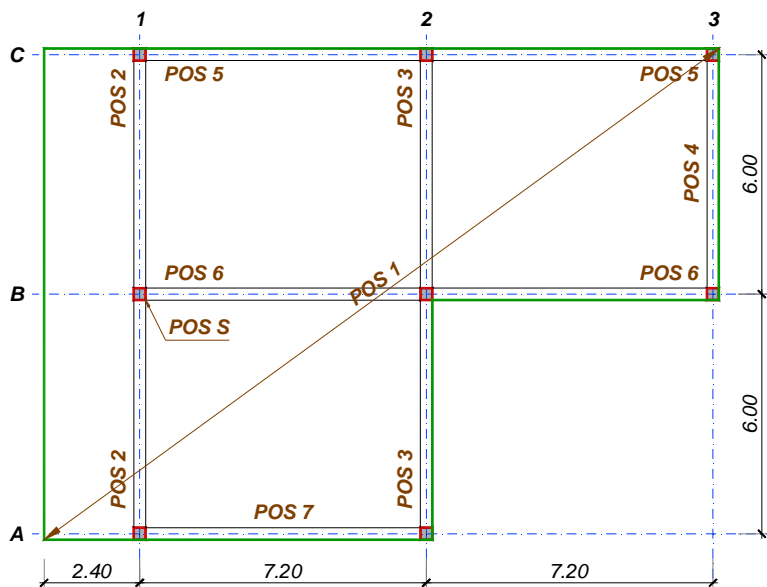


- 01** Za međuspratnu konstrukciju prikazanu na skici, potrebno je:
- 1 Sračunati statičke uticaje i dimenzionisati ploču **POS 1** ($d_p = 16$ cm). Prikazati usvojeni raspored armature u osnovi i presecima.
 - 2 Izvršiti analizu opterećenja, sračunati statičke uticaje i dimenzionisati gredu **POS 6** ($b/d = 30/60$ cm) u karakterističnim presecima



- 3 Dimenzionisati stub **POS S** ($b/d = 30/30$ cm). Uzeti u obzir vitkost stuba (usvojiti dužinu izvijanja $L_i = H = 6.0$ m u oba pravca). Usvojeni raspored armature prikazati u preseku.

$$\Delta g = 2 \text{ kN/m}^2 \quad \text{- težina slojeva na ploči POS 1}$$

$$p = 8 \text{ kN/m}^2 \quad \text{- povremeno opterećenje na ploči POS 1}$$

- 4 Nacrtaati plan armature grede **POS 6** u približnoj razmeri (podužni presek, dimenzionisani poprečni preseki).

Povremeno opterećenje deluje po čitavoj površini ploče. Sve grede su istog poprečnog preseka ($b/d = 30/60$ cm). Kvalitet materijala: MB 30, RA 400/500.

1. POS 1 – ploča $d_p = 16$ cm

$$g = 0.16 \times 25 + 2.0 = 6.0 \text{ kN/m}^2$$

$$p = 8 \text{ kN/m}^2$$

za delove ploče »B«, »C« i »D«:

$$L_y/L_x = 7.2/6.0 = 1.2$$

$$G = 6.0 \times 6.0 \times 7.2 = 259.2 \text{ kN}$$

$$P = 8.0 \times 6.0 \times 7.2 = 345.6 \text{ kN}$$

$$Q_u = 1.6 \times G + 1.8 \times P = 1036.8 \text{ kN}$$

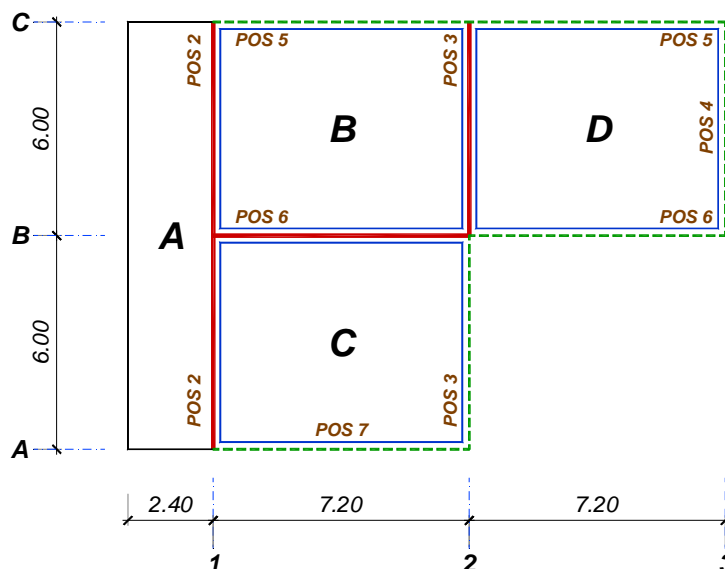
ploča tipa »A«

Konzolna ploča, raspona $L = 2.4$ m.

$$q_u = 1.6 \times 6.0 + 1.8 \times 8.0 = 24.0 \text{ kN/m}^2$$

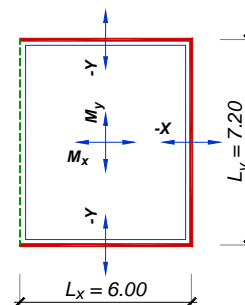
$$M_u = 24.0 \times 2.4^2 / 2 = 69.1 \text{ kNm/m}$$

$$R_g = 6.0 \times 2.4 = 14.4 \text{ kN/m} \quad ; \quad R_p = 8.0 \times 2.4 = 19.2 \text{ kN/m}$$

