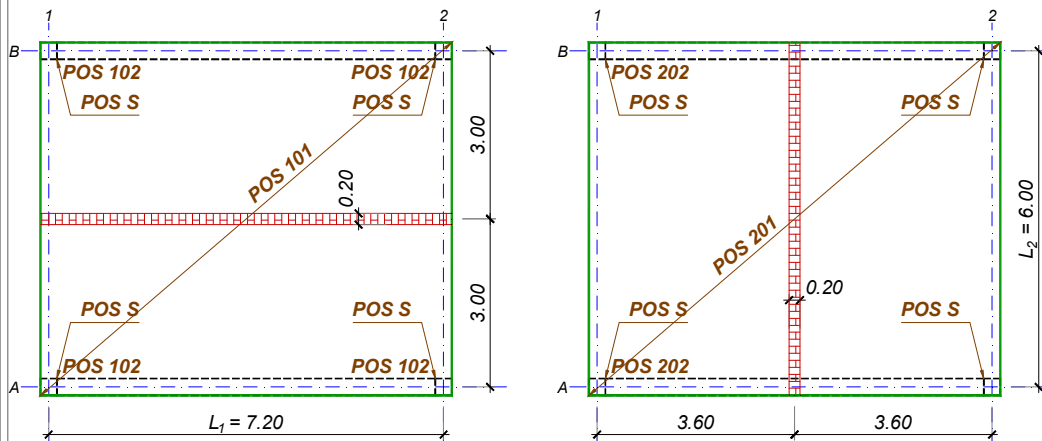


Ploča opterećena linijskim opterećenjem

1



2

Težine zidova od pune opeke (obostrano omalterisani):

zid »na kant« ($d=7$ cm): $g_7 = 1.70$ kN/m²

zid od 1/2 opeke ($d=12$ cm): $g_{12} = 2.60$ kN/m²

zid od cele opeke ($d=25$ cm): $g_{25} = 4.60$ kN/m²

Težine zidova od giter bloka (obostrano omalterisani):

zid $d=20$ cm: $g_{20} = 3.00 \div 3.20$ kN/m²

zid $d=25$ cm: $g_{25} = 3.70$ kN/m²

Težina projektovanog zida od giter bloka debljine 20 cm i visine $H_z = 4.0$ m je:

$$G_z = g_{20} \times H_z = 3.0 \times 4.0 = 12.0 \text{ kN/m}$$

1 PRORAČUN PLOČE POS 101

1.1 ANALIZA OPTEREĆENJA I PRORAČUN STATIČKIH UTICAJA

a. stalno opterećenje

- sopstvena težina ploče $d_p \times \gamma_b = 0.20 \times 25 = 5.0 \text{ kN/m}^2$
- dodatno stalno opterećenje $\Delta g = 1.5 \text{ kN/m}^2$
- ukupno, stalno opterećenje $g = 6.5 \text{ kN/m}^2$
- zid od giter bloka $G = g_{20} \times H_z = 3.0 \times 4.0 = 12.0 \text{ kN/m}^1$

b. povremeno opterećenje

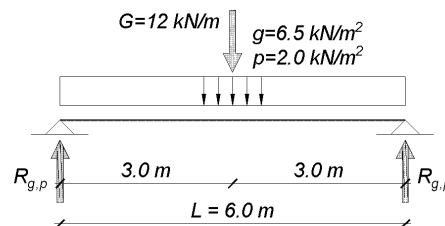
$$p = 2.0 \text{ kN/m}^2$$

$$M_g = \frac{6.5 \times 6.0^2}{8} + \frac{12.0 \times 6.0}{4} = 47.25 \frac{\text{kNm}}{\text{m}}$$

$$M_p = \frac{2.0 \times 6.0^2}{8} = 9.0 \frac{\text{kNm}}{\text{m}}$$

$$R_g = \frac{6.5 \times 6 + 12}{2} = 25.5 \frac{\text{kN}}{\text{m}}$$

$$R_p = \frac{2.0 \times 6}{2} = 6.0 \frac{\text{kN}}{\text{m}}$$



2 PRORAČUN PLOČE POS 201

2.1 ANALIZA OPTEREĆENJA I PRORAČUN STATIČKIH UTICAJA

Jednako raspodeljeno opterećenje koje deluje po čitavoj površini ploče je isto kao za ploču POS 101 i sračunato je u tački 1.1. Težina pregradnog zida se raspodeljuje upravno na pravac glavne armature na širinu b_3 u skladu sa članom 213. PBAB 87:

