{\emptyset, sr.} = (7+19)/2 = 13\ \text{cm}$$

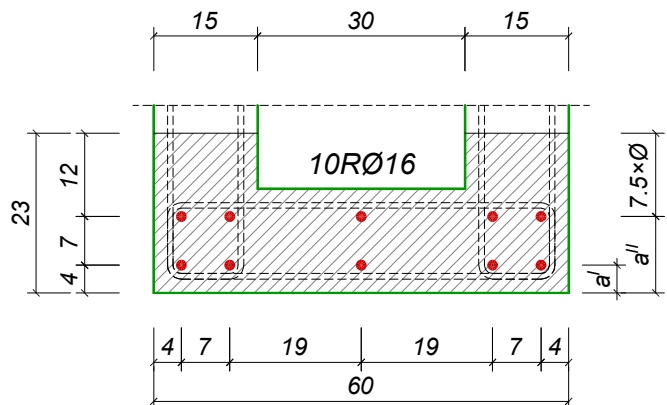
$$k_1 = 0.4 \text{ (RA 400/500)}$$

$$k_2 = 0.125 \text{ (čisto savijanje)}$$

$$h_{bz, ef.} \leq \begin{cases} 11 + 7.5 \times 1.6 = 23\ \text{cm} \\ d/2 = 60/2 = 30\ \text{cm} \end{cases}$$

$$A_{bz, ef.} = 60 \times 23 - (23 - 15) \times 30 = 1140\ \text{cm}^2$$

$$\mu_{z1, ef.} = \frac{A_{a1}}{A_{bz, ef.}} = \frac{2010}{1140} = 0.0176 = 1.76\%$$



$$I_{ps} = 2 \times \left(3.2 + \frac{13}{10} \right) + 0.4 \times 0.125 \times \frac{1.6}{0.0176} = 13.5 \text{ cm}$$

$$\left. \begin{array}{l} \beta_1 = 1.0 \text{ (RA 400/500)} \\ \beta_2 = 1.0 \text{ (} t = 0 \text{)} \end{array} \right\} \Rightarrow \zeta_a = 1 - 1.0 \times 1.0 \times \left(\frac{31.9}{135} \right)^2 = 0.944$$

$$a_{pk} = 1.7 \times \zeta_a \times \varepsilon_{a1} \times I_{ps} = 1.7 \times 0.944 \times 0.686 \times 10^{-3} \times 13.5 = 15 \times 10^{-3} \text{ cm} = 0.15 \text{ mm}$$

17 Dimenzionisati stub pravougaonog poprečnog preseka, dimenzija $b/d = 30/60$ cm, opterećen sledećim uticajima:

$$\begin{array}{ll} M_g = 100 \text{ kNm} & ; N_g = 200 \text{ kN} \\ M_p = 0 & ; N_p = 600 \text{ kN (vertikalno povremeno opterećenje)} \\ M_w = \pm 200 \text{ kNm} & ; N_w = 0 \text{ (vetar, alternativno dejstvo)} \end{array}$$

Kvalitet materijala: MB 30, RA 400/500.

Sva potrebna objašnjenja su data u Primeru 3. Ovde su sračunate neophodne vrednosti.

ZATEGNUTA "LEVA" STRANA STUBA

$$M_u = 1.6 \times 100 + 1.8 \times 200 = 520 \text{ kNm}$$

$$N_u = 1.6 \times 200 = 320 \text{ kN}$$

$$\text{pretp. } a_1 = 6.5 \text{ cm} \Rightarrow h = 60 - 6.5 = 53.5 \text{ cm}$$

$$M_{au} = 520 + 320 \times \left(\frac{0.60}{2} - 0.065 \right) = 595.2 \text{ kNm}$$

$$k = \frac{53.5}{\sqrt{\frac{595.2 \times 10^2}{30 \times 2.05}}} = 1.720 \Rightarrow \varepsilon_p / \varepsilon_a = 3.5 / 3.004\text{‰} ; \bar{\mu} = 43.564\%$$

$$A_{a1} = 43.564 \times \frac{30 \times 53.5}{100} \times \frac{2.05}{40} - \frac{320}{40} = 27.83 \text{ cm}^2$$

