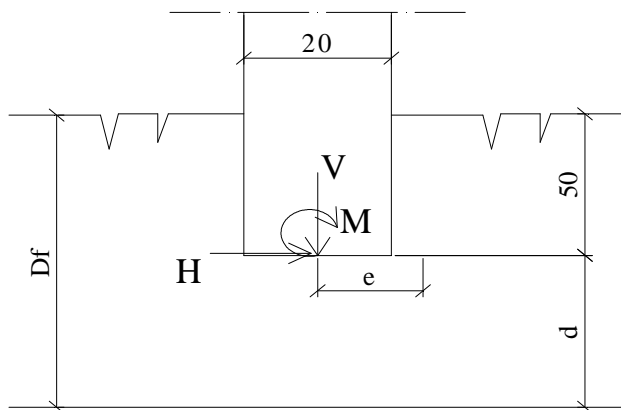


Građevinski fakultet univerziteta u Beogradu - Fundiranje -

1. ZADATAK



$$d_z = 0,2 \text{ m}$$

$$MB \ 30$$

$$H_g = 70 \text{ kN/m}$$

$$V_g = 800 \text{ kN/m}$$

$$M_g = 150 \text{ kNm/m}$$

$$\sigma_{doz} = 200 \text{ kN/m}^2$$

$$\gamma = 18 \text{ kN/m}^3$$

1.1. Centrisanje temelja

$$\sum M = 0 \Rightarrow V \cdot e - M - H \cdot d = 0 \quad \text{Pretpostavljamo: } d = 0,70 \text{ m}$$

$$e = \frac{M + H \cdot d}{V} = \frac{150 + 70 \cdot 0,7}{800} = 0,249 \text{ m}$$

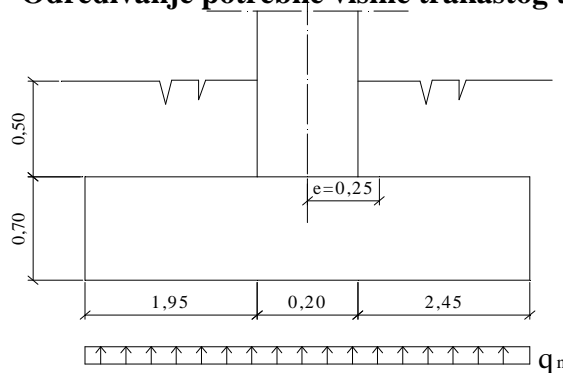
1.2. Određivanje dimenzija kontaktne površine

$$D_f = t + d = 0,5 + 0,7 = 1,2 \text{ m}$$

$$F_{pot} = B \cdot 1 = \frac{V}{\sigma_{doz} - 0,85 \cdot \gamma_b \cdot D_f} = \frac{800}{200 - 0,85 \cdot 25 \cdot 1,2} = 4,585 \text{ m}^2$$

$$\text{Usvojeno: } B = 4,6 \text{ m}$$

1.3. Određivanje potrebne visine trakastog temelja



$$q_n = \frac{V}{B} = \frac{800}{4,6} = 173,91 \text{ kN/m}$$

$$M = \frac{1}{2} \cdot q_n \cdot l^2 = \frac{1}{2} \cdot 173,91 \cdot 2,45^2 = 521,95 \text{ kNm/m}$$

$$T = q_n \cdot l = 173,91 \cdot 2,45 = 426,08 \text{ kN/m}$$

Građevinski fakultet univerziteta u Beogradu - Fundiranje -

- Dimenzionisanje

$$MB\ 30 \Rightarrow f_b = 20,5\ MPa = 2,05\ kN/cm^2 \quad \gamma = 1,60 \quad \varepsilon_b / \varepsilon_a = 3,50/10\ ‰ \quad k = 2,311$$

$$h_M = k \cdot \sqrt{\frac{M_u}{f_b \cdot b}} = 2,311 \cdot \sqrt{\frac{1,6 \cdot 521,95 \cdot 100}{2,05 \cdot 100}} = 46,64\ cm$$

$$h_T = \frac{T_u}{z_b \cdot \tau_b} = \frac{1,6 \cdot 426,08}{0,9 \cdot 100 \cdot 0,11} = 68,86\ cm$$

$$Usvojeno: \quad h = 70\ cm$$

$$Pretpostavlja\ se: \quad \phi\ 22\ (a_a^{(1)} = 3,80\ cm^2)$$

$$h_{stat} = h - 5 - \frac{\phi}{2} = 70 - 5 - \frac{2,2}{2} = 63,9\ cm$$

$$k = \frac{h_{stat}}{\sqrt{\frac{M_u}{f_b \cdot b}}} = \frac{63,9}{\sqrt{\frac{1,6 \cdot 521,95 \cdot 100}{2,05 \cdot 100}}} = 3,166 \quad \Rightarrow \varepsilon_b / \varepsilon_a = 1,925/10\ ‰ \quad \bar{\mu} = 10,552\ ‰$$

$$A_{a,pot} = \bar{\mu} \cdot \frac{b \cdot h}{100} \cdot \frac{f_b}{\sigma_v} = 10,552 \cdot \frac{100 \cdot 63,9}{100} \cdot \frac{2,05}{40} = 34,56\ cm^2$$

$$A_{pod} = 0,2 \cdot A_{a,pot} = 0,2 \cdot 34,56 = 6,91\ cm^2$$

$$\begin{array}{ll} Usvojeno: & Glavna: \quad R\phi\ 22/10\ (38\ cm^2) \\ & Podaona: \quad R\phi\ 14/20\ (7,70\ cm^2) \end{array}$$

1.4. Analiza opterećenja

- Korisno opterećenje:

- Težina temelja:

- Težina nadsloja:

$$\begin{array}{l} 800\ kN/m \\ B \cdot d \cdot \gamma_b = 4,6 \cdot 0,7 \cdot 25 = 80,50\ kN/m \\ (4,6 - 0,20) \cdot 0,50 \cdot 18 = 39,60\ kN/m \\ \hline \sum V = 920,10\ kN/m \end{array}$$

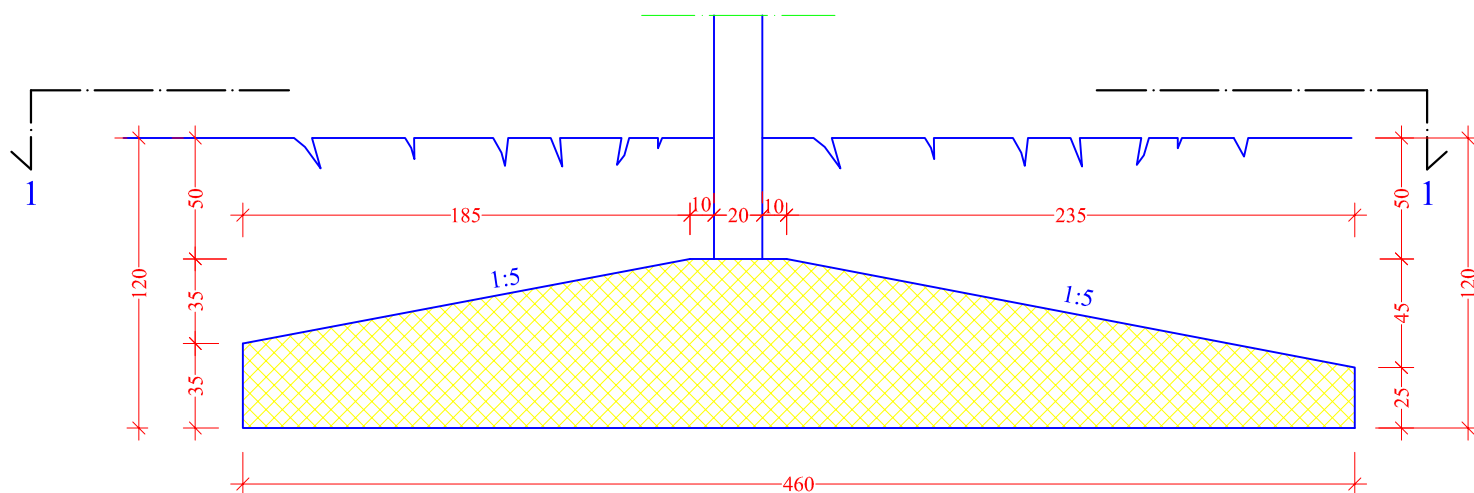
$$\sigma_{rač} = \frac{\sum V}{B} = \frac{920,10}{4,6} = 200,022 \approx \sigma_{doz} = 200\ kN/m^2$$

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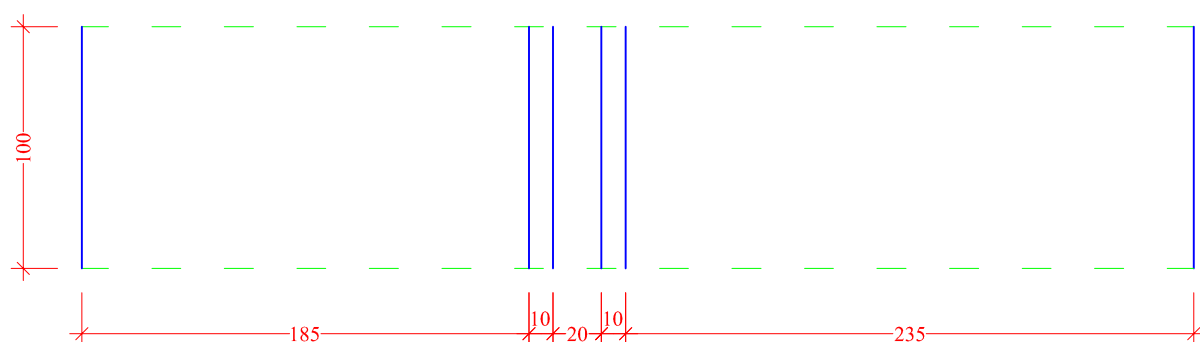
Plan oplate

R 1:25

MB 30



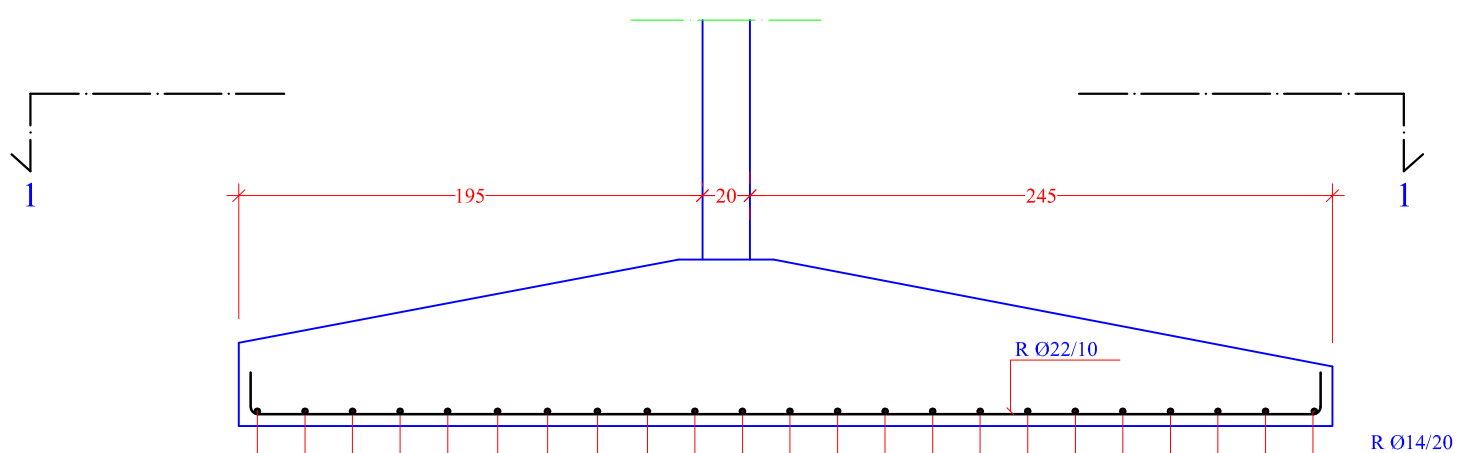
Presek 1-1



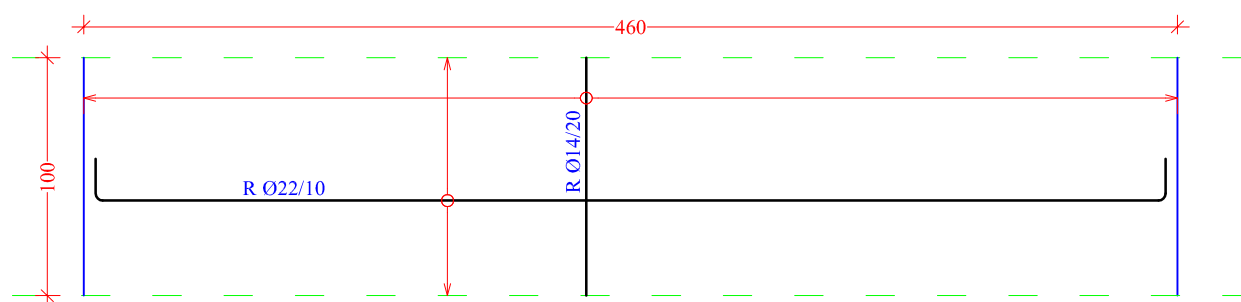
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Plan armature

R 1:25
RA 400/500



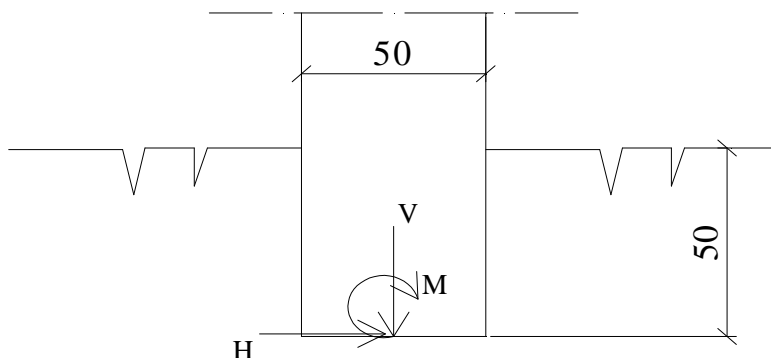
Presek 1-1



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Građevinski fakultet univerziteta u Beogradu - Fundiranje -

2. ZADATAK



Stub 50 x 50 cm

MB 30

 $H_g = 80 \text{ kN/m}$ $V_g = 800 \text{ kN}$ $V_p = 450 \text{ kN}$ $M_g = 160 \text{ kNm/m}$ $M_p = \pm 120 \text{ kNm/m}$ $\gamma = 18 \text{ kN/m}^3$ $c = 20 \text{ kN/m}^2$ $\varphi = 21^\circ$ $F_\varphi = 1.50$ $F_c = 2.50$

2.1. Centrisanje temelja za stalno opterećenje

$$\sum M = 0 \Rightarrow V_g \cdot e - M_g - H_g \cdot d = 0 \quad \text{Pretpostavimo: } d = 0,60 \text{ m}$$

$$e = \frac{M_g + H_g \cdot d}{V_g} = \frac{160 + 80 \cdot 0,6}{800} = 0,26 \text{ m}$$

2.2. Određivanje sila u težištu temeljne spojnice

$$V = V_g + V_p = 800 + 450 = 1250 \text{ kN}$$

$$\overleftarrow{M} = \overleftarrow{M}_p + V_p \cdot e = 120 + 450 \cdot 0,26 = 237 \text{ kNm}$$

$$\overrightarrow{M} = \overrightarrow{M}_p - V_p \cdot e = 120 - 450 \cdot 0,26 = 3,0 \text{ kN/m}$$

2.3. Određivanje dimenzija kontaktne površine

$$\text{Usvojeno: } k = \frac{L}{B} = 1,5 \quad \text{pp. } \sigma_{doz} = 300 \text{ kN/m}^2 \quad D_f = 0,5 + 0,6 = 1,1 \text{ m}$$

$$\frac{V}{F} + \frac{M}{W} \leq \sigma_{doz} - 0,85 \cdot \gamma_b \cdot D_f$$

$$\frac{1250}{k \cdot B^2} + \frac{237 \cdot 6}{k^2 \cdot B^3} \leq 300 - 0,85 \cdot 25 \cdot 1,1$$

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- Fundiranje -

$$\frac{1250}{1.5 \cdot B^2} + \frac{1422}{1.5^2 \cdot B^3} \leq 276.63$$

$$833.33 \cdot B + 632 - 276.63 \cdot B^3 \leq 0$$

$$276.63 \cdot B^3 - 833.33 \cdot B - 632 \geq 0 \Rightarrow B = 2.0435$$

Usvojeno: $B = 2 \text{ m}$ $L = 3 \text{ m}$

2.4. Određivanje dozvoljenog napona

$$D_f = 1.1 \text{ m} \quad B = 2 \text{ m} \quad \varphi = 21^\circ$$

$$\operatorname{tg} \varphi_r = \frac{\operatorname{tg} \varphi}{F_\varphi} = \frac{\operatorname{tg} 21}{1.50} = 0.256 \Rightarrow \varphi_r = 14.35^\circ$$

- Faktori nosivosti

$$N_q = \operatorname{tg}^2 \left(45 + \frac{\varphi_r}{2} \right) \cdot e^{\pi \operatorname{tg} \varphi_r} = \operatorname{tg}^2 \left(45 + \frac{14.35}{2} \right) \cdot e^{\pi \operatorname{tg} 14.35} = 3.704$$

$$N_\gamma = 1.8 \cdot (N_q - 1) \cdot \operatorname{tg} \varphi_r = 1.8 \cdot (3.704 - 1) \cdot \operatorname{tg} 14.35 = 1.245$$

$$N_c = (N_q - 1) \cdot \operatorname{ctg} \varphi_r = (3.704 - 1) \cdot \operatorname{ctg} 14.35 = 10.570$$

- Faktori nosivosti

$$S_c = 1 + 0.2 \cdot \frac{B}{L} = 1 + 0.2 \cdot \frac{2}{3} = 1.13$$

$$S_q = S_c = 1.13$$

$$S_\gamma = 1 - 0.4 \cdot \frac{B}{L} = 1 - 0.4 \cdot \frac{2}{3} = 0.73$$

- Faktori dubine

$$d_c = 1 + 0.35 \cdot \frac{D_f}{B} = 1 + 0.35 \cdot \frac{1.1}{2} = 1.193$$

$$d_q = d_c - \frac{d_c - 1}{N_q} = 1.193 - \frac{1.193 - 1}{3.704} = 1.141$$

$$d_\gamma = 1.0$$

$$\operatorname{tg} \delta = 0 \Rightarrow i_c = i_q = i_\gamma = 1$$

$$\sigma_{dop} = \gamma \cdot D_f + N_q \cdot d_q \cdot S_q + 0.5 \cdot \gamma \cdot B \cdot N_\gamma \cdot S_\gamma \cdot d_\gamma + c \cdot N_c \cdot S_c \cdot d_c =$$

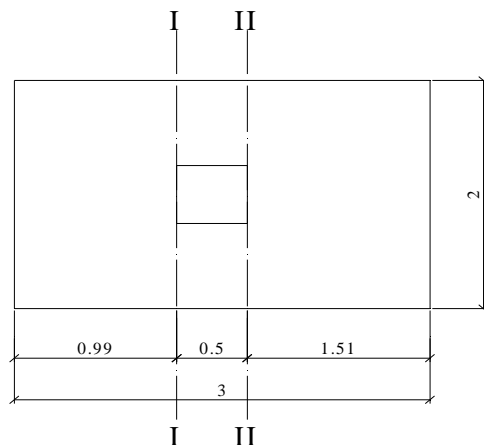
$$= 18 \cdot 1.1 + 3.704 \cdot 1.141 \cdot 1.13 + 0.5 \cdot 18 \cdot 2 \cdot 1.245 \cdot 0.73 \cdot 1 + 20 \cdot 10.57 \cdot 1.13 \cdot 1.193 = 325.92 \text{ kN} / \text{m}^2$$

$$\Delta = \frac{325.92 - 300}{325.92} \cdot 100 = 7.95 \% \quad \text{Usvojeno: } B = 2 \text{ m} \quad L = 3 \text{ m}$$

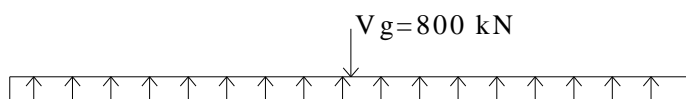
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2.5. Određivanje visine temelja

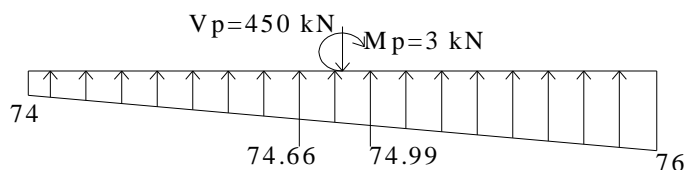


- Stalno opterećenje



$$\sigma = \frac{800}{2 \cdot 3} = 133.33 \text{ kN/m}^2$$

- Korisno opterećenje (I)

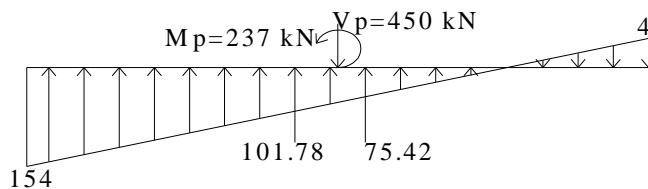


$$\sigma_{1,2} = \frac{450}{2 \cdot 3} \pm \frac{3 \cdot 6}{2 \cdot 3^2} = 75 \pm 1$$

$$\sigma_1 = 76 \text{ kN/m}^2$$

$$\sigma_2 = 74 \text{ kN/m}^2$$

- Korisno opterećenje (II)



$$\sigma_{1,2} = \frac{450}{2 \cdot 3} \pm \frac{237 \cdot 6}{2 \cdot 3^2} = 75 \pm 79 \text{ kN/m}^2$$

$$\sigma_1 = 154 \text{ kN/m}^2$$

$$\sigma_2 = -4 \text{ kN/m}^2$$

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$$M_{U,I-I} = \left(1.6 \cdot 133.33 \cdot \frac{0.99^2}{2} + 1.8 \cdot \left(101.78 \cdot \frac{0.99^2}{2} + \frac{154 - 101.78}{2} \cdot 0.99^2 \cdot \frac{2}{3} \right) \right) \cdot 2 = 450.06 \text{ kNm}$$

$$T_{U,I-I} = \left(1.6 \cdot 133.33 \cdot 0.99 + 1.8 \cdot \left(101.78 \cdot 0.99 + \frac{154 - 101.78}{2} \cdot 0.99 \right) \right) \cdot 2 = 878.19 \text{ kN}$$

$$M_{U,II-II} = \left(1.6 \cdot 133.33 \cdot \frac{1.51^2}{2} + 1.8 \cdot \left(74.99 \cdot \frac{1.51^2}{2} + \frac{76 - 74.99}{2} \cdot 1.51^2 \cdot \frac{2}{3} \right) \right) \cdot 2 = 796.94 \text{ kNm}$$

$$T_{U,II-II} = \left(1.6 \cdot 133.33 \cdot 1.51 + 1.8 \cdot \left(74.99 \cdot 1.51 + \frac{76 - 74.99}{2} \cdot 1.51 \right) \right) \cdot 2 = 1054.64 \text{ kN}$$

$$pp. \quad \varepsilon_b / \varepsilon_a = 3.5 / 10 \text{ ‰} \Rightarrow k = 2.311$$

$$\left. \begin{aligned} h_M &= 2.311 \cdot \sqrt{\frac{1.94 \cdot 796.64 \cdot 100}{200 \cdot 2.05}} = 44.87 \text{ cm} \\ h_T &= \frac{T_U}{0.9 \cdot b \cdot \tau_r} = \frac{1053.64}{0.9 \cdot 200 \cdot 0.11} = 53.21 \text{ cm} \end{aligned} \right\} \Rightarrow \text{Usvojeno : } h = 55 \text{ cm}$$

2.6. Armiranje

- Pravac "L"

$$M_U = 796.94 \text{ kNm}$$

$$pp. \quad \phi 16 \left(a_a^1 = 2.01 \text{ cm}^2 \right)$$

$$h = 55 - 5 - \frac{1.6}{2} = 49.2 \text{ cm}$$

$$k = \frac{49.2}{\sqrt{\frac{796.94 \cdot 100}{200 \cdot 2.05}}} = 3.528 \Rightarrow \varepsilon_b / \varepsilon_a = 1.65 / 10 \text{ ‰} \quad \bar{\mu} = 8.471 \text{ ‰}$$

$$A_a = 8.471 \cdot \frac{49.2 \cdot 200}{100} \cdot \frac{2.05}{40} = 42.72 \text{ cm}^2$$

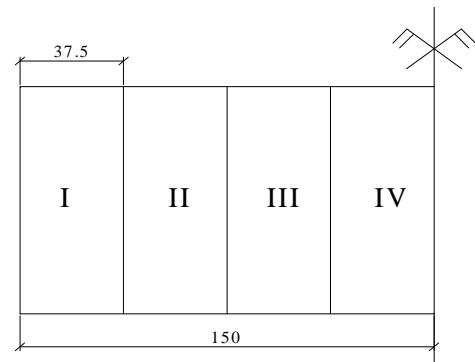
$$n = \frac{42.72}{2.01} \approx 22 \text{ kom}$$

$$I: \quad 0.06 \cdot 22 = 1.32 \quad 2R\phi 16$$

$$II: \quad 0.08 \cdot 22 = 1.76 \quad 2R\phi 16$$

$$III: \quad 0.13 \cdot 22 = 2.86 \quad 3R\phi 16$$

$$IV: \quad 0.23 \cdot 22 = 5.06 \quad 5R\phi 16$$

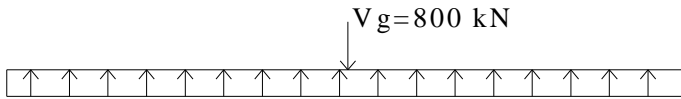


Ukupno : 2x12 = 24 komada (usvojena je po jos jedna sipka sa strane)

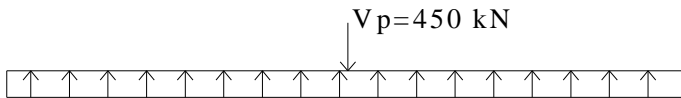
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- Pravac "B"



$$\sigma_n = \frac{800}{6} = 133.34 \text{ kN} / \text{m}^2$$



$$\sigma_n = \frac{450}{6} = 75 \text{ kN} / \text{m}^2$$

$$M_U = (1.6 \cdot 133.34 + 1.8 \cdot 75) \cdot \frac{0.75^2}{2} \cdot 3 = 293.92 \text{ kNm}$$

$$T_U = (1.6 \cdot 133.34 + 1.8 \cdot 75) \cdot 0.75 \cdot 3 = 783.71 \text{ kN}$$

$$pp. \quad R\phi 12 (a_a^1 = 1.13 \text{ cm}^2)$$

$$h = 55 - 5 - 1.6 - \frac{1.2}{2} = 47.8 \text{ cm}$$

$$k = \frac{47.8}{\sqrt{\frac{293.92 \cdot 100}{300 \cdot 2.05}}} = 6.914 \Rightarrow \varepsilon_b / \varepsilon_a = 0.725 / 10 \text{ ‰} \quad \bar{\mu} = 2.154$$

$$A_a = 2.154 \cdot \frac{47.8 \cdot 300}{100} \cdot \frac{2.05}{40} = 15.83 \text{ cm}^2$$

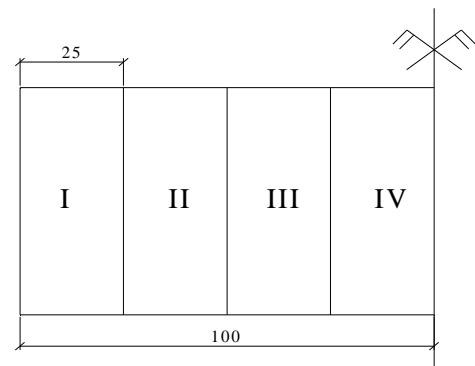
$$n = \frac{15.83}{1.54} \approx 14$$

$$I : \quad 0.06 \cdot 14 = 0.84 \quad 2R\phi 14$$

$$II : \quad 0.08 \cdot 14 = 1.12 \quad 1R\phi 14$$

$$III : \quad 0.13 \cdot 14 = 1.82 \quad 2R\phi 14$$

$$IV : \quad 0.23 \cdot 14 = 3.22 \quad 3R\phi 14$$



Ukupno : $2 \times 8 = 16$ komada (usvojena je po jos jedna sipka sa strane)

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2.7. Kontrola proboja

$$h_{sr} = \frac{1}{2} \cdot (47.7 + 49.2) = 48.45 \text{ cm}$$

$$F_b = (0.50 + 2 \cdot 0.4845)^2 = 2.16 \text{ cm}^2$$

$$P_r = V - \sigma_n \cdot F_b = 1250 - \frac{1250}{6} \cdot 2.16 = 800 \text{ kN}$$

$$\tau_p = \frac{P_r}{F_p} = \frac{800}{4 \cdot (0.5 + 0.4845) \cdot 0.4845} = 419.29 \text{ kN} / \text{m}^2 < \tau_r = 1100 \text{ kN} / \text{m}^2$$

2.8. Analiza opterećenja

- Stalno opterećenje:	1250 kN
- Težina tla iznad temelja:	$(3 \cdot 2 - 0.5^2) \cdot 0.5 \cdot 18 = 51.75 \text{ kN}$
- Težina temelja:	$3 \cdot 2 \cdot 0.55 \cdot 25 = 82.5 \text{ kN}$
	$\Sigma V = 1384.25 \text{ kN}$

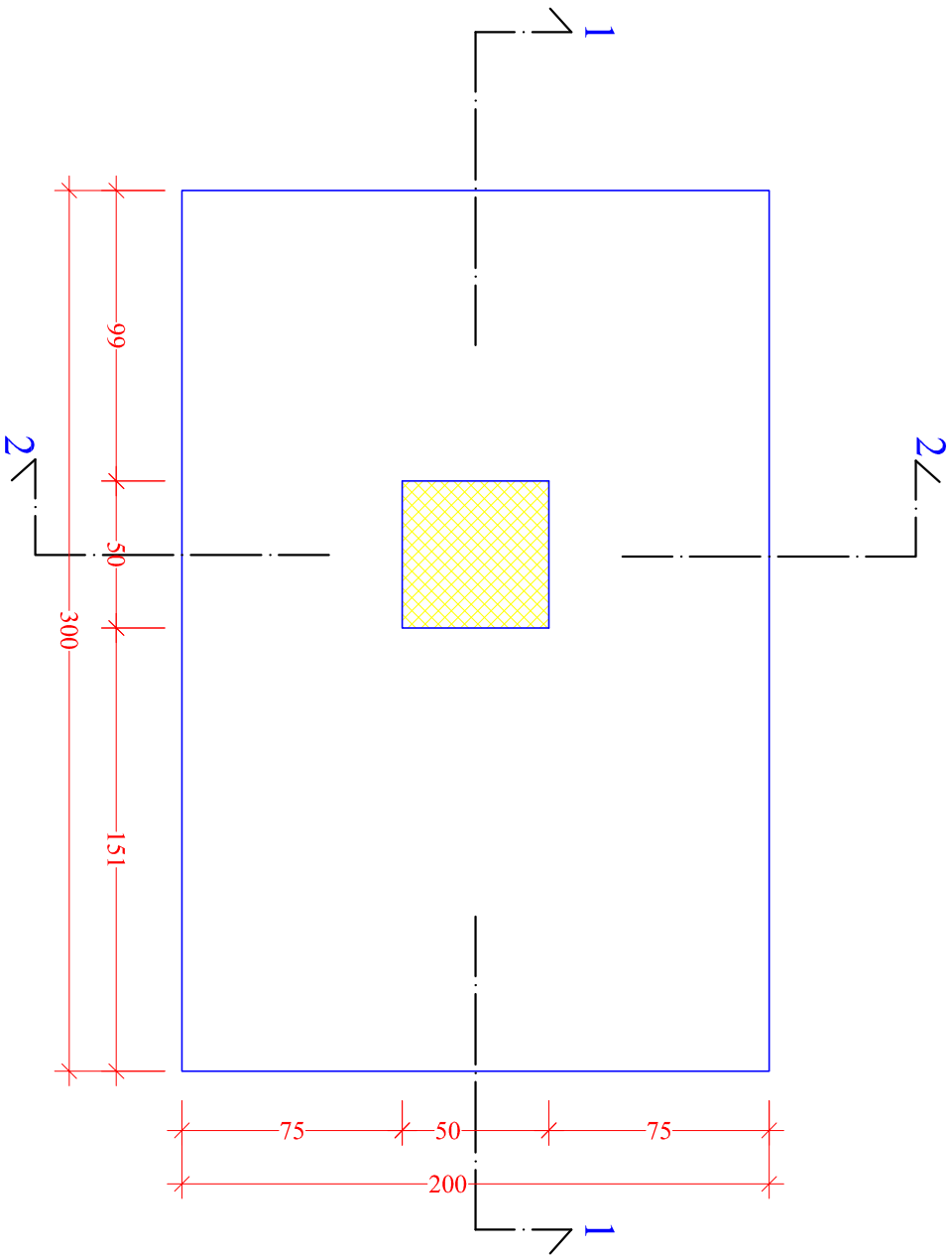
$$\sigma_{rač} = \frac{\Sigma V}{F} \pm \frac{M}{W} = \frac{1384.25}{6} \pm \frac{237 \cdot 6}{2 \cdot 3^2} = 230.71 \pm 79$$

$$\left. \begin{array}{l} \sigma_1 = 300.71 \text{ kN} / \text{m}^2 \\ \sigma_2 = 151.71 \text{ kN} / \text{m}^2 \end{array} \right] < \sigma_{doz} = 325.92 \text{ kN} / \text{m}^2$$