$$b_3 = b_2 + \frac{A_{ap}}{A_a} \times L \leq b_2 + 0.65 \times L$$

gde je b_2 širina rasprostiranja koncentrisanog opterećenja u srednjoj ravni ploče upravno na pravac glavne armature, A_a i A_{ap} površine poprečnog preseka glavne i podeone armature, a L raspon ploče.

Za usvojeni minimalni odnos $A_{ap}/A_a = 0.20$, sledi:

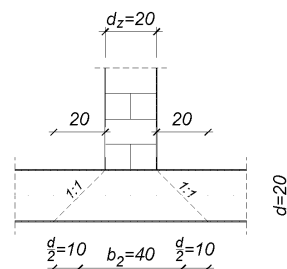
$$b_3 = 40 + 0.2 \times 600 = 160 \text{ cm}$$

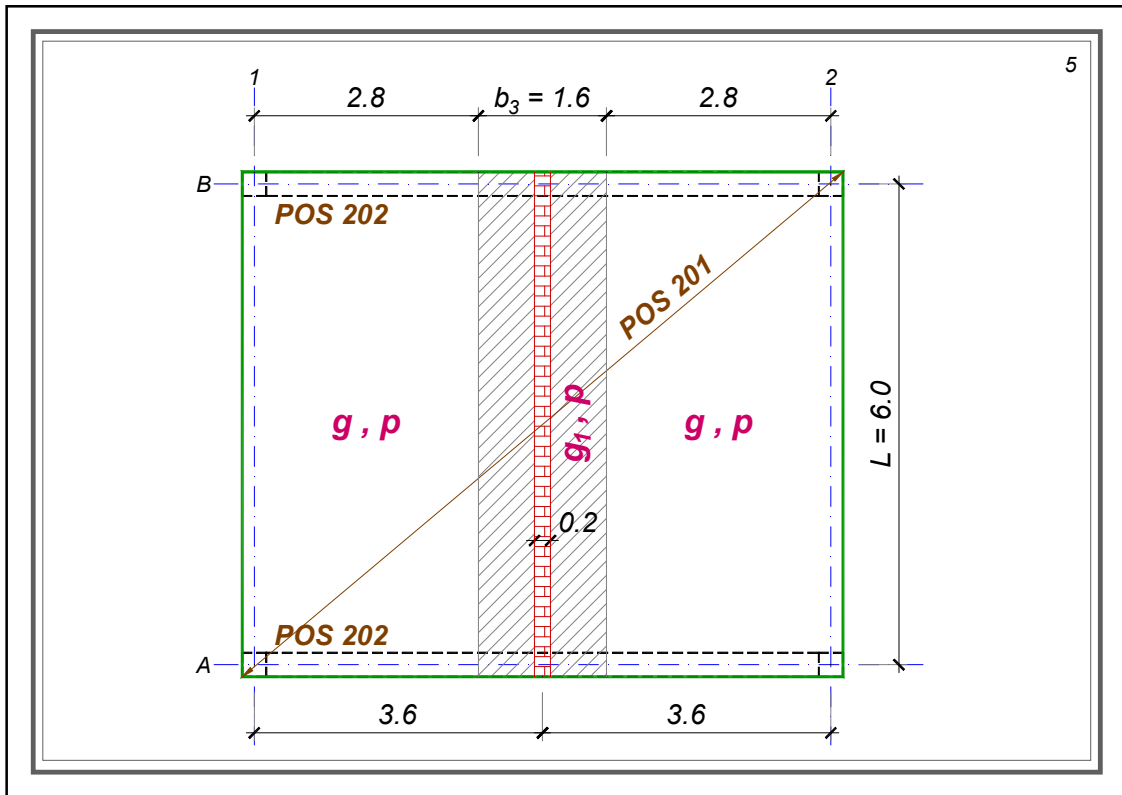
Stalno opterećenje u zoni zida (osenčeni deo ploče na skici, širine $b_3 = 1.6 \text{ m}$), je:

$$g_1 = g + \frac{G_z}{b_3} = 6.5 + \frac{12.0}{1.6} = 6.5 + 7.5 = 14 \frac{\text{kN}}{\text{m}^2}$$

dok je na ostalom delu ploče, ukupne širine $2 \times 2.8 = 5.6 \text{ m}$, opterećenje $g = 6.5 \text{ kN/m}^2$.