Sledeća kombinacija koja se razmatra uključuje i povremeno opterećenje:

$$M_u = 1.6 \times 100 + 1.8 \times 200 = 520 \text{ kNm}$$

$$N_u = 1.6 \times 200 + 1.8 \times 600 = 1400 \text{ kN}$$

$$M_{au} = 520 + 1400 \times \left(\frac{0.60}{2} - 0.065 \right) = 849.0 \text{ kNm}$$

$$k = \frac{53.5}{\sqrt{\frac{849.0 \times 10^2}{30 \times 2.05}}} = 1.440 \Rightarrow \varepsilon_a < 3.0\text{‰} \Rightarrow A_{a2} > 0$$

$$\text{usv. } \varepsilon_a = 3\text{‰} \Rightarrow \left\{ \begin{array}{l} k^* = 1.719 \\ \bar{\mu}^* = 43.590\% \end{array} \right. \Rightarrow M_{abu} = \left(\frac{53.5}{1.719} \right)^2 \times 0.30 \times 2.05 = 595.4 \text{ kNm}$$

$$\Delta M_{au} = 849.0 - 595.4 = 253.6 \text{ kNm}$$

$$\text{pretp. } a_2 = 5 \text{ cm} \Rightarrow A_{a2} = \frac{253.6 \times 10^2}{(53.5 - 5) \times 40} = 13.07 \text{ cm}^2$$

ZATEGNUTA "DESNA" STRANA STUBA

$$M_u = 1.0 \times (-100) + 1.8 \times 200 = 260 \text{ kNm}$$

$$N_u = 1.0 \times 200 = 200 \text{ kN}$$

$$\text{pretp. } a_1 = 5 \text{ cm} \Rightarrow h = 60 - 5 = 55 \text{ cm}$$

$$M_{au} = 260 + 200 \times \left(\frac{0.60}{2} - 0.05 \right) = 310.0 \text{ kNm}$$

$$k = \frac{55}{\sqrt{\frac{310 \times 10^2}{30 \times 2.05}}} = 2.450 \Rightarrow \varepsilon_b / \varepsilon_a = 3.076 / 10\text{‰} ; \bar{\mu} = 18.426\%$$

$$A_{a1} = 18.426 \times \frac{30 \times 55}{100} \times \frac{2.05}{40} - \frac{200}{40}$$

$$A_{a1} = 10.58 \text{ cm}^2 < A_{a2} = 13.07 \text{ cm}^2 \text{ (slučaj 2)}$$

Usvojeno:

"LEVO": **6RØ25** (29.45 cm²)

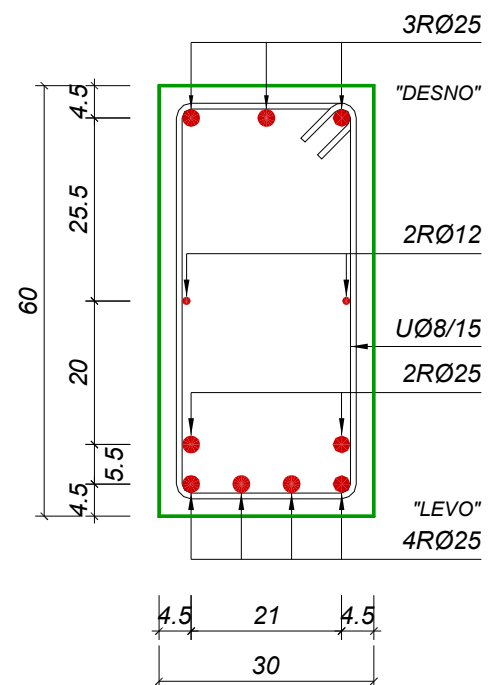
"DESNO": **3RØ25** (14.73 cm²)

$$a_1 = \frac{4 \times 4.5 + 2 \times 10}{6} = 6.33 \text{ cm}$$

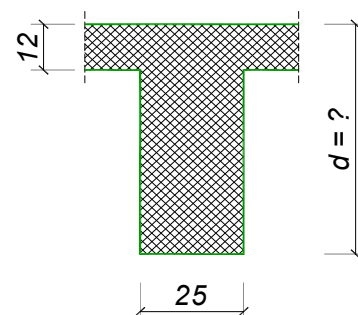
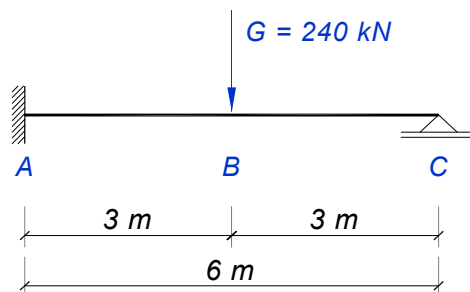
$$h_{stv.} = 60 - 6.33 = 53.67 \text{ cm}$$

