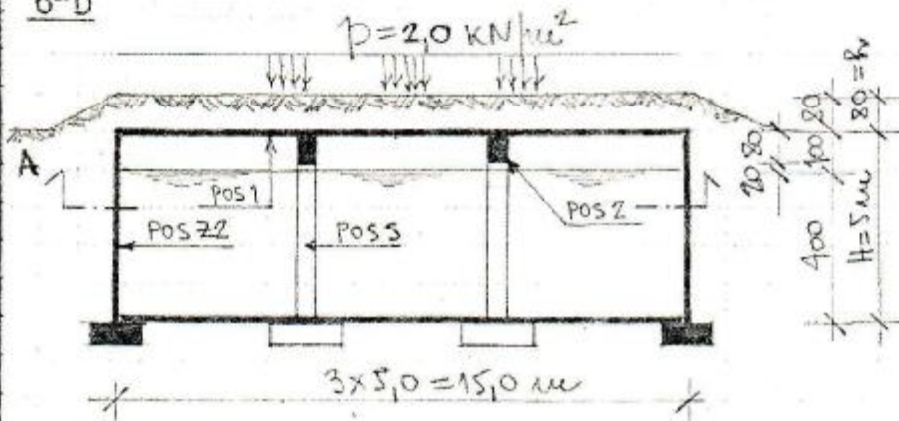


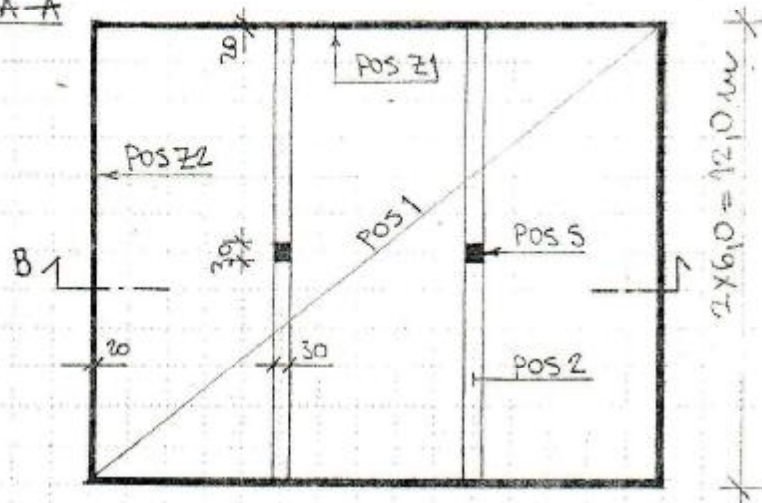
B-B

22.12.1990.

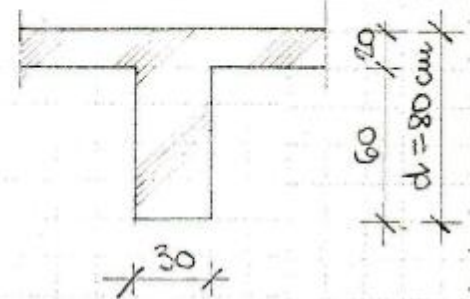


MB 35 RA 400/500 $\gamma_z = 18 \text{ kN/m}^3$ $\varphi = 30^\circ$ $p = 2,0 \text{ kN/m}^2$ $\gamma_w = 10 \text{ kN/m}^3$
---

A-A

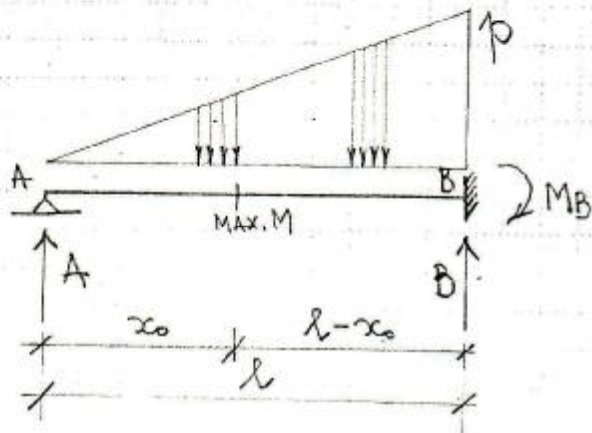


POS 2



ЗА КОНСТРУКЦИЈУ РЕЗЕРВОАРА ПРИКАЗАНО НА СКИЦИ ПОТРЕБНО ЈЕ :

1. НАЦРТАТИ ДИЈАГРАМЕ СТАТИЧКИХ УТИЦАЈА ЗА ПЛОЧУ POS 1 ( $d=20 \text{ cm}$ ) И ДИМЕНЗИОНИСАТИ ЈЕ У КАРАКТЕРИСТИЧНИМ ПРЕСЕЦИМА. УСВОЈЕНИ РАСПОРЕД АРМАТУРЕ ПРИКАЗАТИ У ПРЕСЕКУ У ПОГODНОЈ РАЗМЕРИ.
2. НАЦРТАТИ ДИЈАГРАМЕ СТАТИЧКИХ УТИЦАЈА И ДИМЕНЗИОНИСАТИ У КАРАКТЕРИСТИЧНИМ ПРЕСЕЦИМА ГРЕДУ POS 2 ПРЕМА М И Т.
3. ИЗВРШИТИ АНАЛИЗУ ОПТЕРЕЂЕЊА И НАЦРТАТИ ДИЈАГРАМЕ СТАТИЧКИХ УТИЦАЈА ЗА POS 22 ( $d=20 \text{ cm}$ ) ЗА СЛУЧАЈ :
  - ПРАЗНОГ ЗАТРПАНОГ РЕЗЕРВОАРА
  - ПУНОГ НЕЗАТРПАНОГ РЕЗЕРВОАРА
 А ЗАТИМ ОДРЕДИТИ ПОТРЕБНУ ПОВРШИНУ АРМАТУРЕ ЗИДА У КАРАКТЕРИСТИЧНИМ ПРЕСЕЦИМА ПРЕМА МЕРОДАВНИМ УТИЦАЈИМА. НАЦРТАТИ ПЛАН АРМАТУРЕ ЗИДА У Р 1:20 (1:25) И ОЗНАЧИТИ СВЕ ПОТРЕБНЕ ЕЛЕМЕНТЕ. ОБУХВАТИТИ БЕЗУ СА ТЕМЕЉОМ.
4. ДИМЕНЗИОНИСАТИ POS 3 ( $b/d=30/30 \text{ cm}$ ) ПО ТЕОРИЈИ ГРАНИЧНЕ НОСИВОСТИ.
5. ОДРЕДИТИ КАРАКТЕРИСТИЧНУ ШИРИНУ ПРСЛИНА ЗА POS 2 (ОСЛОНАЦ)