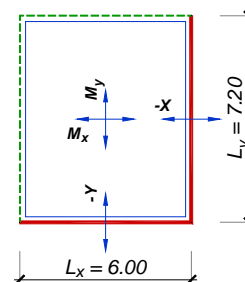


ploča tipa »B«

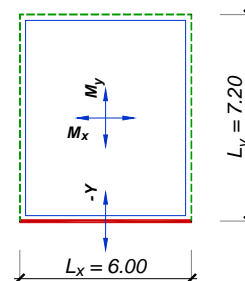
	<i>k</i>		G	P	U
			kNm/m	kNm/m	kNm/m
kraći pravac, polje	0.026	M_x	6.7	9.0	27.0
duži pravac, polje	0.023	M_y	6.0	7.9	23.8
kraći pravac, oslonac	0.062	-X	16.1	21.4	64.3
duži pravac, oslonac	0.058	-Y	15.0	20.0	60.1

ploča tipa »C«

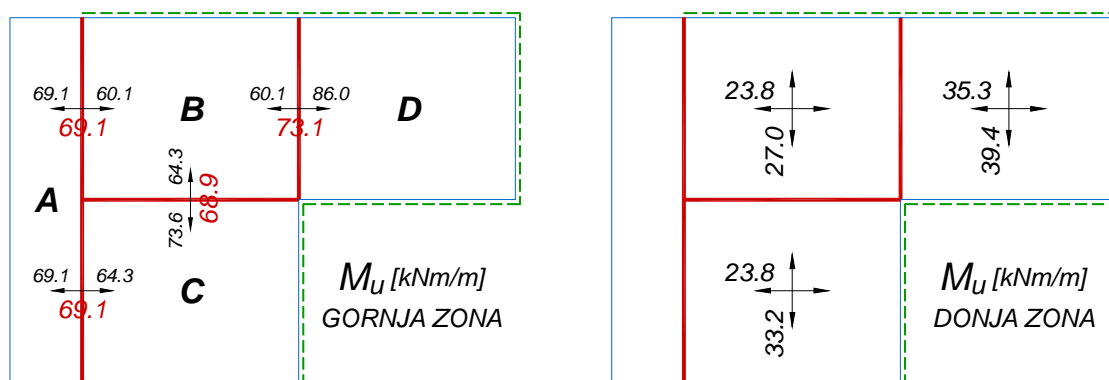
	<i>k</i>		G	P	U
			kNm/m	kNm/m	kNm/m
kraći pravac, polje	0.032	M_x	8.3	11.1	33.2
duži pravac, polje	0.023	M_y	6.0	7.9	23.8
kraći pravac, oslonac	0.071	-X	18.4	24.5	73.6
duži pravac, oslonac	0.062	-Y	16.1	21.4	64.3

ploča tipa »D«

	<i>k</i>		G	P	U
			kNm/m	kNm/m	kNm/m
kraći pravac, polje	0.038	M_x	9.8	13.1	39.4
duži pravac, polje	0.034	M_y	8.8	11.8	35.3
duži pravac, oslonac	0.083	-Y	21.5	28.7	86.1



Grafični momenti savijanja u ploči, posebno za donju, odnosno gornju zonu su prikazani na donjoj šemi. Vrednosti osloničkih momenata susednih ploča su osrednjeni na delovima gde se susstiču dve krstaste ploče različitih konturnih uslova. Na delovima gde se krstasta ploča susstiče sa konzolnim prepustom (ploča »A«), zadržane su vrednosti momenata savijanja sa konzola.



S obzirom na veličinu momenata savijanja, prvi red armature donje zone biće postavljen u Y pravcu ($\max. M_u = 39.4$ kNm/m), preko njega donja zona X pravca, zatim gornja zona Y pravca i konačno gornja zona X pravca ($\max. M_u = 73.1$ kNm/m).

Dimenzionisanje

$$MB\ 30 \Rightarrow f_B = 20.5\ MPa \quad ; \quad RA\ 400/500 \Rightarrow \sigma_v = 400\ MPa$$

$$\max. M_{xu} = 73.1\ kNm/m \quad (\text{upravno na POS 3 - oslonac između ploča B i D})$$

$$a_{1x} = 3.0\ cm \Rightarrow h_x = d - a_{1x} = 16 - 3 = 13\ cm$$

$$k = \frac{13}{\sqrt{\frac{73.1}{2.05}}} = 2.177 \quad \Rightarrow \quad \varepsilon_b/\varepsilon_a = 3.5/8.271\% \quad ; \quad \bar{\mu} = 24.070\% \quad ; \quad \zeta = 0.876$$

$$A_{ax} = 24.070 \times 13 \times \frac{2.05}{40} = 16.04 \text{ cm}^2/\text{m}$$

usvojeno: **RØ16/12.5** (16.08 cm²/m)

$$A_{ap} = 0.2 \times 16.04 = 3.21 \text{ cm}^2/\text{m}$$

usvojeno: **RØ10/20** (3.93 cm²/m) – podeona armatura

Preostala armatura u gornjoj zoni je postavljena upravno na POS 2 – oslonac između konzolne ploče "A" i ploča "B" odnosno "C". Vrednosti momenata savijanja su veoma slične (vidi šemu na prethodnoj strani). Dimenzionisanje može biti sprovedeno tačnim postupkom (pomoću tablica), ili približno – usvajanjem iste vrednosti kraka unutrašnjih sila¹ kao kod određivanja armature upravne na POS 3:

$$A_{ax} \approx \frac{69.1 \times 10^2}{0.876 \times 13 \times 40} = \frac{69.1}{73.1} \times 16.04 = 15.16 \frac{\text{cm}^2}{\text{m}}$$

usvojeno: **RØ16/12.5** (16.08 cm²/m)

max. M_{yu} = 68.9 kNm/m (upravno na POS 6 - oslonac između ploča B i C)

$$h_y = d - (a_0 + \varnothing_x + \varnothing_y/2) = 16 - (2 + 1.6 + 1.6/2) = 11.6 \text{ cm}$$

$$k = \frac{11.6}{\sqrt{\frac{68.9}{2.05}}} = 2.000 \quad \Rightarrow \quad \varepsilon_b/\varepsilon_a = 3.5/6.121\% \quad ; \quad \bar{\mu} = 29.451\% \quad ; \quad \zeta = 0.849$$

$$A_{ay} = 29.451 \times 11.6 \times \frac{2.05}{40} = 17.51 \text{ cm}^2/\text{m}$$

usvojeno: **RØ16/10** (20.10 cm²/m)

$$A_{ap} = 0.2 \times 17.51 = 3.50 \text{ cm}^2/\text{m}$$

usvojeno: **RØ10/20** (3.93 cm²/m) – podeona armatura

Dimenzionisanje u ostalim presećima (donja zona) je sprovedeno uprošćenim postupkom, usvajajući približnu vrednost kraka unutrašnjih sila. ($z \approx 0.9 \times h$). Potrebna i usvojena površina armature prikazane su tabelarno.