$$h_{stv.} > h_{pretp.} = 53.5 \text{ cm}$$

$$a_2 = 4.5 \text{ cm} > a_{2,pretp.} = 5 \text{ cm}$$



18 Gredu čiji su statički sistem, opterećenje i oblik poprečnog preseka prikazani na skici, potrebno je dimenzionisati prema momentima savijanja u karakterističnim presecima, a zatim izvršiti osiguranje od glavnih napona zatezanja na delu B-C. Nakon toga potrebno je izvršiti osiguranje od glavnih napona zatezanja na delu A-B, zadržavajući prečnik i rastojanje uzengija kao na delu B-C, uz dodavanje odgovarajuće površine koso povijenih profila. Odrediti tačna mesta povijanja profila.



Proračunom obuhvatiti samo zadato opterećenje. Kvalitet materijala: MB 30, RA 400/500.

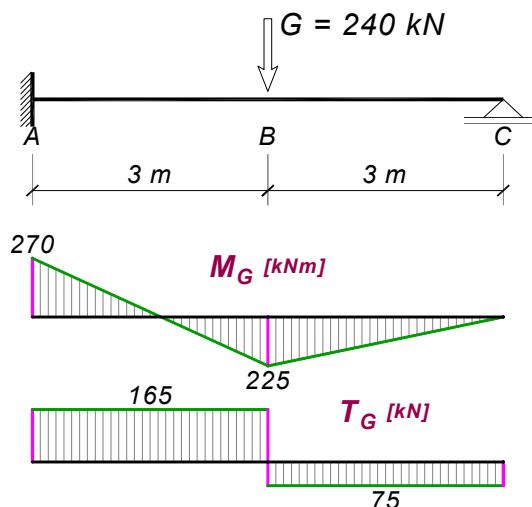
PRORAČUN STATIČKIH UTICAJA

Proračun statičkih uticaja je sproveden pomoću tabele iz Priloga 5 »Koeficijenti za određivanje statičkih uticaja elemenata konstrukcije«, PBAB 87, tom 2 (tabela 3.1, str. 496).

$$M_G^A = -\frac{3}{16} \times 240 \times 6.0 = -270 \text{ kNm}$$

$$M_G^B = -\frac{5}{32} \times 240 \times 6.0 = 225 \text{ kNm}$$

$$A_G = \frac{11}{16} \times 240 = 165 \text{ kN} ; C_G = \frac{5}{16} \times 240 = 75 \text{ kN}$$



DIMENZIONISANJE

Visina poprečnog preseka nije poznata. Najpre se dimenzioniše preseka sa maksimalnim momentom savijanja (tip loma se proizvoljno bira – »slobodno« dimenzionisanje) a zatim se svi ostali preseći sračunaju sa usvojenom visinom (»vezano« dimenzionisanje):

presek nad osloncem

$$M_u = 1.6 \times 270 = 432 \text{ kNm}$$

$$\varepsilon_b / \varepsilon_a = 3.5 / 6.0\text{‰} \Rightarrow k = 1.990, \bar{\mu} = 29.825\%$$

$$h = 1.990 \times \sqrt{\frac{432 \times 10^2}{25 \times 2.05}} = 57.8 \text{ cm}$$

$$A_a = 29.825 \times \frac{25 \times 57.8}{100} \times \frac{2.05}{40} = 22.08 \text{ cm}^2$$

$$\text{usvojeno: } \mathbf{6R\text{\O}22} \text{ (22.80 cm}^2\text{)}$$

$$a_1 = \frac{3 \times (4.5 + 10)}{6} = 7.25 \text{ cm} \Rightarrow d = 57.8 + 7.25 = 65.05 \text{ cm}$$

$$\text{usvojeno: } \mathbf{d = 65 \text{ cm}}$$

presek u polju

$$M_u^B = 1.6 \times 225 = 360 \text{ kNm}$$

Pretpostavlja se da se neutralna linija nalazi u ploči, pa se presek proračunava kao pravougaoni, širine B:

$$l_0 = \frac{225}{225 + 270} \times 300 + 300 = 436 \text{ cm} \Rightarrow B \leq \left\{ \begin{array}{l} 25 + 0.25 \times 436 = 134 \\ 25 + 20 \times 12 = 265 \end{array} \right\} = 134 \text{ cm}$$