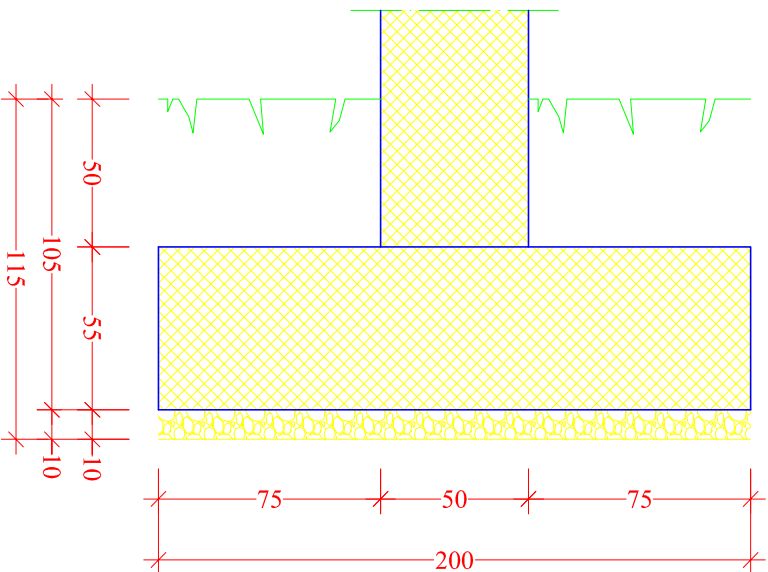
Plan oplate

R 1:25

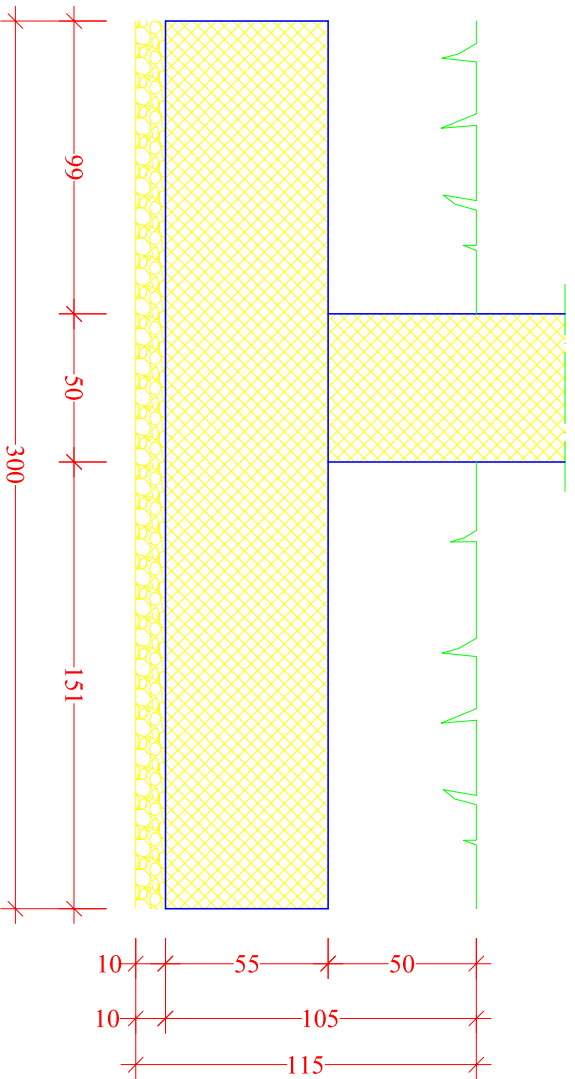
MB 30



Presek 2-2



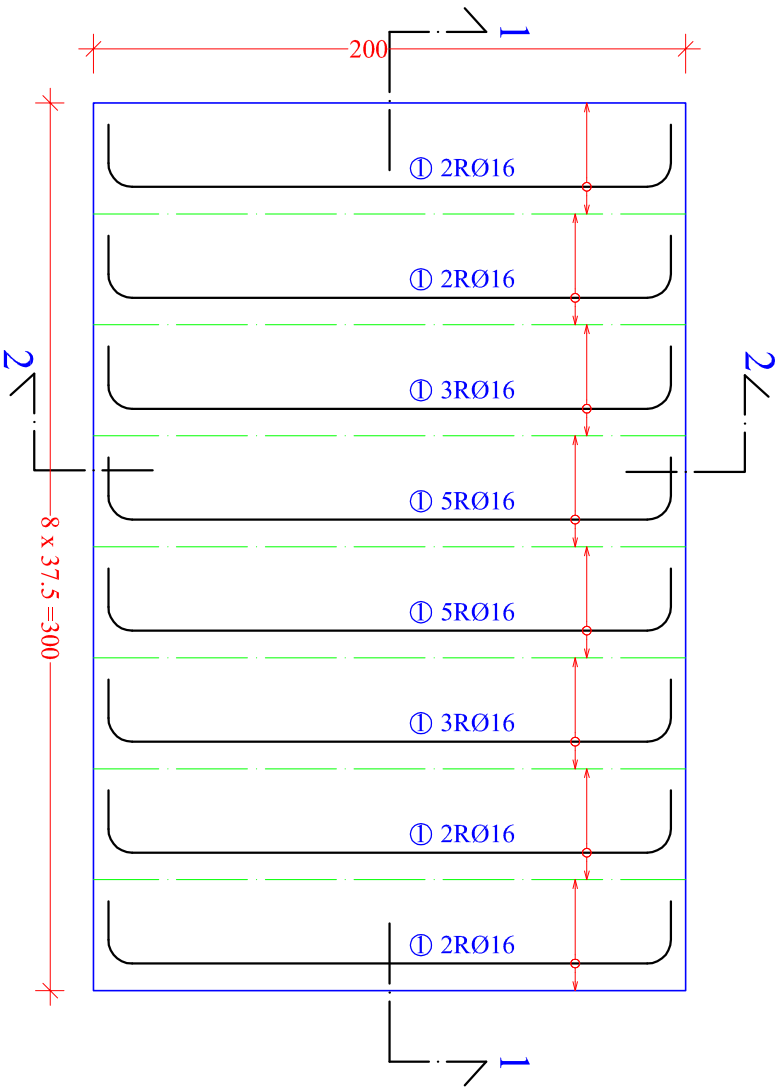
Presek 1-1



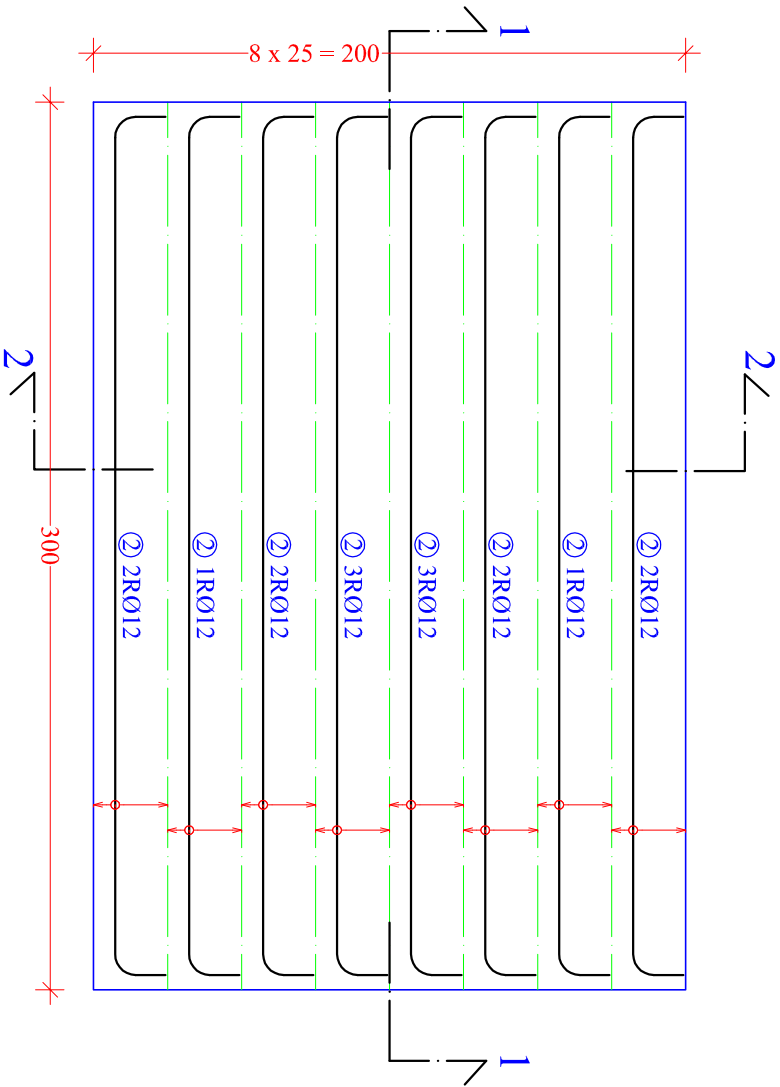
Plan armature R 1:25

RA 400/500

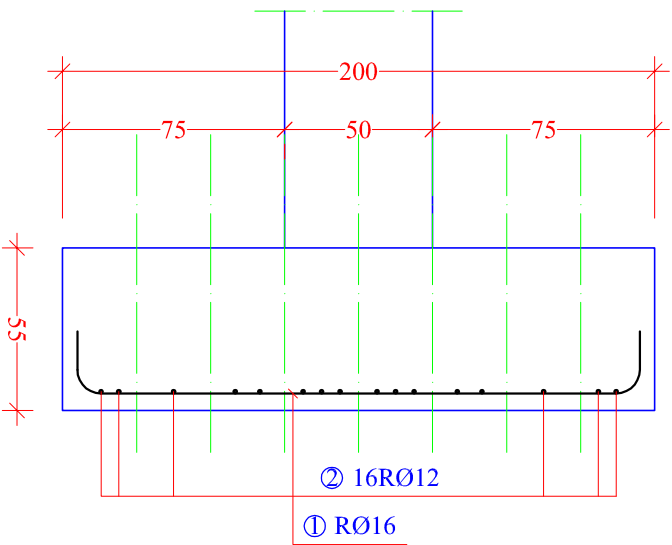
Pravac "L"



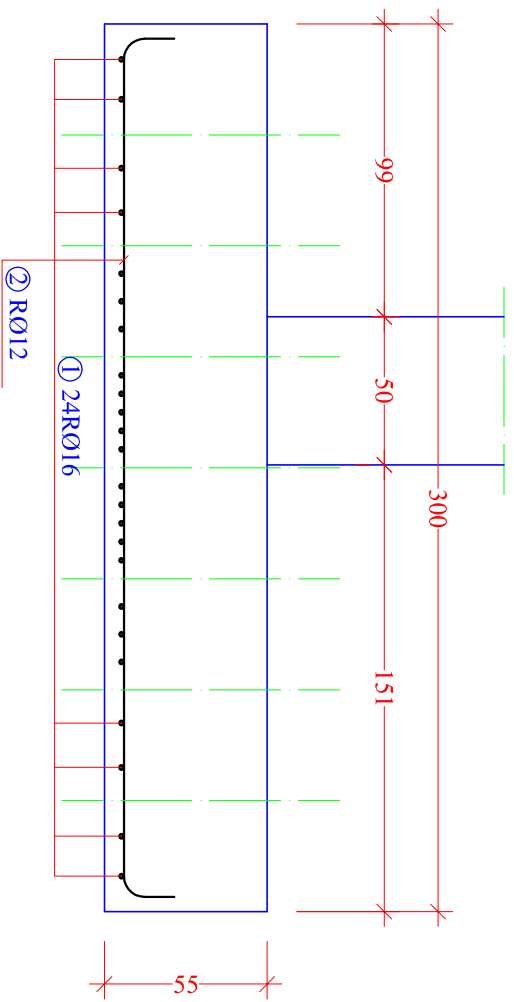
Pravac "B"



Presek 2-2

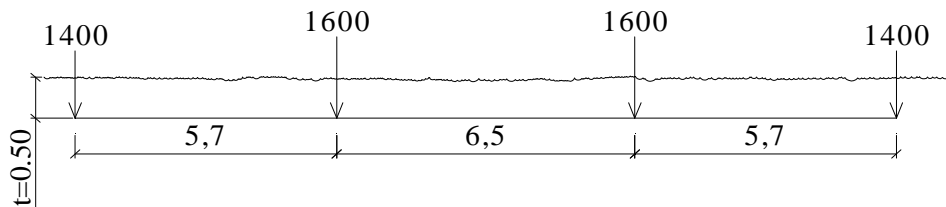


Presek 1-1



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3. ZADATAK

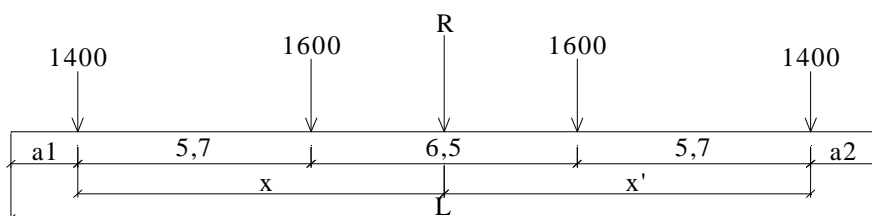


$$a_0 \times b_0 = 0,50 \times 0,50$$

$$\sigma_{doz} = 160 \text{ kN} / \text{m}^2$$

$$\gamma = 18 \text{ kN} / \text{m}^3$$

3.1. Određivanje dužine prepusta



$$R = \sum P_i = 1400 + 1600 + 1600 + 1400 = 6000 \text{ kN}$$

$$x = \frac{1600 \cdot 5,7 + 1600 \cdot 12,2 + 1400 \cdot 17,9}{6000} = 8,95 \text{ m}$$

$$x' = 17,9 - 8,95 = 8,95$$

$$a_1 = 0,25 \cdot l_{\max} = 0,25 \cdot 6,50 = 1,63 \text{ m}$$

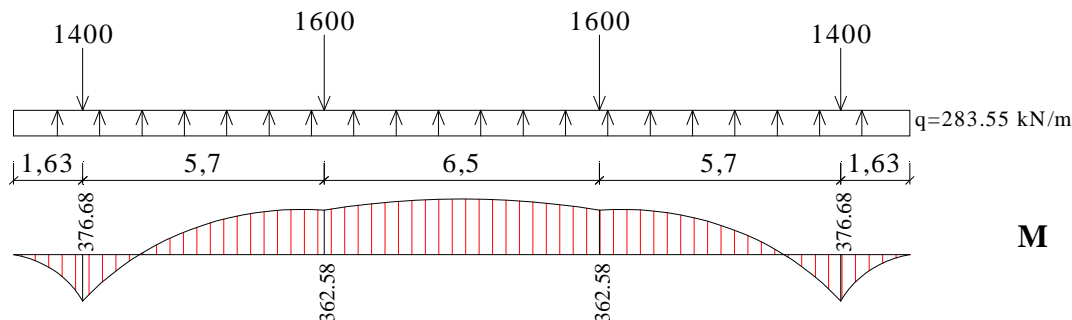
$$a_2 = 1,63 \text{ m}$$

$$L = 5,70 + 6,50 + 5,70 + 2 \cdot 1,63 = 21,16 \text{ m}$$

$$q = \frac{R}{L} = \frac{6000}{21,16} = 283,55 \text{ kN} / \text{m}$$

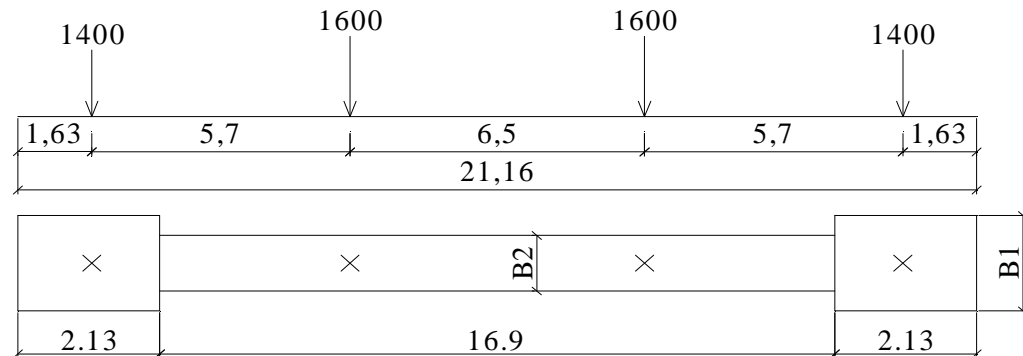
3.2. Statički uticaji

3.2.1. Statički određen sistem



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Na osnovu dijagrama momenata savijanja po dužini nosača može se zaključiti da je potrebno usvojiti promenljivu širinu nosača kako bi se dobile racionalne dimenzije temeljnog nosača. Pretpostavljamo dubinu fundiranja $D_f = 1.5$ m



$$\frac{R}{\sigma_{doz} - 0.85 \cdot \gamma_b \cdot D_f} = 4.26 \cdot B_1 + 16.9 \cdot B_2$$

$$\frac{6000}{160 - 0.85 \cdot 25 \cdot 1.5} = 4.26 \cdot B_1 + 16.9 \cdot B_2$$

$$46.829 = 4.26 \cdot B_1 + 16.9 \cdot B_2$$

Iz gornje jednačine usvajanjem $B_2 = 2.0$ m dobijamo da je $B_1 = 3.0$ m.

- Dijagram reaktivnog opterećenja tla:

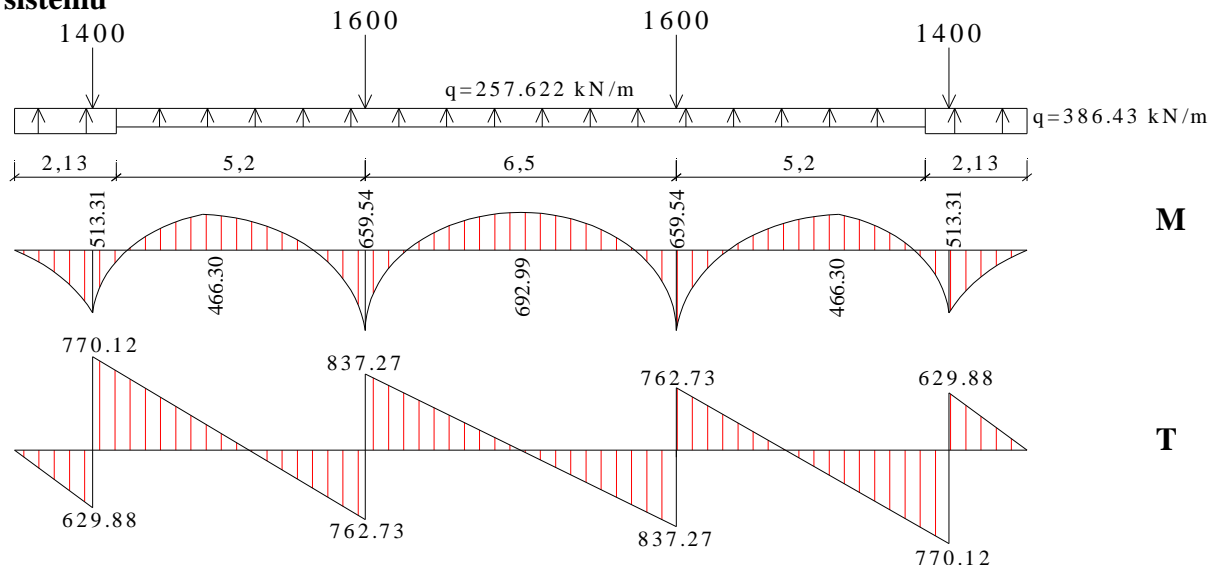
$$q = \frac{R}{F} = \frac{6000}{3 \cdot 4.26 + 2 \cdot 16.9} = 128.811 \text{ kN} / \text{m}^2$$

$$q_1 = B_1 \cdot q = 3.0 \cdot 128.811 = 386.43 \text{ kN} / \text{m}$$

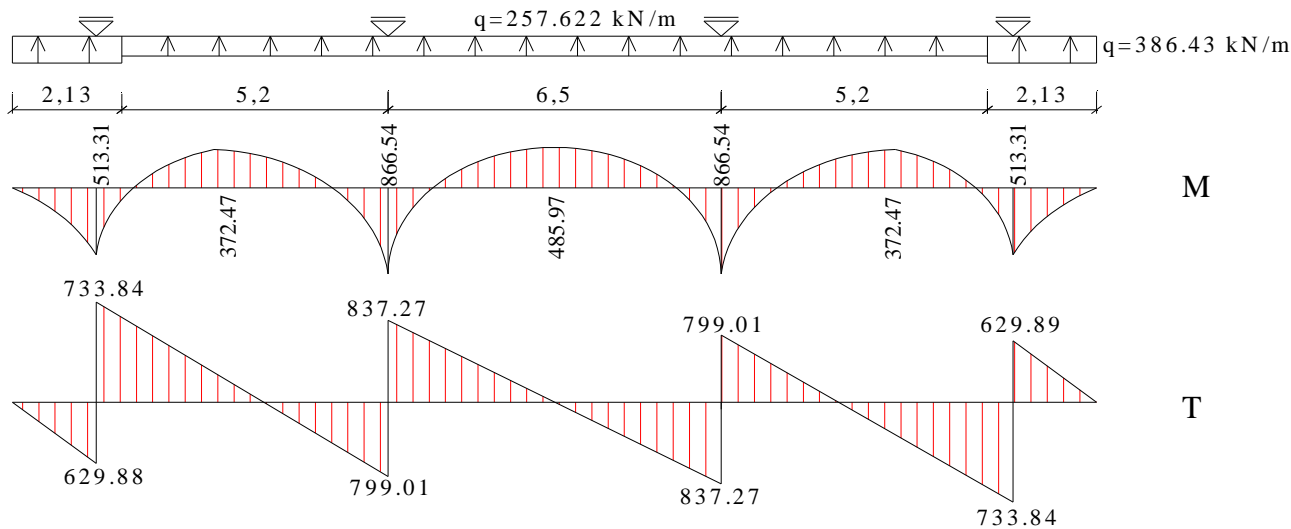
$$q_2 = B_2 \cdot q = 2.0 \cdot 128.811 = 257.622 \text{ kN} / \text{m}$$

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3.2.2. Merodavni momenti savijanja za dimenzionisanje temeljnog nosača u statički određenom sistemu



3.2.3. Merodavni momenti savijanja za dimenzionisanje temeljnog nosača u statički neodređenom sistemu



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3.3. Dimenzionisanje

Merodavni uticaji:

$$M = 866.54 \text{ kNm}$$

$$T = 837.27 \text{ kN}$$

3.3.1. Visina temeljnog nosača

$$MB30 \Rightarrow f_b = 2.05 \text{ kN/cm}^2$$

$$RA400/500 \Rightarrow \sigma_v = 40 \text{ kN/cm}^2$$

$$\tau_r = 0.11 \text{ kN/cm}^2$$

$$\bar{\tau} = 2 \cdot \tau_r = 2 \cdot 0.11 = 0.22 \text{ kN/cm}^2$$

$$\gamma_u = 1.6 \cdot 0.7 + 1.8 \cdot 0.3 = 1.66$$

- **Prema momentima savijanja**

$$\varepsilon_b / \varepsilon_a = 3.5 / 10 \text{ ‰} \Rightarrow k = 2.311$$

$$h_m = 2.311 \cdot \sqrt{\frac{1.66 \cdot 866.54 \cdot 100}{70 \cdot 2.05}} = 73.16 \text{ cm}$$

- **Prema T-silama**

$$h_t = \frac{837.27 \cdot 1.66}{0.9 \cdot 70 \cdot 0.22} = 99.279$$

Usvojeno: $d = 100 \text{ cm}$

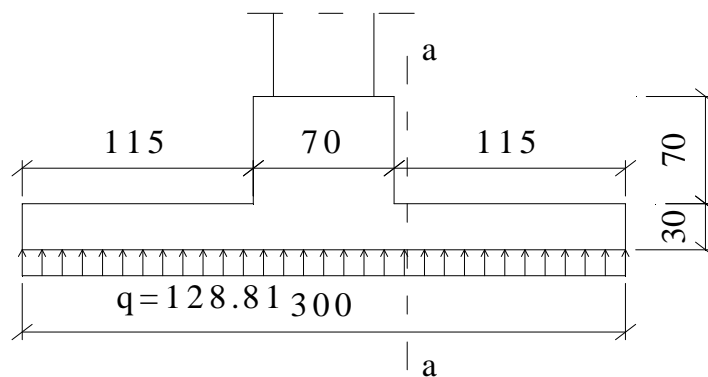
3.3.2. Visina temeljne ploče

$$M_{a-a} = 0.5 \cdot 1.15^2 \cdot 128.81 = 85.176 \text{ kNm/m}$$

$$T_{a-a} = 1.15 \cdot 128.81 = 148.13 \text{ kN}$$

$$h_M = 2.311 \cdot \sqrt{\frac{1.66 \cdot 85.176 \cdot 100}{2.05 \cdot 100}} = 19.19 \text{ cm}$$

$$h_T = \frac{148.13 \cdot 1.66}{0.9 \cdot 100 \cdot 0.22} = 12.41 \text{ cm}$$



Usvaja se debljina ploče 30 cm celom dužinom temeljnog nosača.

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3.4. Analiza opterećenja

- Od stubova 6000 kN
- Težina temelja $(3.0 \cdot 0.30 \cdot 4.26 + 2.0 \cdot 0.3 \cdot 16.9 + 0.7 \cdot 0.7 \cdot 21.16) \cdot 25 = 608.56 \text{ kN}$
- Tlo $(3.0 \cdot 0.5 \cdot 4.26 + 2.0 \cdot 0.5 \cdot 16.9 + 2 \cdot 0.65 \cdot 0.7 \cdot 16.9 + 2 \cdot 1.15 \cdot 0.7) \cdot 18 = 819.497 \text{ kN}$

$$\sum V = 7428.056 \text{ kN}$$

$$\sigma_{rac} = \frac{7428.06}{3.0 \cdot 4.26 + 2.0 \cdot 16.9} = 159.48 \text{ kN} / \text{cm}^2 < \sigma_{doz} = 160 \text{ kN} / \text{cm}^2$$

3.5. Armatura u podužnom pravcu

- Presek ispod srednjih stubova (Presek 1-1)

$$M_u = 1.66 \cdot 866.54 = 1386.46 \text{ kNm}$$

$$h_{stat} = 100 - 7.5 = 92.5 \text{ cm}$$

$$k = \frac{92.5}{\sqrt{\frac{1386.46 \cdot 100}{70 \cdot 2.05}}} = 2.976 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 2.125 / 10 \% \\ \mu = 12.027 \% \end{cases}$$

$$A_a = 12.027 \cdot \frac{70 \cdot 92.52}{100} \cdot \frac{2.05}{40} = 39.91 \text{ cm}^2 \Rightarrow \text{Usvojeno: } 8R\phi 25 (39.28 \text{ cm}^2)$$

- Presek ispod spoljašnjih stubova stubova (Presek 2-2)

$$M_u = 1.66 \cdot 513.36 = 821.38 \text{ kNm}$$

$$h_{stat} = 100 - 7.5 = 92.5 \text{ cm}$$

$$k = \frac{92.5}{\sqrt{\frac{821.38 \cdot 100}{70 \cdot 2.05}}} = 3.866 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 1.45 / 10 \% \\ \mu = 6.962 \% \end{cases}$$

$$A_a = 6.962 \cdot \frac{70 \cdot 92.52}{100} \cdot \frac{2.05}{40} = 23.10 \text{ cm}^2 \Rightarrow \text{Usvojeno: } 5R\phi 25 (24.55 \text{ cm}^2)$$

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- Presek u srednjem polju (Presek 3-3)

Zategnuta gornja zona \Rightarrow Pretpostavljamo da se neutralna linija nalazi u ploči tj. da je oblik pritisnute zona pravougaoni širine B.

$$M_u = 1.66 \cdot 692.99 = 1108.78 \text{ kNm}$$

$$h_{stat} = 100 - 7.5 = 92.5 \text{ cm}$$

$$B = \min \begin{cases} b + 20 \cdot d_{pl} = 70 + 20 \cdot 30 = 670 \text{ cm} \\ b + 0.25 \cdot l_0 = 70 + 0.25 \cdot 465 = 186.25 \text{ cm} \end{cases}$$

$$B = 186.25 \text{ cm}$$

$$k = \frac{92.5}{\sqrt{\frac{1108.78 \cdot 100}{186.25 \cdot 2.05}}} = 5.428 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 0.95 / 10\text{‰} \\ s = 0.087 \\ \mu = 3.469\% \end{cases}$$

$$x = s \cdot h = 0.087 \cdot 92.5 = 8.048 < d_{pl} = 30 \text{ cm} \Rightarrow \text{Pretpostavka o položaju neutralne linije je dobra.}$$

$$A_a = 3.469 \cdot \frac{186.25 \cdot 92.52}{100} \cdot \frac{2.05}{40} = 30.63 \text{ cm}^2 \Rightarrow \text{Usvojeno: } 7R\phi 25 (34.37 \text{ cm}^2)$$

- Preseci u krajnjim poljima (Presek 4-4)

Zategnuta gornja zona \Rightarrow Pretpostavljamo da se neutralna linija nalazi u ploči tj. da je oblik pritisnute zona pravougaoni širine B.

$$M_u = 1.66 \cdot 466.39 = 746.22 \text{ kNm}$$

$$h_{stat} = 100 - 7.5 = 92.5 \text{ cm}$$

$$B = \min \begin{cases} b + 20 \cdot d_{pl} = 70 + 20 \cdot 30 = 670 \text{ cm} \\ b + 0.25 \cdot l_0 = 70 + 0.25 \cdot 387 = 166.75 \text{ cm} \end{cases}$$

$$B = 166.75 \text{ cm}$$

$$k = \frac{92.5}{\sqrt{\frac{746.22 \cdot 100}{166.75 \cdot 2.05}}} = 6.261 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 0.80 / 10\text{‰} \\ s = 0.074 \\ \mu = 2.568\% \end{cases}$$

$$x = s \cdot h = 0.074 \cdot 92.5 = 6.84 < d_{pl} = 30 \text{ cm} \Rightarrow \text{Pretpostavka o položaju neutralne linije je dobra.}$$

$$A_a = 2.568 \cdot \frac{166.75 \cdot 92.52}{100} \cdot \frac{2.05}{40} = 20.3 \text{ cm}^2 \Rightarrow \text{Usvojeno: } 5R\phi 25 (24.55 \text{ cm}^2)$$