ploča	pravac	h	M _u	A _{a,potr.}	Ø	e _a	A _{a,usv.}
		cm	kNm/m	cm ² /m	mm	cm	cm ² /m
B	Y	13.4	27.0	5.59	12	20	5.65
C	Y	13.4	33.2	6.88	12	15	7.54
D	Y	13.4	39.4	8.17	12	12.5	9.05
B	X	12.2	23.8	5.43	12	20	5.65
C	X	12.2	23.8	5.43	12	20	5.65
D	X	12.2	35.3	8.03	12	12.5	9.05

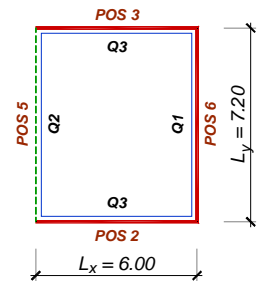
¹ Treba primetiti da je stvarna vrednost kraka unutrašnjih sila manja od uobičajene približne vrednosti $z \approx 0.9h$, pa približan postupak određivanja potrebne površine armature nije na strani sigurnosti. Uostalom, najopterećeniji presek je i dimenzionisan tačnim postupkom da ne bismo načinili takav propust.

2. Analiza opterećenja za grede POS 2 – POS 7

Jednako raspodeljeno opterećenje sa pojedinačnih krstastih ploča:

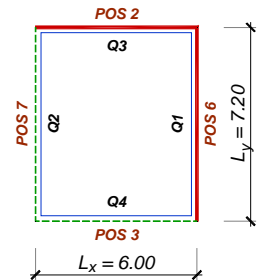
ploča tipa »B«

POS	k	Q	G	P	L	g	p
			kN	kN	m	kN/m	kN/m
6	0.300	Q ₁	77.8	103.7	7.2	10.80	14.40
5	0.210	Q ₂	54.4	72.6	7.2	7.56	10.08
2,3	0.245	Q ₃	63.5	84.7	6.0	10.58	14.11



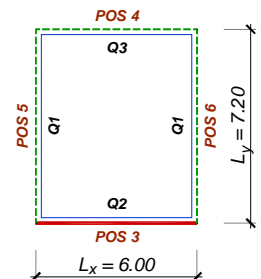
ploča tipa »C«

POS	k	Q	G	P	L	g	p
			kN	kN	m	kN/m	kN/m
6	0.331	Q ₁	85.8	114.4	7.2	11.92	15.89
7	0.226	Q ₂	58.6	78.1	7.2	8.14	10.85
2	0.257	Q ₃	66.6	88.8	6.0	11.10	14.80
3	0.186	Q ₄	48.2	64.3	6.0	8.04	10.71

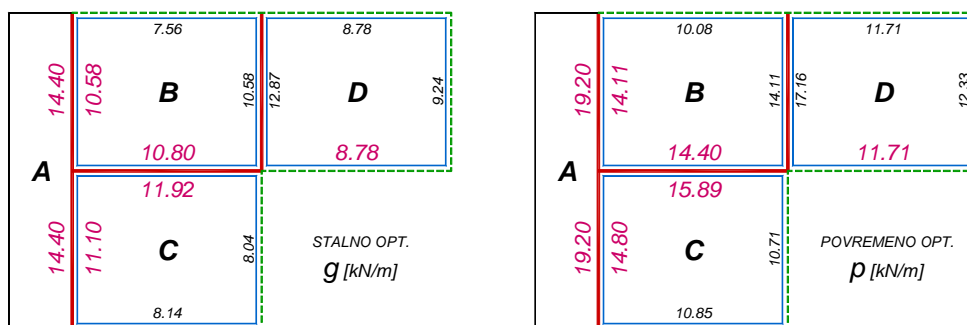


ploča tipa »D«

POS	k	Q	G	P	L	g	p
			kN	kN	m	kN/m	kN/m
5,6	0.244	Q ₁	63.2	84.3	7.2	8.78	11.71
3	0.298	Q ₂	77.2	103.0	7.2	12.87	17.16
4	0.214	Q ₃	55.5	74.0	6.0	9.24	12.33



Stalnom opterećenju potrebno je dodati sopstvenu težinu greda. Opterećenje koje NIJE neophodno sračunati za potrebe zadatka je ispisano sitnijim fontom.



POS 6 – greda b/d = 30/60 cm

Greda je sistema kontinualnog nosača preko tri oslonca, raspona 2x7.2 m.

Analiza opterećenja

a. prvo polje

$$\text{sopstvena težina: } 0.3 \times 0.6 \times 25 = 4.50 \text{ kN/m}$$

$$\text{od POS 1 (ploča »B«) } Q_1^B / L_y = 77.8 / 7.2 = 10.80 \text{ kN/m}$$

$$\text{od POS 1 (ploča »C«) } Q_1^C / L_y = 85.8 / 7.2 = 11.92 \text{ kN/m}$$

$$\text{ukupno, stalno opterećenje } g_1 = 27.22 \text{ kN/m}$$

$$\text{od POS 1 (ploča "B")} \quad Q_1^B/L_y = 103.7/7.2 = 14.40 \text{ kN/m}$$

$$\text{od POS 1 (ploča "C")} \quad Q_1^C/L_y = 114.4/7.2 = 15.89 \text{ kN/m}$$

$$\text{ukupno, povremeno opterećenje} \quad p_1 = 30.29 \text{ kN/m}$$

$$q_{u1} = 1.6 \times 27.22 + 1.8 \times 30.29 = 98.06 \text{ kN/m}$$

b. drugo polje

$$\text{sopstvena težina:} \quad 0.3 \times 0.6 \times 25 = 4.50 \text{ kN/m}$$

$$\text{od POS 1 (ploča "D")} \quad Q_1^D/L_y = 63.2/7.2 = 8.78 \text{ kN/m}$$

$$\text{ukupno, stalno opterećenje} \quad g_2 = 13.28 \text{ kN/m}$$

$$\text{od POS 1 (ploča "D")} \quad Q_1^D/L_y = 84.3/7.2 = 11.71 \text{ kN/m}$$

$$\text{ukupno, povremeno opterećenje} \quad p_2 = 11.71 \text{ kN/m}$$

$$q_{u2} = 1.6 \times 13.28 + 1.8 \times 11.71 = 42.34 \text{ kN/m}$$

Reakcije oslonaca

$$A_g = \frac{7 \times 27.22 - 13.28}{16} \times 7.2 = 79.8 \text{ kN} \quad ; \quad A_p = \frac{7 \times 30.29 - 11.71}{16} \times 7.2 = 90.1 \text{ kN}$$