$$\text{pretp. } a_1 = 7 \text{ cm} \Rightarrow B/d/h = 134/65/58 \text{ cm}$$

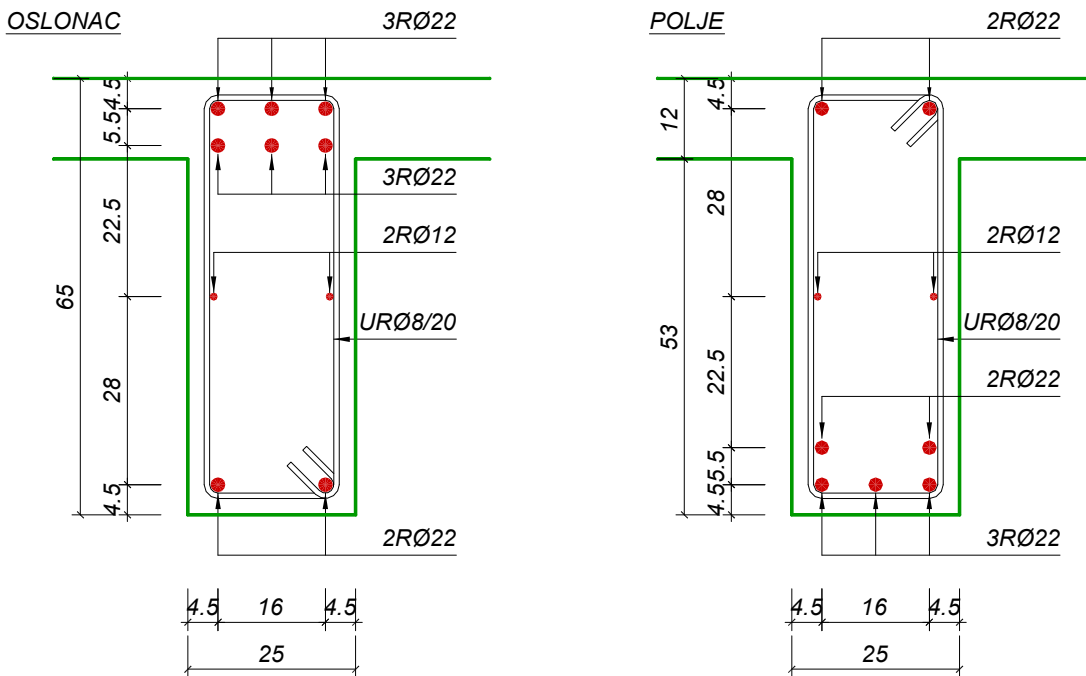
$$k = \frac{58}{\sqrt{\frac{360 \times 10^2}{134 \times 2.05}}} = 5.068 \Rightarrow \varepsilon_b / \varepsilon_a = 1.036 / 10\text{‰} ; s = 0.094 ; \bar{\mu} = 4.026\%$$

$$x = s \cdot h = 0.094 \times 58 = 5.4 \text{ cm} < d_p = 12 \text{ cm}$$

Pretpostavka o položaju neutralne linije je tačna, pa sledi:

$$A_a = 4.026 \times \frac{134 \times 58}{100} \times \frac{2.05}{40} = 16.05 \text{ cm}^2$$

usvojeno: **5RØ22** (19.00 cm²)



OSIGURANJE OD GLAVNIH NAPONA ZATEZANJA

deo B-C

$$T_u^{B-C} \cdot 1.6 \times 75 = 120 \text{ kN} \Rightarrow \tau_n^{B-C} = \frac{120}{25 \times 52.2} = 0.092 \frac{\text{kN}}{\text{cm}^2} < \tau_r = 0.11 \frac{\text{kN}}{\text{cm}^2}$$

Nije potrebna računaska armatura za prihvatanje glavnih napona zatezanja.