Povremeno opterećenje je konstantno po čitavoj površini ploče ($p = 2 \text{ kN/m}^2$).





6

2.1.1 Deo ploče u zoni zida (na širini $b_3 = 1.6$ m)

$$q_{u1} = 1.6 \times g_1 + 1.8 \times p = 1.6 \times 14.0 + 1.8 \times 2.0 = 26.0 \text{ kN/m}^2$$

$$M_{u1} = 26.0 \times 6.0^2 / 8 = 117.0 \text{ kNm/m}$$

$$R_{g1} = 14.0 \times 6.0 / 2 = 42.0 \text{ kN/m} \quad ; \quad R_p = 2.0 \times 6.0 / 2 = 6.0 \text{ kN/m}$$

2.1.2 Deo ploče izvan zone zida

$$q_u = 1.6 \times g + 1.8 \times p = 1.6 \times 6.5 + 1.8 \times 2.0 = 14.0 \text{ kN/m}^2$$

$$M_u = 14.0 \times 6.0^2 / 8 = 63.0 \text{ kNm/m}$$

$$R_g = 6.5 \times 6.0 / 2 = 19.5 \text{ kN/m} \quad ; \quad R_p = 2.0 \times 6.0 / 2 = 6.0 \text{ kN/m}$$

2.2 DIMENZIONISANJE PLOČE

2.2.1 Deo ploče u zoni zida (na širini $b_3 = 1.6$ m)

$$k = \frac{17}{\sqrt{\frac{117.0}{2.05}}} = 2.250 \Rightarrow \varepsilon_b/\varepsilon_a = 3.5/9.203\text{‰} ; \bar{\mu} = 22.305\%$$

$$A_{a,\text{potr.}} = 22.305 \times 17 \times \frac{2.05}{40} = 19.43 \frac{\text{cm}^2}{\text{m}} \Rightarrow \text{usv.: } R\emptyset 16/10 \text{ (20.10 cm}^2/\text{m)}$$

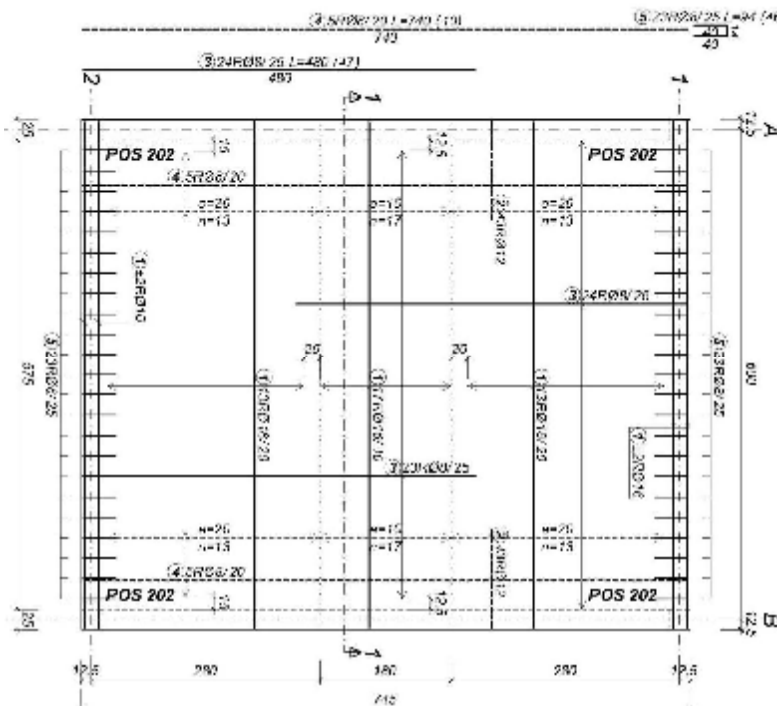
$$A_{ap} = 0.2 \times 19.43 = 3.89 \text{ cm}^2/\text{m} \Rightarrow \text{usv.: } R\emptyset 8/12.5 \text{ (4.02 cm}^2/\text{m)}$$