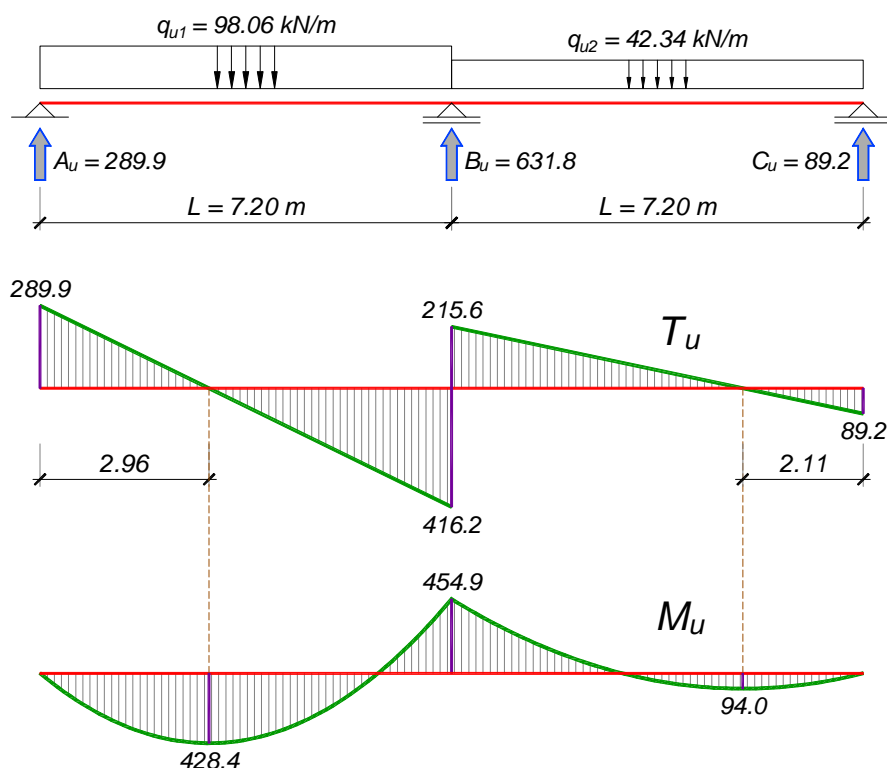
$$C_g = \frac{7 \times 13.28 - 27.22}{16} \times 7.2 = 29.6 \text{ kN} \quad ; \quad C_p = \frac{7 \times 11.71 - 30.29}{16} \times 7.2 = 23.3 \text{ kN}$$

Nije neophodno sračunati srednje reakcije B (ne traži se dimenzionisanje tog stuba, a nije potrebno ni za proračun T sila ili maksimalnog momenta savijanja u polju). Ipak, za kontrolu:

$$B_g = \frac{5}{8} \times (27.22 + 13.28) \times 7.2 = 182.3 \text{ kN}$$

$$B_p = \frac{5}{8} \times (30.29 + 11.71) \times 7.2 = 189.0 \text{ kN}$$

Dijagrami graničnih momenata savijanja i transverzalnih sila



$$A_u = 1.6 \times 79.8 + 1.8 \times 90.1 = 289.9 \text{ kN} = T_u^A$$

$$T_u^{B,L} = 98.06 \times 7.2 - 289.9 = 416.2 \text{ kN}$$

$$x_{\max} = \frac{A_u}{q_{u1}} = \frac{289.9}{98.06} = 2.96 \text{ m} \Rightarrow M_{u1,\max} = 289.9 \times 2.96 - \frac{98.06 \times 2.96^2}{2} = 428.4 \text{ kNm}$$

$$C_u = 1.6 \times 29.6 + 1.8 \times 23.3 = 89.2 \text{ kN} = T_u^C$$

$$T_u^{B,D} = 42.34 \times 7.2 - 89.2 = 215.6 \text{ kN}$$

$$x_{\max} = \frac{C_u}{q_{u2}} = \frac{89.2}{42.34} = 2.11 \text{ m} \Rightarrow M_{u2,\max} = 89.2 \times 2.11 - \frac{42.34 \times 2.11^2}{2} = 94.0 \text{ kNm}$$

$$M_{u,\text{osl}} = (98.06 + 42.34) \times \frac{7.2^2}{16} = 454.9 \text{ kNm} - \text{moment nad osloncem}$$

Dimenzionisanje POS 6

$$MB 30 \Rightarrow f_B = 20.5 \text{ MPa} \quad ; \quad RA 400/500 \Rightarrow \sigma_v = 400 \text{ MPa}$$

presek nad osloncem

$$\text{pretp. } a_1 = 7 \text{ cm} \Rightarrow h = 60 - 7 = 53 \text{ cm}$$

$$k = \frac{53}{\sqrt{\frac{454.9 \times 10^2}{30 \times 2.05}}} = 1.949 \Rightarrow \frac{\varepsilon_b}{\varepsilon_b} = 3.5 / 5.524\% \\ \bar{\mu} = 31.398\%$$

$$A_a = 31.398 \times \frac{30 \times 53}{100} \times \frac{2.05}{40} = 25.59 \text{ cm}^2 \Rightarrow \text{usvojeno } \mathbf{8R\emptyset 22} \text{ (30.41 cm}^2\text{)}$$

prvo polje

$$L_0 = 2 \times 296 = 592 \text{ cm} \Rightarrow B = \min \left\{ \begin{array}{l} 30 + 0.25 \times 592 = 178 \\ 30 + 20 \times 16 = 350 \end{array} \right\} = 178 \text{ cm}$$