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- Armatura ploče

$$pp. R\phi 16 (a_u^1 = 2.01 \text{ cm}^2)$$

$$h_{stst} = 30 - 5 - 1.6 / 2 = 24.2 \text{ cm}$$

$$k = \frac{24.2}{\sqrt{\frac{1.66 \cdot 85.176 \cdot 100}{100 \cdot 2.05}}} = 2.968 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 2.15 / 10 \% \\ \mu = 12.209 \% \end{cases}$$

$$A_a = 12.209 \cdot \frac{100 \cdot 24.2}{100} \cdot \frac{2.05}{40} = 15.14 \text{ cm}^2 / \text{m}' \Rightarrow \text{Usvojeno : } R\phi 16 / 12^5 (16.08 \text{ cm}^2 / \text{m}')$$

Za podužnu armaturu usvaja se: $R\phi 10 / 20$

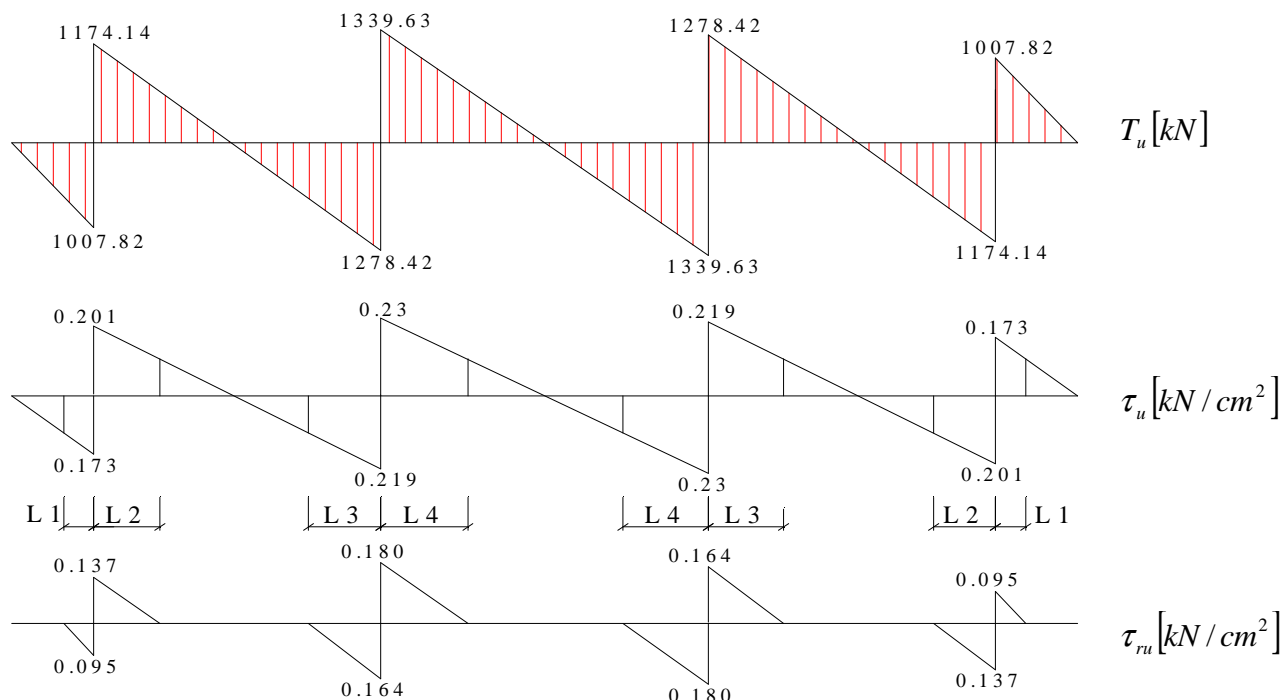
3.6. Osiguranje od glavnih napona zatezanja

$$\tau_r = 0.11 \text{ kN} / \text{cm}^2$$

$$T_{mu} = T_u = 1.66 \cdot T$$

$$\tau_n = \frac{T_{mu}}{b \cdot z} = \frac{T_{mu}}{0.9 \cdot b \cdot h}$$

$$\tau_{ru} = \frac{3}{2} \cdot (\tau_n - \tau_r)$$



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$$L_2 = 123 \text{ cm} : m = 2 \quad \theta = 45 \quad \alpha = 90 \quad pp \quad UR\phi 12 \left(a_u^1 = 1.13 \text{ cm}^2 \right)$$

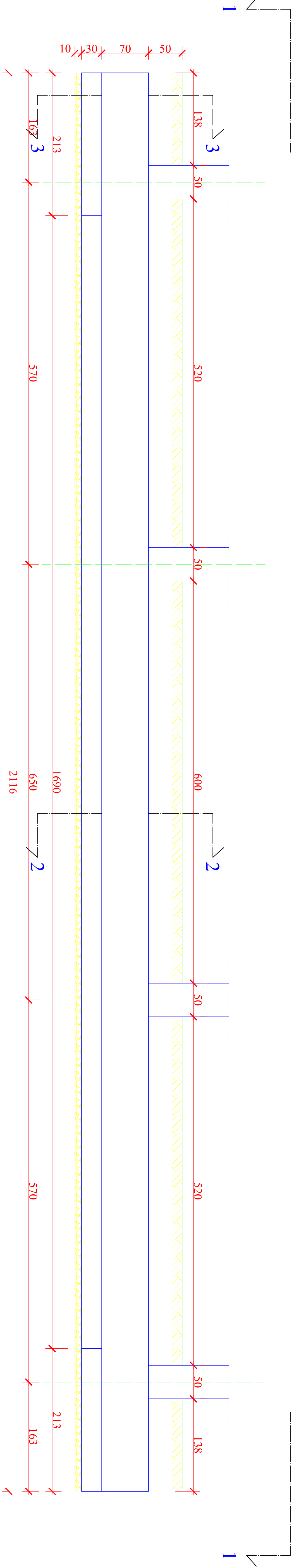
$$e_u = \frac{m \cdot a_u^1}{b \cdot \tau_{ru}} \sigma_v \cdot (\cos \alpha + \sin \alpha \cdot ctg \theta) = \frac{2 \cdot 1.13}{70 \cdot 0.137} \cdot 40 \cdot (0 + 1) = 10.43 \text{ cm} \Rightarrow \text{Usvojeno } UR\phi 12/10$$

$$L_3 = 148 \text{ cm} : m = 4 \quad \theta = 45 \quad \alpha = 90 \quad pp \quad UR\phi 12 \left(a_u^1 = 1.13 \text{ cm}^2 \right)$$

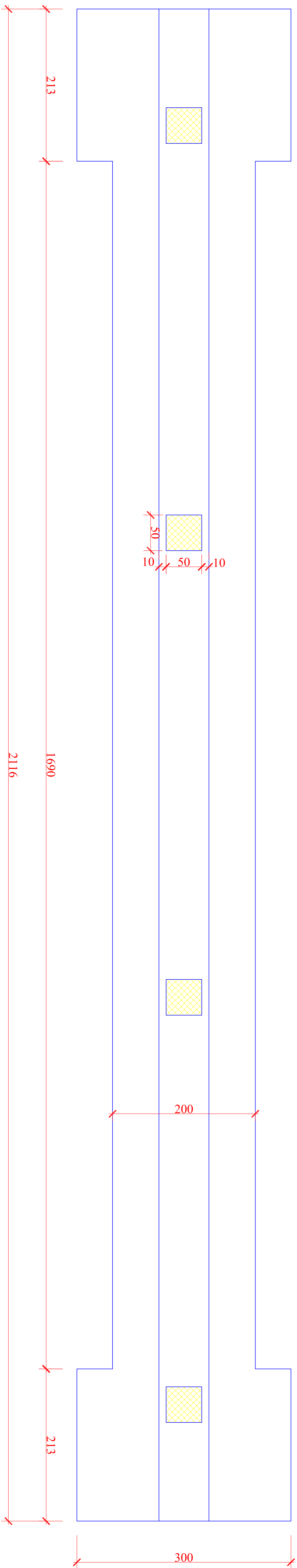
$$e_u = \frac{m \cdot a_u^1}{b \cdot \tau_{ru}} \sigma_v \cdot (\cos \alpha + \sin \alpha \cdot ctg \theta) = \frac{4 \cdot 1.13}{70 \cdot 0.164} \cdot 40 \cdot (0 + 1) = 15.74 \text{ cm} \Rightarrow \text{Usvojeno } UR\phi 12/15$$

$$L_4 = 170 \text{ cm} : m = 4 \quad \theta = 45 \quad \alpha = 90 \quad pp \quad UR\phi 12 \left(a_u^1 = 1.13 \text{ cm}^2 \right)$$

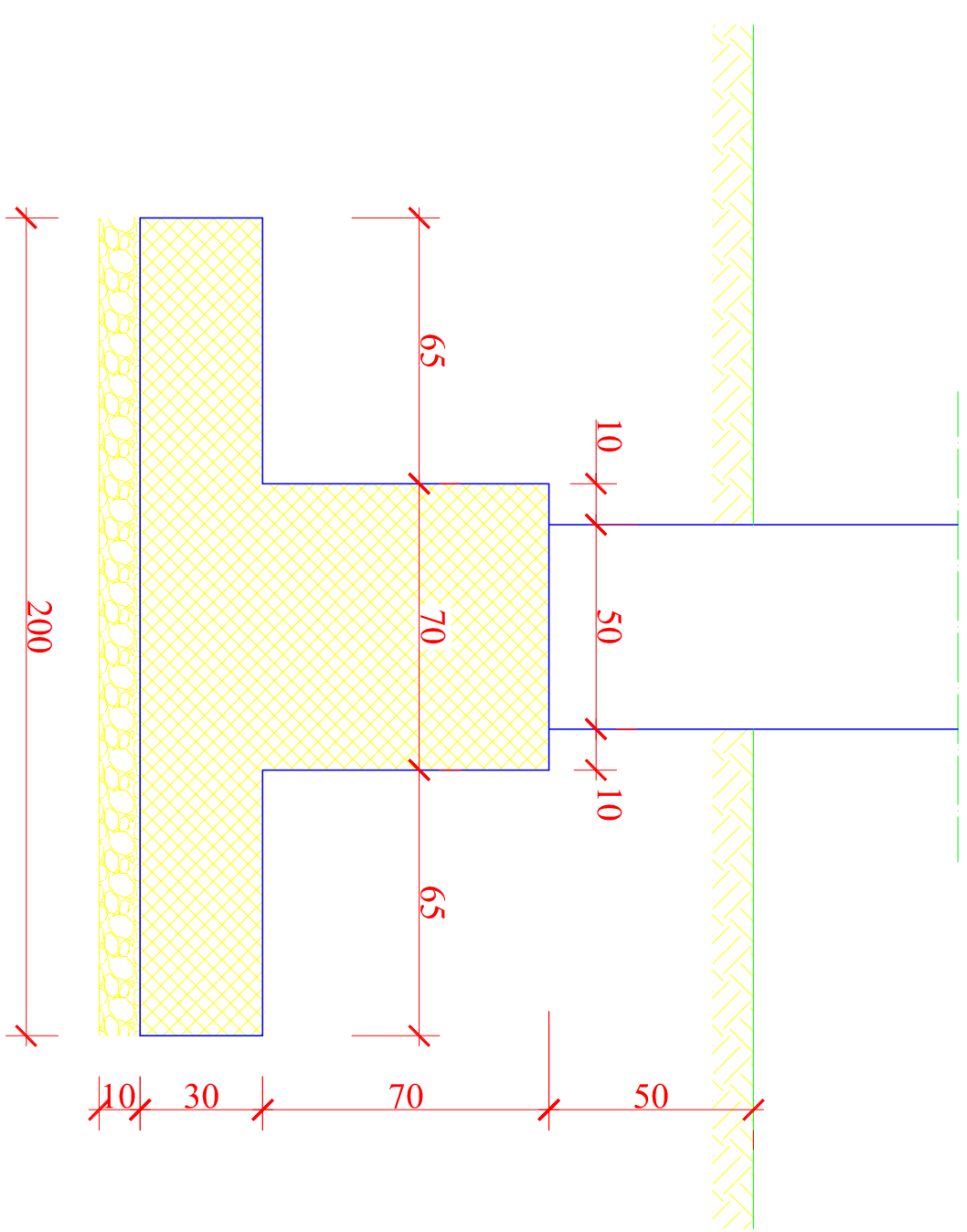
$$e_u = \frac{m \cdot a_u^1}{b \cdot \tau_{ru}} \sigma_v \cdot (\cos \alpha + \sin \alpha \cdot ctg \theta) = \frac{4 \cdot 1.13}{70 \cdot 0.180} \cdot 40 \cdot (0 + 1) = 14.35 \text{ cm} \Rightarrow \text{Usvojeno } UR\phi 12/12^5$$



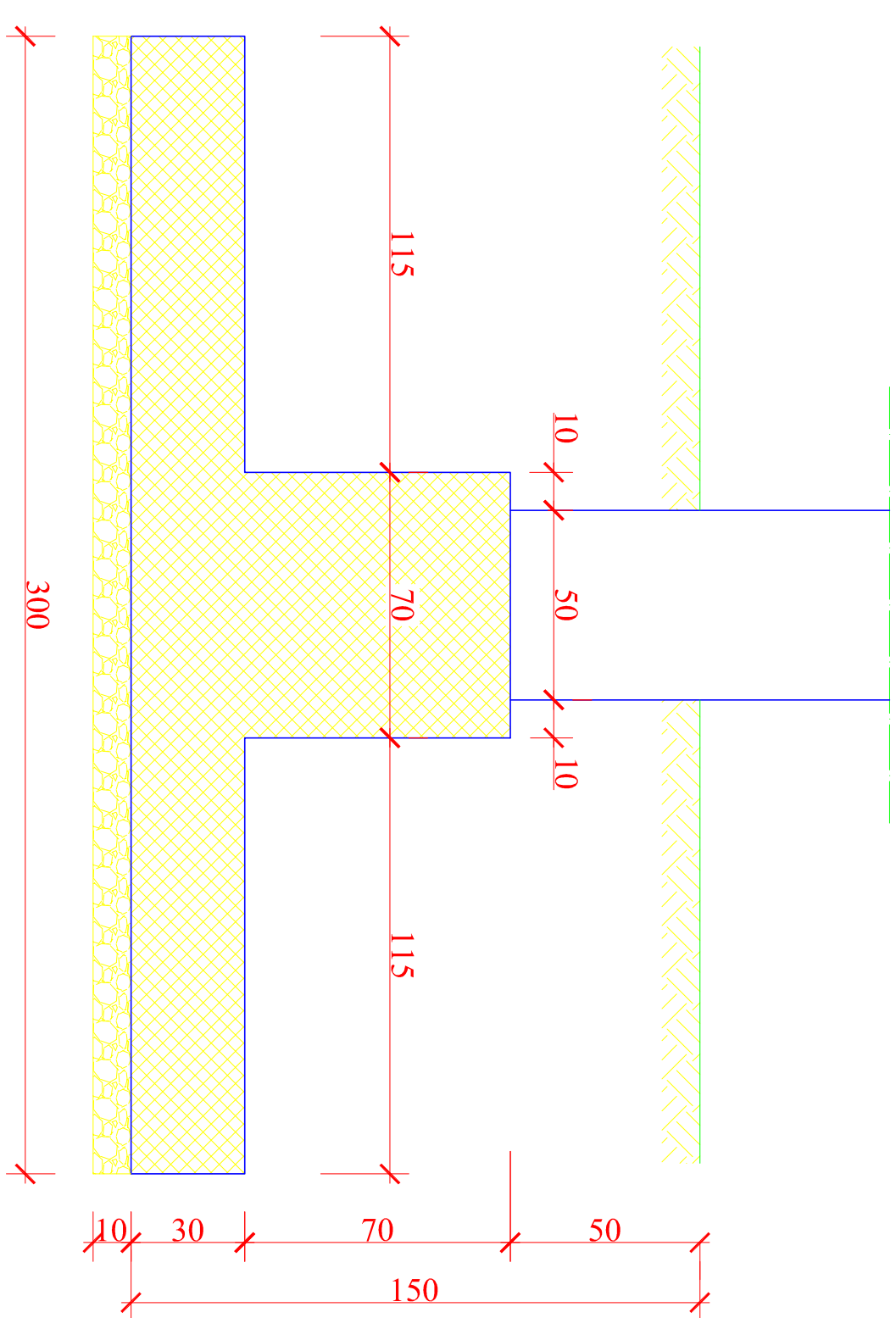
Presek 1-1



Presek 2-2 R1:25

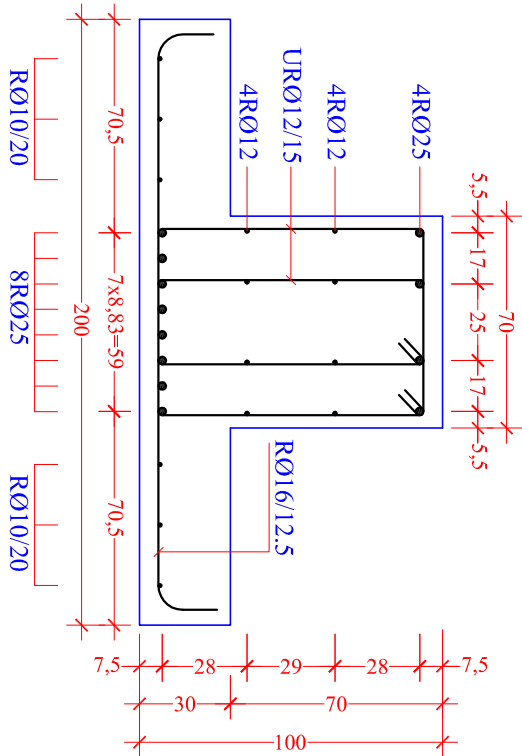


Presek 3-3 R1:25

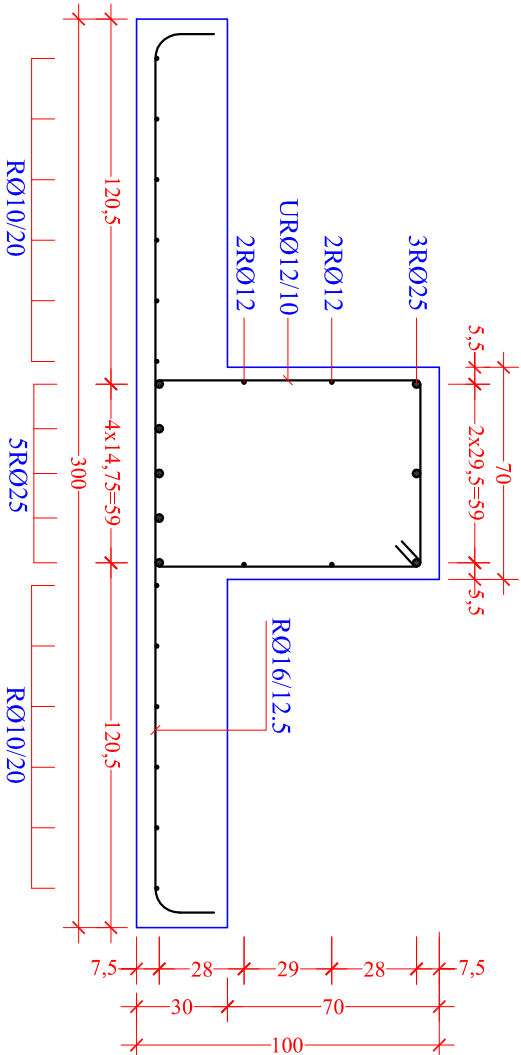


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Oblast za konstruiranje		Katedra za građevinski geotehniku	
Fundiranje			
Predmetnik nastavnika: prof. dr. Miroslav Ljubić		Kandidat: Svetlo Maric 63.03	
PLAN OPLATE			
Kvalitet materijala: M18 30		Skupski godina: 2006-2007	
Rezime: 1:50		Ostalo:	

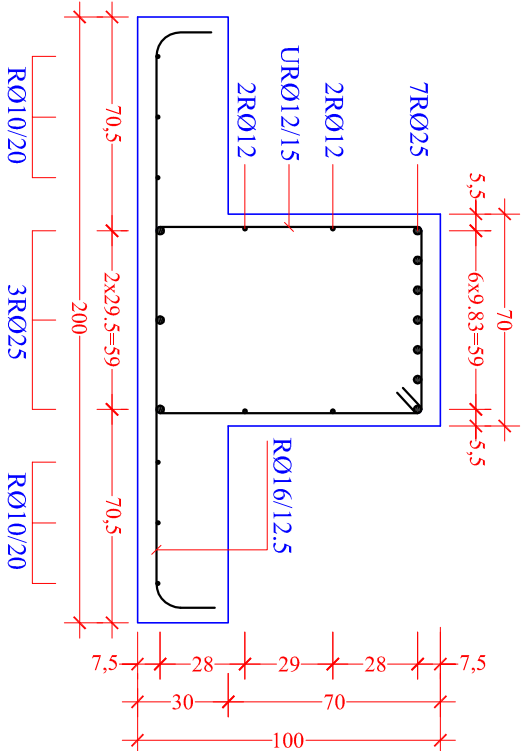
Presek 1-1



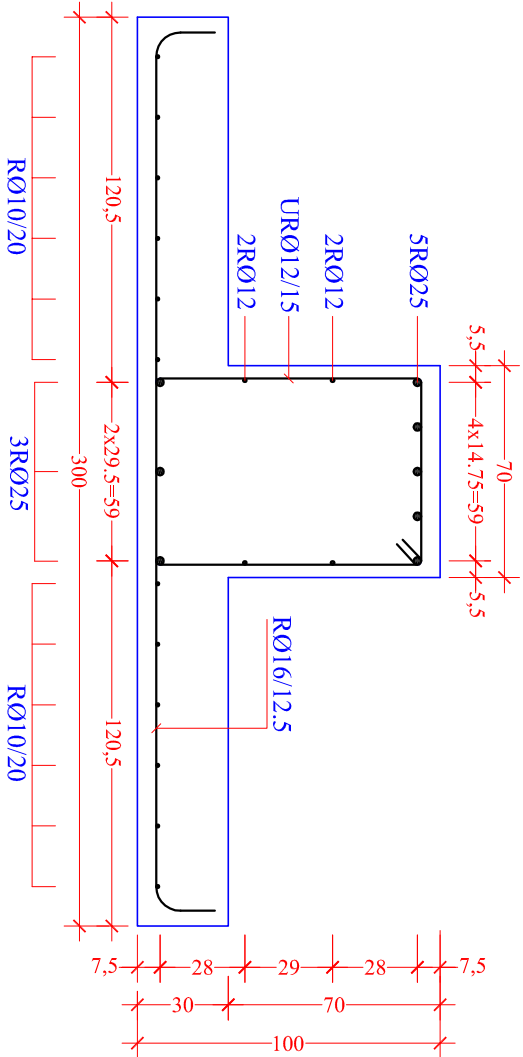
Presek 2-2



Presek 3-3



Presek 4-4

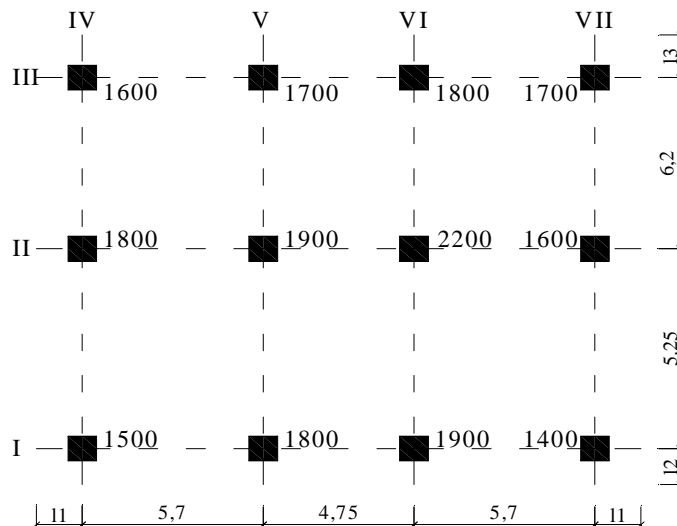


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Fundiranje			
Prednami nastavnik: prof.dr. Miroslav Lazović	Asistent: Selimir Lelović	Kandidat: Slavko Matić 63.03	
PLAN ARMATURE			
Kvalitet materijala: RA 400/500	Raznena: 1:25	Štolska godina: 2006/2007	Overt:

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Odsjek za konstrukcije		Katedra za građevinsku geotehniku	
Fundiranje			
Prednami nastavnik: prof.dr. Miroslav Lazović	Asistent: Selimir Lovović	Kandidat: Stavko Matić 63.03	
PLAN ARMATURE			
Kvalitet materijala: RA 400/500	Raznena: 1:25	Školska godina: 2006/2007	Overt:

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4. ZADATAK



$$a_0 \times b_0 = 0,50 \times 0,50$$

$$t = 0,50 \text{ m}$$

$$\sigma_{doz} = 220 \text{ kN} / \text{m}^2$$

$$\gamma = 18 \text{ kN} / \text{m}^3$$

4.1. Određivanje dužine prepusta

$$l_1 = 0,25 \cdot 5,7 = 1,45 \text{ m}$$

$$l_2 = 0,25 \cdot 5,25 = 1,30 \text{ m}$$

$$l_3 = 0,25 \cdot 6,25 = 1,55 \text{ m}$$

- Podužna traka ima ukupnu dužinu: $L_1 = 2 \cdot 1,45 + 5,7 + 5,7 + 4,75 = 19,05 \text{ m}$

- Poprečna traka ima ukupnu dužinu: $L_2 = 1,30 + 5,25 + 6,20 + 1,55 = 14,30 \text{ m}$

4.2. Potrebna naležuća površina

- Pretpostavljamo dubinu fundiranja: $D_f = 1,60 \text{ m}$

$$F_{pot} = \frac{\sum V_i}{\sigma_{doz} - 0,85 \cdot \gamma_b \cdot D_f} = \frac{20900}{220 - 0,85 \cdot 25 \cdot 1,60} = 112,36 \text{ m}^2$$

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4.3. Prosečna širina traka

$$B_{pr}^1 = \frac{F_{pot}}{\sum L^1} = \frac{112.36}{3 \cdot 19.05 + 4 \cdot 14.30} = 0.983 \text{ m}$$

$$B_{pr}^2 = \frac{F_{pot}}{\sum L^2} = \frac{112.36}{114.35 - 12 \cdot 0.983} = 1.096 \text{ m}$$

$$B_{pr}^3 = \frac{112.36}{114.35 - 12 \cdot 1.096} = 1.110 \text{ m}$$

$$B_{pr}^4 = \frac{112.36}{114.35 - 12 \cdot 1.110} = 1.112$$

$$B_{pr} = 1.11 \text{ m}$$

4.4. Određivanje širine pojedinih traka

4.4.1. Podužne trake

I traka:

$$B_I = 3 \cdot B_{pr} \cdot \frac{R_I}{R} = 3 \cdot 1.11 \cdot \frac{6600}{20900} = 1.05 \text{ m}$$

II traka:

$$B_{II} = 3 \cdot B_{pr} \cdot \frac{R_{II}}{R} = 3 \cdot 1.11 \cdot \frac{7500}{20900} = 1.19 \text{ m}$$

III traka:

$$B_{III} = 3 \cdot B_{pr} \cdot \frac{R_{III}}{R} = 3 \cdot 1.11 \cdot \frac{6800}{20900} = 1.08 \text{ m}$$

4.4.2. Poprečne trake

IV traka:

$$B_{IV} = 4 \cdot B_{pr} \cdot \frac{R_{IV}}{R} = 4 \cdot 1.11 \cdot \frac{4900}{20900} = 1.04 \text{ m}$$

V traka:

$$B_V = 4 \cdot B_{pr} \cdot \frac{R_V}{R} = 4 \cdot 1.11 \cdot \frac{5400}{20900} = 1.15 \text{ m}$$

VI traka:

$$B_{VI} = 4 \cdot B_{pr} \cdot \frac{R_{VI}}{R} = 4 \cdot 1.11 \cdot \frac{5900}{20900} = 1.25 \text{ m}$$

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VII traka:

$$B_{VII} = 4 \cdot B_{pr} \cdot \frac{R_{VII}}{R} = 4 \cdot 1.11 \cdot \frac{4700}{20900} = 1.00 \text{ m}$$

4.5. Centrisanje temelja

$$Y_R = \frac{6800 \cdot 11.45 + 7500 \cdot 5.25}{20900} = 5.61 \text{ m}$$

$$X_R = \frac{4700 \cdot 16.15 + 5900 \cdot 10.45 + 5400 \cdot 5.70}{20900} = 8.06 \text{ m}$$

- Težište naležnice površine

$$\bar{Y}_T = \frac{(1.05 \cdot 1.30 + 1.19 \cdot 6.55 + 1.08 \cdot 12.75) \cdot (19.05 - (1.04 + 1.15 + 1.25 + 1.0)) + 4.44 \cdot 14.30 \cdot 7.15}{(19.05 - 4.44) \cdot (1.05 + 1.19 + 1.08) + 4.44 \cdot 14.30} = 7.04 \text{ m}$$

$$\bar{X}_T = \frac{(1.04 \cdot 1.45 + 1.15 \cdot 7.15 + 1.25 \cdot 11.90 + 1 \cdot 17.60) \cdot (14.30 - (1.05 + 1.19 + 1.08)) + 3.32 \cdot 19.05 \cdot 9.53}{(14.30 - 3.32) \cdot (1.04 + 1.15 + 1.25 + 1.0) + 3.32 \cdot 19.05} = 9.52 \text{ m}$$

$$Y_T = \bar{Y}_T - 1.30 = 7.04 - 1.30 = 5.74 \text{ m}$$

$$X_T = \bar{X}_T - 1.45 = 9.52 - 1.45 = 8.07 \text{ m}$$

- Usvajamo nove širine traka:

$$B^I = 1.15 \text{ m} \quad B^{IV} = 1.05 \text{ m}$$

$$B^{II} = 1.15 \text{ m} \quad B^V = 1.15 \text{ m}$$

$$B^{III} = 1.0 \text{ m} \quad B^{VI} = 1.25 \text{ m}$$

$$B^{VII} = 1.0 \text{ m}$$

$$\bar{Y}_T = \frac{(1.15 \cdot 1.30 + 1.15 \cdot 6.55 + 1.0 \cdot 12.75) \cdot (19.05 - (1.05 + 1.15 + 1.25 + 1.0)) + 4.45 \cdot 14.30 \cdot 7.15}{(19.05 - 4.45) \cdot (1.15 + 1.15 + 1.0) + 4.45 \cdot 14.30} = 6.91 \text{ m}$$

$$\bar{X}_T = \frac{(1.05 \cdot 1.45 + 1.15 \cdot 7.15 + 1.25 \cdot 11.90 + 1.0 \cdot 17.60) \cdot (14.30 - (1.15 + 1.15 + 1.0)) + 3.30 \cdot 19.05 \cdot 9.53}{(14.30 - 3.30) \cdot (1.05 + 1.15 + 1.25 + 1.0) + 3.30 \cdot 19.05} = 9.51 \text{ m}$$

$$Y_T = \bar{Y}_T - 1.30 = 6.91 - 1.30 = 5.61 \text{ m}$$

$$X_T = \bar{X}_T - 1.45 = 9.51 - 1.45 = 8.06 \text{ m}$$

$$F = 19.05 \cdot (1.15 + 1.15 + 1.0) + (14.3 - 3.30) \cdot (1.05 + 1.15 + 1.25 + 1.0) = 112.82 \text{ m}^2$$