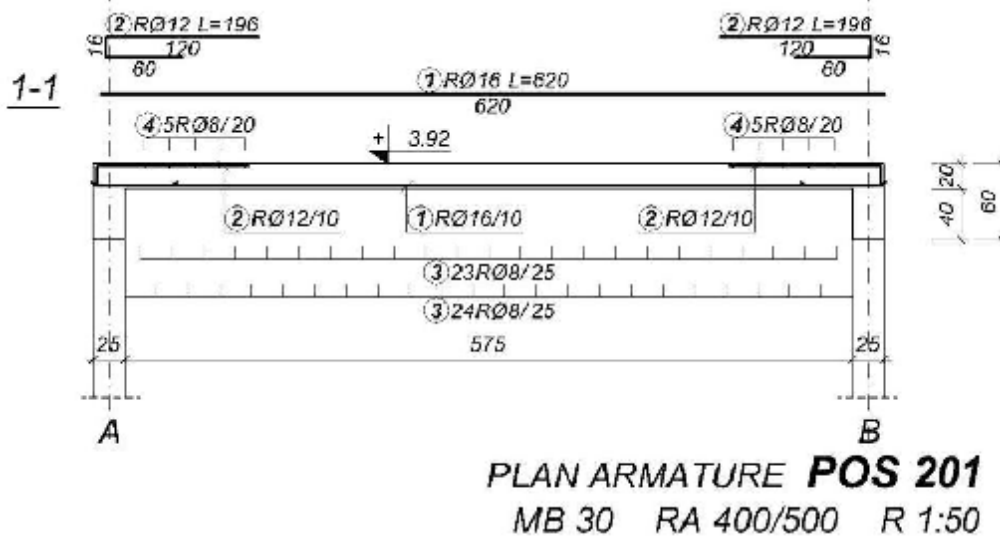
2.2.2 Deo ploče van zone zida

$$k = \frac{17}{\sqrt{\frac{63.0}{2.05}}} = 3.067 \Rightarrow \varepsilon_b/\varepsilon_a = 2.033/10\text{‰} ; \bar{\mu} = 11.355\%$$

$$A_{a,\text{potr.}} = 11.355 \times 17 \times \frac{2.05}{40} = 9.89 \frac{\text{cm}^2}{\text{m}} \Rightarrow \text{usv.: } R\emptyset 16/20 \text{ (10.05 cm}^2/\text{m)}$$

$$A_{ap} = 0.2 \times 9.89 = 1.98 \text{ cm}^2/\text{m} \Rightarrow \text{usv.: } R\emptyset 8/25 \text{ (2.01 cm}^2/\text{m)}$$





2.4 PRORAČUN GREDE POS 202

2.4.1 Analiza opterećenja i statički uticaji

a. stalno opterećenje u zoni zida ($b_3 = 1.6 \text{ m}$)

$$\begin{array}{ll} \text{sopstvena težina POS 202} & b \times d \times \gamma_b = 0.25 \times 0.6 \times 25 = 3.75 \text{ kN/m} \\ \text{od ploče POS 201} & R_g^{\text{POS 201}} = 42.00 \text{ kN/m} \end{array}$$