$$A = \frac{1}{10} \cdot p \cdot l$$

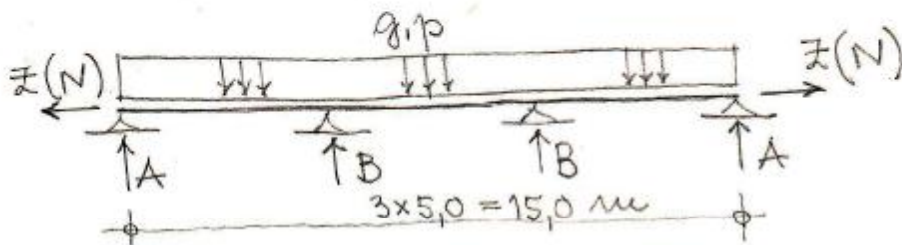
$$B = \frac{2}{5} \cdot p \cdot l$$

$$M_B = \frac{1}{15} \cdot p \cdot l^2 = \text{MIN. } M$$

$$\text{MAX. } M = \frac{1}{\sqrt{5}} \cdot |M_B| = \frac{1}{15 \cdot \sqrt{5}} \cdot p \cdot l^2$$

$$(x_0 = \frac{l}{\sqrt{5}})$$

# POS 1 - ПЛОЧА



- СОПСТВЕНА ТЕЖИНА ПЛОЧЕ:  $0,20 \cdot 25,0 = 5,0 \text{ kN/m}^2$

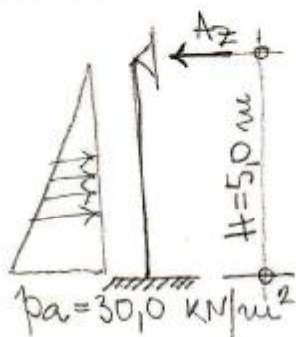
$$q = 5,0 \text{ kN/m}^2$$

- ТЕЖИНА ЗЕМЉЕ:  $0,80 \cdot 18,0 = 14,40 \text{ kN/m}^2$

- ПОВРЕМЕНО ОПТЕРЕЂЕЊЕ:  $2,00 \text{ kN/m}^2$

$$p = 16,40 \text{ kN/m}^2$$

НОРМАЛНА СИЛА ЗАТЕЗАЊА (ОД ВОДЕ) ОДНОСНО ПРИТИСКА (ОД ДЕЈСТВА ТЛА) СУ РЕАКЦИЈЕ ЗИДА POS E2:

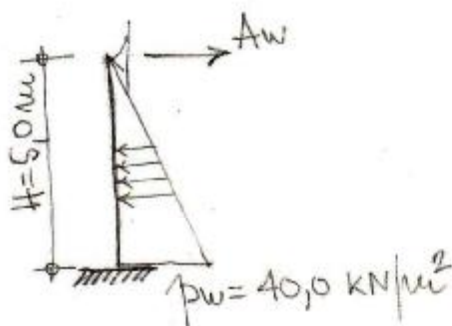
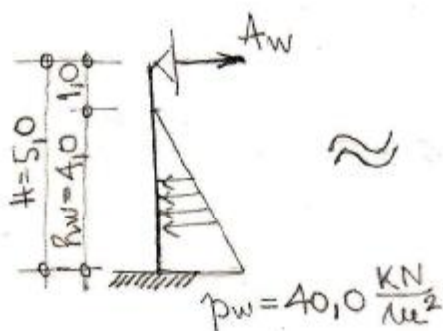


АКТИВНИ ПРИТИСАК ТЛА:

$$p_a = \gamma_z \cdot H \cdot \tan^2\left(45^\circ - \frac{\varphi}{2}\right)$$

$$p_a = 18,0 \cdot 5,0 \cdot \tan^2\left(45^\circ - \frac{30^\circ}{2}\right) = 30,0 \text{ kN/m}^2$$

$$A_z = \frac{1}{10} \cdot p_a \cdot H = \frac{1}{10} \cdot 30,0 \cdot 5,0 = 15,0 \text{ kN/m}^1$$



$$p_{w, \max} \cdot p_w = p_w \cdot \gamma_w = 4,0 \cdot 10,0 = 40,0 \text{ kN/m}^2$$

$$A_w \approx \frac{1}{10} \cdot p_w \cdot H = \frac{1}{10} \cdot 40,0 \cdot 5,0 = 20,0 \text{ kN/m}^1$$

$$\begin{aligned} x &= A_w = 20,0 \text{ kN/m}^1 \\ N &= A_z = 15,0 \text{ kN/m}^1 \end{aligned}$$

(ЗАТЕЗАЊЕ У ПЛОЧИ)

(ПРИТИСАК У ПЛОЧИ)

ЗА ДИМЕНЗИОНИСАЊЕ АРМАТУРЕ ПЛОЧЕ МЕРОДАВНА ЈЕ СИЛА ЗАТЕЗАЊА  $x = 20,0 \text{ kN/m}^1 = \text{const}$ .

a) СТАЛНО ОПТЕРЕЋЕЊЕ

$$A_g = 0,4 \cdot 5,0 \cdot 5,0 = 10,0 \text{ kN/m}^1$$

$$B_g = 1,1 \cdot 5,0 \cdot 5,0 = 27,5 \text{ kN/m}^1$$

$$M_1 = -0,10 \cdot 5,0 \cdot 5,0^2 = -12,5 \text{ kNm/m}^1$$

$$M_{01} = 0,08 \cdot 5,0 \cdot 5,0^2 = 10,0 \text{ kNm/m}^1$$

$$M_{12} = 0,025 \cdot 5,0 \cdot 5,0^2 = 3,13 \text{ kNm/m}^1$$

б) ПОВРЕМЕНО ОПТЕРЕЋЕЊЕ

$$A_p = 0,4 \cdot 16,4 \cdot 5,0 = 32,8 \text{ kN/m}^1$$

$$B_p = 1,1 \cdot 16,4 \cdot 5,0 = 90,2 \text{ kN/m}^1$$

$$M_1 = -0,10 \cdot 16,40 \cdot 5,0^2 = -41,0 \text{ kNm/m}^1$$

$$M_{01} = 0,08 \cdot 16,40 \cdot 5,0^2 = 32,8 \text{ kNm/m}^1$$

$$M_{12} = 0,025 \cdot 16,40 \cdot 5,0^2 = 10,25 \text{ kNm/m}^1$$

$$Z_w = 20,0 \text{ kN/m}^1 = \text{CONST.}$$

ДИМЕНЗИОНИСАЊЕ

- ОСЛОЖАЊА:

$$M_{uc} = 1,6 \cdot 12,50 + 1,8 \cdot 41,0 = 93,8 \text{ kNm/m}^1$$

$$Z_{uc} = 1,8 \cdot 20,0 = 36,0 \text{ kN/m}^1$$

$$b/d/r_s = 100/20/17 \text{ cm}$$

$$M_{all} = 93,80 - 36,0 \cdot \left( \frac{0,20}{2} - 0,03 \right) = 91,28 \text{ kNm/m}^1$$

$$k = \frac{17,0}{\sqrt{\frac{91,28}{2,3}}} = 2,699 \quad \longrightarrow \quad \begin{aligned} \epsilon_b/\epsilon_a &= 2,525/10\% \\ \bar{\mu} &= 14,837\% \end{aligned}$$

$$A_a = 14,837 \cdot 17,0 \cdot \frac{2,30}{40,0} + \frac{36,0}{40,0} = 15,40 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО:  $\boxed{R\phi 16/12,5}$  (16,09 cm<sup>2</sup>/m<sup>1</sup>)

$$A_{ap} = 0,20 \cdot 15,40 = 3,08 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО:  $\boxed{R\phi 10/25}$  (3,14 cm<sup>2</sup>/m<sup>1</sup>)

- КРАЙНЕ ПОЛЪЕ

$$M_u = 1,6 \cdot 10,0 + 1,8 \cdot 32,8 = 75,04 \text{ kNm/m}^1$$

$$Z_u = 36,0 \text{ kN/m}^1$$

$$M_{au} = 75,04 - 36,0 \cdot \left( \frac{0,20}{2} - 0,03 \right) = 72,52 \text{ kNm/m}^1$$

$$k_v = \frac{17,0}{\sqrt{\frac{72,52}{2,30}}} = 3,027 \longrightarrow \varepsilon_b / \varepsilon_a = 2,075 / 10\%$$

$$\bar{\mu} = 11,663\%$$

$$A_a = 11,663 \cdot 17,0 \cdot \frac{2,30}{40,0} + \frac{36,0}{40,0} = 12,30 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО:  $\boxed{R\phi 14/12,5}$  (12,32 cm<sup>2</sup>/m<sup>1</sup>)

$$A_{ap} = 0,20 \cdot 12,30 = 2,46 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО:  $\boxed{R\phi 8/20}$  (2,51 cm<sup>2</sup>/m<sup>1</sup>)

- СРЕДНЕ ПОЛЪЕ

$$M_u = 1,6 \cdot 3,13 + 1,8 \cdot 10,25 = 23,45 \text{ kNm/m}^1$$

$$q_u = 1,6 \cdot 5,0 + 1,8 \cdot 16,40 = 37,52 \text{ kN/m}^2$$

$$\text{MIN. } M_{2,u} = q_u \cdot l^2 / 24 = 37,52 \cdot 5,0^2 / 24 = 39,08 \text{ kNm/m}^1$$

$$Z_u = 1,8 \cdot 20,0 = 36,0 \text{ kN/m}^1$$

$$M_{au} = 39,08 - 36,0 \cdot \left( \frac{0,20}{2} - 0,03 \right) = 36,56 \text{ kNm/m}^1$$

$$k_v = \frac{17,0}{\sqrt{\frac{36,56}{2,30}}} = 4,264 \longrightarrow \varepsilon_b / \varepsilon_a = 1,275 / 10\%$$

$$\bar{\mu} = 5,677\%$$

$$A_a = 5,677 \cdot 17,0 \cdot \frac{2,30}{40,0} + \frac{36,0}{40,0} = 6,45 \text{ cm}^2/\text{m}^1$$

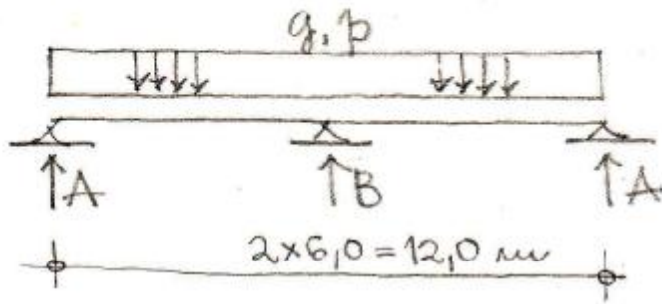
УСВОЈЕНО:  $\boxed{R\phi 10/12,5}$  (6,28 cm<sup>2</sup>/m<sup>1</sup>)

$$\Delta = \frac{6,28 - 6,45}{6,45} \cdot 100\% = -2,58\% < 3\%$$

$$A_{ap} = 0,20 \cdot 6,45 = 1,29 \text{ cm}^2/\text{m}^1$$

$$\text{MIN. } A_{ap} = 0,085 \cdot 20,0 = 1,70 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО:  $\boxed{R\phi 8/25}$  (2,01 cm<sup>2</sup>/m<sup>1</sup>)



- СОПСТВЕНА ТЕЖИНА:  $(0,80 - 0,20) \cdot 0,30 \cdot 25,0 = 4,50 \text{ kN/m}^1$   
 - ОД ПЛОЧЕ POS 1:  $B_g = 27,50 \text{ kN/m}^1$

$g = 32,0 \text{ kN/m}^1$
$p = 90,2 \text{ kN/m}^1$

- ПОВРЕМЕНО ОПТЕРЕТЕЊЕ ОД POS 1:

$B_p =$

$p = 90,2 \text{ kN/m}^1$
---------------------------

а) СТАЛНО ОПТЕРЕТЕЊЕ

$$M_0^g = -\frac{1}{8} \cdot 32,0 \cdot 6,0^2 = 144,0 \text{ kNm}$$

$$M_{01}^g = \frac{9}{128} \cdot 32,0 \cdot 6,0^2 = 81,0 \text{ kNm}$$

$$A_g = 0,375 \cdot 32,0 \cdot 6,0 = 72,0 \text{ kN}$$

$$B_g = 1,25 \cdot 32,0 \cdot 6,0 = 240,0 \text{ kN}$$

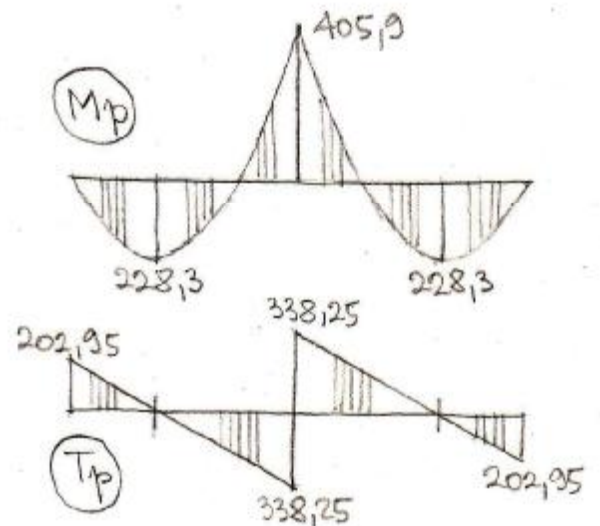
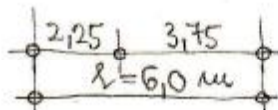
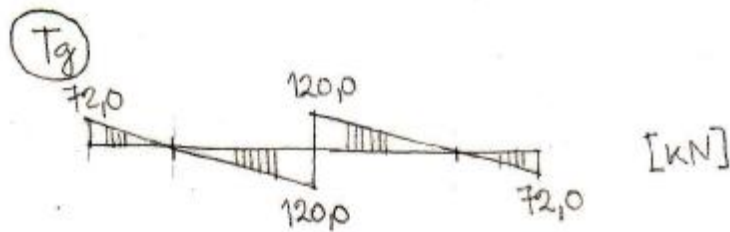
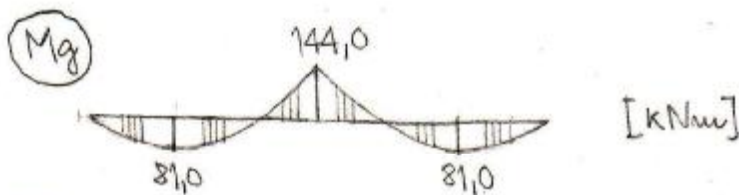
б) ПОВРЕМЕНО ОПТЕРЕТЕЊЕ

$$M_0^p = -\frac{1}{8} \cdot 90,2 \cdot 6,0^2 = 405,9 \text{ kNm}$$

$$M_{01}^p = \frac{9}{128} \cdot 90,2 \cdot 6,0^2 = 228,3 \text{ kNm}$$

$$A_p = 0,375 \cdot 90,2 \cdot 6,0 = 202,95 \text{ kN}$$

$$B_p = 1,25 \cdot 90,2 \cdot 6,0 = 676,5 \text{ kN}$$



ДИМЕНЗИОНИСАЊЕ

$$M_u = 1,6 \cdot 144,0 + 1,8 \cdot 405,9 = 961,02 \text{ kNm}$$

$$b/d/h = 30/80/72 \text{ cm}$$

$$k = \frac{72,0}{\sqrt{\frac{961,02}{0,30 \cdot 2,30}}} = 1,929 \longrightarrow \varepsilon_b/\varepsilon_a = 3,5/5,3\%$$

$$\bar{\mu} = 32,196\%$$

$$A_{ay} = 32,196 \cdot \frac{30,0 \cdot 72,0}{100} \cdot \frac{2,30}{40} = 39,99 \text{ cm}^2$$

УСВОЈЕНО 8R $\varnothing$ 25 (39,27 cm<sup>2</sup>)

ПОБЕ

$$M_{ue} = 1,6 \cdot 81,0 + 1,8 \cdot 228,3 = 540,57 \text{ kNm}$$

$$B = \min \left\{ \begin{array}{l} 30 + 20 \cdot 20 = 430 \text{ cm} \\ 30 + 0,25 \cdot 0,75 \cdot 600 = 142,5 \text{ cm} \\ 500 \text{ cm} \end{array} \right\} = 142,5 \text{ cm}$$

$$B/d/h = 142,5/80/75 \text{ cm}$$

$$k = \frac{75,0}{\sqrt{\frac{540,57 \cdot 10^2}{142,5 \cdot 2,30}}} = 5,840 \longrightarrow \varepsilon_b/\varepsilon_a = 0,875/10\%$$

$$\delta = 0,080$$

$$\bar{\mu} = 3,007\%$$

$$\delta \cdot h = 0,080 \cdot 75,0 = 6,0 \text{ cm} < 20,0 \text{ cm} = d_p$$

$$A_a = 3,007 \cdot \frac{142,5 \cdot 75,0}{100} \cdot \frac{2,30}{40,0} = 18,48 \text{ cm}^2$$

УСВОЈЕНО 4R $\varnothing$ 25 (19,64 cm<sup>2</sup>)

КОНТРОЛ ГЛАВНИХ НАПОНА ЗАТЕЗАЊА

$$T_{u1}^1 = 1,6 \cdot 120,0 + 1,8 \cdot 338,25 = 800,85 \text{ kN}$$

$$T_{tr}^1 = \frac{800,85}{30,0 \cdot 0,9 \cdot 72,0} = 0,412 \text{ kN/cm}^2 > 3T_c = 0,36 \text{ kN/cm}^2$$

$$< 5T_c = 0,60 \text{ kN/cm}^2$$

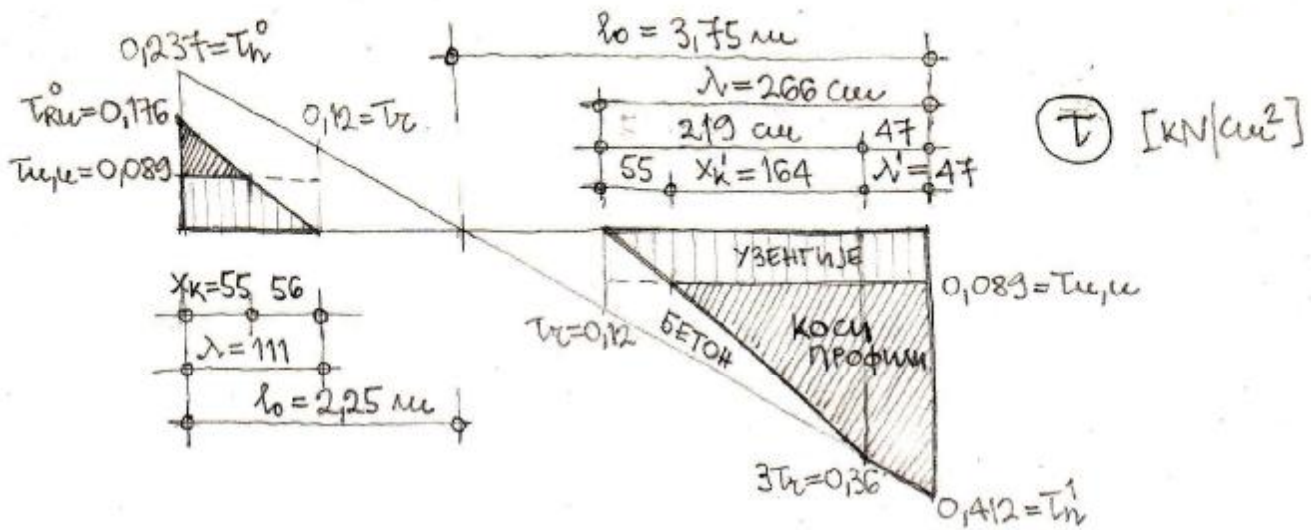
$$T_{u0}^0 = 1,6 \cdot 72,0 + 1,8 \cdot 202,95 = 480,51 \text{ kN}$$

$$T_{tr}^0 = \frac{480,81}{30,0 \cdot 0,9 \cdot 75,0} = 0,237 \text{ kN/cm}^2 > T_c = 0,12 \text{ kN/cm}^2$$

$$< 3T_c$$

$$T_{ru}^0 = \frac{3}{2} \cdot (0,237 - 0,12) = 0,176 \text{ kN/cm}^2$$

$$T_{bu} = \frac{1}{2} \cdot (3 \cdot 0,12 - 0,237) \cdot 30,0 \cdot 0,9 \cdot 75,0 = 124,2 \text{ kN}$$



УСВОЈЕНО:  $UR\phi 8$  ( $a_{ei}^{(1)} = 0,503 \text{ cm}^2$ );  $m_r = 2$ ;  $\theta = 45^\circ$ ;  $\alpha = 90^\circ$ :

$$e_u \leq \frac{m \cdot a_{ei}^{(1)}}{b \cdot \min(\mu_{uz})} = \frac{2 \cdot 0,503}{30,0 \cdot 0,2 \cdot 10^{-2}} = 16,75 \text{ cm}$$

УСВОЈЕНО  $UR\phi 8/15$  ( $m_r = 2$ )

$$T_{u,\mu} = \frac{2 \cdot 0,503}{30,0 \cdot 15,0} \cdot 40,0 = 0,089 \text{ KN/cm}^2$$

— КРАЈЊИ ОСЛОНАЦИ

$$\lambda = \lambda_0 \cdot \left(1 - \frac{T_c}{T_n^0}\right) = 225,0 \cdot \left(1 - \frac{0,12}{0,237}\right) = 111,0 \text{ cm}$$

$$x_k = \lambda \cdot \left(1 - \frac{T_{u,\mu}}{T_{ku}^0}\right) = 111,0 \cdot \left(1 - \frac{0,089}{0,176}\right) = 55,0 \text{ cm}$$

$$H_{u,k} = \frac{0,176 - 0,089}{2} \cdot 55,0 \cdot 30,0 = 71,1 \text{ KN}$$

$$A_{ak} = \frac{71,1}{40,0 \cdot \sqrt{2}} = 1,26 \text{ cm}^2 \quad (\alpha_k = 45^\circ)$$

УСВОЈЕНО  $2R\phi 25$  ( $9,82 \text{ cm}^2$ )

$$\Delta A_a = \frac{T_{mu}}{2b_v} (\text{ctg } \theta - \text{ctg } \alpha)$$

$$T_{mu} = T_{be} + T_{u,\mu} = 124,2 + 0,089 \cdot 30,0 \cdot 0,9 \cdot 75,0 = 304,47 \text{ KN}$$

$$\Delta A_a = \frac{304,47}{2 \cdot 40,0} (\text{ctg } 45^\circ - \text{ctg } 90^\circ) = 3,81 \text{ cm}^2$$

УСВОЈЕНО  $2R\phi 25$  ( $9,82 \text{ cm}^2$ )



СРЕДЊИ ОСЛОЊАЊ

$$\lambda = 375,0 \cdot \left(1 - \frac{0,12}{0,412}\right) = 266,0 \text{ см} \quad (\Delta E O \text{ ГДЕ JE } T_n > T_c)$$

$$\lambda' = 375,0 \cdot \left(1 - \frac{3 \cdot 0,12}{0,412}\right) = 47,0 \text{ см} \quad (\Delta E O \text{ ГДЕ JE } T_n > 3T_c)$$

$$x_k' = (\lambda - \lambda') \left(1 - \frac{T_{c,u}}{3T_c}\right) = 219,0 \cdot \left(1 - \frac{0,089}{3 \cdot 0,12}\right) = 164,0 \text{ см}$$

$$x_k = x_k' + \lambda' = 164,0 + 47,0 = 211,0 \text{ см}$$

$$H_{u,k} = \left[ \frac{3 \cdot 0,12 - 0,089}{2} \cdot 164,0 + \left( \frac{0,412 + 3 \cdot 0,12}{2} - 0,089 \right) \cdot 47,0 \right] \cdot 30,0$$

$$H_{u,k} = 1087,6 \text{ kN}$$

$$\alpha_k = 45^\circ \rightarrow A_{sk} = \frac{1087,6}{40,0 \cdot \sqrt{2}} = 19,23 \text{ см}^2$$

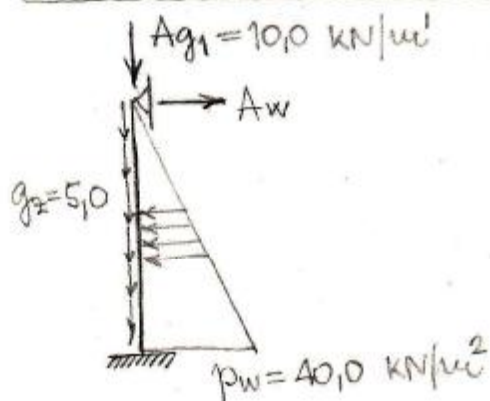
УСВОЈЕНО 4R $\varnothing$ 25 (19,64 см<sup>2</sup>)

POS 2

- СОПСТВЕНА ТЕЖИНА ЗИДА:  $0,20 \cdot 25,0 = 5,0 \text{ kN/m}^2$

ЗА ОБА СЛУЧАЈА (ПУН ОТКОПАИ И ПРАЗАН ЗАТРПАИ РЕЗЕРВОАР) СМАТРАМО ДА НЕМА ЗЕМЉЕ И КОРИСНОГ ОПТЕРЕЂЕЊА  $p = 2,0 \text{ kN/m}^2$  НА ПЛОЧИ (МИНИМАЛНА НОРМАЛНА СИЛА)

а) ПУН ОТКОПАИ РЕЗЕРВОАР



$$A_w = \frac{1}{10} \cdot 40,0 \cdot 5,0 = 20,0 \text{ kN/m}^1$$

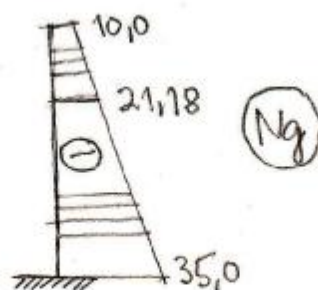
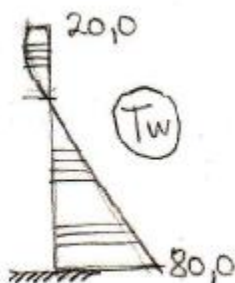
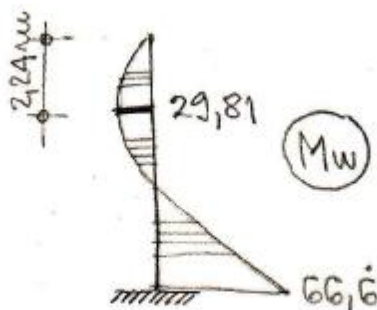
$$B_w = \frac{2}{5} \cdot 40,0 \cdot 5,0 = 80,0 \text{ kN/m}^1$$

$$M_w^0 = \frac{40,0 \cdot 5,0^2}{15} = 66,6 \text{ kNm/m}^1$$

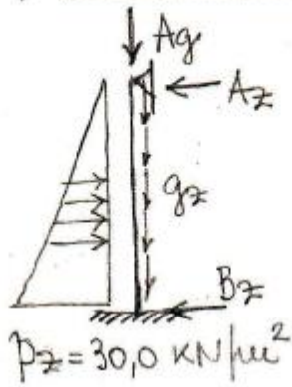
$$M_w^p = \frac{40,0 \cdot 5,0^2}{15 \cdot \sqrt{5}} = 29,81 \text{ kNm/m}^1$$

$$N_g^0 = 10,0 + 5,0 \cdot 5,0 = 35,0 \text{ kN/m}^1$$

$$N_g^p = 10,0 + 5,0 \cdot 2,24 = 21,18 \text{ kN/m}^1$$



### 5) ПРАЗАН ЗАТРПААН РЕЗЕРВОАР

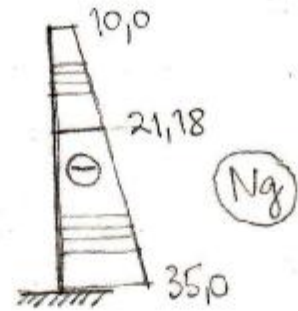
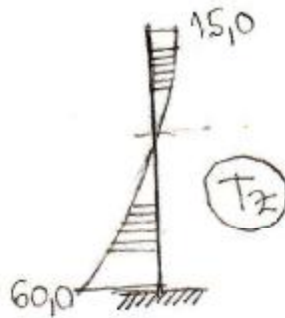
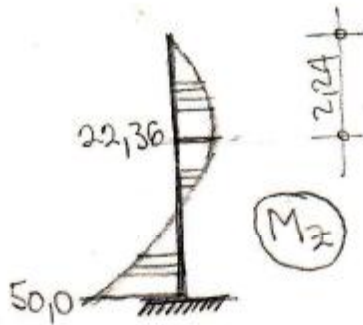


$$M_z^o = \frac{30,0 \cdot 5,0^2}{15} = 50,0 \text{ kNm/m}^1$$

$$M_z^p = \frac{30,0 \cdot 5,0^2}{15 \cdot \sqrt{2}} = 22,36 \text{ kNm/m}^1$$

$$A_z = \frac{1}{10} \cdot 30,0 \cdot 5,0 = 15,0 \text{ kN/m}^1$$

$$B_z = \frac{2}{5} \cdot 30,0 \cdot 5,0 = 60,0 \text{ kN/m}^1$$



### ДИМЕНЗИОНИСАЊЕ

#### а) ОСЛОЊАЦ

СПОЉНА ИВНИЦА:

$$M_u = 1,8 \cdot 50,0 = 90,0 \text{ kNm/m}^1$$

$$N_u = 1,0 \cdot 35,0 = 35,0 \text{ kN/m}^1$$

$$b/d/h = 100/20/17 \text{ cm}$$

$$M_{au} = 90,0 + 35,0 \cdot \left( \frac{0,20}{2} - 0,03 \right) = 92,45 \text{ kNm}$$

$$k = \frac{17,0}{\sqrt{\frac{92,45}{2,30}}} = 2,681 \longrightarrow \varepsilon_b/\varepsilon_a = 2,575/10\%$$

$$\mu = 15,176\%$$

$$A_a = 15,176 \cdot 17,0 \cdot \frac{2,30}{40,0} - \frac{35,0}{40,0} = 13,96 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО  $\boxed{R\varnothing 14/10}$  (15,39 cm<sup>2</sup>/m<sup>1</sup>)

$$A_{ap} = 0,20 \cdot 13,96 = 2,79 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО  $\boxed{R\varnothing 10/25}$  (3,14 cm<sup>2</sup>/m<sup>1</sup>)

УНУТРАШЊА ИВИЦА:

$$M_{ue} = 1,8 \cdot 66,6 = 120,0 \text{ kNm/m}^1$$

$$N_{ue} = 35,0 \text{ kN/m}^1$$

$$M_{aue} = 120,0 + 35,0 \cdot \left( \frac{0,20}{2} - 0,03 \right) = 122,45 \text{ kNm/m}^1$$

$$k = \frac{17,0}{\sqrt{\frac{122,45}{2,30}}} = 2,330 \longrightarrow \varepsilon_b / \varepsilon_a = 3,425 / 10 \%$$

$$\bar{\mu} = 20,546 \%$$

$$A_a = 20,546 \cdot 17,0 \cdot \frac{2,30}{40,0} - \frac{35,0}{40,0} = 19,21 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО  $R\phi 16/10$  (20,10 cm<sup>2</sup>/m<sup>1</sup>)

$$A_{ap} = 0,20 \cdot 19,21 = 3,84 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО  $R\phi 12/25$  (4,52 cm<sup>2</sup>/m<sup>1</sup>)ПРЕСЕК У ПОЉУ

СПОЉНА ИВИЦА:

$$M_{ue} = 1,8 \cdot 29,81 = 53,67 \text{ kNm/m}^1$$

$$N_{ue} = 1,0 \cdot 21,18 = 21,18 \text{ kN/m}^1$$

$$M_{aue} = 53,67 + 21,18 \cdot \left( \frac{0,20}{2} - 0,03 \right) = 55,15 \text{ kNm/m}^1$$

$$k = \frac{17,0}{\sqrt{\frac{55,15}{2,30}}} = 3,472 \longrightarrow \varepsilon_b / \varepsilon_a = 1,7 / 10 \%$$

$$\bar{\mu} = 8,851 \%$$

$$A_a = 8,851 \cdot 17,0 \cdot \frac{2,30}{40,0} - \frac{21,18}{40,0} = 8,12 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО  $R\phi 12/10$  (11,31 cm<sup>2</sup>/m<sup>1</sup>)

$$A_{ap} = 0,20 \cdot 8,12 = 1,62 \text{ cm}^2/\text{m}^1$$

$$\text{MIN. } A_{ap} = 0,085 \cdot 20,0 = 1,70 \text{ cm}^2/\text{m}^1$$

УСВОЈЕНО  $R\phi 8/25$  (2,01 cm<sup>2</sup>/m<sup>1</sup>)

УНУТРАШЊА ИВИЦА:

$$M_{ue} = 1,8 \cdot 22,36 = 40,25 \text{ kNm/m}^1$$

$$N_{ue} = 21,18 \text{ kN/m}^1$$

$$M_{aue} = 40,25 + 21,18 \cdot \left( \frac{0,20}{2} - 0,03 \right) = 41,73 \text{ kNm/m}^1$$

$$k = \frac{17,0}{\sqrt{\frac{41,73}{2,30}}} = 3,991 \longrightarrow \varepsilon_b / \varepsilon_a = 1,4 / 10 \%$$

$$\bar{\mu} = 6,591 \%$$

$$A_a = 6,591 \cdot 17,0 \cdot \frac{2,30}{40} - \frac{21,18}{40} = 5,91 \text{ cm}^2/\text{cm}^1$$

УСЛОВИЕНО  $\boxed{R\phi 10/10}$  ( $7,85 \text{ cm}^2/\text{cm}^1$ )

$$A_{ap} = 0,20 \cdot 5,91 = 1,18 \text{ cm}^2/\text{cm}^1 < \text{MIN. } A_{ap} = 1,70 \text{ cm}^2/\text{cm}^1$$

УСЛОВИЕНО  $\boxed{R\phi 8/25}$  ( $2,01 \text{ cm}^2/\text{cm}^1$ )

## POS 5

$$b = d = 30,0 \text{ cm} \rightarrow i_{\text{MIN.}} = \frac{30}{\sqrt{12}} = 8,66 \text{ cm}$$

$$\lambda_{\text{CB.}} l_i = 0,7 \cdot 500 = 350 \text{ cm}$$

$$\lambda = \frac{350}{8,66} = 40,4 \quad \begin{matrix} > 25 \\ < 75 \end{matrix}$$

$$e_0 = \frac{350}{300} = 1,17 \text{ cm} \rightarrow \lambda_{\text{CB.}} e_0 = 2,0 \text{ cm} = \text{MIN. } e_0$$

$$e_p = 0 \quad (\lambda < 50)$$

$$e_d = 30,0 \cdot \frac{40,4 - 25}{100} \cdot \sqrt{0,1 + 0} = 1,46 \text{ cm}$$

$$e = e_0 + e_d = 2,0 + 1,46 = 3,46 \text{ cm}$$

$$N_g = B_{g2} = 240,0 \text{ kN}$$

$$N_p = B_{p2} = 676,5 \text{ kN}$$

$$e_{a1} < 0\% \rightarrow N_u = 1,9 \cdot 240,0 + 2,1 \cdot 676,5 = 1876,6 \text{ kN}$$

$$M_u = 1876,6 \cdot 3,46 \cdot 10^{-2} = 64,98 \text{ kNm}$$

$$m_u = \frac{1876,6}{30,0 \cdot 30,0 \cdot 2,30} = 0,907 \quad \left. \begin{array}{l} A_{a1} = A_{a2} \\ a/d = 4,5/30,0 = 0,15 \\ R_A 400/500 \end{array} \right\}$$

$$m_{ue} = \frac{64,98 \cdot 10^2}{30,0 \cdot 30,0^2 \cdot 2,30} = 0,105 \quad \left. \begin{array}{l} \text{ЛНКАРПАН 2.4.12} \\ \downarrow \end{array} \right\}$$

$$e_{a1} < 0\% \rightarrow \begin{matrix} \gamma_{\text{ug}} = 1,9 \\ \gamma_{\text{up}} = 2,1 \end{matrix} \rightarrow \bar{\mu}_1 = \bar{\mu}_2 = 0,11$$

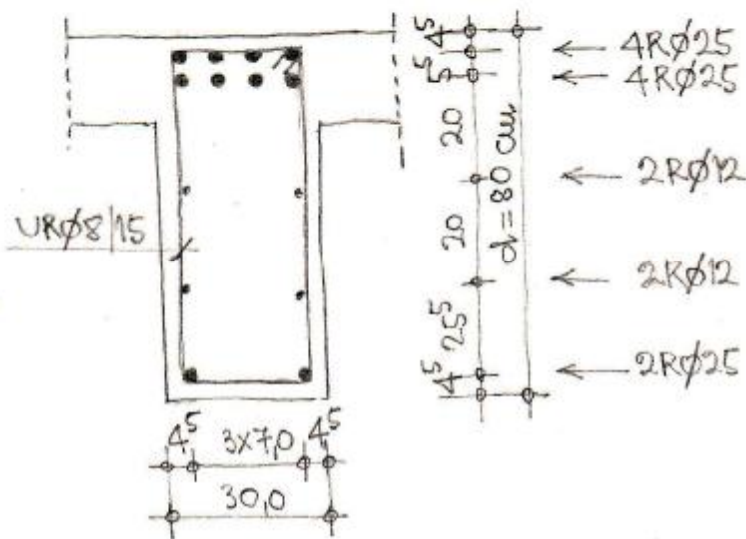
$$A_{a1} = A_{a2} = 0,11 \cdot 30,0 \cdot 30,0 \cdot \frac{2,30}{40} = 5,69 \text{ cm}^2$$

УСЛОВИЕНО  $\boxed{\pm 2R\phi 19}$  ( $\pm 5,67 \text{ cm}^2$ )

$$\text{MAX. } e_u = \text{MIN. } \left\{ \begin{array}{l} 15 \cdot 1,9 = 28,5 \text{ cm} \\ b = 30 \text{ cm} \\ 30 \text{ cm} \end{array} \right\} = 28,5 \text{ cm}$$

УСЛОВИЕНО  $\boxed{UR\phi 8/25}$

# POS 2 - PRORACHUNA PRSLIHNA



$$A_{s1} = 39,27 \text{ cm}^2 \quad (8R\phi 25)$$

$$A_{s2} = 9,82 \text{ cm}^2 \quad (2R\phi 25)$$

$$m = \frac{210}{33,0} = 6,36$$

$$a' = 4,5 \text{ cm} \quad \left. \begin{array}{l} \\ \\ \end{array} \right\} a_1 = 7,25 \text{ cm}$$

$$a'' = 10,0 \text{ cm}$$

$$r_v = 80,0 - 7,25 = 72,75 \text{ cm}$$

$$a_2 = 4,5 \text{ cm}$$

$$\alpha_2 = 4,5 / 72,75 = 0,062$$

$$\mu_1 = \frac{A_{s1}}{b \cdot r_v} = \frac{39,27}{30,0 \cdot 72,75} = 0,018$$

$$\mu_2 = \frac{A_{s2}}{b \cdot r_v} = \frac{9,82}{30,0 \cdot 72,75} = 0,004$$

## ПОЛОЖАЈ НЕУТРАЛНЕ ЛИНИЈЕ

$$s^2 + 2m(\mu_1 + \mu_2) \cdot s - 2m(\mu_1 + \alpha_2 \mu_2) = 0$$

$$s^2 + 2 \cdot 6,36 \cdot (0,018 + 0,004) \cdot s - 2 \cdot 6,36 \cdot (0,018 + 0,004 \cdot 0,062) = 0$$

$$s^2 + 0,286 \cdot s - 0,233 = 0 \quad \rightarrow \quad \boxed{s = 0,360}$$

$$J_{II B} = \frac{s^2}{2} \left(1 - \frac{s}{3}\right) = 0,057$$

$$M = M_g + M_p = 144,0 + 405,9 = 549,9 \text{ kNm}$$

$$\sigma_B = \frac{549,9 \cdot 10^2}{30,0 \cdot 72,75^2} \cdot \frac{0,360}{0,057 + 6,36 \cdot 0,004 \cdot (1 - 0,062)(0,360 - 0,062)} = 1,92 \text{ kN/cm}^2$$

$$\sigma_{s1} = 6,36 \cdot 1,92 \cdot \frac{1 - 0,36}{0,36} = 21,71 \text{ kN/cm}^2 = 217,1 \text{ MPa}$$

$$\epsilon_{s1} = \frac{\sigma_{s1}}{E_s} = \frac{217,1}{210 \cdot 10^3} = 1,034 \text{ ‰}$$

$$M^* \approx f_{b25} \cdot W_{B1}$$

$$f_{b25} = 0,7 \cdot 2,65 \cdot \left(0,6 + \frac{0,4}{\sqrt{10,8}}\right) = 1,90 \text{ MPa} = 0,19 \text{ MN/cm}^2$$

$$W_{B1} \sim W_{B, \text{REBRA}} = \frac{30,0 \cdot 80,0^2}{6} = 32000 \text{ cm}^3$$

$$M^* = 0,190 \cdot 32000 \cdot 10^{-2} = 60,72 \text{ kNm}$$

$$\beta_1 = 1,0 \text{ (RA 400/500)}$$

$$\beta_2 = 1,0 \text{ (} \xi = 0 \text{)}$$

$$\xi_a = 1 - 1,0 \cdot 1,0 \cdot \left( \frac{60,72}{549,9} \right)^2 = 0,988$$

$$\varepsilon_{a1,SR} = \xi_a \cdot \varepsilon_{a1} = 0,988 \cdot 1,034 = 1,021\%$$

$$\boxed{\varepsilon_{a1,SR} = 1,021\%} \rightarrow \text{СРЕДЊА ДИЛАТАЦИЈА У ЗАТЕГНУТОЈ АРМАТУРИ НА ДЕЛУ ИЗМЕЂУ ПРСЛИНА}$$

$$a_0 = 4,5 - \frac{2,5}{2} = 3,25 \text{ cm}$$

$$r_{b2,ef} = \min. \left\{ \begin{array}{l} a'' + 7,5 \cdot \emptyset = 10,0 + 7,5 \cdot 2,5 = 28,75 \text{ cm} \\ d - x = 80,0 - 0,36 \cdot 72,75 = 53,8 \text{ cm} \end{array} \right\} = 28,75 \text{ cm}$$

$$\mu_{z,ef} = \frac{A_{a1}}{b \cdot r_{b2,ef}} = \frac{39,27}{30,0 \cdot 28,75} = 0,046$$

$$k_1 = 0,4 \text{ (RA 400/500)}$$

$$k_2 = 0,125 \text{ (САБИЈАЊЕ)}$$

$$e_{\emptyset} = 7,0 \text{ cm}$$

$$l_{ps} = 2 \cdot \left( 3,25 + \frac{7,0}{10} \right) + 0,4 \cdot 0,125 \cdot \frac{2,5}{0,046} = 10,65 \text{ cm}$$

$$\boxed{l_{ps} = 10,65 \text{ cm}} \rightarrow \text{СРЕДЊЕ РАСТОЈАЊЕ ПРСЛИНА}$$

$$a_{prk} = 1,7 \cdot \varepsilon_{a1,SR} \cdot l_{ps}$$

$$a_{prk} = 1,7 \cdot 1,021 \cdot 10^{-3} \cdot 10,65 \text{ cm} = 18,5 \cdot 10^{-3} \text{ cm}$$

$$\boxed{a_{prk} = 0,185 \text{ mm}} \rightarrow \text{КАРАКТЕРИСТИЧНА ШИРИНА ПРСЛИНА}$$

НАПОМЕНА:

НАПОН У ЗАТЕГНУТОЈ АРМАТУРИ  $\sigma_{a1}$  МОЖЕ БИТИ СРАЧУНАТ ПРЕМА ПРИБЛИЖНОМ ИЗРАЗУ:

$$\sigma_{a1} \approx \frac{M}{0,9 \cdot b \cdot A_{a1}} = \frac{549,9 \cdot 10^2}{0,9 \cdot 72,75 \cdot 39,27} = 21,4 \text{ kN/cm}^2 = 214 \text{ MPa}$$

ШТО ЈЕ ЗА ПРАКТИЧАН ПРОРАЧУН САСВИМ ЗАДОВОЉАВАЈУЋЕ РЕШЕЊЕ,