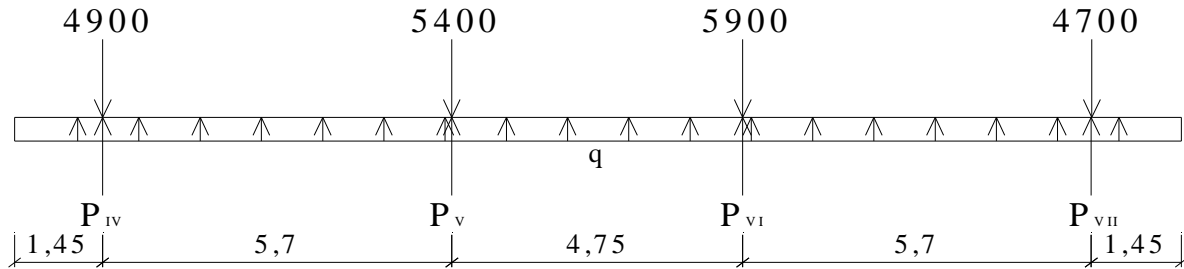
$$p = \frac{\sum V}{F} = \frac{20900}{112.82} = 186.91 \text{ kN / m}^2$$

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4.6. Proračun statičkih uticaja u trakama roštilja

4.6.1. Podužne trake-SON



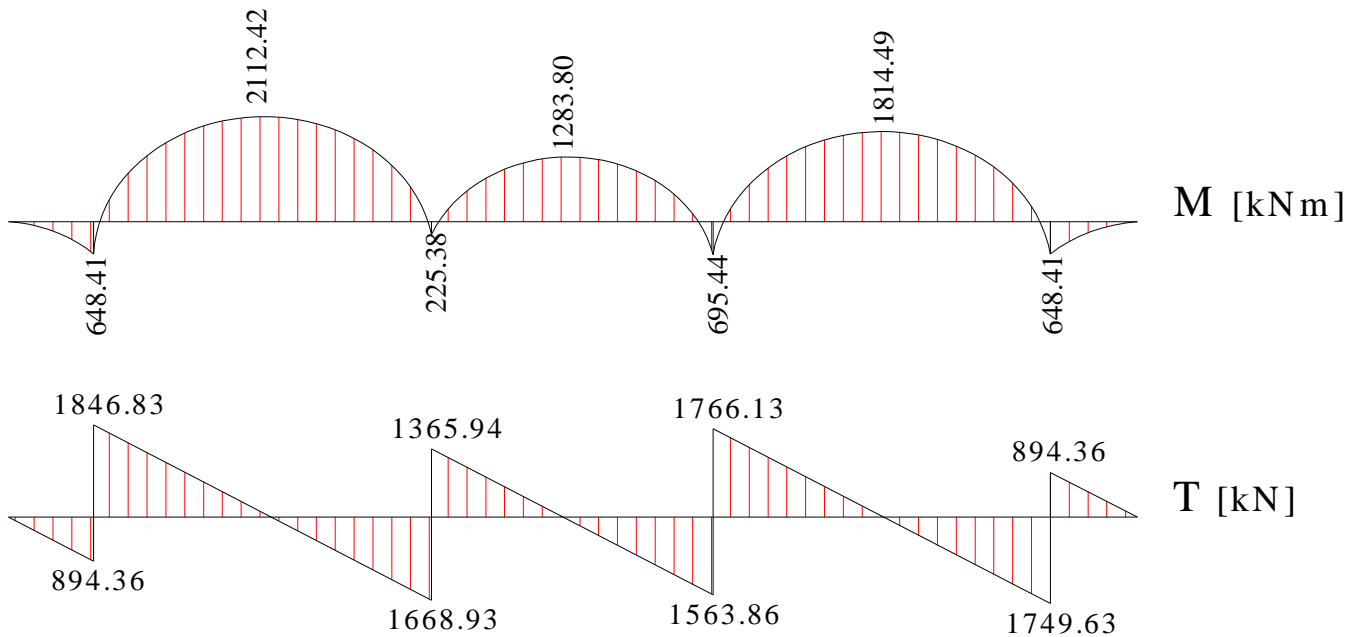
$$q = (1.15 + 1.15 + 1.0) \cdot 186.91 = 616.80 \text{ kN/m}$$

$$P_{IV} = 1.05 \cdot (14.3 - (1.15 + 1.15 + 1.0)) \cdot 186.91 = 2158.81 \text{ kN}$$

$$P_V = 1.15 \cdot 11 \cdot 186.91 = 2364.41 \text{ kN}$$

$$P_{VI} = 1.25 \cdot 11 \cdot 186.91 = 2570.01 \text{ kN}$$

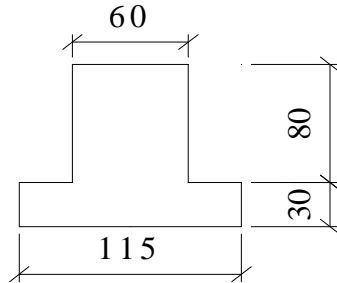
$$P_{VII} = 1.0 \cdot 11 \cdot 186.91 = 2056.01 \text{ kN}$$



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4.6.1.1. Raspored momenata savijanja po trakama srazmerno njihovim krutostima

- Traka I i II

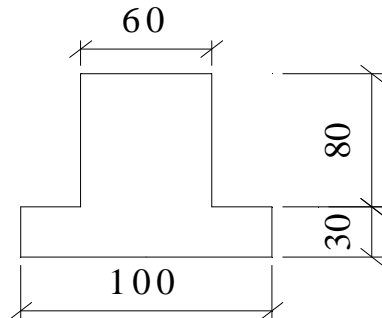


$$F = F_1 + F_2 = 0.3 \cdot 1.15 + 0.8 \cdot 0.6 = 0.825 \, m^2$$

$$Y_T = \frac{0.345 \cdot 0.15 + 0.48 \cdot 0.7}{0.825} = 0.470 \, m$$

$$I_1 = I_2 = \frac{1}{12} \cdot 1.15 \cdot 0.3^3 + 0.345 \cdot (0.47 - 0.15)^2 + \frac{1}{12} \cdot 0.6 \cdot 0.8^3 + 0.48 \cdot (0.7 - 0.470)^2 = 0.089 \, m^4$$

- Traka III



$$F = F_1 + F_2 = 0.3 \cdot 1.0 + 0.8 \cdot 0.6 = 0.780 \, m^2$$

$$Y_T = \frac{0.30 \cdot 0.15 + 0.48 \cdot 0.7}{0.780} = 0.488 \, m$$

$$I_1 = I_2 = \frac{1}{12} \cdot 1.0 \cdot 0.3^3 + 0.30 \cdot (0.488 - 0.15)^2 + \frac{1}{12} \cdot 0.6 \cdot 0.8^3 + 0.48 \cdot (0.7 - 0.488)^2 = 0.084 \, m^4$$

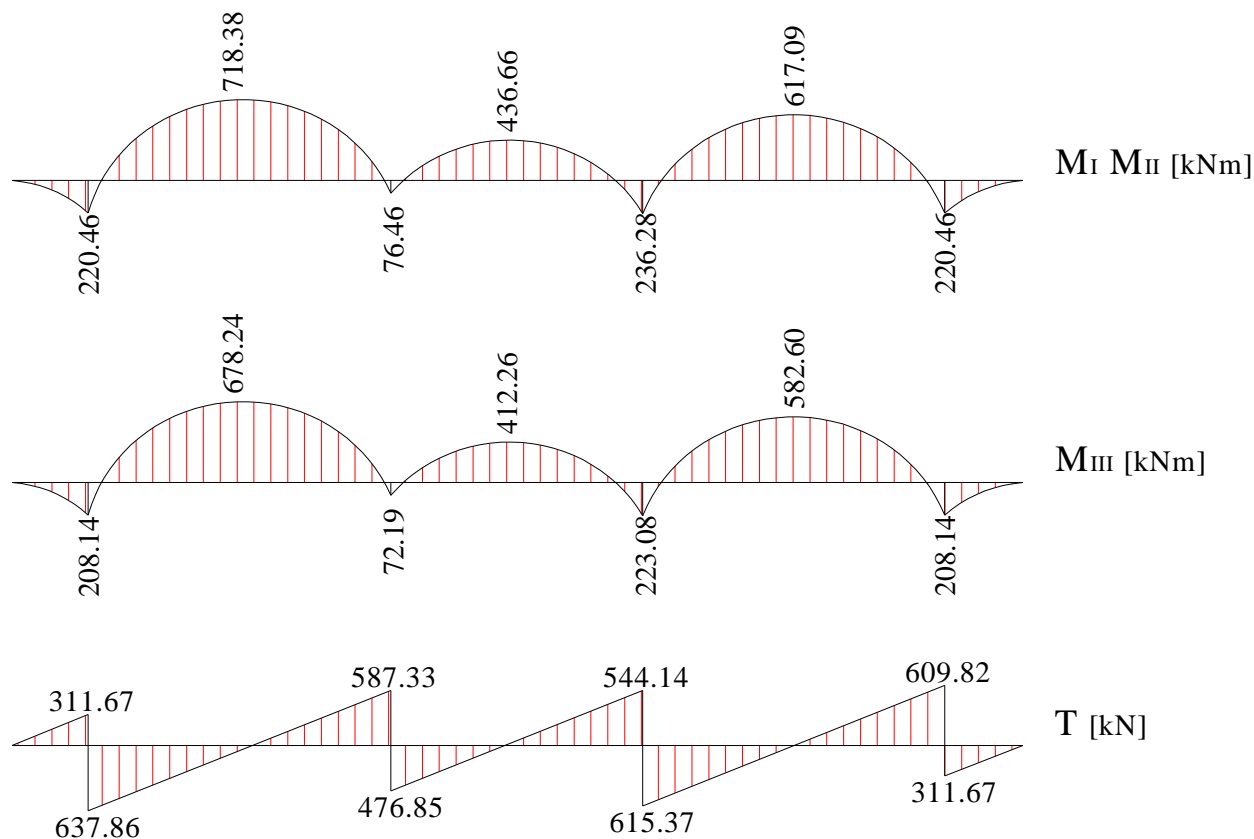
$$\sum I = 0.089 \cdot 2 + 0.084 = 0.262 \, m^4$$

$$M_I = M_{II} = M \cdot \frac{I_I}{\sum I} = M \cdot \frac{0.089}{0.262} = 0.340 \cdot M$$

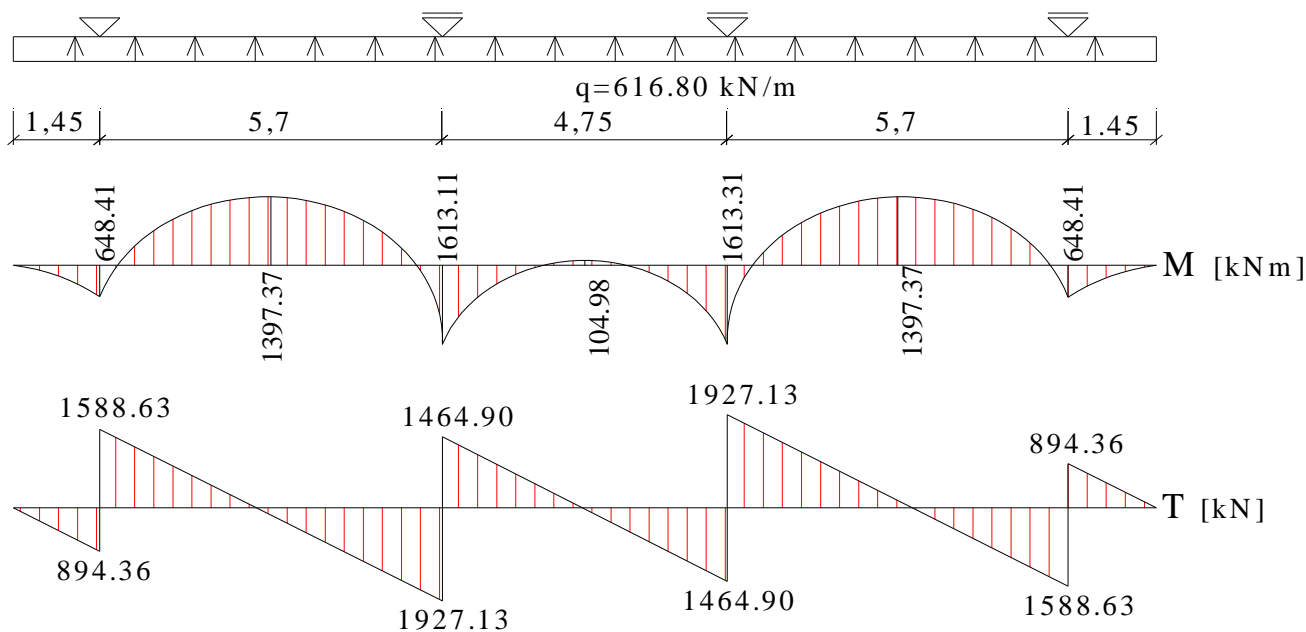
$$M_{III} = M \cdot \frac{I_{III}}{\sum I} = M \cdot \frac{0.084}{0.262} = 0.321 \cdot M$$

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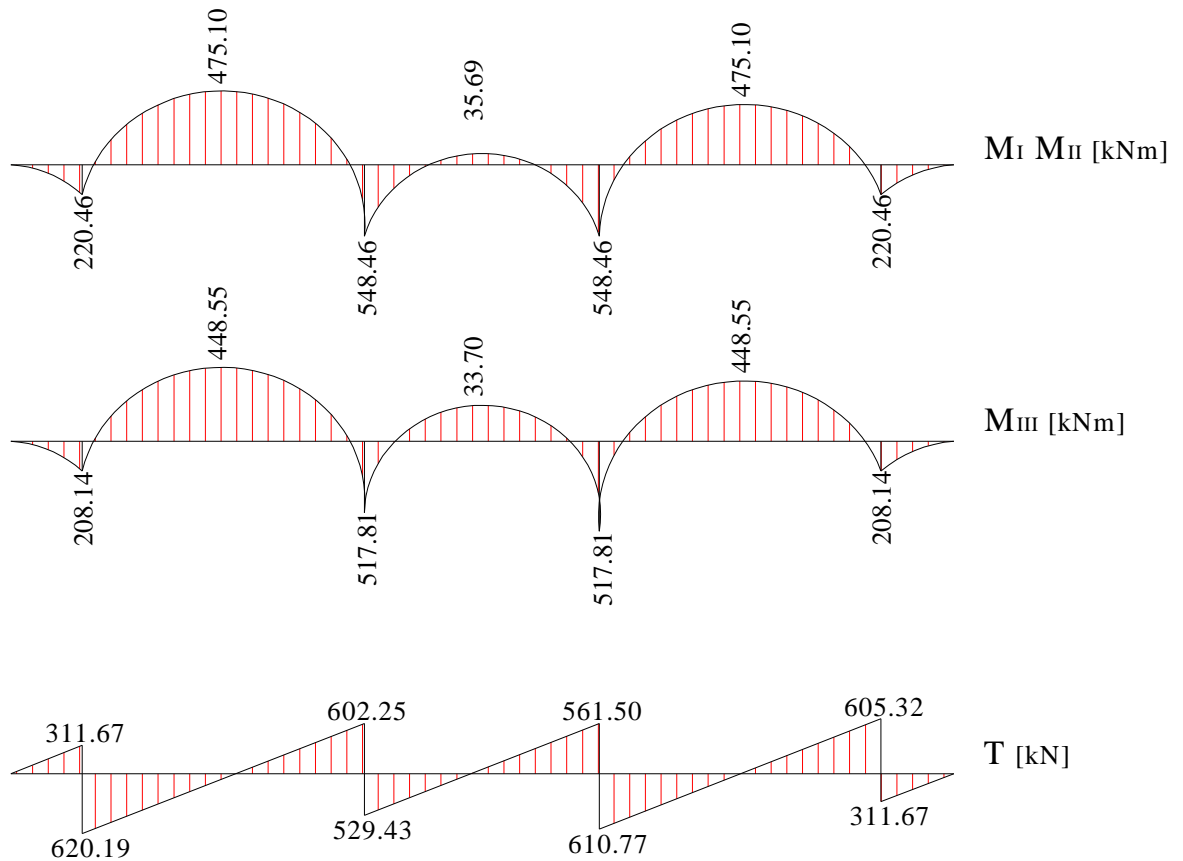


4.6.2. Podužne trake-SNN

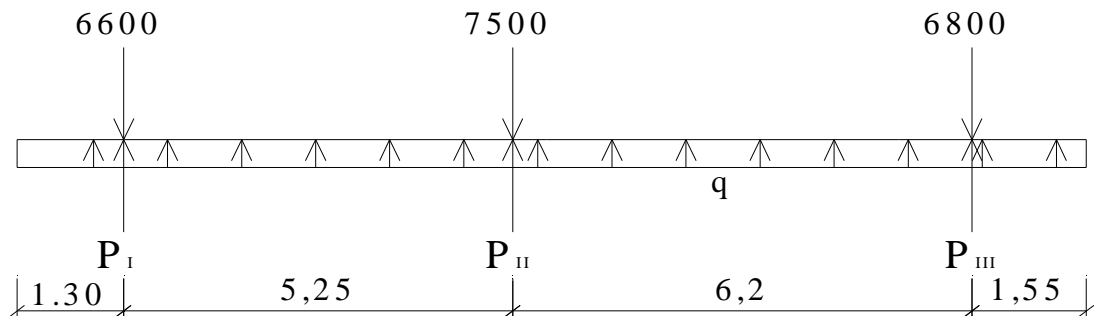


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4.6.3. Poprečne trake-SON



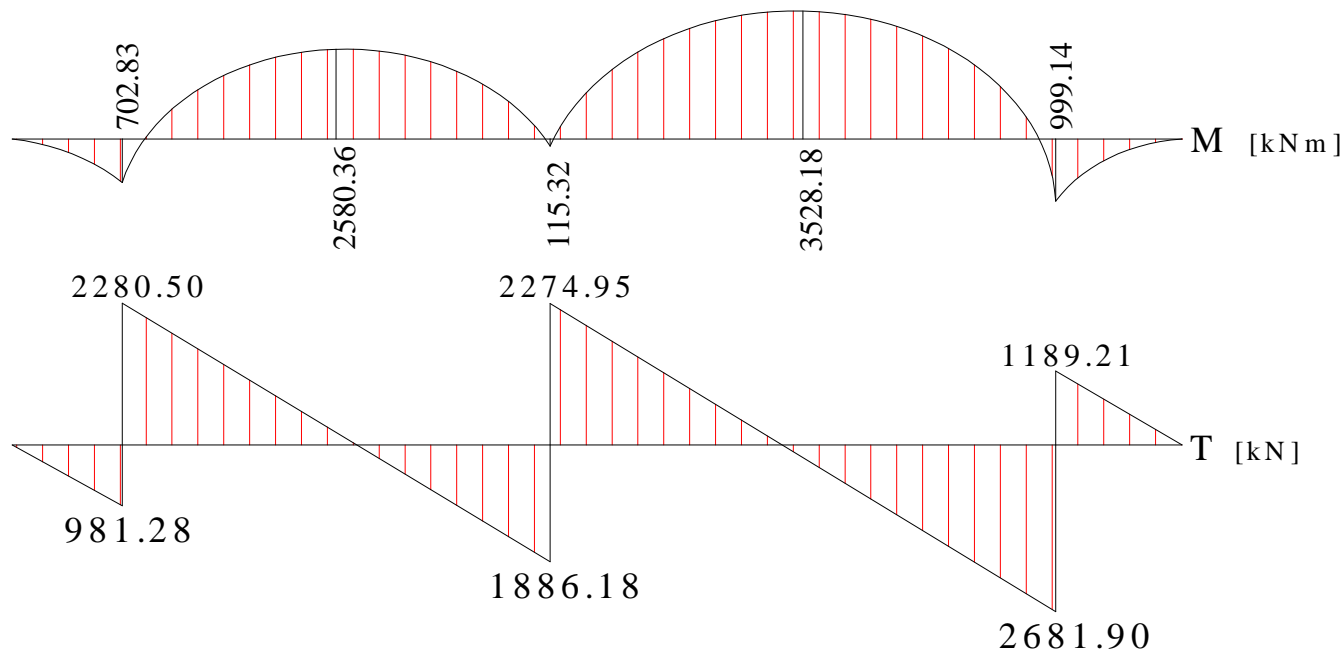
$$q = (1.05 + 1.15 + 1.25 + 1.0) \cdot 186.91 = 831.75 \text{ kN} / m$$

$$P_I = 1.15 \cdot (19.05 - (1.05 + 1.15 + 1.25 + 1.0)) \cdot 186.91 = 3138.22 \text{ kN}$$

$$P_{II} = 1.15 \cdot 14.6 \cdot 186.91 = 3138.22 \text{ kN}$$

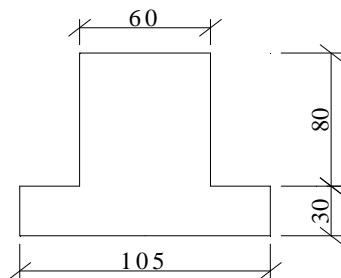
$$P_{III} = 1.0 \cdot 14.6 \cdot 186.91 = 2728.89 \text{ kN}$$

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4.6.3.1. Raspored momenata savijanja po trakama srazmerno njihovim krutostima

- Traka IV

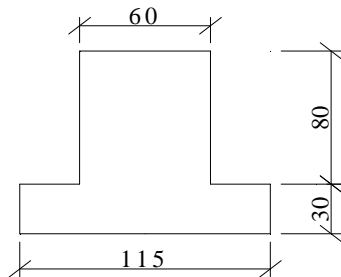


$$F = F_1 + F_2 = 0.3 \cdot 1.05 + 0.8 \cdot 0.6 = 0.795 \text{ m}^2$$

$$Y_T = \frac{0.315 \cdot 0.15 + 0.48 \cdot 0.7}{0.795} = 0.482 \text{ m}$$

$$I_{IV} = \frac{1}{12} \cdot 1.05 \cdot 0.3^3 + 0.315 \cdot (0.482 - 0.15)^2 + \frac{1}{12} \cdot 0.6 \cdot 0.8^3 + 0.48 \cdot (0.7 - 0.482)^2 = 0.085 \text{ m}^4$$

- Traka V



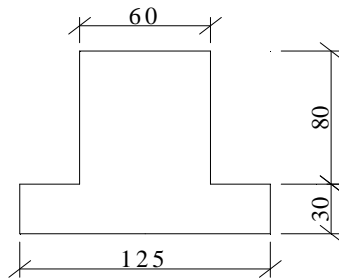
$$F = F_1 + F_2 = 0.3 \cdot 1.15 + 0.8 \cdot 0.6 = 0.825 \text{ m}^2$$

$$Y_T = \frac{0.345 \cdot 0.15 + 0.48 \cdot 0.7}{0.825} = 0.470 \text{ m}$$

$$I_V = \frac{1}{12} \cdot 1.15 \cdot 0.3^3 + 0.345 \cdot (0.470 - 0.15)^2 + \frac{1}{12} \cdot 0.6 \cdot 0.8^3 + 0.48 \cdot (0.7 - 0.470)^2 = 0.089 \text{ m}^4$$

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- Traka VI

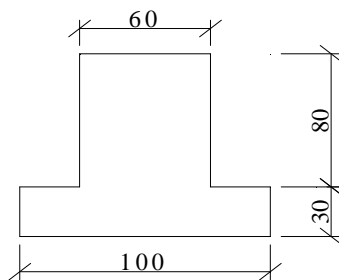


$$F = F_1 + F_2 = 0.3 \cdot 1.25 + 0.8 \cdot 0.6 = 0.855 \, m^2$$

$$Y_T = \frac{0.375 \cdot 0.15 + 0.48 \cdot 0.7}{0.855} = 0.459 \, m$$

$$I_{VI} = \frac{1}{12} \cdot 1.15 \cdot 0.3^3 + 0.375 \cdot (0.459 - 0.15)^2 + \frac{1}{12} \cdot 0.6 \cdot 0.8^3 + 0.48 \cdot (0.7 - 0.459)^2 = 0.092 \, m^4$$

- Traka VII



$$F = F_1 + F_2 = 0.78 \, m^2$$

$$Y_T = 0.488 \, m$$

$$I_{VII} = 0.084 \, m^4$$

$$\sum I = 0.085 + 0.089 + 0.092 + 0.084 = 0.35 \, m^4$$

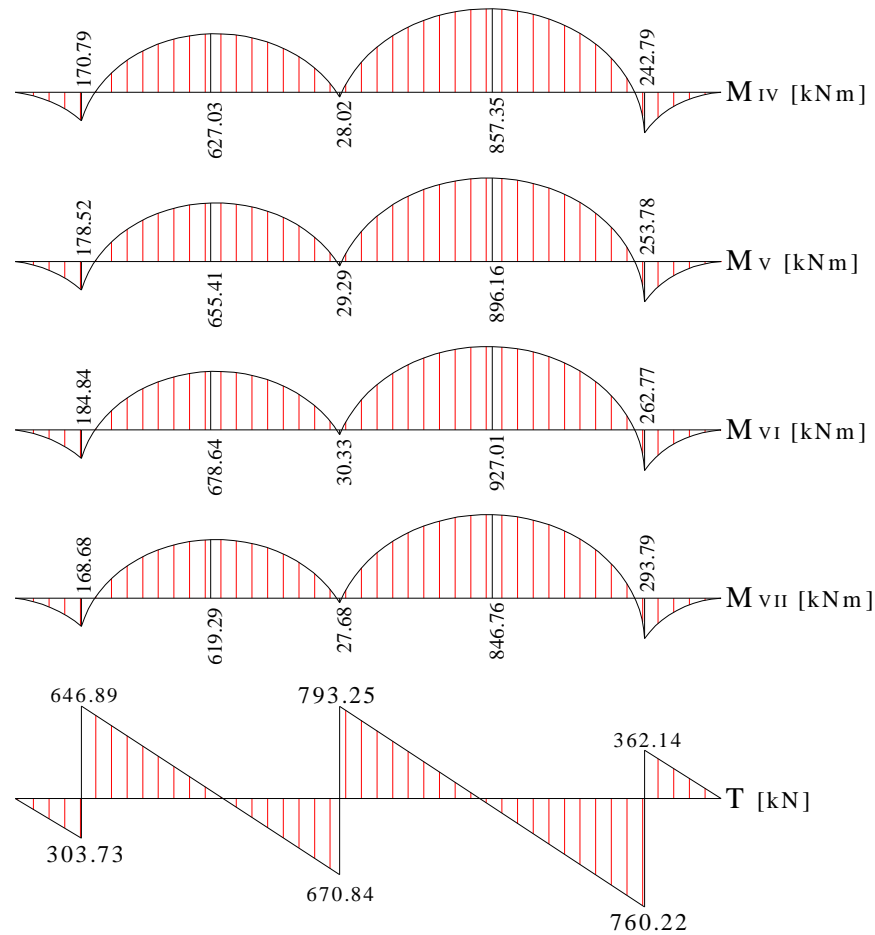
$$M_{IV} = M \cdot \frac{I_{IV}}{\sum I} = M \cdot \frac{0.085}{0.35} = 0.243 \cdot M$$

$$M_V = M \cdot \frac{I_V}{\sum I} = M \cdot \frac{0.089}{0.35} = 0.254 \cdot M$$

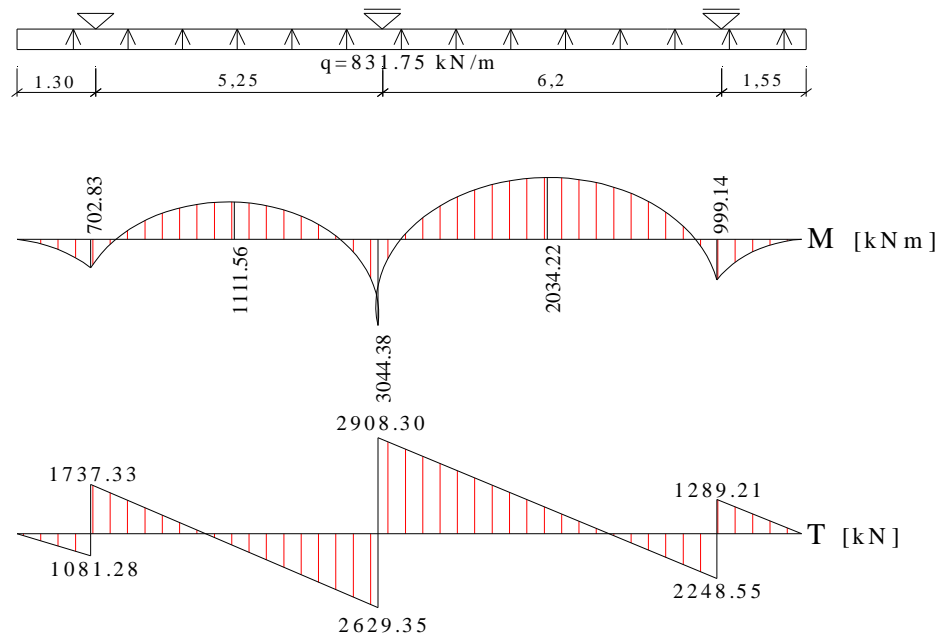
$$M_{VI} = M \cdot \frac{I_{VI}}{\sum I} = M \cdot \frac{0.092}{0.35} = 0.263 \cdot M$$

$$M_{VII} = M \cdot \frac{I_{VII}}{\sum I} = M \cdot \frac{0.084}{0.35} = 0.240 \cdot M$$

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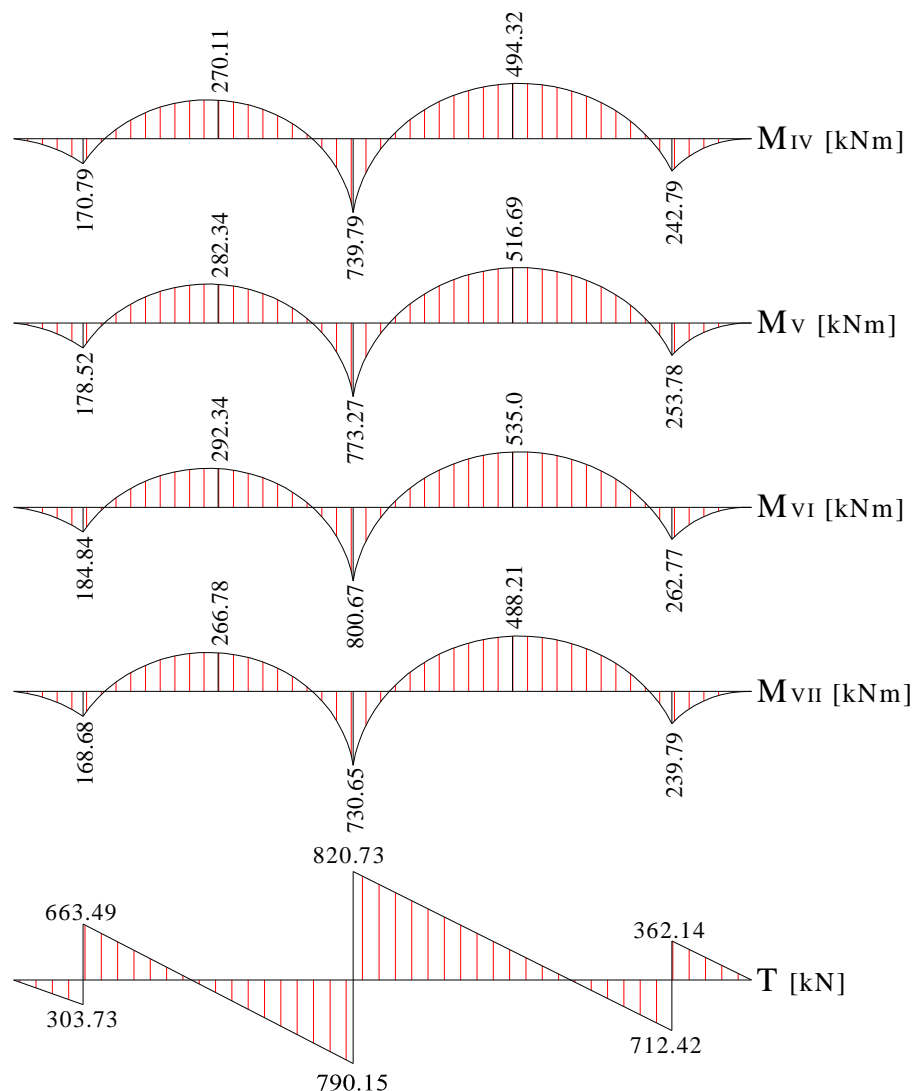