$$\text{ukupno, stalno opterećenje} \quad g_1 = 45.75 \text{ kN/m}$$

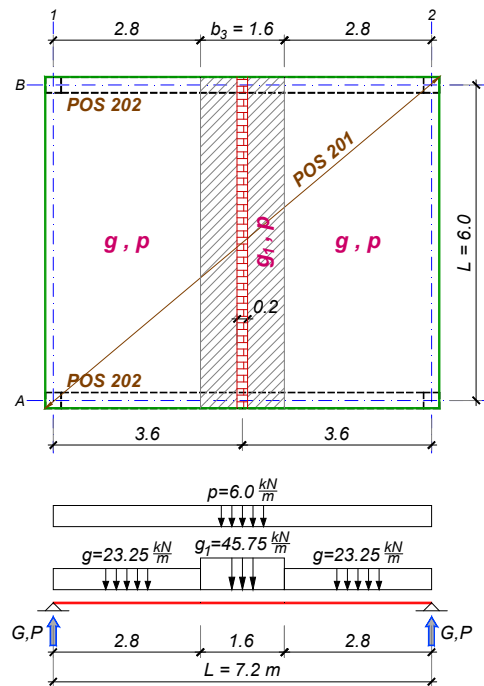
b. stalno opterećenje van zone zida

$$\begin{array}{ll} \text{sopstvena težina POS 202} & b \times d \times \gamma_b = 0.25 \times 0.6 \times 25 = 3.75 \text{ kN/m} \\ \text{od ploče POS 201} & R_g^{\text{POS 201}} = 19.50 \text{ kN/m} \end{array}$$

$$\text{ukupno, stalno opterećenje} \quad g = 23.25 \text{ kN/m}$$

c. povremeno opterećenje van zone zida

$$\text{od ploče POS 201} \quad R_p^{\text{POS 201}} = p = 6.00 \text{ kN/m}$$



$$G = 23.25 \times 2.8 + \frac{45.75 \times 1.6}{2} = 101.7 \text{ kN}$$

$$P = 6.0 \times 7.2 / 2 = 21.6 \text{ kN}$$

$$A_u = 1.61 \times 101.7 + 1.8 \times 21.6 = 201.6 \text{ kN}$$

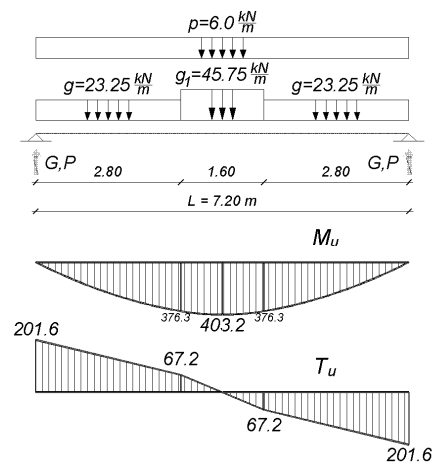
$$q_u = 1.6 \times 23.25 + 1.8 \times 6.0 = 48.0 \text{ kN/m}$$

$$q_{u1} = 1.6 \times 45.75 + 1.8 \times 6.0 = 84.0 \text{ kN/m}$$

$$T_{u1} = 201.6 - 84.0 \times 2.8 = 67.2 \text{ kN}$$

$$M_{u1} = 201.6 \times 2.8 - \frac{48.0 \times 2.8^2}{2} = 376.3 \text{ kNm}$$

$$M_u = 376.3 + 67.2 \times 0.8 - \frac{84.0 \times 0.8^2}{2} = 403.2 \text{ kNm}$$



2.4.2 Dimenzionisanje

$M_{u,max} = 403.2 \text{ kNm}$ (dijagram M_u , tačka 2.4.1)

$$B = \min. \left\{ \begin{array}{l} 0 + 25 + \frac{0.25}{3} \times 720 = 85 \\ 0 + 25 + 8 \times 20 = 185 \\ 600 / 2 = 300 \end{array} \right\} = 85 \text{ cm}$$

Pretpostavlja se da je neutralna linija u ploči, pa se presek dimenzioniše kao pravougaoni, širine $B = 85 \text{ cm}$:

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

$$k = \frac{53}{\sqrt{\frac{403.2 \times 10^2}{85 \times 2.05}}} = 3.484 \Rightarrow \varepsilon_b / \varepsilon_a = 1.679 / 10\text{‰} ; \bar{\mu} = 8.695\% ; s = 0.144$$

$$x = s \times h = 0.144 \times 53 = 7.6 \text{ cm} < d_p = 20 \text{ cm}$$

Pretpostavka o položaju neutralne linije je dobra, pa sledi:

$$A_a = 8.695 \times \frac{85 \times 53}{100} \times \frac{2.05}{40} = 20.07 \text{ cm}^2$$

usvojeno: **6 RØ22** (22.81 cm^2)

