

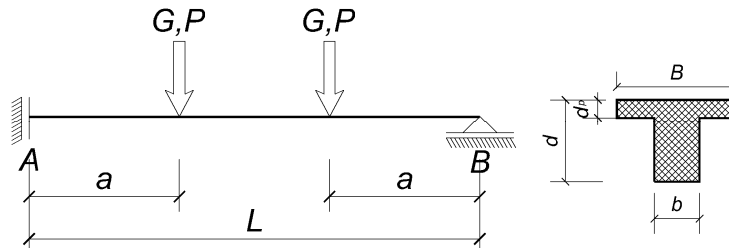
**PRVI RAČUNSKI KOLOKVIJUM - grupa 1**

1. Za gredu datog poprečnog preseka, opterećenu stalnim odnosno povremenim opterećenjem prema skici dole, potrebno je:

1.1 Dimenzionisati u karakterističnim presecima prema momentima savijanja

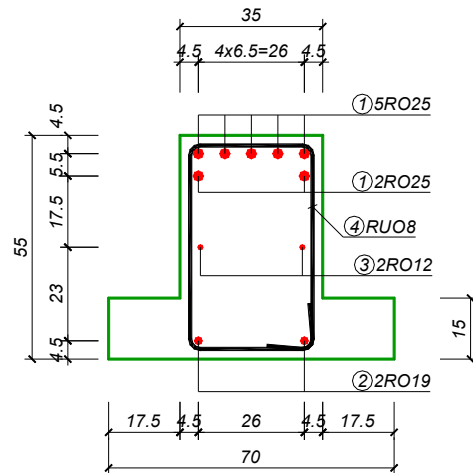
$L = 6.0 \text{ m}$   
 $a = 2.0 \text{ m}$   
 $G = 50 \text{ kN}$   
 $P = 120 \text{ kN}$   
 $b = 30 \text{ cm}$   
 $B = 80 \text{ cm}$   
 $d = 55 \text{ cm}$   
 $d_p = 12 \text{ cm}$

**MB30 RA 400/500**



2. Odrediti koliki moment savijanja od stalnog opterećenja može prihvatiti presek prikazan na skici desno, koji je osim momenta savijanja opterećen i silom zatezanja od  $Z_p = 200 \text{ kN}$  usled povremenog opterećenja. Proračun sprovesti uz zanemarenje nosivosti pritisnute armature.

**MB30 RA 400/500**



3. Dimenzionisati centrično napregnut element pravougaonog poprečnog preseka, dimenzija  $b/d = 30/20 \text{ cm}$ , opterećen zadatim silama usled stalnog i povremenog opterećenja.

$N_g = 800 \text{ kN}$  (sila pritiska, stalno opterećenje)

$Z_p = 500 \text{ kN}$  (sila zatezanja, povremeno opterećenje)

$N_{\Delta} = \pm 200 \text{ kN}$  (sila alternativnog znaka, "ostala opterećenja")

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4. Odrediti dimenziju stuba kružnog poprečnog preseka, armiranog podužnom armaturom  $8R\emptyset 19$  i spiralnom armaturom  $\emptyset_s 12/5,5$  tako da može prihvatiti navedene statičke uticaje uz propisane koeficijente sigurnosti.

$N_g = 1000 \text{ kN}$        $N_p = 2000 \text{ kN}$

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5. Odrediti potrebnu površinu armature i oblikovati poprečni presek pravougaonog oblika dimenzija  $40/70 \text{ cm}$ . **MB30 RA 400/500**

$M_G = 300 \text{ kNm}$        $M_P = 0 \text{ kNm}$        $M_{\Delta} = \pm 300 \text{ kNm}$   
 $N_G = 200 \text{ kN}$        $N_P = \pm 300 \text{ kN}$        $N_{\Delta} = 0 \text{ kN}$

**Nacrtati usvojeni raspored armature u SVIM dimenzionisanim presecima. Dopuštene su pregledne slobodoručne skice sa svim neophodnim kotama i oznakama. Zadate dimenzije elemenata ne menjati. Računati samo sa zadatim opterećenjima, prema teoriji graničnih stanja i pravilniku BAB 87.**

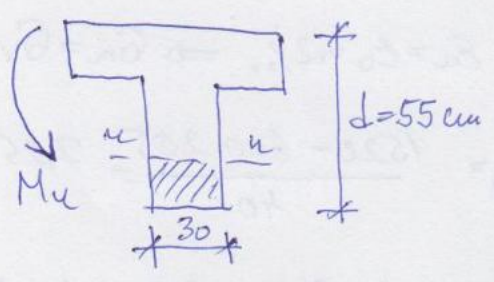
**ZA SVE ZADATKE: MB30 RA 400/500**

1.

ОСЛОНАЦ :  $M_u = 592 \text{ кНм}$

ПОЛЪЕ :  $M_u = 395 \text{ кНм}$

1.1. ДИМЕНЗИОНИСАВЕ - ПРЕСЕК НАД ОСЛОНЦЕМ



гпрі.  $a_1 = 7 \text{ см}$   
 $h = 48 \text{ см}$

$k = 1,547 \rightarrow \epsilon_a < 3\text{‰} \Rightarrow$  ДВОИНО АРМУРАВЕ

$k^* = 1,719 \quad \mu^* = 43,59$

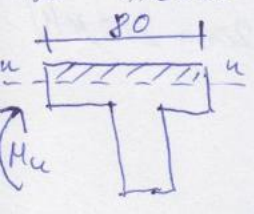
$M_{bu} = 479,5$

$\Delta M_{au} = 112,5 (= M_{au} - M_{bu})$

$$A_{a2} = \frac{\Delta M_{au}}{\sigma_v (h - a_2)} = \frac{112,5}{40(48 - 5)} = 6,54 \text{ см}^2$$

$$A_{a1} = 43,59 \cdot \frac{30 \cdot 48}{100} \cdot \frac{2,05}{40} + 6,54 = 38,7 \text{ см}^2$$

1.2. ПРЕСЕК У ПОЛЪУ



гпрі.  $a_1 = 7 \text{ см}$   
 $h = 48$

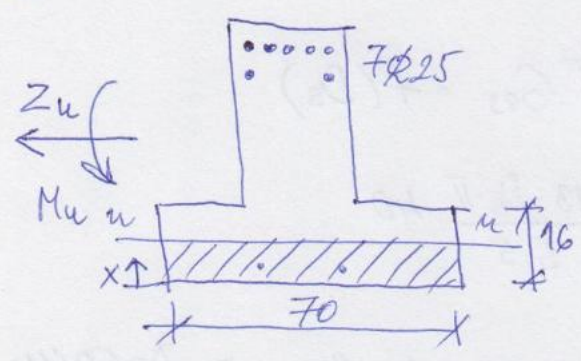
$$k = 3,094 \left( = \frac{48}{\sqrt{\frac{395}{80 \cdot 2,05}}} \right)$$

$\epsilon_0 / \epsilon_a = 2 / 10\text{‰}$

$s = 0,167 \rightarrow x = 0,167 \cdot 48 = 8 < 12 \text{ см}$

$$A_a = 11,111 \cdot \frac{80 \cdot 48}{100} \cdot \frac{2,05}{40} = 21,87 \text{ см}^2$$

2.



$$A_{a1} = 7 \cdot 4,91 = 34,37 \text{ см}^2$$

$$Z_u = 1,8 \cdot 200 = 360 \text{ кН}$$

$$a_1 = \frac{5 \cdot 4,5 + 2 \cdot 10}{7} = 6,07 \Rightarrow h = 48,93 \text{ см}$$

$$A_{a1} = \bar{\mu} \frac{B \cdot h}{100} \cdot \frac{f_B}{\sigma_v} + \frac{Z_u}{\sigma_v} \Rightarrow \bar{\mu} = \frac{A_{a1} \cdot \sigma_v - Z_u}{B \cdot h \cdot f_B} \cdot 100$$

$$\bar{\mu} = \frac{34,37 \cdot 40 - 360}{70 \cdot 48,93 \cdot 2,05} \cdot 100 = 14,45\% \Rightarrow \epsilon_b / \epsilon_a = 2,775 / 10$$

$s = 0,198$

$x = s \cdot h = 0,198 \cdot 48,93 < 16 \text{ см}$

$$k = 2,734$$

$$M_{au} = \left( \frac{h}{k} \right)^2 \cdot B \cdot f_B = \left( \frac{48,93}{2,734} \right)^2 \cdot 70 \cdot 2,05 = 459,6 \text{ кНм}$$

$$M_u = 459,6 + 360 \left( \frac{0,55}{2} - 0,06 \right) = 536,4 \text{ кНм} \rightarrow M_g = \frac{M_u}{1,6} = 335,25 \text{ кНм}$$

3.

$$N_g = 800 \text{ kN}$$

$$Z_p = 500 \text{ kN}$$

$$N_{\Delta} = \pm 200 \text{ kN}$$

$$\max N_{1u} = 1.9 \cdot 800 = 1520 \text{ kN}$$

$$\max N_{2u} = 1.5 \cdot 800 + 1.5 \cdot 200 = 1500 \text{ kN}$$

$$\max N_u = \max \{ N_{1u}, N_{2u} \} = 1520 \text{ kN}$$

$$b/d = 30/20 \text{ cm}$$

$$N_u = A_b \cdot f_B + A_a \cdot \sigma_a \Rightarrow A_{a1} = \frac{N_u - A_b f_B}{\sigma_a}$$

$$\epsilon_a = \epsilon_b = 2\text{‰} \Rightarrow \sigma_a = \sigma_b = 400 \text{ MPa}$$



$$A_{a1} = \frac{1520 - 600 \cdot 205}{40} = 7.25 \text{ cm}^2$$

$$\max Z_{1u} = -1.0 \cdot 800 + 1.8 \cdot 500 = 100 \text{ kN}$$

$$A_{a, \max} = \max \{ A_{a1}, A_{a2} \} = 7.25$$

$$\max Z_{2u} = (-1.0) \cdot 800 + 1.5 \cdot 500 + 1.3 \cdot 200 = 210 \text{ kN}$$

Требуются: 4РØ16 (0,04 м²)

$$A_{a2} = \frac{210}{40} = 5.25$$

$$\max Z_u = \max \{ Z_{1u}, Z_{2u} \} = 210 \text{ kN}$$

4.

$$N_u = 1.9 N_g + 2.1 N_p = 1.9 \cdot 1000 + 2.1 \cdot 2000 = 6700 \text{ kN}$$

$$N_u = A_b \cdot f_B + A_a \cdot \sigma_a + 2 A_{as} \cdot \sigma_{as}$$

$$N_u = \frac{D_s^2 \pi}{4} \cdot f_B + A_a \cdot \sigma_a + 2 \cdot \frac{a_s^{(1)} \cdot D_s \cdot \pi}{e_s} \cdot \sigma_{as} = f(D_s)$$

$$6700 = \frac{D_s^2 \pi}{4} \cdot 205 + 22.68 \cdot 40 + 2 \cdot \frac{1.13 \cdot D_s \cdot \pi}{5.5} \cdot 40$$

$$\Rightarrow D_s = 44.98$$

$$D = D_s + 2a_0 + \phi_s = 44.98 + 2 \cdot 25 + 1.2 = 49.18 \text{ cm} \Rightarrow D = 50 \text{ cm}$$

5.

$$M_g = 300 \text{ кНм} \quad N_g = 200 \text{ кН}$$

$$M_p = \emptyset \quad N_p = \pm 300 \text{ кН}$$

$$M_{\Delta} = \pm 300 \text{ кНм} \quad N_{\Delta} = \emptyset$$

$$1) \quad \begin{aligned} \max M_u &= 1,6 \cdot 300 = 480 \text{ кНм} \\ \min N_u &= -1,8 \cdot 200 + 1,8 \cdot 300 = 220 \text{ кН (ЗАТЕЗАНИЕ)} \end{aligned}$$

$$2) \quad \begin{aligned} \max M_u &= 1,6 \cdot 300 = 480 \text{ кНм} \\ \max N_u &= 1,6 \cdot 200 + 1,8 \cdot 300 = 860 \text{ кН (ПРИТЯЖЕНИЕ)} \end{aligned}$$

$$3) \quad \begin{aligned} \max M_u &= 1,3 \cdot 300 + 1,3 \cdot 300 = \underline{780 \text{ кНм}} \\ \min N_u &= -1,3 \cdot 200 + 1,5 \cdot 300 = \underline{+190 \text{ кН (ЗАТЕЗАНИЕ)}} \end{aligned}$$

$$4) \quad \begin{aligned} \max M_u &= 780 \text{ кНм} \\ \max N_u &= 1,3 \cdot 200 + 1,5 \cdot 300 = 710 \text{ кН (ПРИТЯЖЕНИЕ)} \end{aligned}$$

$$5) \quad \begin{aligned} \max M_u &= -1,0 \cdot 300 + 1,3 \cdot 300 = 90 \text{ кНм} \\ \min N_u &= -1,0 \cdot 200 + 1,5 \cdot 300 = 250 \text{ кН (ЗАТЕЗАНИЕ)} \end{aligned}$$

$$3) \Rightarrow \max A_{a1} \Rightarrow A_{a1} = 38,98 \text{ см}^2 \text{ (8R}\phi 25)$$

$$4) \Rightarrow \kappa = 1,801 \geq 1,719 \Rightarrow A_{a1} < A_{a1} \text{ из комб. 3}$$

$$A_{a2} = \emptyset$$

$$5) \Rightarrow \max A_{a2} = 7,16 \text{ см}^2 \Rightarrow A_{a2} \text{ (4R}\phi 16)$$