4.6.4. Poprečne trake – SNN



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4.7. Dimenzionisanje

$$MB30 \Rightarrow f_b = 2.05 \text{ kN} / \text{cm}^2 \quad \tau_r = 0.11 \text{ kN} / \text{cm}^2$$

$$RA400 / 500 \Rightarrow \sigma_v = 40 \text{ kN} / \text{cm}^2$$

$$\bar{\tau} = (2 - 2.5) \tau_r = 0.248 \text{ kN} / \text{cm}^2$$

$$\max M_u = 1.65 \cdot 927.91 = 1531.05 \text{ kNm}$$

$$\max T_u = 1.65 \cdot 820.73 = 1354.21 \text{ kN}$$

$$h_M = 2.311 \cdot \sqrt{\frac{1531.05 \cdot 100}{2.05 \cdot 60}} = 81.53 \text{ cm}$$

$$h_T = \frac{1354.21}{0.9 \cdot 60 \cdot 0.248} = 101.12 \text{ cm}$$

Usvojeno: d=110 cm

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4.8. Analiza opterećenja

- Opterećenje: 20900 kN

- Težina temelja: $(19.05 \cdot 3 \cdot 0.6 \cdot 0.8 + 4 \cdot 0.6 \cdot 0.8 \cdot (14.3 - 3 \cdot 0.6) + 19.05 \cdot 0.3 \cdot (1.15 + 1.15 + 1.0) + 0.3 \cdot (14.3 - 1.15 - 1.15 - 1.0) \cdot (1.05 + 1.15 + 1.25 + 1.0)) \cdot 25 = 2124.41 \text{ kN}$

- Tlo: $(19.05 \cdot 0.5 \cdot (1.15 + 1.15 + 1.0) + (19.05 - 4 \cdot 0.6) \cdot 2 \cdot 0.8 \cdot (0.2 + 2 \cdot 0.275) + (14.3 - 1.15 - 1.15 - 1) \cdot 0.5 \cdot (0.225 + 0.275 + 0.325 + 0.2)) \cdot 18 = 1690.70 \text{ kN}$

$$\sum V = 24715.11 \text{ kN}$$

$$\sigma_{rač} = \frac{\sum V}{F} = \frac{24715.11}{112.82} = 219.07 \text{ kN/m}^2 < \sigma_{doz} = 220 \text{ kN/m}^2$$

4.9. Proračun potrebne armature

4.9.1. Trake I i II

- Oslonac

$$M_U = 1.65 \cdot 548.46 = 904.96 \text{ kNm}$$

$$h = 110 - 7.5 = 102.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{904.96 \cdot 100}{2.05 \cdot 60}}} = 3.779 \Rightarrow \begin{cases} \varepsilon_a / \varepsilon_b = 1.5 / 10 \% \\ \mu = 7.337 \% \end{cases}$$

$$A_a = 7.337 \cdot \frac{60 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 23.12 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 5R\phi 25 (24.55 \text{ cm}^2)$$

- Polje

Zategnuta gornja zona \Rightarrow Pretpostavljamo da se neutralna linija nalazi u ploči tj. da je oblik pritisnute zona pravougaoni širine B.

$$M_u = 1.65 \cdot 718.38 = 1185.33 \text{ kNm}$$

$$h = 100 - 7.5 = 92.5 \text{ cm}$$

$$B = \min \begin{cases} b + 20 \cdot d_{pl} = 60 + 20 \cdot 30 = 660 \text{ cm} \\ b + 0.25 \cdot l_0 = 60 + 0.25 \cdot 520 = 190 \text{ cm} \end{cases}$$

$$B = 190 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1185.33 \cdot 100}{190 \cdot 2.05}}} = 5.876 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 0.875 / 10 \% \\ s = 0.080 \\ \mu = 3.007 \% \end{cases}$$

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$$x = s \cdot h = 0.080 \cdot 102.5 = 8.20 < d_{pl} = 30 \text{ cm} \Rightarrow \text{Pretpostavka o položaju neutralne linije je dobra.}$$

$$A_a = 3.007 \cdot \frac{190 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 30.01 \text{ cm}^2 \Rightarrow \text{Usvojeno: } 7R\phi 25 (34.37 \text{ cm}^2)$$

4.9.2. Traka III

- Oslonac

$$M_U = 1.65 \cdot 517.81 = 854.38 \text{ kNm}$$

$$h = 110 - 7.5 = 102.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{854.38 \cdot 100}{2.05 \cdot 60}}} = 3.889 \Rightarrow \begin{cases} \varepsilon_a / \varepsilon_b = 1.45 / 10 \text{ ‰} \\ - \\ \mu = 6.962 \text{ ‰} \end{cases}$$

$$A_a = 6.962 \cdot \frac{60 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 21.94 \text{ cm}^2 \Rightarrow \text{Usvojeno: } 5R\phi 25 (24.55 \text{ cm}^2)$$

- Polje

Zategnuta gornja zona \Rightarrow Pretpostavljamo da se neutralna linija nalazi u ploči tj. da je oblik pritisnute zona pravougaoni širine B.

$$M_u = 1.65 \cdot 678.24 = 1119.10 \text{ kNm}$$

$$h = 100 - 7.5 = 92.5 \text{ cm}$$

$$B = \min \begin{cases} b + 20 \cdot d_{pl} = 60 + 20 \cdot 30 = 660 \text{ cm} \\ b + 0.25 \cdot l_0 = 60 + 0.25 \cdot 520 = 190 \text{ cm} \end{cases}$$

$$B = 190 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1119.10 \cdot 100}{190 \cdot 2.05}}} = 6.047 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 0.85 / 10 \text{ ‰} \\ s = 0.078 \\ - \\ \mu = 2.858 \text{ ‰} \end{cases}$$

$$x = s \cdot h = 0.078 \cdot 102.5 = 7.99 < d_{pl} = 30 \text{ cm} \Rightarrow \text{Pretpostavka o položaju neutralne linije je dobra.}$$

$$A_a = 2.858 \cdot \frac{190 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 28.53 \text{ cm}^2 \Rightarrow \text{Usvojeno: } 6R\phi 25 (29.46 \text{ cm}^2)$$

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4.9.3. Traka IV

- Oslonac

$$M_U = 1.65 \cdot 739.79 = 1220.65 \text{ kNm}$$

$$h = 110 - 7.5 = 102.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1220.65 \cdot 100}{2.05 \cdot 60}}} = 3.254 \Rightarrow \begin{cases} \varepsilon_a / \varepsilon_b = 1.85 / 10 ‰ \\ - \\ \mu = 9.988 \% \end{cases}$$

$$A_a = 9.988 \cdot \frac{60 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 31.48 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 7R\phi 25 (34.37 \text{ cm}^2)$$

- Polje

Zategnuta gornja zona \Rightarrow Pretpostavljamo da se neutralna linija nalazi u ploči tj. da je oblik pritisnute zona pravougaoni širine B.

$$M_u = 1.65 \cdot 857.35 = 1414.63 \text{ kNm}$$

$$h = 100 - 7.5 = 92.5 \text{ cm}$$

$$B = \min \begin{cases} b + 20 \cdot d_{pl} = 60 + 20 \cdot 30 = 660 \text{ cm} \\ b + 0.25 \cdot l_0 = 60 + 0.25 \cdot 550 = 197.5 \text{ cm} \end{cases}$$

$$B = 197.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1414.63 \cdot 100}{197.5 \cdot 2.05}}} = 5.484 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 0.93 / 10 ‰ \\ s = 0.087 \\ - \\ \mu = 3.469 \% \end{cases}$$

$$x = s \cdot h = 0.087 \cdot 102.5 = 8.99 < d_{pl} = 30 \text{ cm} \Rightarrow \text{Pretpostavka o položaju neutralne linije je dobra.}$$

$$A_a = 3.469 \cdot \frac{197.5 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 35.99 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 8R\phi 25 (39.28 \text{ cm}^2)$$

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4.9.4. Traka V

- Oslonac

$$M_U = 1.65 \cdot 773.27 = 1275.90 \text{ kNm}$$

$$h = 110 - 7.5 = 102.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1275.90 \cdot 100}{2.05 \cdot 60}}} = 3.182 \Rightarrow \begin{cases} \varepsilon_a / \varepsilon_b = 1.925 / 10 \text{ ‰} \\ - \\ \mu = 10.552 \text{ ‰} \end{cases}$$

$$A_a = 10.552 \cdot \frac{60 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 33.26 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 7R\phi 25 (34.37 \text{ cm}^2)$$

- Polje

Zategnuta gornja zona \Rightarrow Pretpostavljamo da se neutralna linija nalazi u ploči tj. da je oblik pritisnute zona pravougaoni širine B.

$$M_u = 1.65 \cdot 896.16 = 1478.66 \text{ kNm}$$

$$h = 100 - 7.5 = 92.5 \text{ cm}$$

$$B = \min \begin{cases} b + 20 \cdot d_{pl} = 60 + 20 \cdot 30 = 660 \text{ cm} \\ b + 0.25 \cdot l_0 = 60 + 0.25 \cdot 550 = 197.5 \text{ cm} \end{cases}$$

$$B = 197.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1478.66 \cdot 100}{197.5 \cdot 2.05}}} = 5.364 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 0.975 / 10 \text{ ‰} \\ s = 0.089 \\ - \\ \mu = 3.627 \text{ ‰} \end{cases}$$

$$x = s \cdot h = 0.089 \cdot 102.5 = 9.12 < d_{pl} = 30 \text{ cm} \Rightarrow \text{Pretpostavka o položaju neutralne linije je dobra.}$$

$$A_a = 3.627 \cdot \frac{197.5 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 37.63 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 8R\phi 25 (39.28 \text{ cm}^2)$$

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4.9.5. Traka VI

- Oslonac

$$M_U = 1.65 \cdot 800.67 = 1321.11 \text{ kNm}$$

$$h = 110 - 7.5 = 102.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1321.11 \cdot 100}{2.05 \cdot 60}}} = 3.182 \Rightarrow \begin{cases} \varepsilon_a / \varepsilon_b = 1.975 / 10\text{‰} \\ \mu = 10.926\% \end{cases}$$

$$A_a = 10.926 \cdot \frac{60 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 34.13 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 7R\phi 25 (34.37 \text{ cm}^2)$$

- Polje

Zategnuta gornja zona \Rightarrow Pretpostavljamo da se neutralna linija nalazi u ploči tj. da je oblik pritisnute zona pravougaoni širine B.

$$M_u = 1.65 \cdot 927.01 = 1529.57 \text{ kNm}$$

$$h = 100 - 7.5 = 92.5 \text{ cm}$$

$$B = \min \begin{cases} b + 20 \cdot d_{pl} = 60 + 20 \cdot 30 = 660 \text{ cm} \\ b + 0.25 \cdot l_0 = 60 + 0.25 \cdot 550 = 197.5 \text{ cm} \end{cases}$$

$$B = 197.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1529.57 \cdot 100}{197.5 \cdot 2.05}}} = 5.274 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 0.975 / 10\text{‰} \\ s = 0.089 \\ \mu = 3.627\% \end{cases}$$

$$x = s \cdot h = 0.089 \cdot 102.5 = 9.12 < d_{pl} = 30 \text{ cm} \Rightarrow \text{Pretpostavka o položaju neutralne linije je dobra.}$$

$$A_a = 3.627 \cdot \frac{197.5 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 37.63 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 8R\phi 25 (39.28 \text{ cm}^2)$$

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4.9.6. Traka VII

- Oslonac

$$M_U = 1.65 \cdot 730.65 = 1205.57 \text{ kNm}$$

$$h = 110 - 7.5 = 102.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1205.57 \cdot 100}{2.05 \cdot 60}}} = 3.274 \Rightarrow \begin{cases} \varepsilon_a / \varepsilon_b = 1.825 / 10 \text{ ‰} \\ - \\ \mu = 9.799 \text{ ‰} \end{cases}$$

$$A_a = 9.799 \cdot \frac{60 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 30.38 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 7R\phi 25 (34.37 \text{ cm}^2)$$

- Polje

Zategnuta gornja zona \Rightarrow Pretpostavljamo da se neutralna linija nalazi u ploči tj. da je oblik pritisnute zona pravougaoni širine B.

$$M_u = 1.65 \cdot 846.76 = 1397.15 \text{ kNm}$$

$$h = 100 - 7.5 = 92.5 \text{ cm}$$

$$B = \min \begin{cases} b + 20 \cdot d_{pl} = 60 + 20 \cdot 30 = 660 \text{ cm} \\ b + 0.25 \cdot l_0 = 60 + 0.25 \cdot 550 = 197.5 \text{ cm} \end{cases}$$

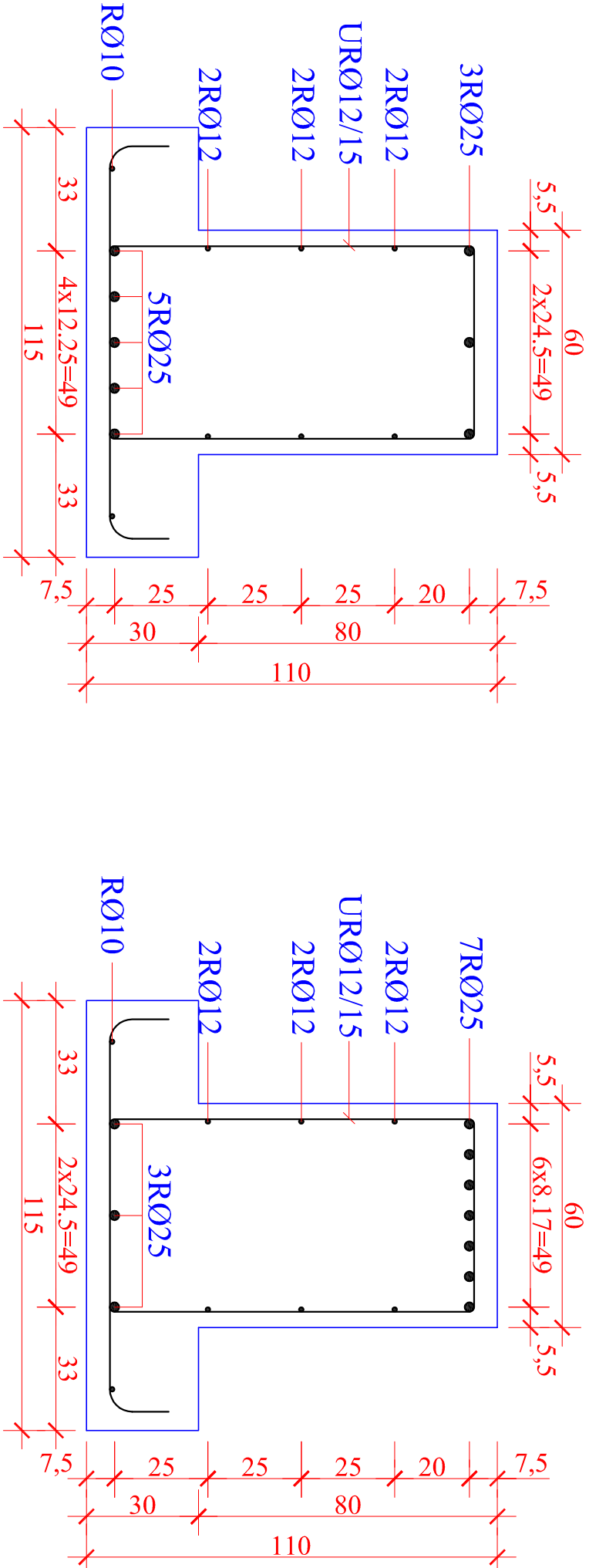
$$B = 197.5 \text{ cm}$$

$$k = \frac{102.5}{\sqrt{\frac{1397.15 \cdot 100}{197.5 \cdot 2.05}}} = 5.462 \Rightarrow \begin{cases} \varepsilon_b / \varepsilon_a = 0.95 / 10 \text{ ‰} \\ s = 0.087 \\ - \\ \mu = 3.469 \text{ ‰} \end{cases}$$

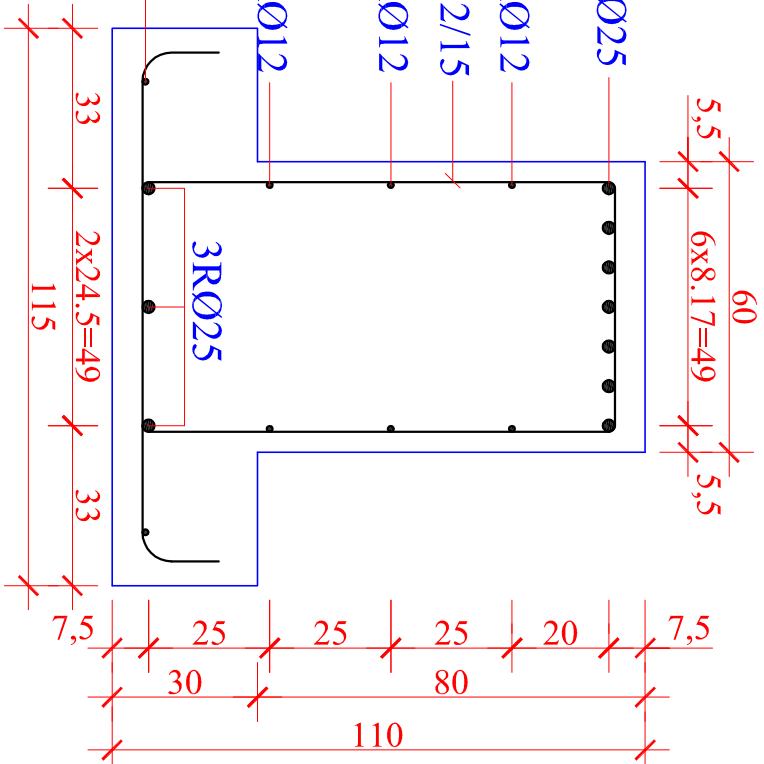
$$x = s \cdot h = 0.087 \cdot 102.5 = 8.99 < d_{pl} = 30 \text{ cm} \Rightarrow \text{Pretpostavka o položaju neutralne linije je dobra.}$$

$$A_a = 3.469 \cdot \frac{197.5 \cdot 102.5}{100} \cdot \frac{2.05}{40} = 35.99 \text{ cm}^2 \Rightarrow \text{Usvojeno : } 8R\phi 25 (39.28 \text{ cm}^2)$$

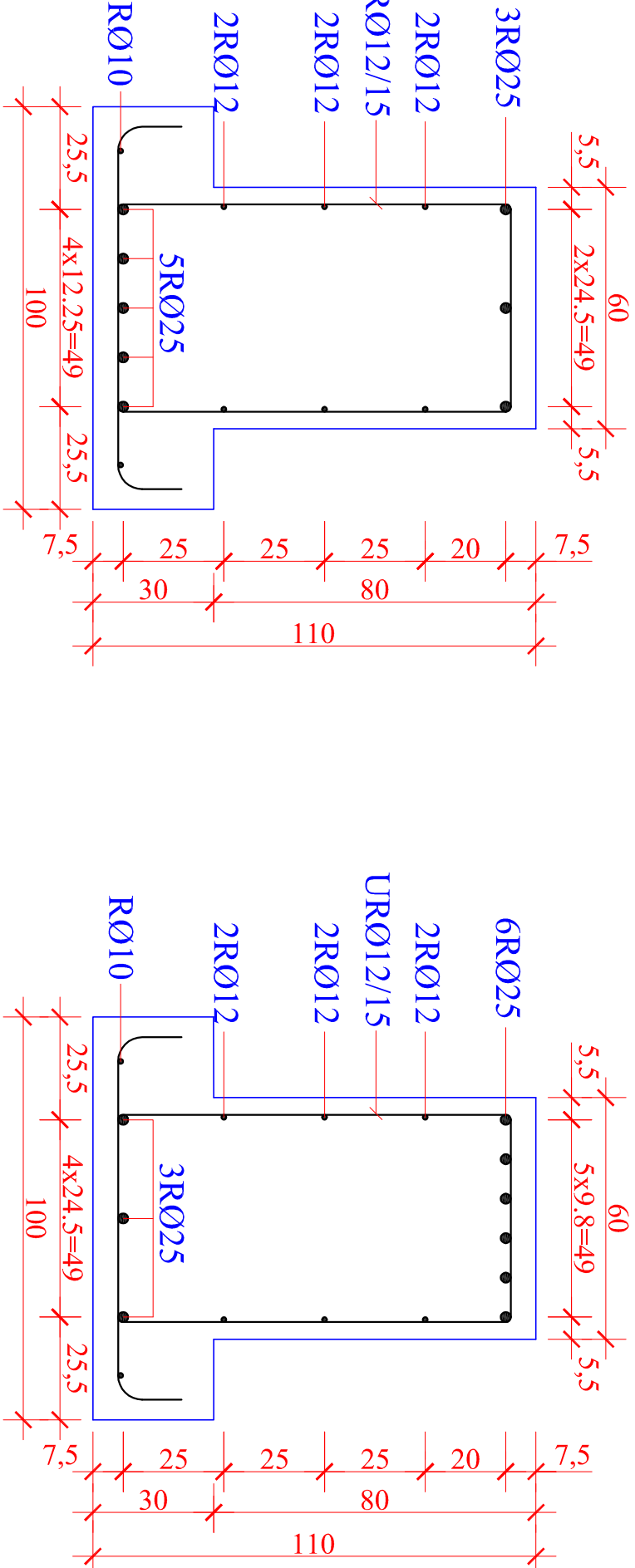
Trake I, II (Presek nad osloncem)



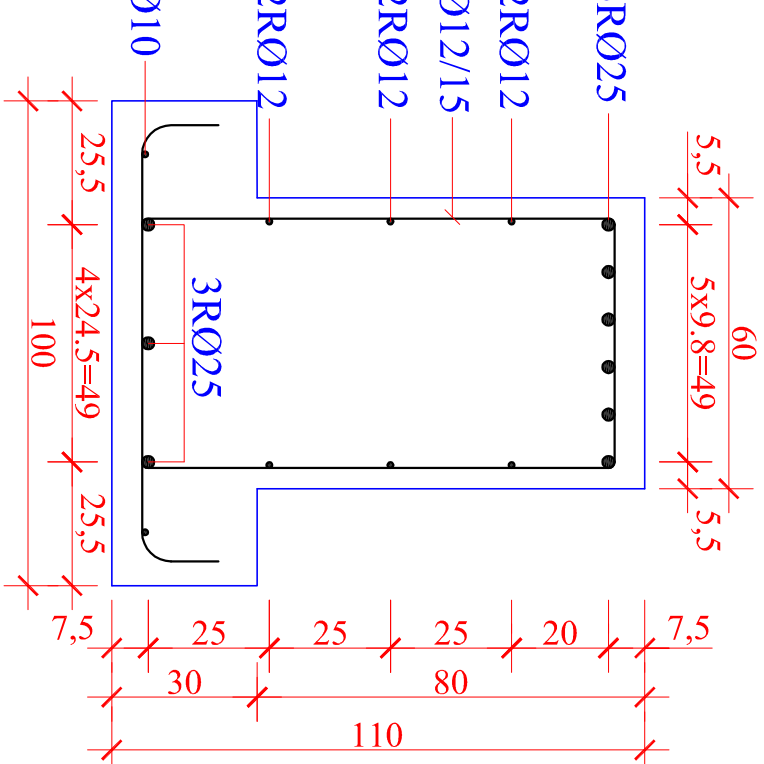
Trake I, II (Presek u polju)



Traka III (Presek nad osloncem)

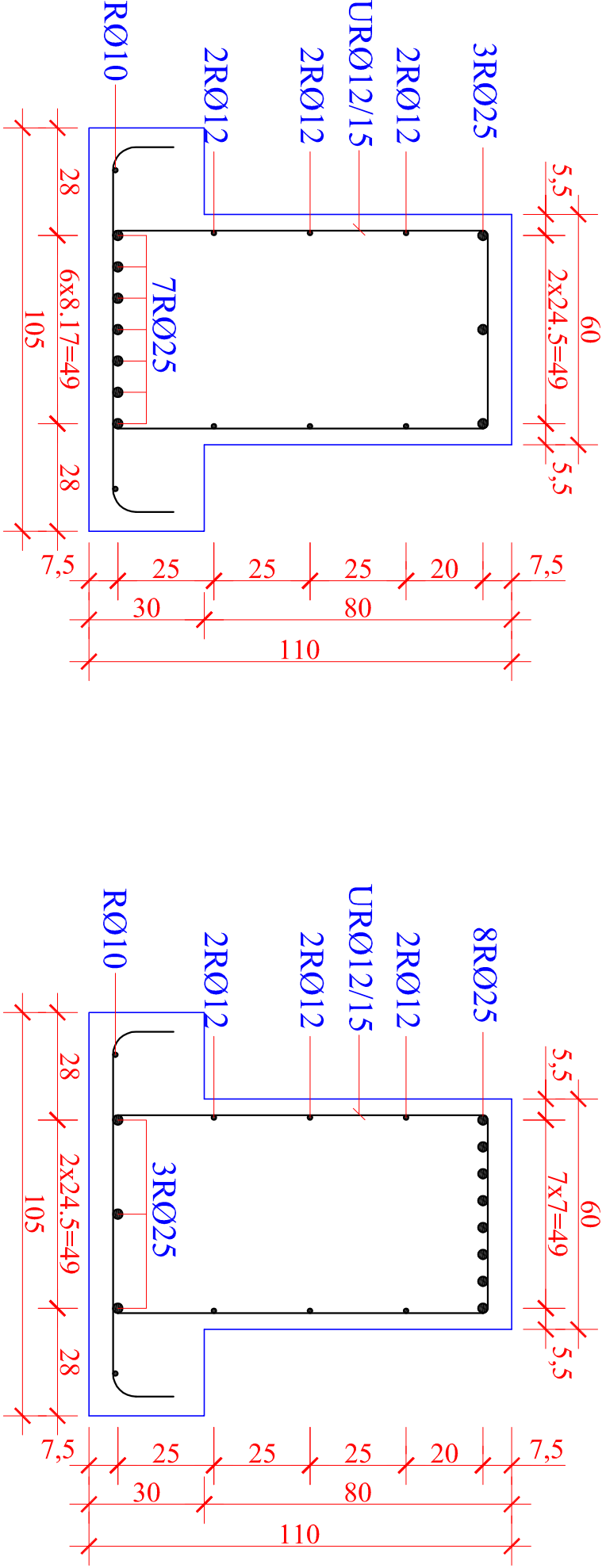


Traka III (Presek u polju)

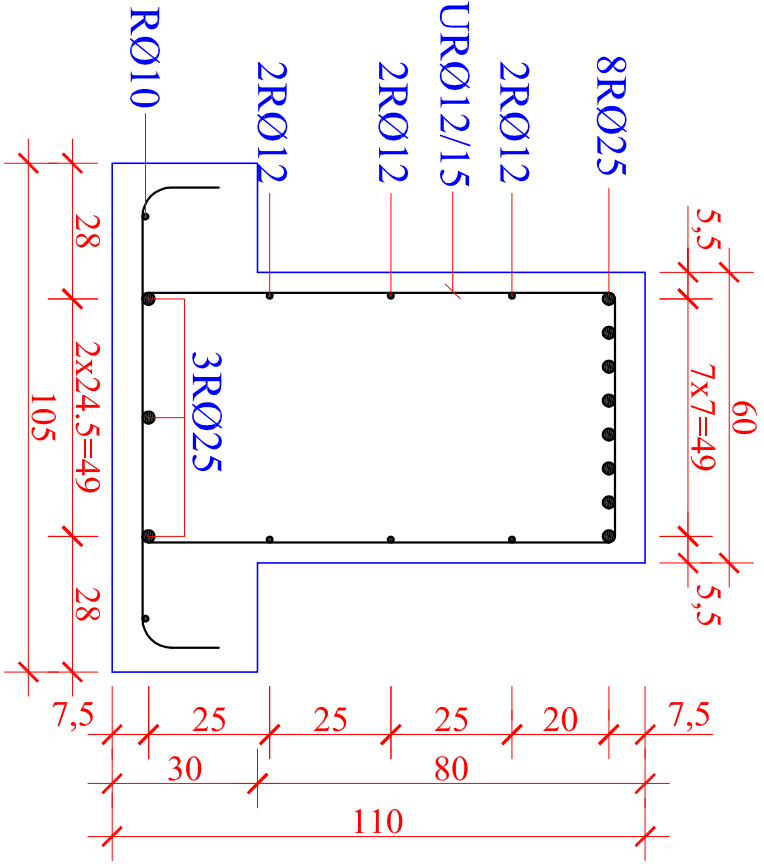


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Fundiranje			
Predmetni nastavnik: prof.dr. Milos Lazovic	Asistent: Selimir Lazovic	Kandidat: Savo Matic 6303	
PLAN ARMATURE			
Kvalitet materijala: RA 400/500	Razmera: 1:25	Školska godina: 2006/2007	Overa:

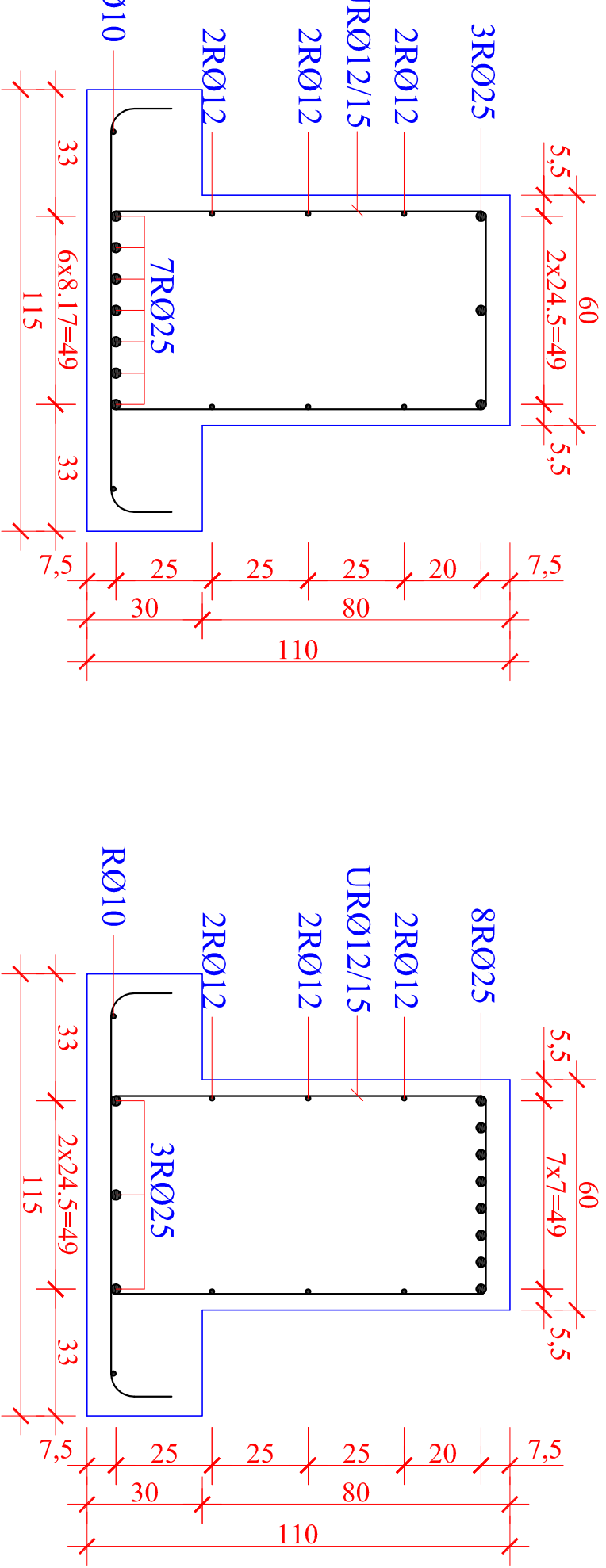
Traka IV (Presek nad osloncem)