2.4.3 Kontrola glavnih napona zatezanja

$T_{u,max} = 201.6 \text{ kN}$ (dijagram T_u , tačka 2.4.1)

$$\tau_n^A = \frac{201.6}{25 \times 0.9 \times 53} = 0.169 \frac{\text{kN}}{\text{cm}^2} > \tau_r$$

$$\tau_n^B = \frac{67.2}{25 \times 0.9 \times 53} = 0.056 \frac{\text{kN}}{\text{cm}^2} < \tau_r$$

$$\lambda = \frac{1.69 - 1.1}{1.69 - 0.56} \times 280 = 146.7 \text{ cm}$$

$$\tau_{Ru}^A = \frac{3}{2} \times (0.169 - 0.11) = 0.089 \frac{\text{kN}}{\text{cm}^2}$$

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

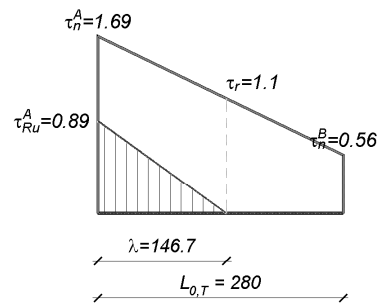
$$e_u = \frac{2 \times a_u^{(1)}}{25 \times 0.089} \times 40 \times (\cos 90^\circ + \sin 90^\circ \times \cot 45^\circ) = 36.1 \times a_u^{(1)}$$

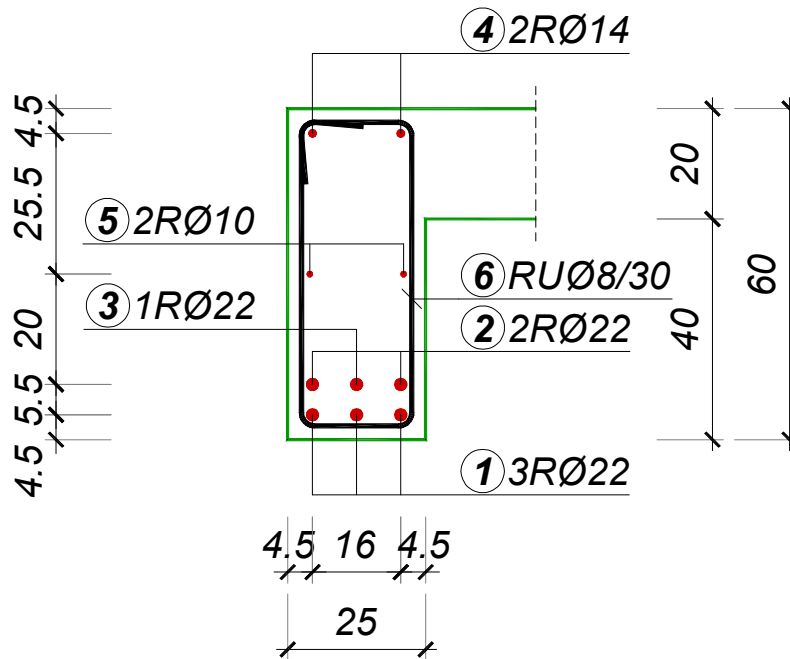
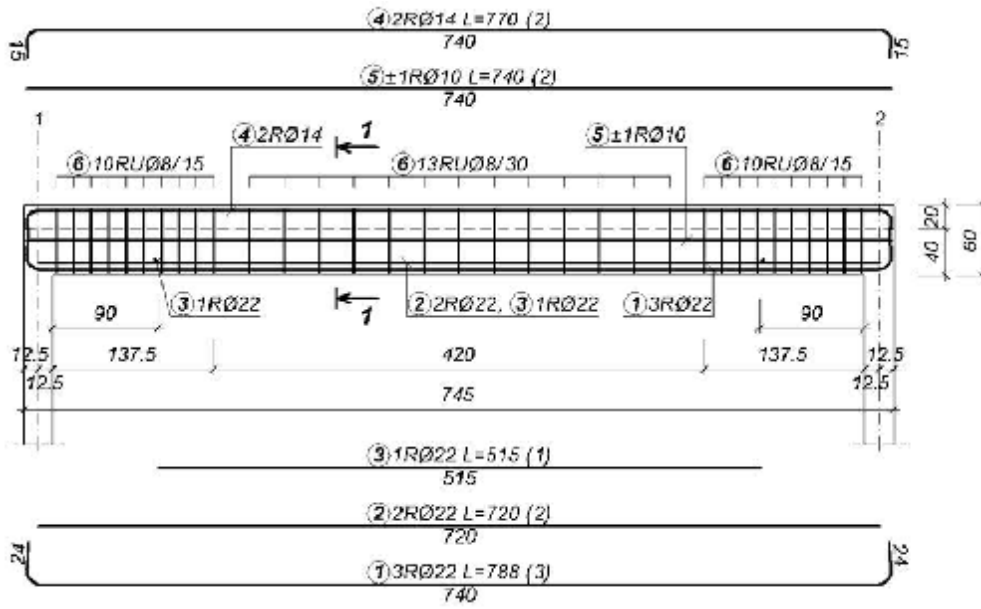
pretp. URØ8 ($a_u^{(1)} = 0.503 \text{ cm}^2$) $\Rightarrow e_u = 36.1 \times 0.503 = 18.2 \text{ cm}$