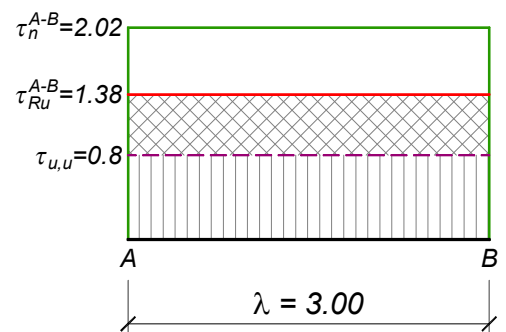
usvojeno: **URØ8/20** (m=2)

deo A-B

$$T_u^{A-B} = 1.6 \times 165 = 264 \text{ kN}$$

$$\tau_n^{A-B} = \frac{264}{25 \times 52.2} = 0.202 \frac{\text{kN}}{\text{cm}^2} \begin{cases} > \tau_r \\ < 3\tau_r \end{cases}$$

$$\tau_{Ru}^{A-B} = \frac{3}{2} \times (0.202 - 0.11) = 0.138 \frac{\text{kN}}{\text{cm}^2}$$



Kako je na čitavom delu A-B prekoračen napon τ_r , dužina osiguranja je $\lambda = 3.0 \text{ m}$.

Po uslovu zadatka, potrebno je usvojiti iste uzengije kao na delu B-C. Na tom delu uzengije nisu računski potrebne, pa se moraju usvojiti makar minimalne:

usvojeno: $m=2$; $\alpha = 90^\circ$; $\theta = 45^\circ$; URØ8:

$$e_u = \frac{2 \times a_u^{(1)}}{b \times \mu_{uz,min}} = \frac{2 \times a_u^{(1)}}{25 \times 0.2 \times 10^{-2}} = 40 \times a_u^{(1)} = 40 \times 0.503 = 20.1 \text{ cm}$$

usvojeno: **URØ8/20** ($m=2$) $\Rightarrow \tau_{u,u} = \frac{2 \times 0.503}{25 \times 20} \times 40 \times (0 + 1 \times 1) = 0.08 \frac{\text{kN}}{\text{cm}^2}$

Preostali deo sile biće prihvaćen koso povijenim profilima:

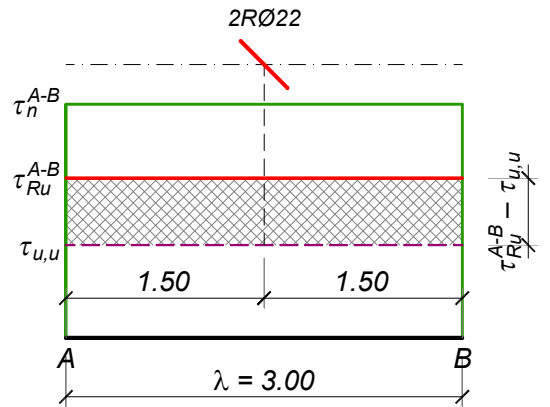
$$H_{vu,k} = (0.138 - 0.08) \times 300 \times 25 = 435 \text{ kN}$$

$$\alpha_k = 45^\circ \Rightarrow A_{ak} = \frac{435}{40 \times \sqrt{2}} = 7.65 \text{ cm}^2$$

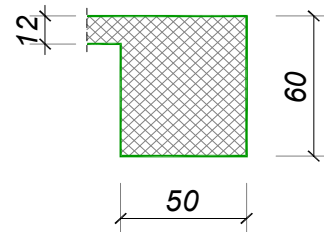
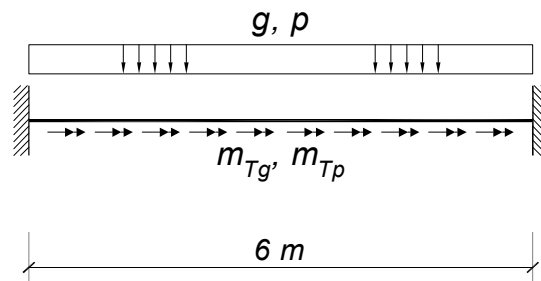
usvojeno: **2RØ22** (7.60 cm^2)

$$\Delta A_a = 0 \text{ ("špic" momenta)}$$

Oba profila se povijaju na istom mestu, radi očuvanja simetrije preseka. Šipke treba poviti pod uglom od 45° u težištu šrafirane površine.



19 Dimenzionisati u karakterističnim presecima gredu čiji su statički sistem, opterećenje i presek prikazani na skici. Kvalitet materijala: MB 30, RA 400/500.



$g = 30 \text{ kN/m}$ $p = 20 \text{ kN/m}$ $m_{Tg} = 6 \text{ kNm/m}$ $m_{Tp} = 12 \text{ kNm/m}$

PRORAČUN STATIČKIH UTICAJA

$$q_u = 1.6 \times 30 + 1.8 \times 20 = 84 \text{ kN/m}$$

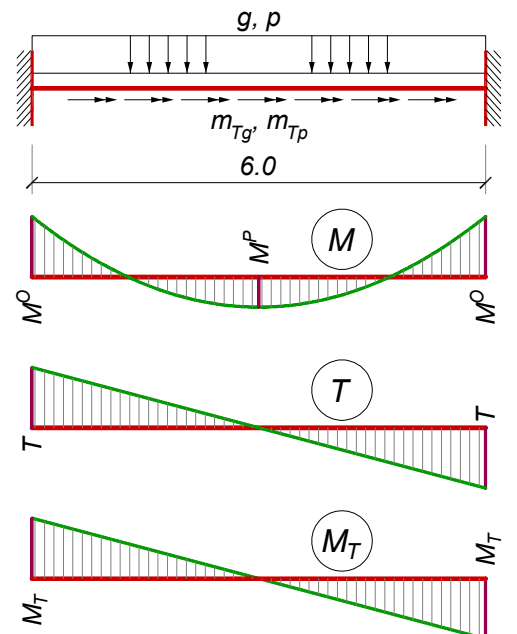
$$M_u^o = \frac{84 \times 6^2}{12} = 252 \text{ kNm}$$

$$M_p^o = \frac{84 \times 6^2}{24} = 126 \text{ kNm}$$

$$T_u = \frac{84 \times 6}{2} = 252 \text{ kN}$$

$$m_{Tu} = 1.6 \times 6 + 1.8 \times 12 = 31.2 \text{ kN/m}$$

$$M_{Tu} = \frac{31.2 \times 6}{2} = 93.6 \text{ kNm}$$



KONTROLA GLAVNIH NAPONA ZATEZANJA

$$\text{usv. } a = 4 \text{ cm} \Rightarrow b_0 = 50 - 2 \times 4 = 42 \text{ cm} \quad ; \quad d_0 = 60 - 2 \times 4 = 52 \text{ cm}$$

$$A_{b_0} = b_0 \times d_0 = 42 \times 52 = 2184 \text{ cm}^2 \quad ; \quad O_{b_0} = 2 \times (42 + 52) = 188 \text{ cm}$$

$$\delta = \frac{d_m}{8} = \frac{42}{8} = 5.25 \text{ cm} \Rightarrow \tau_n^{M_T} = \frac{M_{T_u}}{2 \times A_{b_0} \times \delta} = \frac{93.6 \times 10^2}{2 \times 2184 \times 5.25} = 0.408 \frac{\text{kN}}{\text{cm}^2}$$

$$a_1 = 4.5 \text{ cm} \Rightarrow z \approx 0.9 \times h = 0.9 \times 55.5 = 50.0 \text{ cm}$$

$$\tau_n^T = \frac{T_{m_u}}{b \times z} = \frac{252}{50 \times 50} = 0.101 \frac{\text{kN}}{\text{cm}^2}$$

$$\tau_n = \tau_n^T + \tau_n^{M_T} = 0.408 + 0.101 = 0.509 \frac{\text{kN}}{\text{cm}^2} \left\{ \begin{array}{l} > \tau_r = 0.11 \text{ kN/cm}^2 \\ < 5\tau_r \end{array} \right.$$

$$\lambda = \frac{L}{2} \times \left(1 - \frac{\tau_r}{\tau_n} \right) = \frac{600}{2} \times \left(1 - \frac{1.1}{5.09} \right) = 235 \text{ cm}$$

$$\tau_n > 3\tau_r \Rightarrow T_{b_u} = 0 \Rightarrow T_{R_u} = T_{m_u}$$

$$M_{T_{b_u}} = 0 \Rightarrow M_{T_{R_u}} = M_{T_u}$$

potrebne uzengije za prihvatanje transverzalne sile

$$\text{usvojeno: } m = 4 \quad ; \quad \alpha = 90^\circ \quad ; \quad \theta = 45^\circ$$

$$a_{u,T}^{(1)} = \frac{b \times \tau_{R_u}^T}{m \times \sigma_v} \times \frac{1}{(\cos \alpha + \sin \alpha \times \cot \theta)} \times e_u = \frac{50 \times 0.101}{4 \times 40} \times \frac{1}{(0 + 1 \times 1)} \times e_u = 0.032 \times e_u$$