$$k = \frac{53}{\sqrt{\frac{428.4 \times 10^2}{178 \times 2.05}}} = 4.889 \Rightarrow \frac{\varepsilon_b}{\varepsilon_b} = 1.083 / 10\% \\ s = 0.098 \Rightarrow x = 0.098 \times 53 = 5.2 \text{ cm} < 16 \text{ cm} \\ \bar{\mu} = 4.333\%$$

$$A_a = 4.333 \times \frac{178 \times 53}{100} \times \frac{2.05}{40} = 20.92 \text{ cm}^2 \Rightarrow \text{usvojeno } \mathbf{6R\emptyset 22} \text{ (22.81 cm}^2\text{)}$$

drugo polje

$$L_0 = 2 \times 211 = 422 \text{ cm} \Rightarrow B = \min \left\{ \begin{array}{l} 30 + \frac{0.25}{3} \times 422 = 65 \\ 30 + 8 \times 16 = 174 \end{array} \right\} = 65 \text{ cm}$$

$$k = \frac{55}{\sqrt{\frac{90.4 \times 10^2}{65 \times 2.05}}} = 6.554 \Rightarrow \frac{\varepsilon_b}{\varepsilon_b} = 0.768 / 10\% \\ s = 0.071 \Rightarrow x = 0.071 \times 55 = 3.9 \text{ cm} < 16 \text{ cm} \\ \bar{\mu} = 2.387\%$$

$$A_a = 2.387 \times \frac{65 \times 55}{100} \times \frac{2.05}{40} = 4.38 \text{ cm}^2 \Rightarrow \text{usvojeno } \mathbf{2R\emptyset 22} \text{ (7.60 cm}^2\text{)}$$

Osiguranje od glavnih napona zatezanjausvojeno: $z = 0.9 \times 53 = 47.7 \text{ cm}$ **presek levo od srednjeg oslonca**

$$\tau_n^{B,l} = \frac{416.2}{30 \times 47.7} = 0.291 \frac{\text{kN}}{\text{cm}^2} \left\{ \begin{array}{l} > \tau_r = 1.1 \text{ MPa} \\ < 3\tau_r \end{array} \right.$$

$$L_{0,T} = \frac{416.2}{98.06} = 4.244 \text{ m}$$

$$\lambda = 424.4 \times \left(1 - \frac{0.11}{0.291} \right) = 263.9 \text{ cm}$$

$$\tau_{Ru}^{B,l} = \frac{3}{2} \times (0.291 - 0.11) = 0.271 \frac{\text{kN}}{\text{cm}^2}$$

$$e_u = \frac{4 \times 0.785}{30 \times 0.271} \times 40 = 15.4 \text{ cm} \quad \Rightarrow \quad \text{usvojeno UR}\mathbf{\emptyset}10/15 \text{ (m=4)}$$

Dvosečne uzengije **UR** $\mathbf{\emptyset}10/15$, koje prihvataju napon:

$$\tau_{u,u}^{(1)} = \frac{2 \times 0.785}{30 \times 15} \times 40 = 0.140 \frac{\text{kN}}{\text{cm}^2}$$

nisu dovoljne na dužini λ_1 (skica gore desno):

$$\lambda_1 = \lambda \times \left(1 - \frac{\tau_{u,u}^{(1)}}{\tau_{Ru}^{B,l}} \right) = 263.9 \times \left(1 - \frac{0.140}{0.271} \right) = 128.1 \text{ cm}$$

 $\Delta A_a = 0$ ("špic" momenata)**presek kod levog oslonca**

$$\tau_n^A = \frac{289.9}{30 \times 47.7} = 0.203 \frac{\text{kN}}{\text{cm}^2} \left\{ \begin{array}{l} > \tau_r \\ < 3\tau_r \end{array} \right.$$

$$\lambda = (720 - 424.4) \times \left(1 - \frac{0.11}{0.203} \right) = 135.1 \text{ cm}$$

$$\tau_{Ru}^A = \frac{3}{2} \times (0.203 - 0.11) = 0.139 \frac{\text{kN}}{\text{cm}^2}$$

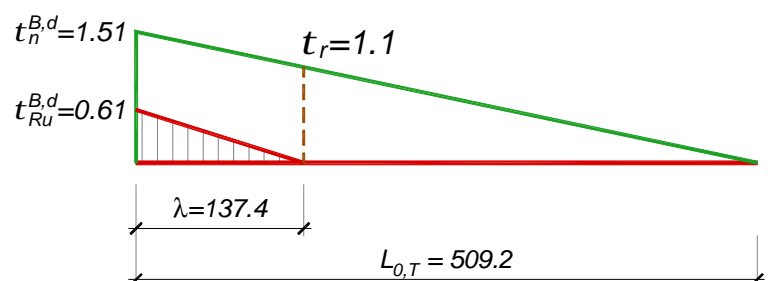
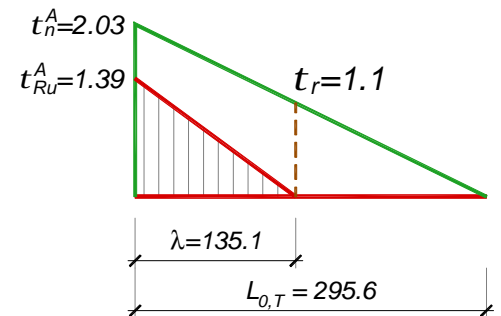
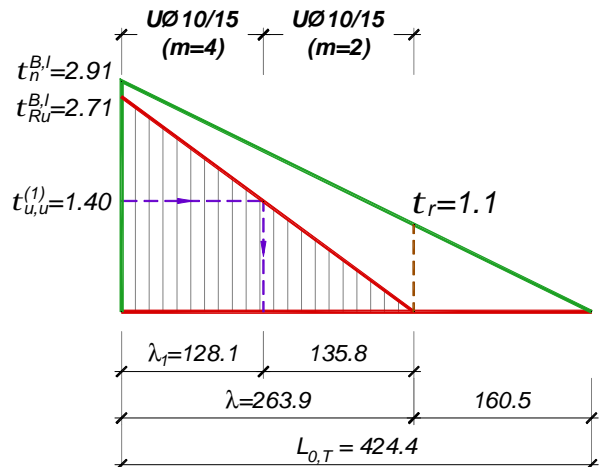
$$e_u = \frac{2 \times 0.785}{30 \times 0.139} \times 40 = 15.08 \text{ cm} \quad \Rightarrow \quad \text{usvojeno UR}\mathbf{\emptyset}10/15 \text{ (m=2)}$$