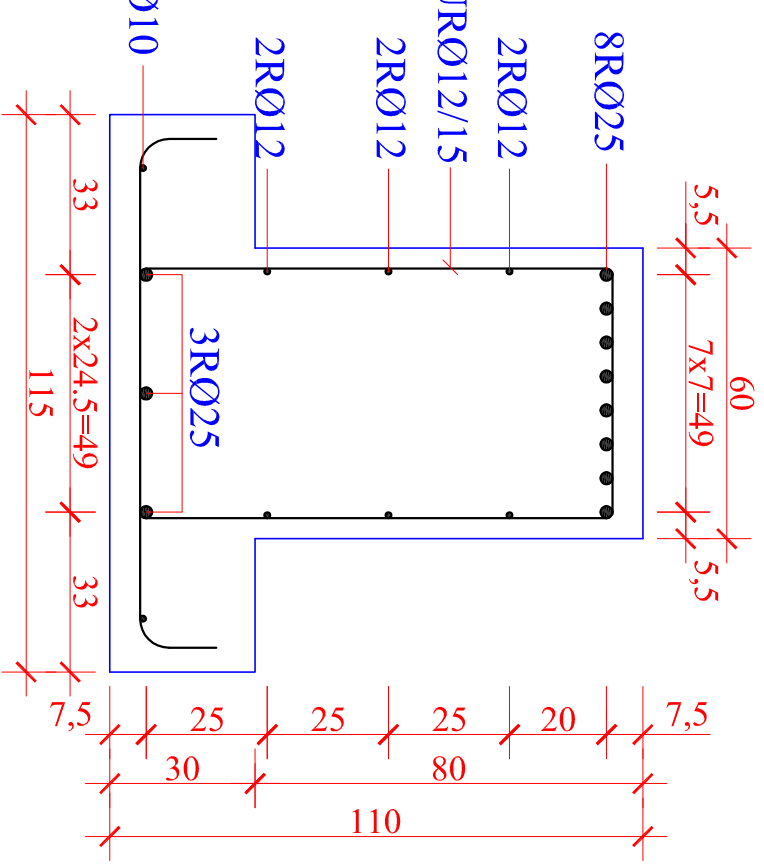
Traka IV (Presek u polju)



Traka V (Presek nad osloncem)

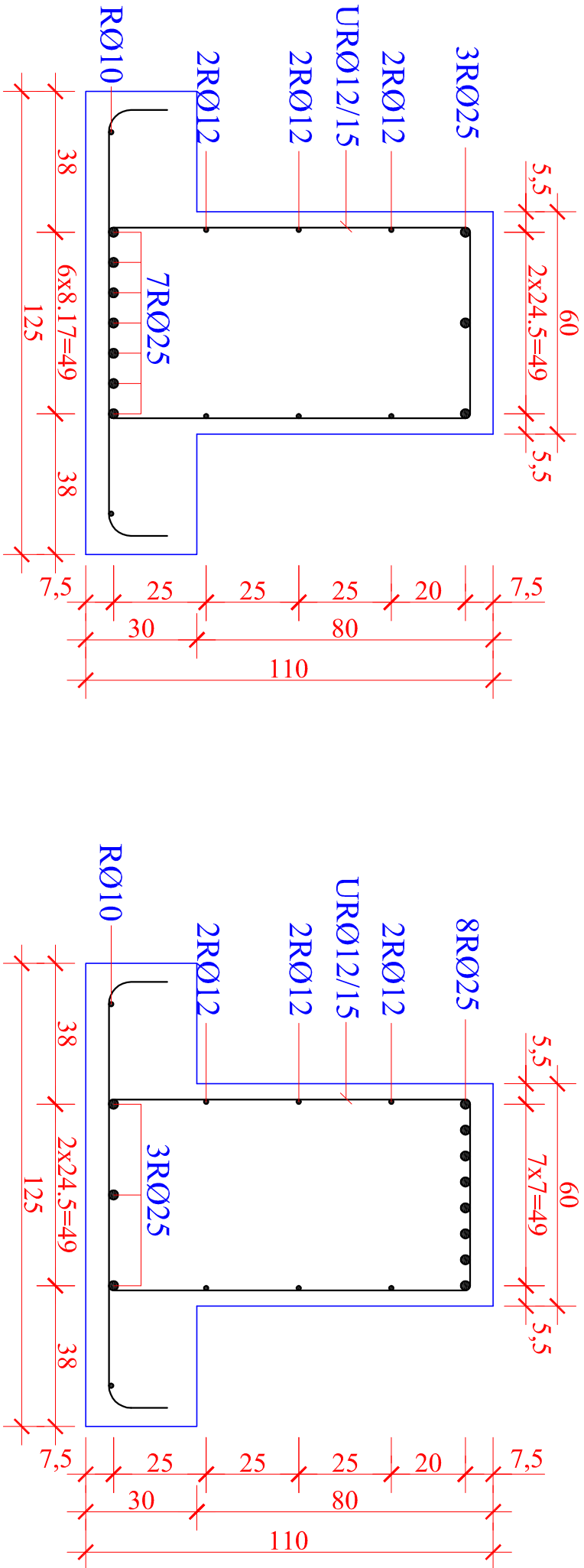


Traka V (Presek u polju)

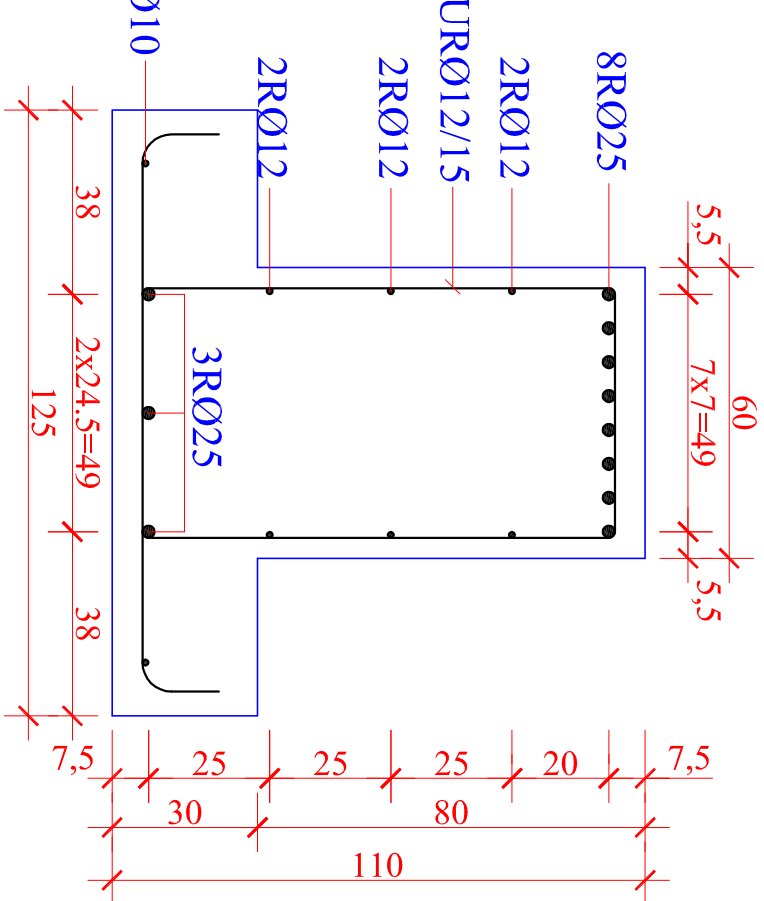


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PLAN ARMATURE			
Kvalitet materijala: RA 400/500	Razmera: 1:25	Školska godina: 2006/2007	Overa:

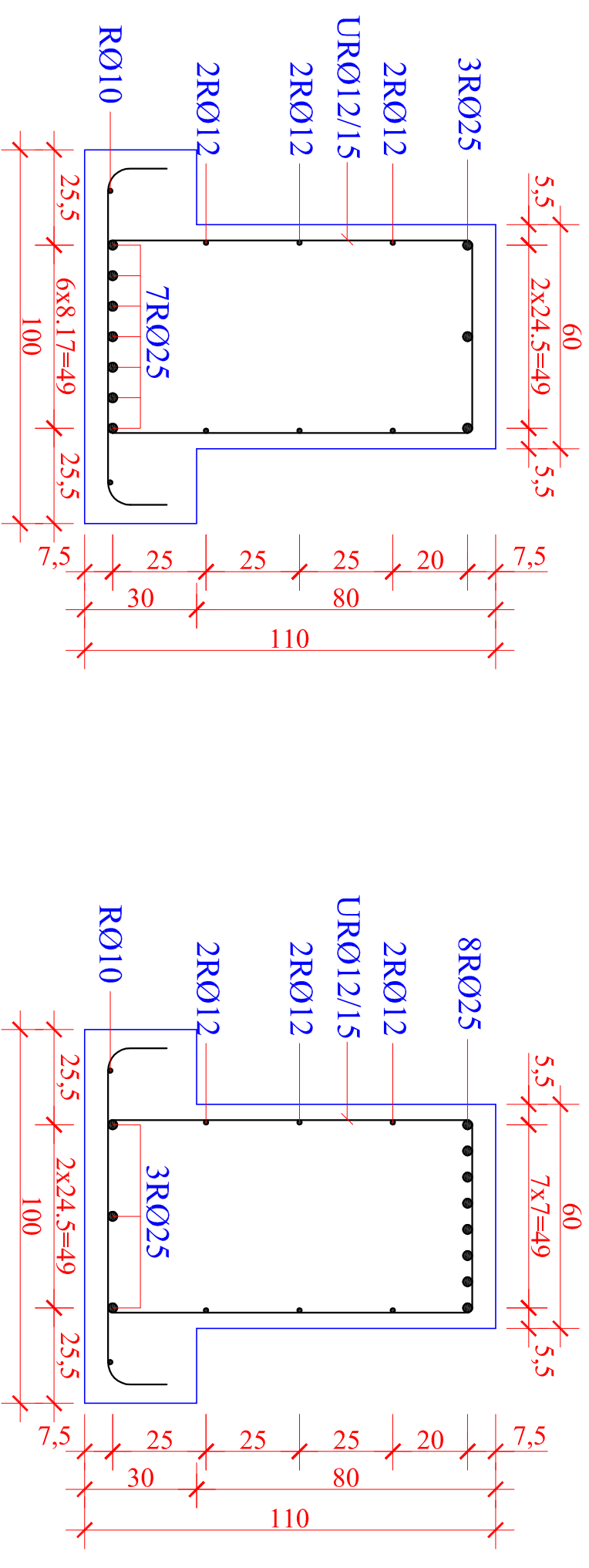
Traka VI (Presek nad osloncem)



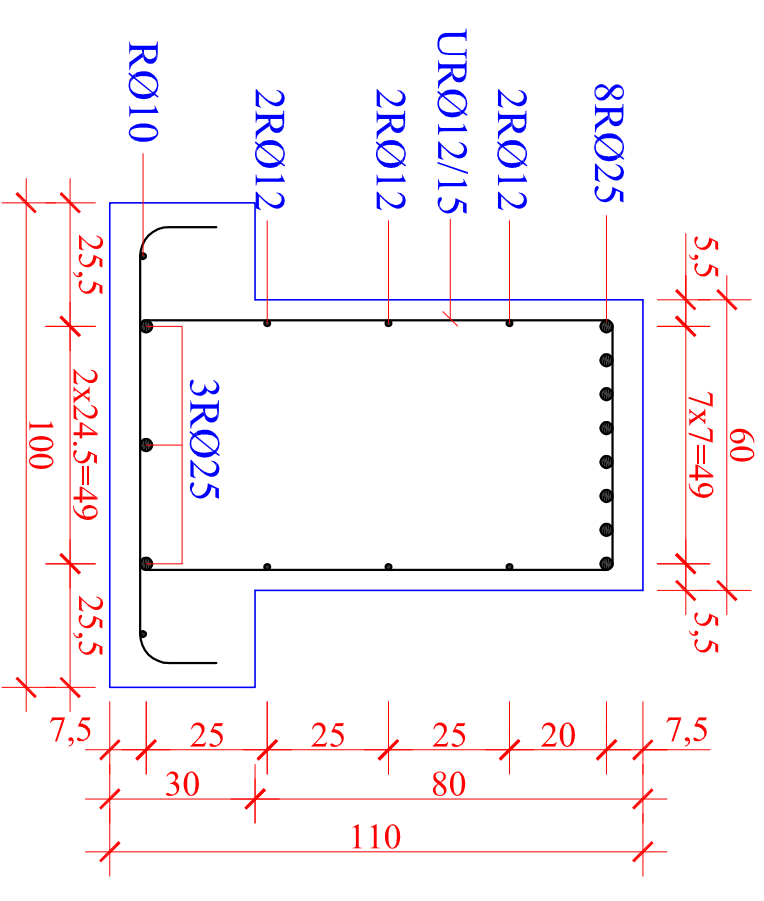
Traka VI (Presek u polju)



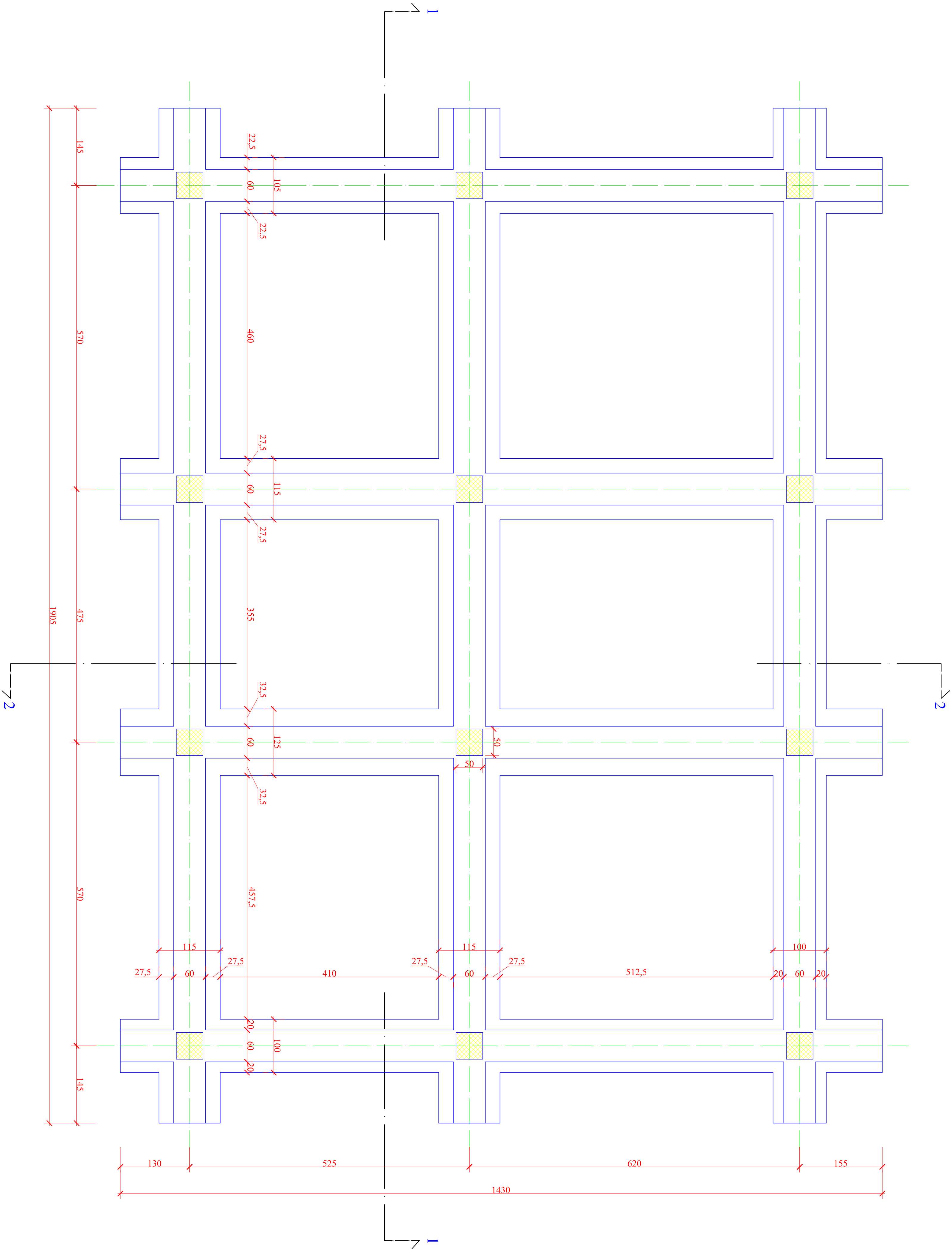
Traka VII (Presek nad osloncem)



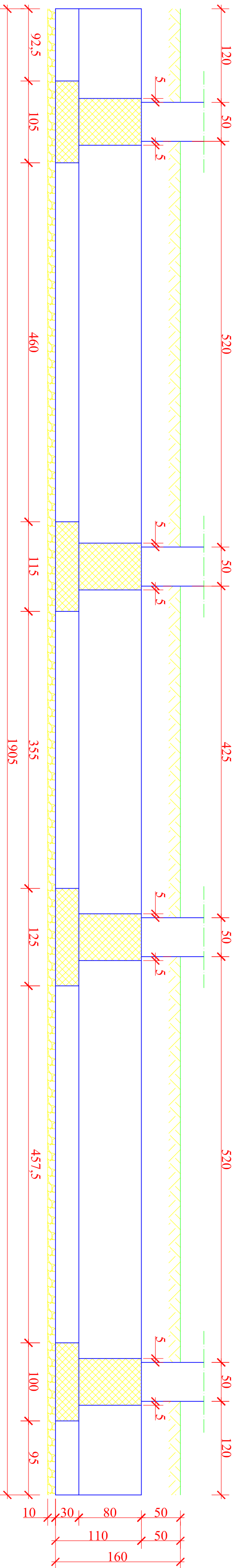
Traka VII (Presek u polju)



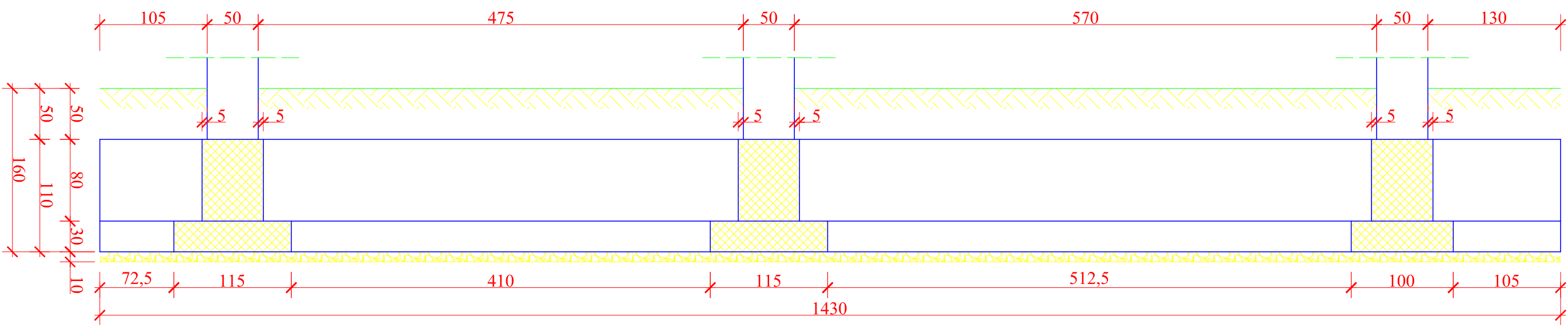
Građevinski fakultet u Beogradu			
Odeljak za konstrukcije		Katedra za građevinsku geotehniku	
Fundiranje			
Predmetni nastavnik: prof.dr. Milos Lazovic	Asistent: Selimir Lazovic	Kandidat: Savo Matic 6303	
PLAN ARMATURE			
Kvalitet materijala: RA 400/500	Razmera: 1:25	Školska godina: 2006/2007	Overa:



Presek 1-1



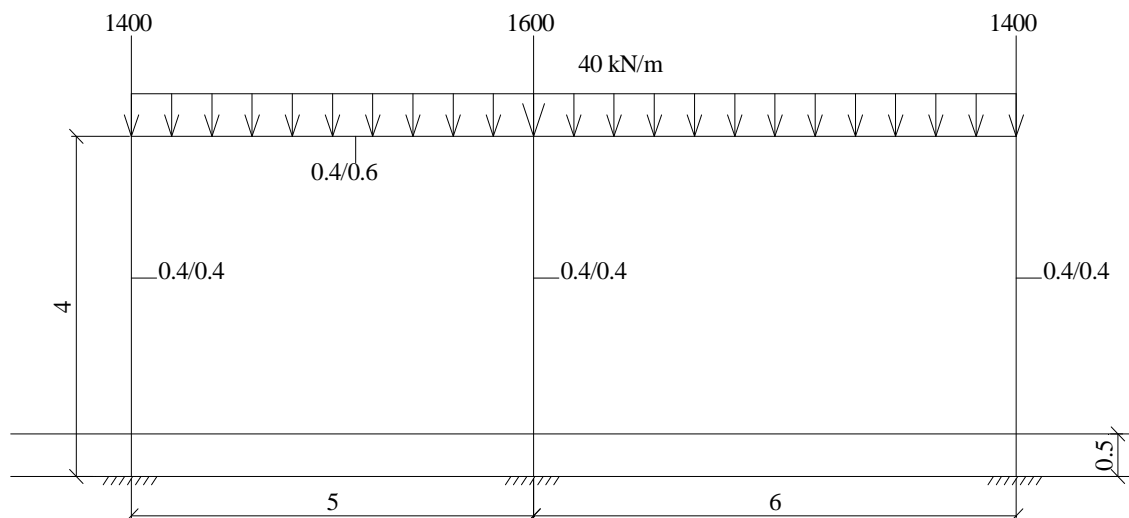
Presek 2-2



Gradjevinski fakultet u Beogradu			
Odeljak za konstrukcije		Katedra za gradjevinsku geotehniku	
Fundiranje			
Predmetni nastavnici:	Asistent:		Kandidat:
prof.dr. Miroslav Lazović	Selimir Lazović		Savoje Vlatić 63/03
PLAN OPLATE			
Kvalitet materijala:	Raznara:		Overt:
M16 S10	1:50		Slojstva godina: 2006/2007

Građevinski fakultet univerziteta u Beogradu
- Fundiranje -

VEŽBA 5



MB 30

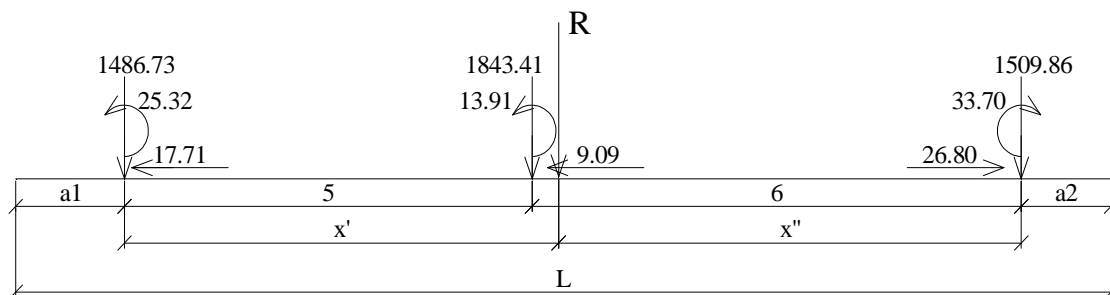
$$\gamma = 18 \text{ kN} / \text{m}^3$$

$$\sigma_{\text{dov}} = 160 \text{ kN} / \text{m}^2$$

$$E_0 = 8000 \text{ kN} / \text{m}^2$$

$$\nu = 0.3$$

5.1. Određivanje dužine prepusta



$$R = 1486.73 + 1843.41 + 1509.86 = 4840.0 \text{ kN}$$

$$x' = \frac{1843.41 \cdot 5 + 1509.86 \cdot 11 + 33.70 - 13.91 - 25.32}{4840.0} = 5.33 \text{ m}$$

$$x'' = 11 - 5.33 = 5.67 \text{ m}$$

$$a_1 = \frac{1}{3} L_{\text{max}} = \frac{1}{3} \cdot 6 = 2.0 \text{ m}$$

$$L = 2 \cdot (5.33 + 2) = 14.65 \text{ m}$$

$$a_2 = 14.65 - 11 - 2.0 = 1.65 \text{ m}$$

$$q = \frac{R}{L} = \frac{4840.0}{14.65} = 330.38 \text{ kN} / \text{m}$$

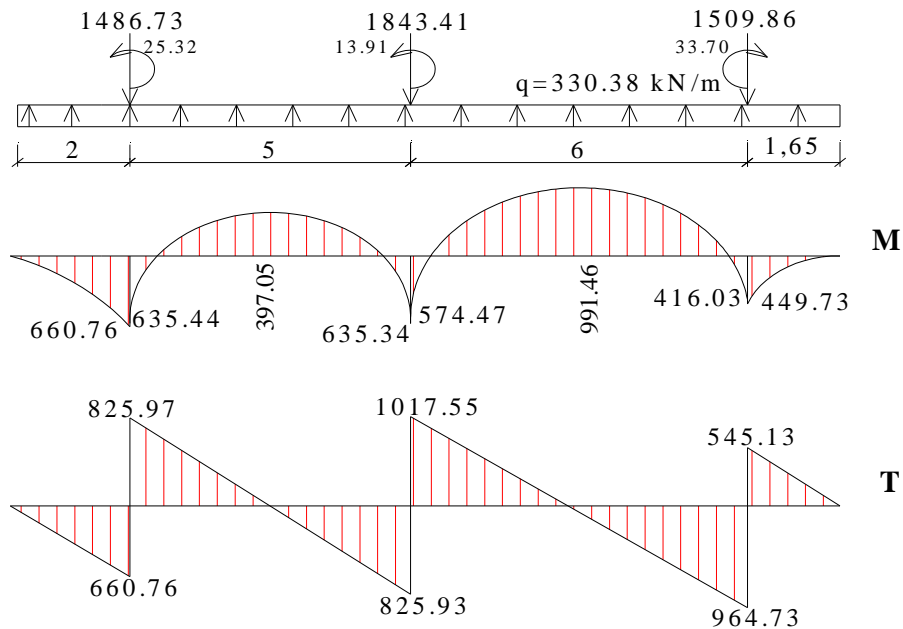
Matić Slavko 63/03

Građevinski fakultet univerziteta u Beogradu - Fundiranje -

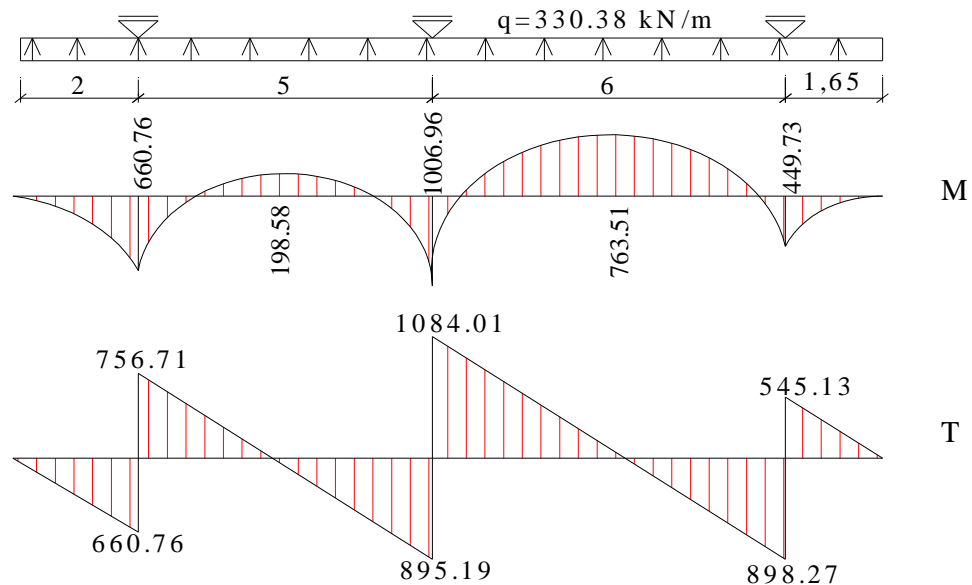
5.2. Klasični postupak

5.2.1. Statički uticaji

5.2.1.1. Merodavni momenti savijanja za dimenzionisanje temeljnog nosača u statički određenom sistemu



5.2.1.2. Merodavmi momenti savijanja za dimenzionisanje temeljnog nosača u statički neodređenom sistemu



Građevinski fakultet univerziteta u Beogradu - Fundiranje -

5.2.2. Dimenzionisanje

Merodavni uticaji:

$$M = 1006.96 \text{ kNm}$$

$$T = 1084.01 \text{ kN}$$

5.2.2.1. Visina temeljnog nosača

$$MB30 \Rightarrow f_b = 2.05 \text{ kN/cm}^2$$

$$RA400/500 \Rightarrow \sigma_v = 40 \text{ kN/cm}^2$$

$$\tau_r = 0.11 \text{ kN/cm}^2$$

$$\bar{\tau} = (2 - 2.5) \cdot \tau_r = 0.275 \text{ kN/cm}^2$$

$$\gamma_u = 1.6 \cdot 0.7 + 1.8 \cdot 0.3 = 1.66$$

- **Prema momentima savijanja**

$$\varepsilon_b / \varepsilon_a = 3.5 / 10 \text{ ‰} \Rightarrow k = 2.311$$

$$h_m = 2.311 \cdot \sqrt{\frac{1.66 \cdot 1006.96 \cdot 100}{60 \cdot 2.05}} = 85.19 \text{ cm}$$

- **Prema T-silama**

$$h_t = \frac{1084.01 \cdot 1.66}{0.9 \cdot 60 \cdot 0.275} = 121.17 \text{ cm}$$

Usvojeno: $d = 125 \text{ cm}$

5.2.2.2. Širina temeljnog nosača

$$\sigma_{doz} = 160 \text{ kN/m}^2$$

$$D_f = d + t = 125 + 50 = 175 \text{ cm}$$

$$F_{pot} = \frac{R}{\sigma_{doz} - 0.85 \cdot \gamma_b \cdot D_f} = \frac{4840.0}{160 - 0.85 \cdot 25 \cdot 1.75} = 39.41 \text{ m}^2$$

$$B_{pot} = \frac{F_{pot}}{L} = \frac{39.41}{14.65} = 2.69 \text{ m} \Rightarrow \text{Usvojeno } B = 270 \text{ cm}$$

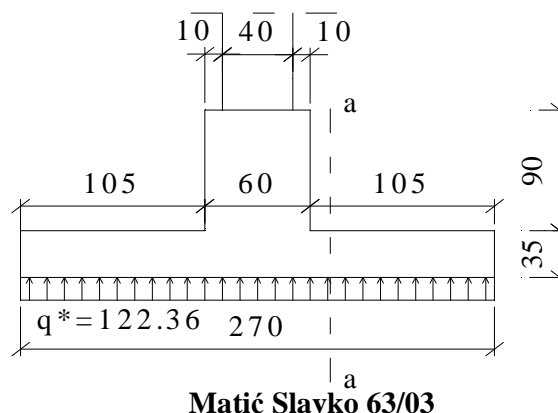
5.2.2.3. Visina temeljne ploče

$$q^* = \frac{4840.0}{14.65 \cdot 2.7} = 122.36 \text{ kN/m}^2$$

$$M_{a-a} = 0.5 \cdot 1.05^2 \cdot 122.36 = 67.45 \text{ kNm/m}$$

$$h_M = 2.311 \cdot \sqrt{\frac{1.66 \cdot 67.45 \cdot 100}{2.05 \cdot 100}} = 17.08 \text{ cm}$$

Usvaja se ploča debljine 35 cm.