usvojeno: **URØ8/15** ($m=2$)

$$\Delta A_a = \frac{T_{mu}}{2\sigma_v} \times (\cot \theta - \cot \alpha) = \frac{201.6}{2 \times 40} \times (1 - 0) = 2.52 \text{ cm}^2$$

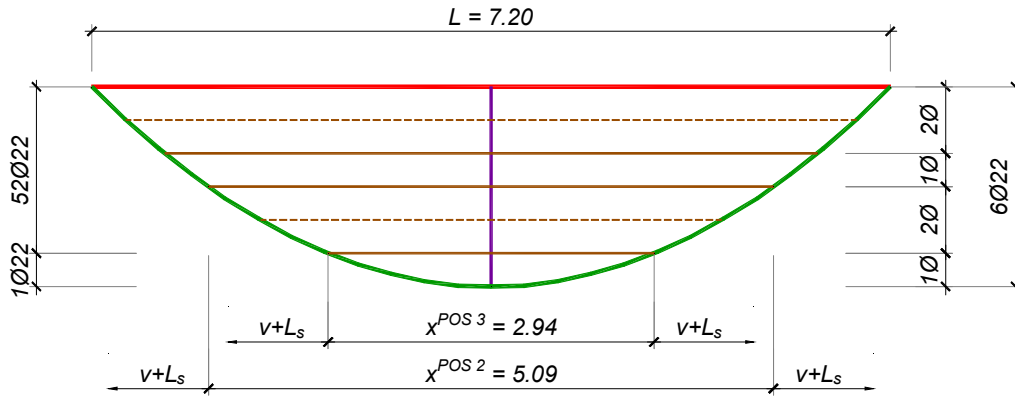
usvojeno: **2 RØ22** (7.60 cm^2)





Procena dužine šipki u donjoj zoni

17



Procena dužine šipki u donjoj zoni

18

$$x^{POS3} = L \times \sqrt{\frac{M_1}{M}} = L \times \sqrt{\frac{1\emptyset22}{6\emptyset22}} = 7.20 \times \sqrt{\frac{1}{6}} = 2.94 \text{ m}$$

$$v + L_s = v + L_{s1} = 0.75 \times h + L_{s1} \approx 40 + 31.75 \times 2.2 \approx 110 \text{ cm}$$

$$L^{POS3} \approx v + L_s + x^{POS3} + v + L_s = 110 + 294 + 110 = 514 \approx 515 \text{ cm}$$

$$x^{POS2} = L \times \sqrt{\frac{M_2}{M}} = L \times \sqrt{\frac{3\emptyset22}{6\emptyset22}} = 7.20 \times \sqrt{\frac{1}{2}} = 5.09 \text{ m}$$

$$L^{POS2} \approx v + L_s + x_2 + v + L_s = 110 + 509 + 110 = 729 \text{ cm}$$