potrebne uzengije za prihvatanje torzije

$$a_{u,M_T}^{(1)} = \frac{M_{T_{R_u}}}{2 \times A_{b_0} \times \sigma_v} \times \tan \theta \times e_u = \frac{93.6 \times 10^2}{2 \times 2184 \times 40} \times 1.0 \times e_u = 0.054 \times e_u$$

$$a_{u,spolja}^{(1)} = a_{u,M_T}^{(1)} + a_{u,T}^{(1)} = (0.032 + 0.054) \times e_u = 0.086 \times e_u$$

$$\text{pretp. UR}\emptyset 12 \Rightarrow e_{u,spolja} = \frac{1.13}{0.086} = 13.3 \text{ cm} \Rightarrow \text{usvojeno: UR}\emptyset 12/12.5$$

$$a_{u,unutra}^{(1)} = a_{u,T}^{(1)} = 0.032 \times e_u$$

$$\text{pretp. UR}\emptyset 8 \Rightarrow e_{u,unutra} = \frac{0.503}{0.032} = 15.9 \text{ cm} \Rightarrow \text{usvojeno: UR}\emptyset 8/12.5$$

horizontalna armatura

$$\sum A_a = \frac{M_{T_u}}{2 \times A_{b_0} \times \sigma_v} \times \cot \theta \times O_{b_0} = \frac{93.6 \times 10^2}{2 \times 2184 \times 40} \times 1.0 \times 188 = 10.07 \text{ cm}^2$$

$$\text{usvojeno: } \mathbf{14R}\emptyset 10 \text{ (11.00 cm}^2\text{)}$$

$$\Delta A_a = 0 \text{ ("špic" momenta)}$$

DIMENZIONISANJE PREMA MOMENTIMA SAVIJANJApresek nad osloncem

Pritisnuta je donja ivica nosača, pa je oblik pritisnute zone pravougaoni, širine $b=50$ cm:

$$\text{pretp. } a_1 = 4.5 \text{ cm} \Rightarrow h = 60 - 4.5 = 55.5 \text{ cm}$$

$$k = \frac{55.5}{\sqrt{\frac{252 \times 10^2}{50 \times 2.05}}} = 3.540 \Rightarrow \varepsilon_b/\varepsilon_a = 1.643/10\text{‰} ; \bar{\mu} = 8.415\%$$

$$A_{a,\text{potr.}} = 8.415 \times \frac{50 \times 55.5}{100} \times \frac{2.05}{40} = 11.97 \text{ cm}^2$$

presek u polju

Pritisnuta je gornja ivica nosača, pa je oblik pritisnute zone ili Γ ili pravougaoni, širine B :

$$B = \min. \left\{ \begin{array}{l} b + 8 \times d_p = 50 + 8 \times 12 = 146 \text{ cm} \\ b + \frac{0.25}{3} \times l_0 = 50 + \frac{0.25}{3} \times 0.7 \times 600 = 85 \text{ cm} \end{array} \right\} = 85 \text{ cm}$$

Pretpostavlja se da je neutralna linija u ploči. Sledi:

$$k = \frac{55.5}{\sqrt{\frac{126 \times 10^2}{85 \times 2.05}}} = 6.527 \Rightarrow \varepsilon_b/\varepsilon_a = 0.771/10\text{‰} ; \bar{\mu} = 2.407\% ; s = 0.072$$

$$x = 0.072 \times 55.5 = 4.0 \text{ cm} < d_p = 12 \text{ cm}$$

Pretpostavka o položaju neutralne linije je dobra, pa sledi:

$$A_{a,\text{potr.}} = 2.407 \times \frac{85 \times 55.5}{100} \times \frac{2.05}{40} = 5.82 \text{ cm}^2$$

$$A_{a,\text{min.}} = \mu_{\text{min}} \times \frac{b \times d}{100} = 0.20 \times \frac{50 \times 60}{100} = 6.0 \text{ cm}^2 > A_{a,\text{potr.}}$$

usvojeno: **4RØ14** (6.16 cm^2)

Oslonac - konačno usvajanje armature

U preseku nad osloncem potrebno je:

$$\text{za } M_T: 4RØ10 = 3.14 \text{ cm}^2$$

$$\text{za } M: \quad \quad \quad = 6.00 \text{ cm}^2$$

$$\text{ukupno:} \quad \quad \quad = 9.14 \text{ cm}^2$$

$$\text{usvojeno: } \mathbf{7RØ14} \text{ (} 10.78 \text{ cm}^2 \text{)}$$