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5.2.3. Analiza opterećenja

- Od stubova: 4840.0 kN
- Težina temelja: $(2.7 \cdot 0.35 + 0.9 \cdot 0.6) \cdot 25 \cdot 14.65 = 543.88 \text{ kN}$
- Težina tla: $(0.5 \cdot (2.7 - 0.4) + 2 \cdot 1.05 \cdot 0.9) \cdot 18 \cdot 14.65 = 801.65 \text{ kN}$

$$\sum V = 6185.53 \text{ kN}$$

$$\sigma_{rač} = \frac{6185.53}{2.7 \cdot 14.65} = 156.38 \text{ kN / cm}^2 < \sigma_{doz} = 160 \text{ kN / cm}^2$$

5.3. Winkler-ov model za tlo

5.3.1. Sleganje

$$s = \frac{1 - \nu^2}{E_0 \cdot F} \cdot \frac{V}{F} \cdot B \cdot \alpha = \frac{1 - 0.3^2}{8000} \cdot \frac{4840}{14.65 \cdot 2.7} \cdot 2.7 \cdot \alpha$$

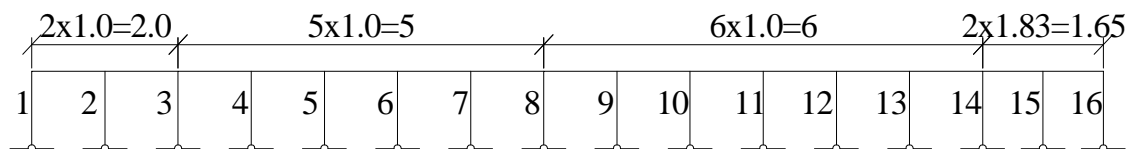
$$\frac{L}{B} = \frac{14.65}{2.7} = 5.43$$

$$\left. \begin{array}{l} \alpha(L/B = 5) = 2.10 \\ \alpha(L/B = 2.53) = 2.53 \end{array} \right\} \Rightarrow \alpha(L/B = 5.43) = 2.137$$

$$s = \frac{1 - 0.3^2}{8000} \cdot \frac{4840}{14.65 \cdot 2.7} \cdot 2.137 \cdot 2.7 = 0.0803 \text{ m} = 8.03 \text{ cm}$$

- Ukupna krutost celokupnog tla ispod temeljnog nosača:

$$k^* = \frac{R}{s} = \frac{4840.0}{0.0803} = 60273.97 \text{ kN / m}$$



$$k_i = k^* \cdot \frac{F_i}{F}$$

$$F_1 = 0.5 \cdot 1 \cdot 2.7 = 1.35 \text{ m}^2$$

$$F_2 = \dots\dots\dots = F_{13} = 1 \cdot 2.7 = 2.7 \text{ m}^2$$

$$F_{14} = 0.5 \cdot (1 + 0.85) \cdot 2.7 = 2.46 \text{ m}^2$$

$$F_{15} = 0.825 \cdot 2.7 = 2.23 \text{ m}^2$$

$$F_{16} = 0.5 \cdot 0.825 \cdot 2.7 = 1.11 \text{ m}^2$$

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- Fundiranje -

$$k_1 = 60273.97 \cdot \frac{1.35}{14.65 \cdot 2.7} = 2057.13 \text{ kN / m}$$

$$k_2 = \dots = k_{13} = 60273.97 \cdot \frac{2.7}{14.65 \cdot 2.7} = 4114.26 \text{ kN / m}$$

$$k_{14} = 60273.97 \cdot \frac{2.46}{14.65 \cdot 2.7} = 3748.55 \text{ kN / m}$$

$$k_{15} = 60273.97 \cdot \frac{2.23}{14.65 \cdot 2.7} = 3398.08 \text{ kN / m}$$

$$k_{16} = 60273.97 \cdot \frac{1.11}{14.65 \cdot 2.7} = 1691.42 \text{ kN / m}$$

$$F_i = k_i \cdot \frac{l_i}{E_b}$$

$$F_1 = 2057.13 \cdot \frac{1.0}{31.5 \cdot 10^6} = 65.31 \cdot 10^{-6} \text{ m}^2$$

$$F_2 = \dots = F_{13} = 4114.26 \cdot \frac{1.0}{31.5 \cdot 10^6} = 130.61 \cdot 10^{-6} \text{ m}^2$$

$$F_{14} = 3748.55 \cdot \frac{1.0}{31.5 \cdot 10^6} = 119.00 \cdot 10^{-6} \text{ m}^2$$

$$F_{15} = 3398.08 \cdot \frac{1.0}{31.5 \cdot 10^6} = 107.88 \cdot 10^{-6} \text{ m}^2$$

$$F_{16} = 1691.42 \cdot \frac{1.0}{31.5 \cdot 10^6} = 53.69 \cdot 10^{-6} \text{ m}^2$$

Građevinski fakultet univerziteta u Beogradu - Fundiranje -

5.3.2. Dimenzionisanje

Merodavni uticaji:

$$M = 850.08 \text{ kNm}$$

$$T = 856.19 \text{ kN}$$

5.3.2.1. Visina temeljnog nosača

$$MB30 \Rightarrow f_b = 2.05 \text{ kN/cm}^2$$

$$RA400/500 \Rightarrow \sigma_v = 40 \text{ kN/cm}^2$$

$$\tau_r = 0.11 \text{ kN/cm}^2$$

$$\bar{\tau} = (2 - 2.5) \cdot \tau_r = 0.275 \text{ kN/cm}^2$$

$$\gamma_u = 1.6 \cdot 0.7 + 1.8 \cdot 0.3 = 1.66$$

- **Prema momentima savijanja**

$$\varepsilon_b / \varepsilon_a = 3.5 / 10 \text{ ‰} \Rightarrow k = 2.311$$

$$h_m = 2.311 \cdot \sqrt{\frac{1.66 \cdot 850.08 \cdot 100}{60 \cdot 2.05}} = 78.28 \text{ cm}$$

- **Prema T-silama**

$$h_t = \frac{856.19 \cdot 1.66}{0.9 \cdot 60 \cdot 0.275} = 95.71 \text{ cm} \quad \text{Usvojeno: } d = 100 \text{ cm}$$

5.3.2.2. Širina temeljnog nosača

$$\sigma_{doz} = 160 \text{ kN/m}^2$$

$$D_f = d + t = 100 + 50 = 150 \text{ cm}$$

$$F_{pot} = \frac{R}{\sigma_{doz} - 0.85 \cdot \gamma_b \cdot D_f} = \frac{4840.0}{160 - 0.85 \cdot 25 \cdot 1.50} = 37.77 \text{ m}^2$$

$$B_{pot} = \frac{F_{pot}}{L} = \frac{37.77}{14.65} = 2.58 \text{ m} \Rightarrow \text{Usvojeno } B = 260 \text{ cm}$$

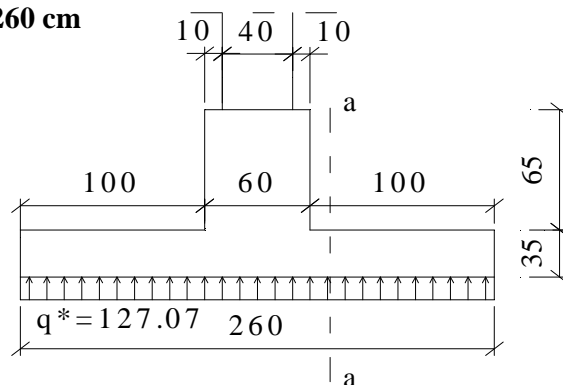
5.3.2.3. Visina temeljne ploče

$$q^* = \frac{4840.0}{14.65 \cdot 2.6} = 127.07 \text{ kN/m}^2$$

$$M_{a-a} = 0.5 \cdot 1.00^2 \cdot 127.07 = 63.53 \text{ kNm/m}$$

$$h_M = 2.311 \cdot \sqrt{\frac{1.66 \cdot 63.53 \cdot 100}{2.05 \cdot 100}} = 16.58 \text{ cm}$$

Usvaja se ploča debljine 35 cm.




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5.3.3. Analiza opterećenja

- Od stubova: 4840.0 kN
- Težina temelja: $(2.6 \cdot 0.35 + 0.65 \cdot 0.6) \cdot 25 \cdot 14.65 = 476.13 \text{ kN}$
- Težina tla: $(0.5 \cdot (2.6 - 0.4) + 2 \cdot 1.00 \cdot 0.65) \cdot 18 \cdot 14.65 = 632.88 \text{ kN}$

$$\sum V = 5949.01 \text{ kN}$$

$$\sigma_{rač} = \frac{5949.01}{2.6 \cdot 14.65} = 156.18 \text{ kN / cm}^2 < \sigma_{doz} = 160 \text{ kN / cm}^2$$

	Građevinski fakultet univerziteta u Beogradu		
	Katedra za geotehniku	Fundiranje	Vežba 5
	Matić Slavko 43/03		

Улазни подаци - Конструкција

Координате чворова

No	X [m]	Y [m]	Z [m]
1	0.0000	0.0000	-1.0000
2	0.0000	0.0000	0.0000
3	1.0000	0.0000	-1.0000
4	1.0000	0.0000	0.0000
5	2.0000	0.0000	-1.0000
6	2.0000	0.0000	0.0000
7	3.0000	0.0000	-1.0000
8	3.0000	0.0000	0.0000
9	4.0000	0.0000	-1.0000
10	4.0000	0.0000	0.0000
11	5.0000	0.0000	-1.0000
12	5.0000	0.0000	0.0000

No	X [m]	Y [m]	Z [m]
13	6.0000	0.0000	-1.0000
14	2.0000	0.0000	4.0000
15	6.0000	0.0000	0.0000
16	7.0000	0.0000	-1.0000
17	7.0000	0.0000	0.0000
18	8.0000	0.0000	-1.0000
19	8.0000	0.0000	0.0000
20	9.0000	0.0000	-1.0000
21	9.0000	0.0000	0.0000
22	10.0000	0.0000	-1.0000
23	10.0000	0.0000	0.0000
24	11.0000	0.0000	-1.0000

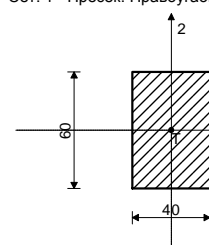
No	X [m]	Y [m]	Z [m]
25	7.0000	0.0000	4.0000
26	11.0000	0.0000	0.0000
27	12.0000	0.0000	-1.0000
28	12.0000	0.0000	0.0000
29	13.0000	0.0000	-1.0000
30	13.825	0.0000	-1.0000
31	13.0000	0.0000	0.0000
32	14.650	0.0000	-1.0000
33	13.825	0.0000	0.0000
34	14.650	0.0000	0.0000
35	13.0000	0.0000	4.0000

Табела материјала

No	Назив материјала	E[kN/m ²]	μ	γ[kN/m ³]	α[1/°C]	Em[kN/m ²]	μm
1	Beton MB 30	3.150e+7	0.20	25.00	1.000e-5	3.150e+7	0.20
2	Beton MB 30	3.150e+7	0.30	25.00	1.000e-5	3.150e+7	0.20

Сетови греда

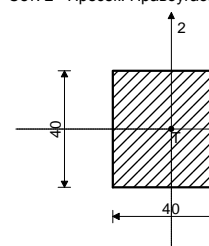
Сет: 1 Пресек: Правоугаони



[cm]

Мат.	P/Z	A1	A2	A3	I1	I2	I3
1		2.400e-1	2.000e-1	2.000e-1	7.512e-3	3.200e-3	7.200e-3

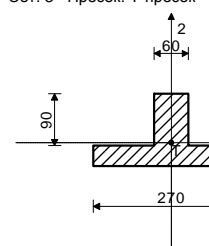
Сет: 2 Пресек: Правоугаони



[cm]

Мат.	P/Z	A1	A2	A3	I1	I2	I3
1		1.600e-1	1.333e-1	1.333e-1	3.605e-3	2.133e-3	2.133e-3

Сет: 3 Пресек: Т-пресек



[cm]

Мат.	P/Z	A1	A2	A3	I1	I2	I3
1		4.000e-2	3.333e-2	3.333e-2	2.533e-4	1.333e-4	1.333e-4

Сет: 4 Пресек: Произвольни

Мат.	P/Z	A1	A2	A3	I1	I2	I3
1	P+Z	6.531e-5	3.333e-2	3.333e-2	2.533e-4	1.000e-6	1.000e-6

Сет: 5 Пресек: Произвольни

Мат.	P/Z	A1	A2	A3	I1	I2	I3
1	P+Z	1.306e-4	3.333e-2	3.333e-2	2.533e-4	1.000e-6	1.000e-6

Сет: 6 Пресек: Произвольни

Мат.	P/Z	A1	A2	A3	I1	I2	I3
2	P+Z	1.190e-4	3.333e-2	3.333e-2	2.533e-4	1.000e-6	1.000e-6

Сет: 7 Пресек: Произвольни


Мат.	P/Z	A1	A2	A3	I1	I2	I3
2	P+Z	1.079e-4	3.333e-2	3.333e-2	2.533e-4	1.000e-6	1.000e-6

Сет: 8 Пресек: Произвольни

Мат.	P/Z	A1	A2	A3	I1	I2	I3
2	P+Z	5.369e-5	3.333e-2	3.333e-2	2.533e-4	1.000e-6	1.000e-6

Сетови тачкастих ослонаца

Сет	K,R1	K,R2	K,R3	Oca 1			Oca 2		
	K,M1	K,M2	K,M3	x	y	z	x	y	z
1				1.000000	0.000000	0.000000	0.000000	0.000000	0.000000

	Građevinski fakultet univerziteta u Beogradu		
	Katedra za geotehniku	Fundiranje	Vežba 5
	Matić Slavko 43/03		

Контуре греда


Контура преда			Ослобађање утицаја												Оса 1	Оса 2	Оса 3	Мимоилажење
No	Чвор I	Чвор J	Чвор I						Чвор J									
			M1	M2	M3	N1	T2	T3	M1	M2	M3	N1	T2	T3				
1	2	4													0.000000	0.000000	1.000000	
2	4	6													0.000000	0.000000	1.000000	
3	14	6													1.000000	0.000000	0.000000	
4	6	8													0.000000	0.000000	1.000000	
5	8	10													0.000000	0.000000	1.000000	
6	10	12													0.000000	0.000000	1.000000	
7	12	15													0.000000	0.000000	1.000000	
8	15	17													0.000000	0.000000	1.000000	
9	25	17													1.000000	0.000000	0.000000	
10	17	19													0.000000	0.000000	1.000000	
11	19	21													0.000000	0.000000	1.000000	
12	21	23													0.000000	0.000000	1.000000	
13	23	26													0.000000	0.000000	1.000000	
14	26	28													0.000000	0.000000	1.000000	
15	28	31													0.000000	0.000000	1.000000	
16	35	31													1.000000	0.000000	0.000000	
17	14	25													0.000000	0.000000	1.000000	
18	25	35													0.000000	0.000000	1.000000	
19	31	33													0.000000	0.000000	1.000000	
20	33	34													0.000000	0.000000	1.000000	
21	2	1													1.000000	0.000000	0.000000	
22	4	3													1.000000	0.000000	0.000000	
23	6	5													1.000000	0.000000	0.000000	
24	8	7													1.000000	0.000000	0.000000	
25	10	9													1.000000	0.000000	0.000000	
26	12	11													1.000000	0.000000	0.000000	
27	15	13													1.000000	0.000000	0.000000	
28	17	16													1.000000	0.000000	0.000000	
29	19	18													1.000000	0.000000	0.000000	
30	21	20													1.000000	0.000000	0.000000	
31	23	22													1.000000	0.000000	0.000000	
32	26	24													1.000000	0.000000	0.000000	
33	28	27													1.000000	0.000000	0.000000	
34	31	29													1.000000	0.000000	0.000000	
35	33	30													1.000000	0.000000	0.000000	
36	34	32													1.000000	0.000000	0.000000	

Контуре тачкастих ослонаца

Чворови	Сет
1, 3, 5, 7, 9, 11, 13, 16, 18, 20, 22, 24, 27,	1

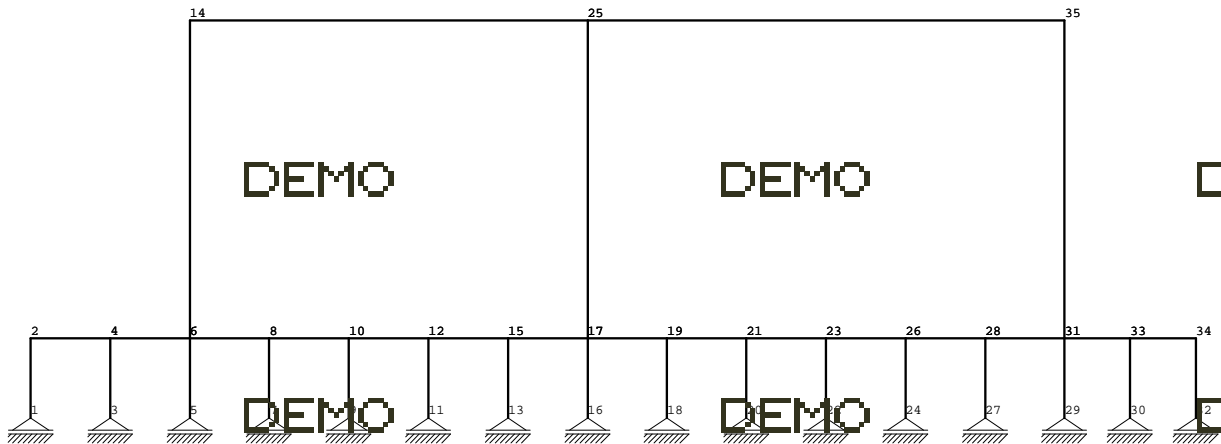
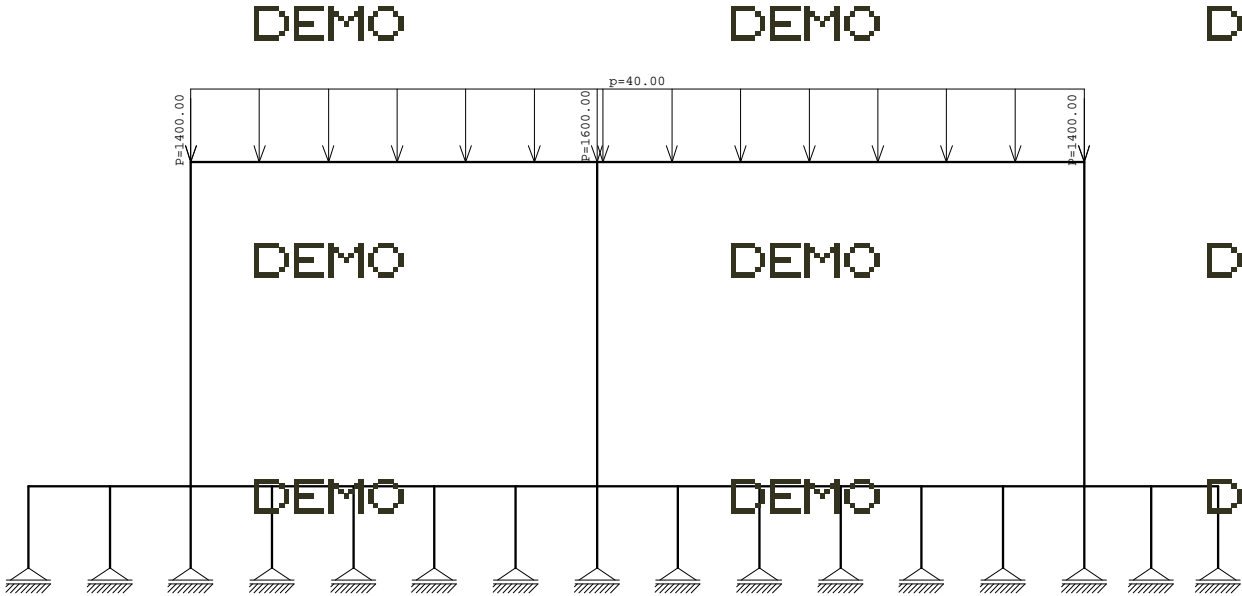
DEMO


Чворови	Сет
29, 30, 32	

	Građevinski fakultet univerziteta u Beogradu		
	Katedra za geotehniku	Fundiranje	Vežba 5
	Matić Slavko 63/03		

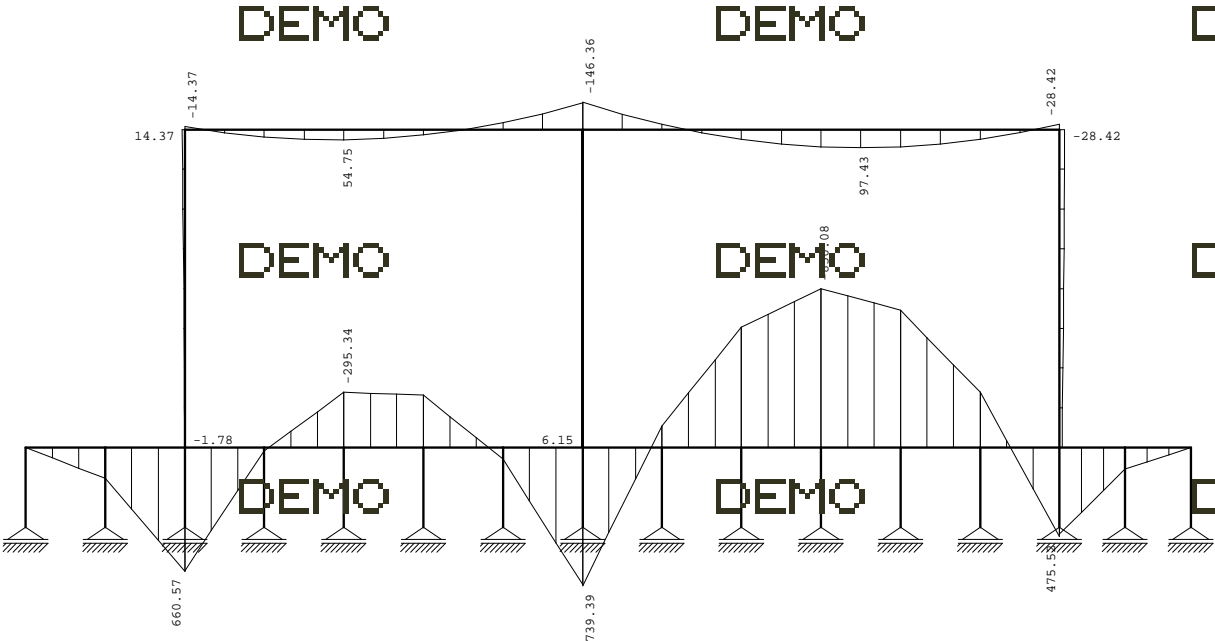
Улазни подаци - Оптерећење, Статички прорачун

Опт. 1:

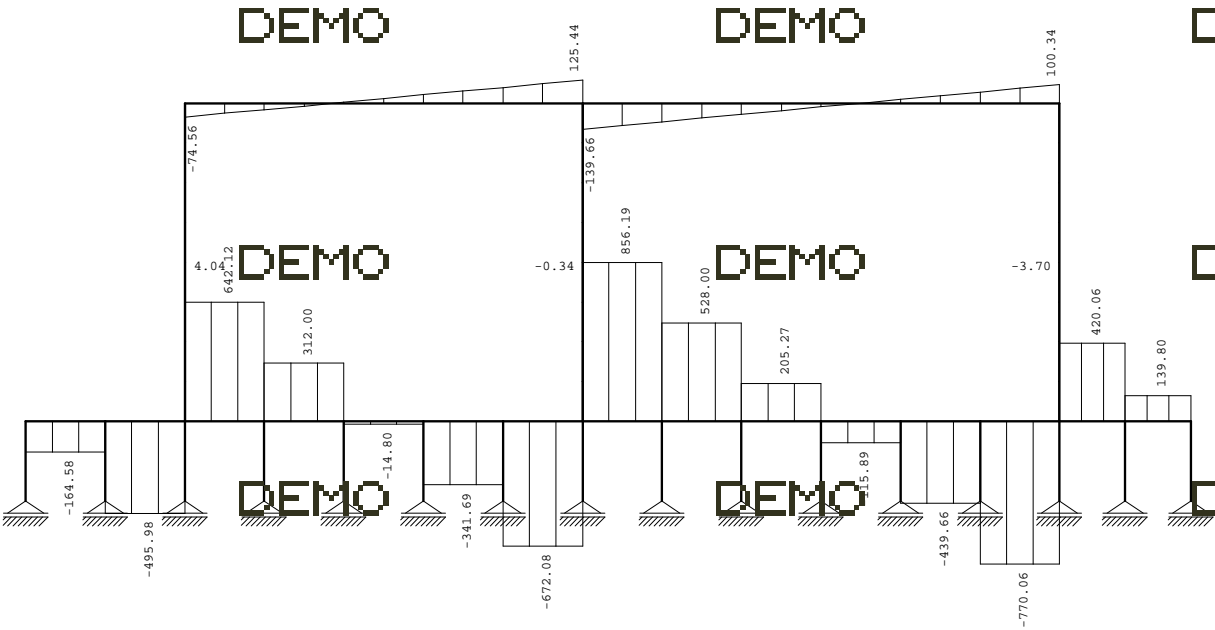


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Опт. 1:



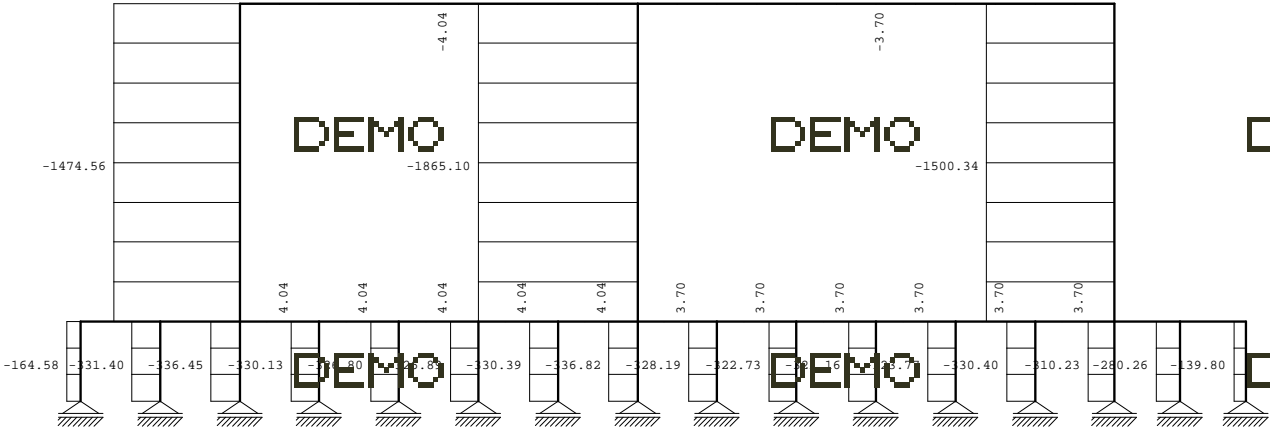
Утицаји у греди: max M3= 739.39 / min M3= -850.08 kNm
Опт. 1:



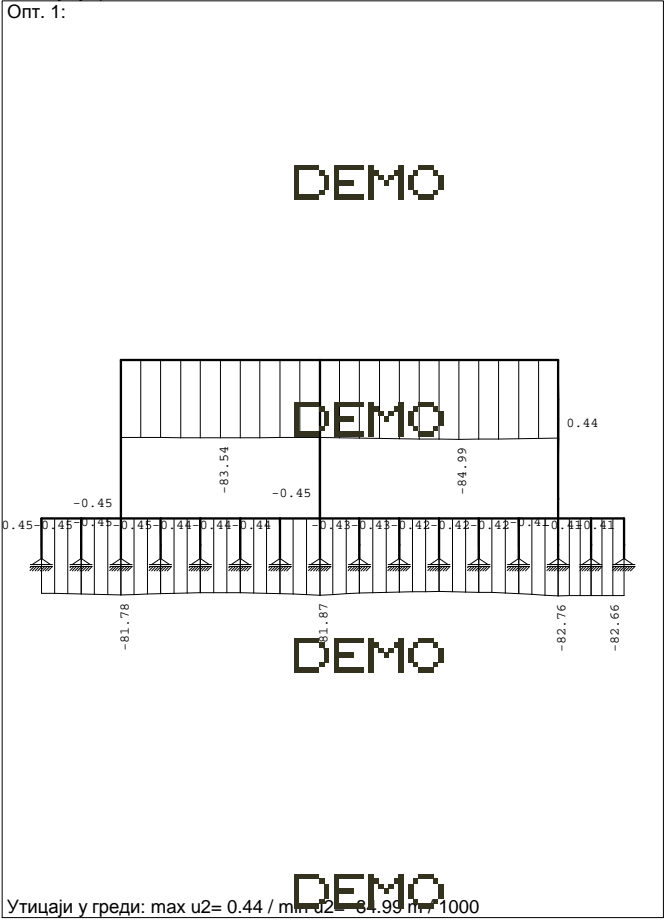
Утицаји у греди: max T2= 856.19 / min T2= -770.06 kN
Tower - 3D Model Builder 5.4 DEMO

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Опт. 1:



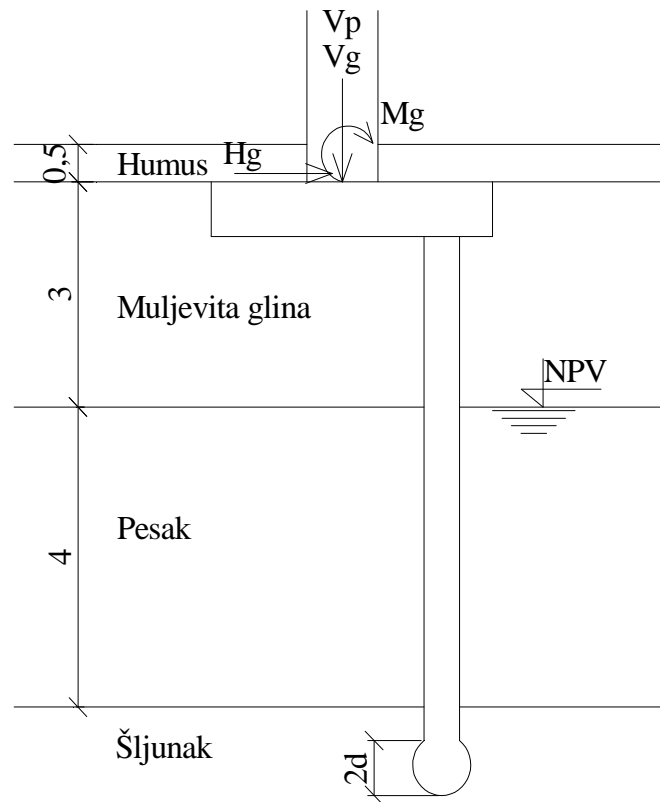
Утицаји у греди: max N1= 4.04 / min N1= -1865.10 kN
Опт. 1:



Утицаји у греди: max u2= 0.44 / min u2= -84.99 mm/1000

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VEŽBA 6



Opterećenje:

$$H_g = 480 \text{ kN}$$

$$V_g = 4900 \text{ kN}$$

$$V_p = 1900 \text{ kN}$$

$$M_g = 420 \text{ kN}$$

- Karakteristike slojeva:

Humus:	Muljevita glina:	Pesak:	Šljunak:
$\gamma = 18 \text{ kN} / \text{m}^3$	$\gamma = 17.5 \text{ kN} / \text{m}^3$	$\gamma = 18 \text{ kN} / \text{m}^3$	$\gamma = 18.5 \text{ kN} / \text{m}^3$
	$\varphi = 22^\circ$	$\varphi = 29^\circ$	$\varphi = 30^\circ$
	$c = 10 \text{ kN} / \text{m}^2$	$c = 0$	$c = 0$
	$E = 5000 \text{ kN} / \text{m}^2$	$E = 17000 \text{ kN} / \text{m}^2$	$E = 30000 \text{ kN} / \text{m}^2$
	$\nu = 0.35$	$\nu = 0.30$	$\nu = 0.25$