$$\Delta A_a = \frac{289.9}{2 \times 40} \times (\cot 45^\circ - \cot 90^\circ) = 3.62 \text{ cm}^2 \quad \Rightarrow \quad \text{usvojeno } \mathbf{2R}\mathbf{\emptyset}22 \text{ (7.60 cm}^2\text{)}$$

presek desno od srednjeg oslonca

$$\tau_n^{B,d} = \frac{215.6}{30 \times 47.7} = 0.151 \frac{\text{kN}}{\text{cm}^2} \left\{ \begin{array}{l} > \tau_r \\ < 3\tau_r \end{array} \right.$$

$$\lambda = (7.2 - 2.11) \times \left(1 - \frac{0.11}{0.151} \right) = 1.37 \text{ m}$$



$$\tau_{Ru}^{B,desno} = \frac{3}{2} \times (0.151 - 0.11) = 0.061 \frac{\text{kN}}{\text{cm}^2}$$

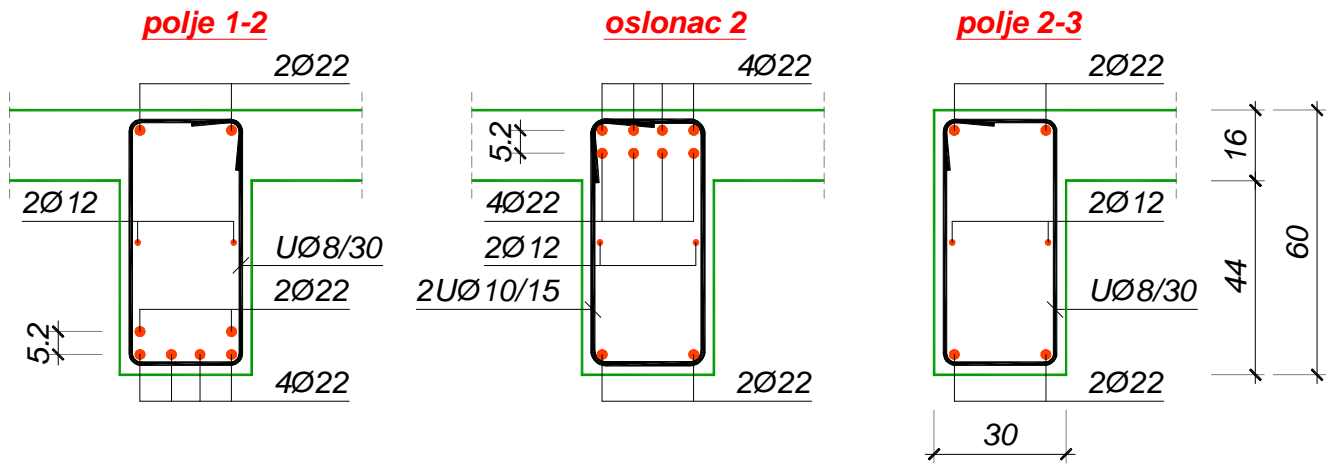
Biće usvojene minimalne vertikalne uzengije ($\mu=0.2\% \Rightarrow \tau_{u,u} = 0.8 \text{ MPa} > \tau_{Ru}$)

$$e_u \leq \frac{2 \times 0.503}{30 \times 0.2 \times 10^{-2}} = 16.7 \text{ cm} \quad \Rightarrow \quad \text{usvojeno UR}\mathbf{\emptyset 8/15} \text{ (} m=2 \text{)}$$

$\Delta A_a = 0$ ("špic" momenata)

presek kod desnog oslonca

$$\tau_n^C = \frac{89.1}{30 \times 47.7} = 0.062 \frac{\text{kN}}{\text{cm}^2} < \tau_r \quad \Rightarrow \quad \text{usvojeno UR}\mathbf{\emptyset 8/30(15)} \text{ (} m=2 \text{)}$$



3. Dimenzionisanje stuba POS S

Označeni stub predstavlja krajnji oslonac dimenzionisane grede POS 6, odnosno srednji oslonac grede POS 2. Potrebno je izvršiti analizu opterećenja za POS 2 i sračunati SAMO srednju reakciju.

Analiza opterećenja

a. prvo polje (između POS 6 i POS 7)

sopstvena težina:	$0.3 \times 0.6 \times 25$	=	4.50 kN/m
od POS 1 (ploča "A")	R_g	=	14.40 kN/m
od POS 1 (ploča "C")	$Q_3^C / L_x = 66.6 / 6.0$	=	11.10 kN/m
ukupno, stalno opterećenje	g_1	=	30.00 kN/m

od POS 1 (ploča "A")	R_p	=	19.20 kN/m
od POS 1 (ploča "C")	$Q_3^C / L_x = 88.8 / 6.0$	=	14.80 kN/m
ukupno, povremeno opterećenje	p_1	=	34.00 kN/m

b. drugo polje (između POS 6 i POS 5)

sopstvena težina:	$0.3 \times 0.6 \times 25$	=	4.50 kN/m
od POS 1 (ploča "A")	R_g	=	14.40 kN/m
od POS 1 (ploča "B")	$Q_3^B / L_x = 63.5 / 6.0$	=	10.58 kN/m
ukupno, stalno opterećenje	g_2	=	29.48 kN/m

od POS 1 (ploča "A")	R_p	=	19.20 kN/m
od POS 1 (ploča "B")	$Q_3^B / L_x = 84.7 / 6.0$	=	14.11 kN/m
ukupno, povremeno opterećenje	p_2	=	33.31 kN/m

Reakcije oslonaca

$$B_g^{POS2} = \frac{5}{8} \times (30.0 + 29.48) \times 6.0 = 223.1 \text{ kN} \quad ; \quad B_p^{POS2} = \frac{5}{8} \times (34.0 + 33.31) \times 6.0 = 252.4 \text{ kN}$$

$$G = A_g^{POS6} + B_g^{POS2} = 79.8 + 223.1 = 302.9 \text{ kN}$$

$$P = A_p^{POS6} + B_p^{POS2} = 90.1 + 252.4 = 342.5 \text{ kN}$$

$$i = \sqrt{\frac{I_b}{A_b}} = \frac{b}{\sqrt{12}} = \frac{30}{\sqrt{12}} = 8.66 \text{ cm} \quad \Rightarrow \quad \lambda = \frac{L_i}{i} = \frac{600}{8.66} = 69.3 > 25$$

$$e_0 = L_i/300 = 600/300 = 2.0 \text{ cm}$$

$$I_b = \frac{b \times d^3}{12} = \frac{30 \times 30^3}{12} = 67500 \text{ cm}^4 \quad ; \quad E_b = 31.5 \text{ GPa} = 31.5 \cdot 10^6 \text{ kN/m}^2$$

$$N_E = 31.5 \times 10^6 \times 67500 \times 10^{-8} \times \frac{\pi^2}{6.0^2} = 5829 \text{ kN}$$

$$\alpha_E = \frac{N_g}{N_E} = \frac{302.9}{5829} = 0.052 \quad ; \quad e_g = \frac{M_g}{N} = 0 \quad ; \quad \varphi_\infty = 2.5$$

$$e_\varphi = (e_0 + e_g) \times \left(e^{\frac{\alpha_E \times \varphi_\infty}{1 - \alpha_E}} - 1 \right) = (2 + 0) \times \left(e^{\frac{0.052 \times 2.5}{1 - 0.052}} - 1 \right) = 0.29 \text{ cm}$$

$$e_1/d = 0 \Rightarrow e_d = 30 \times \frac{69.3 - 25}{100} \times \sqrt{0.1 + 0} = 4.2 \text{ cm}$$

$$e_2 = e_1 + e_0 + e_j + e_d = 0 + 2.0 + 0.29 + 4.2 = 6.49 \text{ cm}$$

$$N_u = 1.9 \times 302.9 + 2.1 \times 342.5 = 1294.8 \text{ kN} \quad \Rightarrow \quad n_u = \frac{1294.8}{30 \times 30 \times 2.05} = 0.702$$

$$M_u = N_u \times e_2 = 1294.8 \times 6.49 = 8410 \text{ kNcm} \quad \Rightarrow \quad m_u = \frac{8410}{30 \times 30^2 \times 2.05} = 0.152$$

$$\frac{a}{d} = \frac{4.5}{30} = 0.15 \Rightarrow \bar{\mu}_1 \approx 0.1, \quad \varepsilon_{a1} \approx 0.35\text{‰} \Rightarrow \gamma_{uG} = 1.865, \quad \gamma_{uP} = 2.065$$

Nakon korekcije koeficijenata sigurnosti, sledi:

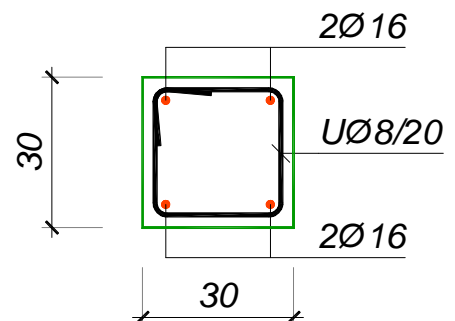
$$N_u = 1.865 \times 302.9 + 2.065 \times 342.5 = 1272.2 \text{ kN} \quad \Rightarrow \quad n_u = \frac{1272.2}{30 \times 30 \times 2.05} = 0.690$$

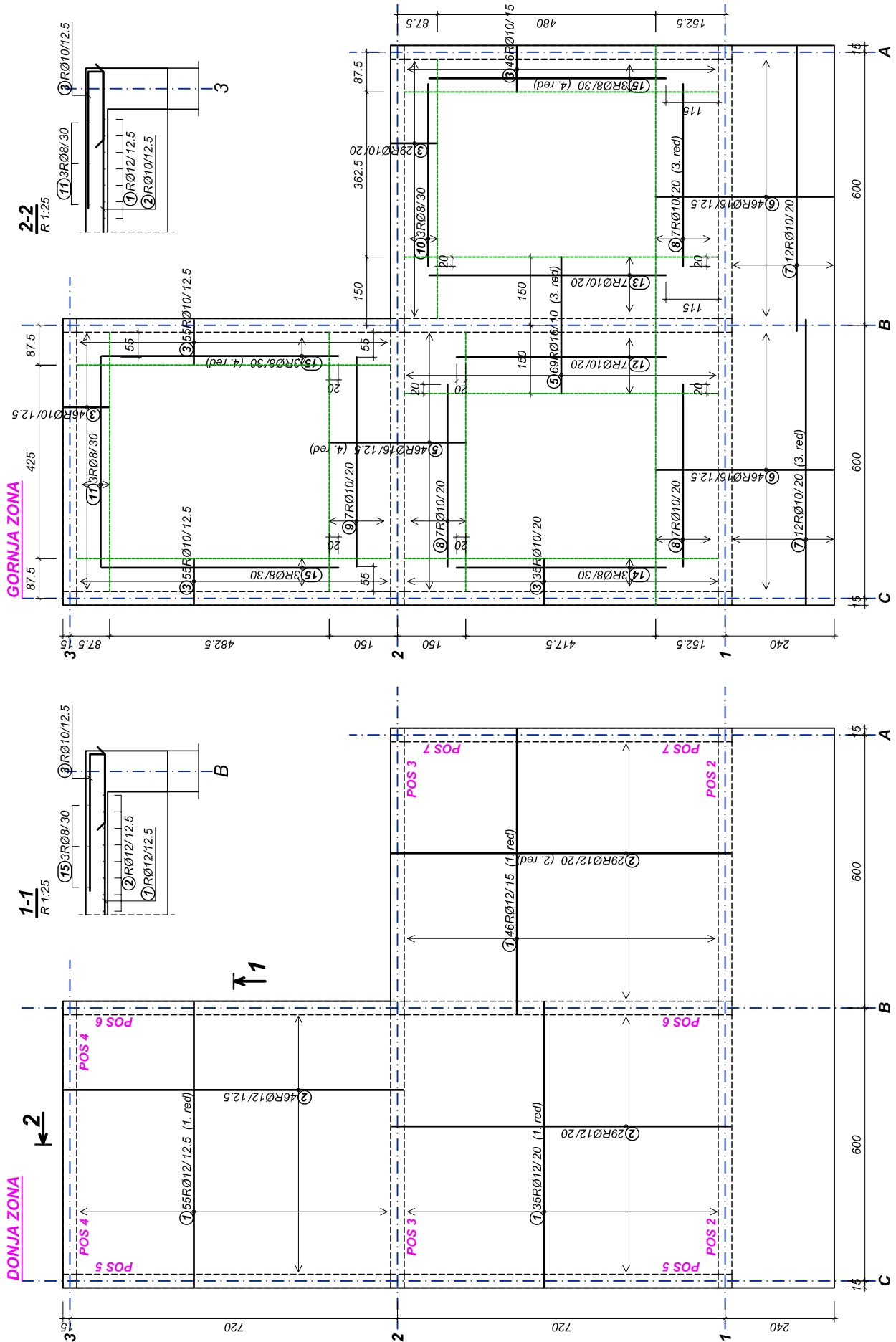
$$M_u = N_u \times e_2 = 1272.2 \times 6.49 = 8260 \text{ kNcm} \quad \Rightarrow \quad m_u = \frac{8260}{30 \times 30^2 \times 2.05} = 0.149$$

$$\frac{a}{d} = \frac{4.5}{30} = 0.15 \Rightarrow \bar{\mu}_1 \approx 0.086, \quad \varepsilon_{a1} \approx 0.39\text{‰} \Rightarrow \gamma_{uG} = 1.861, \quad \gamma_{uP} = 2.061$$

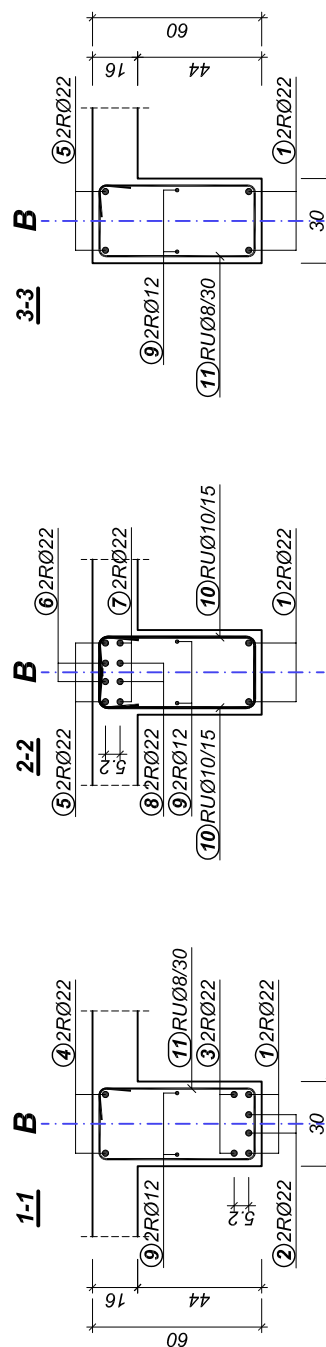
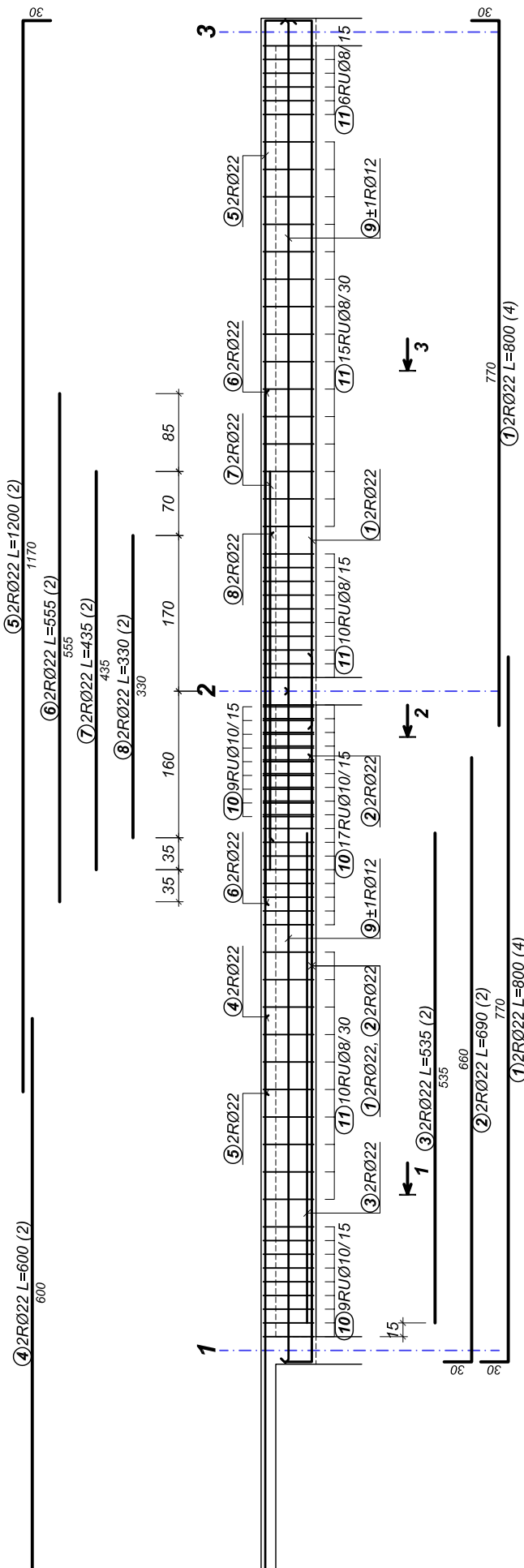
$$A_{a1} = A_{a2} = 0.086 \times 30 \times 30 \times \frac{2.05}{40} = 3.98 \text{ cm}^2$$

usvojeno $\pm 2R\emptyset 16$ ($\pm 4.02 \text{ cm}^2$)





PLAN ARMATURE POS 1
MB 30 RA 400/500



PLAN ARMATURE POS 6
 MB 30 RA 400/500