- Temeljna stopa se izvodi na “FRANKI” šipovima $\phi 520$

$$d = 0.60 \text{ m} \quad d_{baze} = 1.5 \cdot d = 0.90 \text{ m} \quad S_{\max} = 1100 \text{ kN}$$

- Pretpostavljamo da je visina naglavne grede $h=1.0 \text{ m}$

6.1. Potreban broj šipova:

$$V_{\max} = V_g + V_p = 4900 + 1900 = 6800 \text{ kN}$$

$$n = \frac{1.1 \cdot V_{\max}}{S_{\text{doz}}} \cdot \eta = \frac{1.1 \cdot 6800}{1100} \cdot 1.1 = 7.48 \Rightarrow \text{Usvojeno: } 7\phi 520$$

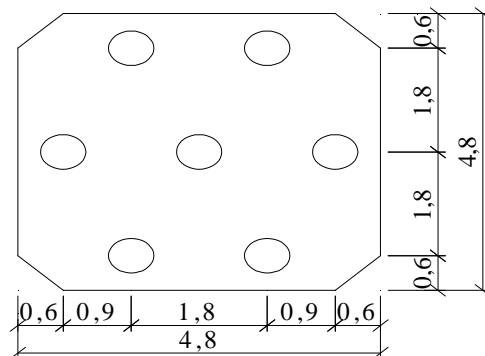
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6.2. Centrisanje šipova za stalno opterećenje:

$$\sum M_g = 0 \Rightarrow e = \frac{\sum M_g}{\sum V_g} = \frac{420 + 480 \cdot 1.0}{4900} = 0.18 \text{ m}$$

6.3. Raspored šipova:



6.4. Analiza opterećenja:

- Korisno opterećenje: 6800 kN
 - Težina naglavne grede: $(4.8 \cdot 4.8 - 4 \cdot 0.6^2 / 2) \cdot 25 \cdot 1 = 558 \text{ kN}$
 - Težina tla: $(4.8 \cdot 4.8 - 4 \cdot 0.6^2 / 2) \cdot 18 \cdot 0.5 = 200.88 \text{ kN}$
-
- $\sum V = 7558.88 \text{ kN}$

$$S_{\max} = \frac{\sum V}{n} + \frac{V_p \cdot e - H \cdot 1.0}{\sum y_i^2} \cdot y_i$$

$$S_{\max} = \frac{7558.88}{7} + \frac{1900 \cdot 0.18 - 480 \cdot 1.0}{0.9^2 \cdot 4 + 1.8^2 \cdot 2} \cdot 1.8 = 1054.28 \text{ kN} < S_{\text{doz}} = 1100 \text{ kN}$$

6.5. Određivanje dužine šipa:

- Dozvoljena sila u šipu:

$$S = S_b + S_0$$

6.5.1. Nosivost baze šipa:

$$S_b = F_b \cdot \sigma_{\text{doz}}$$

$$\sigma_{\text{doz}} = k_s \cdot \left(\sum \gamma_i \cdot h_i \right) \cdot N_q$$

$$\sum \gamma_i \cdot h_i = 0.5 \cdot 18 + 3 \cdot 17.5 + 4 \cdot 10.5 + h \cdot 11 = 103.5 + 11 \cdot h$$

$$\varphi = 30^\circ \quad \tan \phi_r = \frac{\tan \varphi}{F_s} = \frac{\tan 30}{1.5} \Rightarrow \phi_r = 21^\circ \Rightarrow N_q = 15$$

$$k_s = 1 - \sin 30 = 0.50$$

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$$\sigma_{doz} = 0.5 \cdot (103.5 + 11h) \cdot 15 = 776.25 + 82.5h$$

$$F_b = \frac{0.9^2 \cdot \pi}{4} = 0.64 \text{ m}^2$$

$$S_b = F_b \cdot \sigma_{doz} = 0.64 \cdot (776.25 + 82.5h) = 496.8 + 52.8 \cdot h$$

6.5.2. Nosivost omotača šipa

$$S_0 = \sum t_i \cdot F_{0i}$$

$$t_i = \frac{c_i}{2.5} + q_i \cdot (1 - \sin \varphi) \cdot \frac{\text{tg } \varphi}{1.5}$$

$$t_1 = \frac{10}{2.5} + (0.5 \cdot 18 + 1.5 \cdot 17.5) \cdot (1 - \sin 22) \cdot \frac{\text{tg } 22}{1.5} = 9.94 \text{ kN / m}^2$$

$$t_2 = (0.5 \cdot 18 + 3 \cdot 17.5 + 2 \cdot 10.5) \cdot (1 - \sin 29) \cdot \frac{\text{tg } 29}{1.5} = 15.71 \text{ kN / m}^2$$

$$t_3 = \left(0.5 \cdot 18 + 3 \cdot 17.5 + 4 \cdot 10.5 + \frac{h}{2} \cdot 11 \right) \cdot (1 - \sin 30) \cdot \frac{\text{tg } 30}{1.5} = 19.92 + 1.06h$$

$$F_{0,1} = d \cdot \pi \cdot h_1 = 0.6 \cdot \pi \cdot 2 = 3.77 \text{ m}^2$$

$$F_{0,2} = d \cdot \pi \cdot h_2 = 0.6 \cdot \pi \cdot 4 = 7.54 \text{ m}^2$$

$$F_{0,3} = d \cdot \pi \cdot h_3 = 0.6 \cdot \pi \cdot h = 1.88h$$

$$S_0 = \sum t_i \cdot F_{0i} = 9.94 \cdot 3.77 + 15.71 \cdot 7.54 + (19.92 + 1.06h) \cdot 1.88h$$

$$S = S_b + S_0 = 496.8 + 52.8h + 155.93 + 33.45h + 1.99h^2$$

$$S = 1.99h^2 + 90.25h + 652.73 \Rightarrow h = 6.34 \text{ m}$$

$$L = 2 + 4 + 6.34 = 12.34 \text{ m}$$

6.6. Metoda deformacija

- Prosečni modul elastičnosti za slojeve date deformabilnosti:

$$E_s = \frac{1}{L} \sum_{i=1}^n E_i \cdot h_i = \frac{1}{12.34} \cdot (5000 \cdot 2 + 17000 \cdot 4 + 30000 \cdot 6.34) = 21734.20 \text{ kN / m}^2$$

- Koeficijent relativne krutosti

$$k = \frac{E_b}{E_s} = \frac{30 \cdot 10^6}{21734.20} = 1380.31 \text{ kN / m}^2$$

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- Potrebni koeficijenti prema dijagramima parametarske analize:

$$\left. \begin{aligned} d_b / d &= 0.9 / 0.6 = 1.5 \\ L / d &= 12.34 / 0.6 = 20.57 \end{aligned} \right\} \Rightarrow I_0 = 0.085$$

$$\left. \begin{aligned} k &= 1380.31 \text{ kN} / \text{m}^2 \\ L / d &= 20.57 \end{aligned} \right\} \Rightarrow R_k = 1.080$$

$$\left. \begin{aligned} L / h &= 0 \\ L / d &= 20.57 \end{aligned} \right\} \Rightarrow R_h = 1.0$$

$$\nu_s = \frac{1}{L} \sum \nu_i \cdot h_i = \frac{1}{12.34} \cdot (2 \cdot 0.35 + 4 \cdot 0.30 + 6.34 \cdot 0.25) = 0.28$$

$$\left. \begin{aligned} k &= 1380.31 \text{ kN} / \text{m}^2 \\ \nu_s &= 0.28 \end{aligned} \right\} \Rightarrow R_v = 0.94$$

$$\left. \begin{aligned} k &= 1380.31 \\ \frac{E_b}{E_s} &= \frac{30 \cdot 0.60}{21734.20} = 1.38 \\ L / d &= 20.57 \end{aligned} \right\} \Rightarrow R_b = 0.96$$

$$I = I_0 \cdot R_k \cdot R_h \cdot R_v \cdot R_b = 0.085 \cdot 1.080 \cdot 1.0 \cdot 0.94 \cdot 0.96 = 0.083$$

- Sleganje usled jedinične sile $P=1.0$

$$F_{22} = \frac{P}{E_s \cdot d} \cdot I = \frac{1.0}{21734.20 \cdot 0.6} \cdot 0.083 = 6.36 \cdot 10^{-6}$$

- Određivanje koeficijenata horizontalne reakcije prema Vesiću:

$$k_s = \frac{0.65}{d} \cdot \sqrt[12]{\frac{E_s \cdot d^4}{E_b \cdot I_b}} \cdot \frac{E_s}{1 - \nu_s}$$

$$k_s = \frac{0.65}{0.6} \cdot \sqrt[12]{\frac{21734.20 \cdot 0.6^4}{30 \cdot 10^6 \cdot 0.00636}} \cdot \frac{21734.20}{1 - 0.28} = \frac{0.65}{0.6} \cdot \sqrt[12]{0.01476} \cdot 23583.12 = 17979.89 \text{ kN} / \text{m}^3$$

$$\lambda = \sqrt[4]{\frac{k_s \cdot d}{4 \cdot E_b \cdot I_b}} = \sqrt[4]{\frac{17979.89 \cdot 0.6}{4 \cdot 190800}} = 0.345$$

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- Koeficijenti fleksibilnosti za uticaje jedinične horizontalne sile ($H_0=1.0$, $Z=0$)

$$F_{11} = \frac{2 \cdot H_0 \cdot \lambda}{k_s \cdot d} \cdot e^{-\lambda z} \cdot \cos \lambda z = \frac{2 \cdot \lambda}{k_s \cdot d} = \frac{2 \cdot 0.345}{17979.89 \cdot 0.6} = 63.96 \cdot 10^{-6}$$

$$F_{31} = \frac{2 \cdot H_0 \cdot \lambda^2}{k_s \cdot d} \cdot e^{-\lambda z} (\cos \lambda z + \sin \lambda z) = \frac{2 \cdot \lambda^2}{k_s \cdot d} = \frac{2 \cdot 0.345^2}{17979.89 \cdot 0.6} = 22.066 \cdot 10^{-6}$$

- Koeficijenti fleksibilnosti za uticaj jediničnog momenta savijanja ($M_0=1.0$, $Z=0$)

$$F_{13} = \frac{2 \cdot M_0 \cdot \lambda^2}{k_s \cdot d} \cdot e^{-\lambda z} \cdot (\cos \lambda z - \sin \lambda z) = \frac{2 \cdot \lambda^2}{k_s \cdot d} = \frac{2 \cdot 0.345^2}{17979.89 \cdot 0.6} = 22.066 \cdot 10^{-6}$$

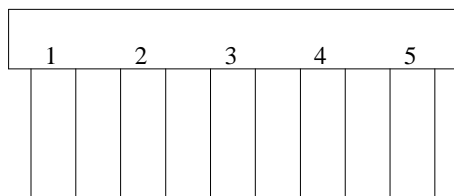
$$F_{33} = \frac{4 \cdot M_0 \cdot \lambda^3}{k_s \cdot d} \cdot e^{-\lambda z} \cos \lambda z = \frac{4 \cdot \lambda^3}{k_s \cdot d} = \frac{4 \cdot 0.345^3}{17979.89 \cdot 0.6} = 15.23 \cdot 10^{-6}$$

- Matrica fleksibilnosti

$$F = \begin{bmatrix} 63.96 & 0 & 22.066 \\ 0 & 6.36 & 0 \\ 22.066 & 0 & 15.23 \end{bmatrix} \cdot 10^{-6}$$

- Matrica krutosti

$$K = F^{-1} = \begin{bmatrix} 0.3126 & 0 & -0.4529 \\ 0 & 1.5723 & 0 \\ -0.4529 & 0 & 1.3128 \end{bmatrix} \cdot 10^5$$



Za šipove 1:

$$I_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -1.8 \\ 0 & 0 & 1 \end{bmatrix}$$

Za šipove 2:

$$I_2 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -0.9 \\ 0 & 0 & 1 \end{bmatrix}$$

Za šipove 3:

$$I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Za šipove 4:

$$I_4 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0.9 \\ 0 & 0 & 1 \end{bmatrix}$$

Za šipove 5:

$$I_5 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1.8 \\ 0 & 0 & 1 \end{bmatrix}$$

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$$\bar{K}_1 = I_1^T \cdot K \cdot I_1 = \begin{bmatrix} 0.3126 & 0 & -0.4529 \\ 0 & 1.5723 & -2.8302 \\ -0.4529 & -2.8302 & 6.4071 \end{bmatrix} \cdot 10^5$$

$$\bar{K}_2 = I_2^T \cdot K \cdot I_2 = \begin{bmatrix} 0.3126 & 0 & -0.4529 \\ 0 & 1.5723 & -1.4151 \\ -0.4529 & -1.4151 & 2.5864 \end{bmatrix} \cdot 10^5$$

$$\bar{K}_3 = I_3^T \cdot K \cdot I_3 = \begin{bmatrix} 0.3126 & 0 & -0.4529 \\ 0 & 1.5723 & 0 \\ -0.4529 & 0 & 1.3128 \end{bmatrix} \cdot 10^5$$

$$\bar{K}_4 = I_4^T \cdot K \cdot I_4 = \begin{bmatrix} 0.3126 & 0 & -0.4529 \\ 0 & 1.5723 & 1.4151 \\ -0.4529 & 1.4151 & 2.5864 \end{bmatrix} \cdot 10^5$$

$$\bar{K}_5 = I_5^T \cdot K \cdot I_5 = \begin{bmatrix} 0.3126 & 0 & -0.4529 \\ 0 & 1.5723 & 2.8302 \\ -0.4529 & 2.8302 & 6.4071 \end{bmatrix} \cdot 10^5$$

- Matrica krutosti sistema

$$K_0 = 1 \cdot \bar{K}_1 + 2 \cdot \bar{K}_2 + 1 \cdot \bar{K}_3 + 2 \cdot \bar{K}_4 + 1 \cdot \bar{K}_5$$

$$K_0 = \begin{bmatrix} 0.2188 & 0 & -0.3170 \\ 0 & 1.1006 & 0 \\ -0.3170 & 0 & 2.4473 \end{bmatrix} \cdot 10^6$$

- Nepoznata generalisana pomeranja:

$$\begin{bmatrix} H_0 \\ V_0 \\ M_0 \end{bmatrix} = K_0 \cdot \begin{bmatrix} u_0 \\ \vartheta_0 \\ \varphi_0 \end{bmatrix} \quad \begin{aligned} H_0 &= 480 \text{ kN} \\ V_0 &= 7558.88 \text{ kN} \\ M_0 &= 480 \cdot 1 + 420 = 900 \text{ kNm} \end{aligned}$$

$$\begin{bmatrix} u_0 \\ \vartheta_0 \\ \varphi_0 \end{bmatrix} = K_0^{-1} \cdot \begin{bmatrix} H_0 \\ V_0 \\ M_0 \end{bmatrix} = 10^5 \begin{bmatrix} 0.5626 & 0 & 0.0729 \\ 0 & 0.0909 & 0 \\ 0.0729 & 0 & 0.0503 \end{bmatrix} \cdot \begin{bmatrix} 0.48 \\ 7.5588 \\ 0.9 \end{bmatrix} \cdot 10^3 = \begin{bmatrix} 0.0034 \\ 0.0069 \\ 0.0008 \end{bmatrix}$$

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$$q_1 = \begin{bmatrix} u_1 \\ \vartheta_1 \\ \varphi_1 \end{bmatrix} = I_1 \cdot q = \begin{bmatrix} 0.0034 \\ 0.0054 \\ 0.0008 \end{bmatrix} \quad \begin{bmatrix} H_1 \\ V_1 \\ M_1 \end{bmatrix} = K \cdot q_1 = \begin{bmatrix} 68.57 \\ 852.70 \\ -46.65 \end{bmatrix}$$

$$q_2 = \begin{bmatrix} u_2 \\ \vartheta_2 \\ \varphi_2 \end{bmatrix} = I_2 \cdot q = \begin{bmatrix} 0.0034 \\ 0.0061 \\ 0.0008 \end{bmatrix} \quad \begin{bmatrix} H_2 \\ V_2 \\ M_2 \end{bmatrix} = K \cdot q_2 = \begin{bmatrix} 68.57 \\ 966.27 \\ -46.65 \end{bmatrix}$$

$$q_3 = \begin{bmatrix} u_3 \\ \vartheta_3 \\ \varphi_3 \end{bmatrix} = I_3 \cdot q = \begin{bmatrix} 0.0034 \\ 0.0069 \\ 0.0008 \end{bmatrix} \quad \begin{bmatrix} H_3 \\ V_3 \\ M_3 \end{bmatrix} = K \cdot q_3 = \begin{bmatrix} 68.57 \\ 1079.8 \\ -46.65 \end{bmatrix}$$

$$q_4 = \begin{bmatrix} u_4 \\ \vartheta_4 \\ \varphi_4 \end{bmatrix} = I_4 \cdot q = \begin{bmatrix} 0.0034 \\ 0.0076 \\ 0.0008 \end{bmatrix} \quad \begin{bmatrix} H_4 \\ V_4 \\ M_4 \end{bmatrix} = K \cdot q_4 = \begin{bmatrix} 68.57 \\ 1193.4 \\ -46.65 \end{bmatrix}$$

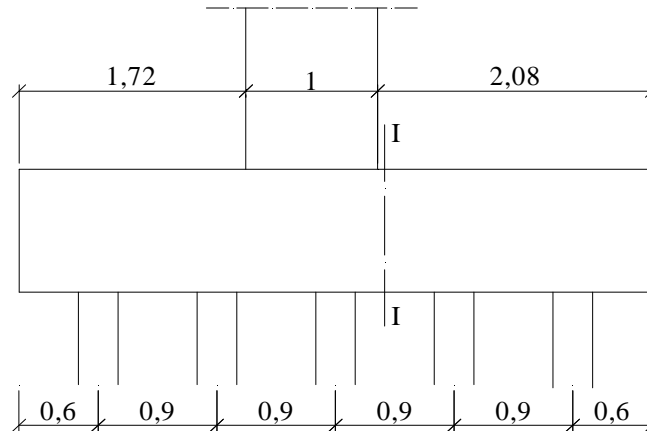
$$q_5 = \begin{bmatrix} u_5 \\ \vartheta_5 \\ \varphi_5 \end{bmatrix} = I_5 \cdot q = \begin{bmatrix} 0.0034 \\ 0.0083 \\ 0.0008 \end{bmatrix} \quad \begin{bmatrix} H_5 \\ V_5 \\ M_5 \end{bmatrix} = K \cdot q_5 = \begin{bmatrix} 68.57 \\ 1307 \\ -46.65 \end{bmatrix}$$

$$\sum V = 852.70 + 2 \cdot 966.27 + 1079.8 + 2 \cdot 1193.4 + 1307 = 7558.88 \text{ kN}$$

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6.7. Dimenzionisanje naglavne grede

6.7.1. Podužne trake



$$M_{I-I} = 1307 \cdot 1.48 + 2 \cdot 1193.40 \cdot 0.58 = 3318.7 \text{ kNm}$$

$$M_u = 1.65 \cdot 3318.7 = 5475.86 \text{ kNm}$$

$$b = 60 \text{ cm}$$

$$h = 100 - 10 = 90 \text{ cm}$$

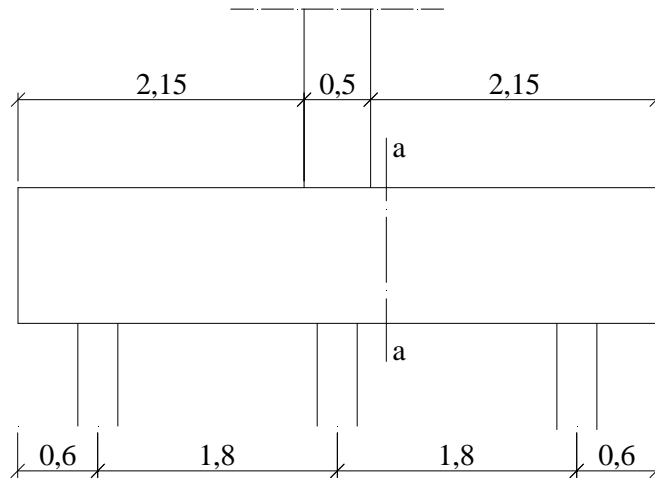
$$k = \frac{90}{\sqrt{\frac{5475.86 \cdot 100}{3 \cdot 60 \cdot 2.05}}} = 2.336 \Rightarrow \bar{\mu} = 20.546\%$$

$$A_a = 20.546 \cdot \frac{60 \cdot 90}{100} \cdot \frac{2.05}{40} = 56.86 \text{ cm}^2$$

$$\text{Usvojeno: } 12R\phi 25 (58.92 \text{ cm}^2)$$

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6.7.2. Poprečne trake



$$M_{a-a} = 966.27 \cdot 1.8 + 1193.40 \cdot 1.8 = 3887.41 \text{ kNm}$$

$$M_u = 1.65 \cdot 3887.41 = 6414.22 \text{ kNm}$$

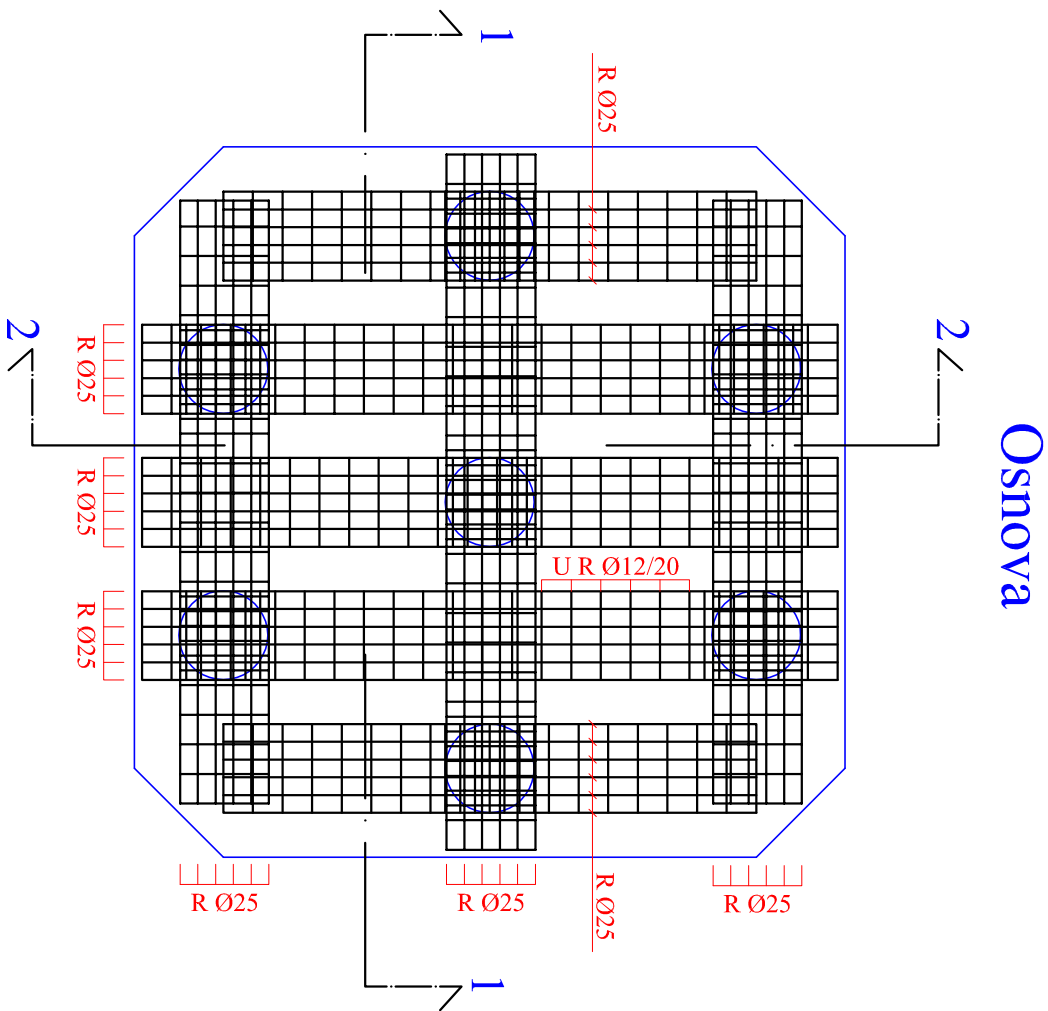
$$b = 60 \text{ cm}$$

$$h = 100 - 10 = 90 \text{ cm}$$

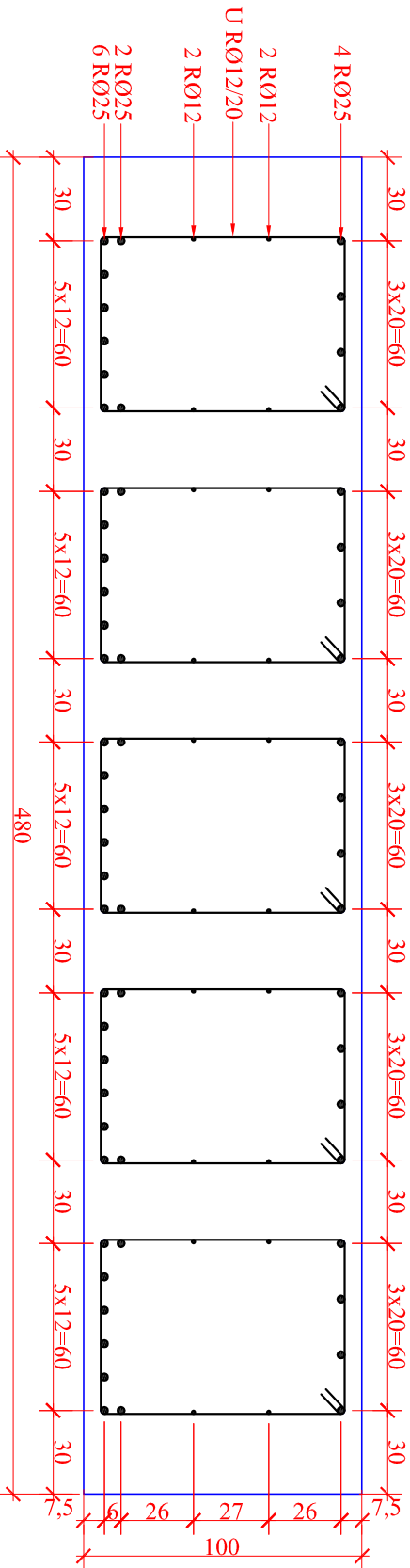
$$k = \frac{90}{\sqrt{\frac{6414.22 \cdot 100}{5 \cdot 60 \cdot 2.05}}} = 2.787 \Rightarrow \bar{\mu} = 13.987\%$$

$$A_a = 13.987 \cdot \frac{60 \cdot 90}{100} \cdot \frac{2.05}{40} = 38.69 \text{ cm}^2$$

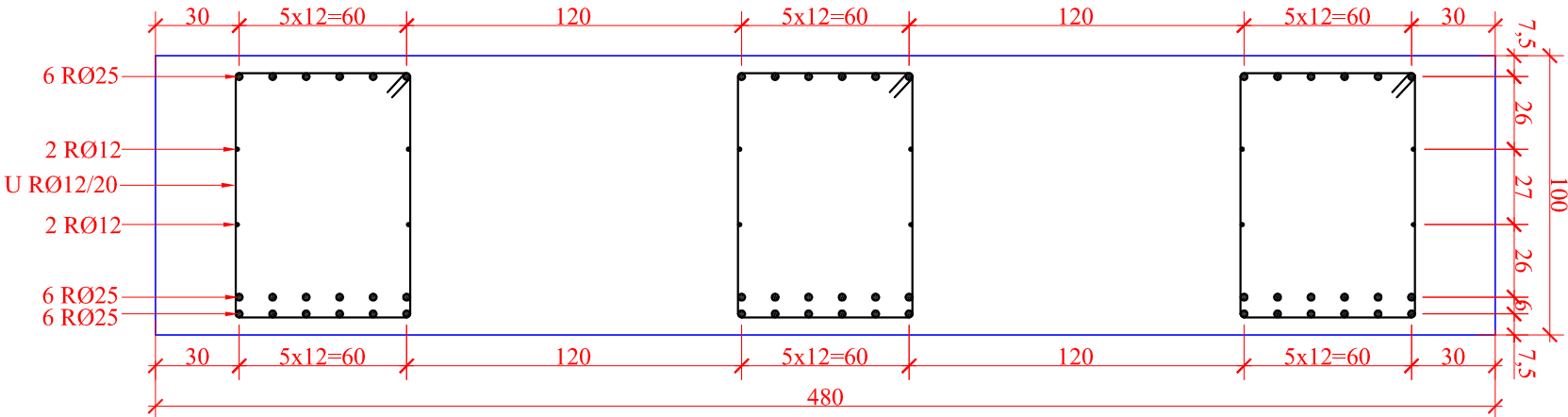
Usvojeno: $8R\phi 25 (38.69 \text{ cm}^2)$



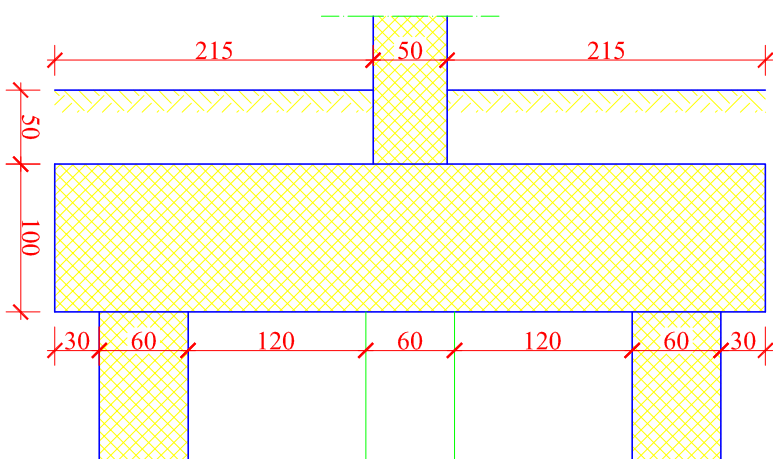
Presek 1-1 R 1:25



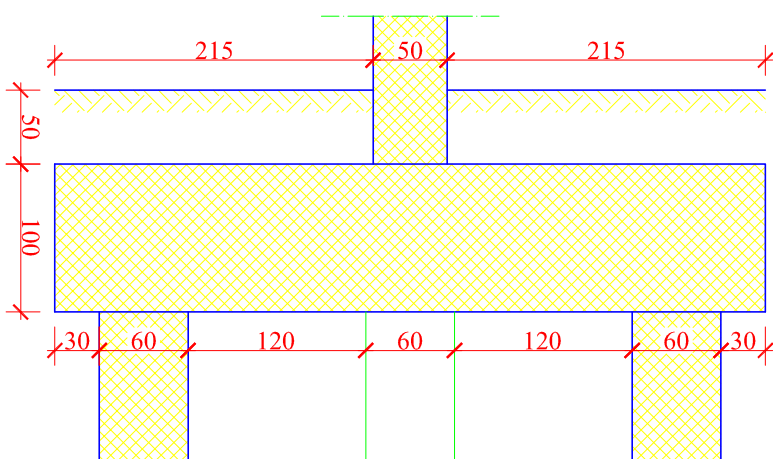
Presek 2-2 R 1:25



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PLAN ARMATURE			
Kvalitet materijala: RA 400/500	Razmera: 1:50	Školska godina: 2007/2008	Overa:



Presek 3-3



Presek 2-2

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Odsek za konstrukcije		Katedra za gradjevinsku geotehniku	
FUNDIRANJE			
Predmetni nastavnik: prof.dr. Miroš Lazović	Asistent: Selimir Lelović	Kandidat: Slavko Matić 63/03	
PLAN OPLATE			
Kvalitet materijala: MB 30	Razmera: 1:50	Školska godina: 2007/2008	Oveta: