Univerzitet Crne Gore
Građevinski fakultet u Podgorici
Menađment u građevinarstvu

BETONSKE KONSTRUKCIJE

VJEŽBA 2.

Zadatak1.

Dimenzionisati pravougaoni poprečni presjek za zadate podatke i za slučaj dostizanja granične nosivosti po :

a) betonu;

b) armaturi;

c) armaturi i betonu simultano.

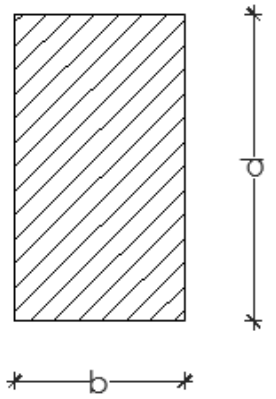
MB30 RA400/500

M_u= 300 *kNm*

b = 30 *cm*

Nacrtati raspored armature u poprečnom presjeku u razmjeri 1:10.

Rješenje:



MB 30 ⇨ f_b= 2.05 *kN/cm²*

RA 400/500 σ_v= 40 *kN/cm²*

M_u= 300 *kNm*

b= 30 *cm*

a) Lom po betonu (ε_b= 3.5‰ i ε_a < 10‰)

$$\varepsilon_a / \varepsilon_b = 7.5/3.5‰ \Rightarrow \begin{cases} k = 2.115 \\ \bar{\mu} = 25.757\% \\ s = 0.318 \\ \xi_b = 0.868 \end{cases}$$

$$_{potr.}h = k \cdot \sqrt{\frac{M_u}{b \cdot ff_b}} = 2.115 \cdot \sqrt{\frac{300}{0.3 \cdot 2.05}} = 46.71cm$$

$$A_a = \bar{\mu} \cdot b \cdot h \cdot \frac{f_b}{\sigma_v} = \frac{25.757}{100} \cdot 30 \cdot 46.7 \cdot \frac{2.05}{40}$$

$$A_a = 18.5cm^2$$

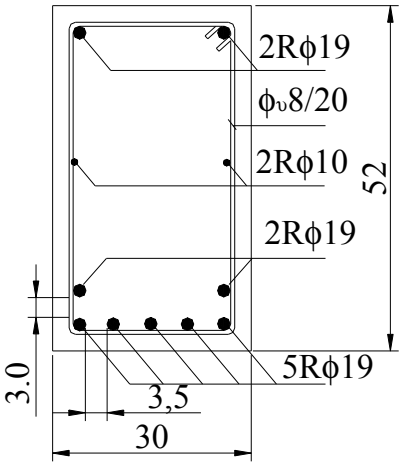
usvojeno: $7R\phi19(19.9cm^2)$

$$_{potr.}d = h + a_a$$

$$a_a = \frac{\left(5 \cdot a_\phi \cdot \left(a_0 + \phi_u + \frac{\phi}{2}\right) + 2 \cdot a_\phi \cdot \left(a_0 + \phi_u + \phi + 3 + \frac{\phi}{2}\right)\right)}{7 \cdot a_\phi}$$

$$a_a = \frac{5}{7} \cdot \left(2.5 + 0.8 + \frac{1.9}{2}\right) + \frac{2}{7} \cdot \left(2.5 + 0.8 + 3.0 + \frac{3}{2} \cdot 1.9\right) = 5.65cm$$

$$_{potr.}d = h + a_a = 46.7 + 5.65 = 52.35cm \approx 52cm$$



$$a_h = \frac{(30 - 2.5 \cdot 2 - 2 \cdot 0.8 - 5 \cdot 1.9)}{4} = 3.47cm > 3cm$$

b) Lom po armaturi (ε_a > 10‰)

$$\varepsilon_a / \varepsilon_b = 10 / 2.5‰ \Rightarrow \begin{cases} k = 2.720 \\ \bar{\mu} = 14.667\% \end{cases}$$

$$_{potr.}h = k \cdot \sqrt{\frac{M_u}{b \cdot f_b}} = 2.72 \cdot \sqrt{\frac{300}{0.3 \cdot 2.05}} = 60.1cm$$

$$A_a = \bar{\mu} \cdot b \cdot h \cdot \frac{f_b}{\sigma_v} = \frac{14.667}{100} \cdot 30 \cdot 60.1 \cdot \frac{2.05}{40} = 13.55cm^2 \qquad \text{usvojeno: } 5R\phi 19(14.2cm^2)$$

$$_{potr.}d = h + a_a = h + a_0 + \phi_u + \frac{\phi}{2} = 60.1 + 2.5 + 0.8 + \frac{1.9}{2} = 64.35cm \approx 65cm$$

usvojeno: $b / d = 30 / 65[cm]$

c) Simultani lom ($\varepsilon_b/\varepsilon_a$ = 3.5/10‰)

$$\varepsilon_a / \varepsilon_b = 10 / 3.5‰ \Rightarrow \begin{cases} k = 2.311 \\ \bar{\mu} = 20.987\% \end{cases}$$

$$_{potr.}h = k \cdot \sqrt{\frac{M_u}{b \cdot f_b}} = 2.311 \cdot \sqrt{\frac{300}{0.3 \cdot 2.05}} = 51.04cm$$

$$A_a = \bar{\mu} \cdot b \cdot h \cdot \frac{f_b}{\sigma_v} = \frac{20.987}{100} \cdot 30 \cdot 51.04 \cdot \frac{2.05}{40} = 16.45cm^2 \quad \text{usvojeno: } 6R\phi 19(17.04cm^2)$$

Ako smjestimo 4 šipke u prvom redu, 2 šipke u drugom redu sa razmakom od 3*cm,* onda je:

$$a_a = \frac{4}{6} \cdot \left(2.5 + 0.8 + \frac{1.9}{2}\right) + \frac{2}{6} \cdot \left(2.5 + 0.8 + 3.0 + \frac{3}{2} \cdot 1.9\right) = 5.88cm$$

$$_{potr.}d = h + a_a = 51.04 + 5.88 = 56.92cm \approx 57cm \qquad \text{usvojeno: } b / d = 30 / 57[cm]$$

$$a_h = \frac{30 - 2\cdot(2.5+0.8) - 4\cdot 1.9}{3} = 5.27cm$$

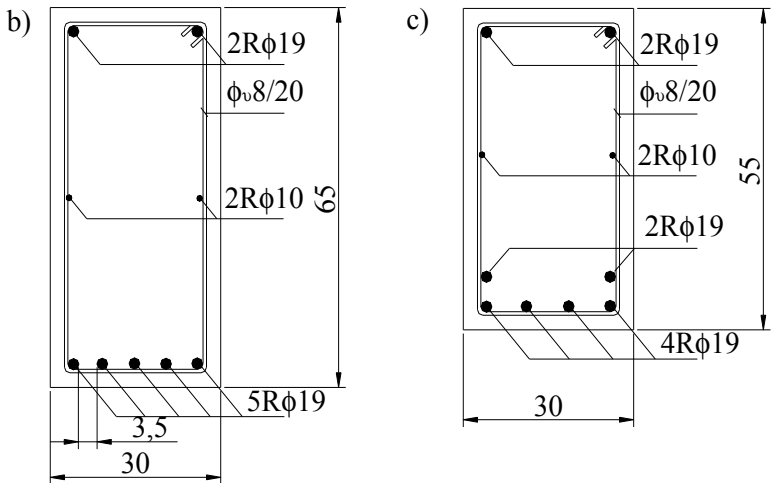
- Da li se može usvojiti 30/55 i $6R\phi 19$?

$$h_{st\,\mathrm{var}} = 55 - 5.88 = 49.12cm$$

$$k_b = \frac{49.12}{\sqrt{\frac{300}{0.3\cdot 2.05}}} = 2.224 \Rightarrow \bar{\mu} = 22.945\%$$

$$A_a = \bar{\mu}\cdot b\cdot h\cdot\frac{f_b}{\sigma_v} = \frac{22.945}{100}\cdot 30\cdot 49.12\cdot\frac{2.05}{40} = 17.33cm^2 > 17.04cm^2 = A_{ausvojeno}$$

$$\Delta = \frac{17.33-17.04}{17.04}\cdot 100 = 1.69\% < 3\%$$ Usvojena armatura $6R\phi 19$ je zadovoljavajuća



Zadatak 2.

Za pravougaoni poprečni presjek utvrđenih dimenzija i datog momenta savijanja odrediti potrebnu količinu armature za slučaj unaprijed utvrđenih dilatacija $\varepsilon_a/\varepsilon_b$=3/3.5‰.

MB30 RA400/500 b=30 cm, d=55 cm

Mg=120 kNm Mp=190kNm

Nacrtati raspored armature u poprečnim presjecima u razmjeri 1:10.

Rješenje:

$$M_u = 1.6\cdot M_g + 1.8\cdot M_p = 1.6\cdot 120 + 1.8\cdot 190 = 534kNm$$

$$\varepsilon_a/\varepsilon_b = 3.0/3.5‰ \Rightarrow \begin{cases} k^* = 1.719 \\ \bar{\mu}^* = 43.589\% \end{cases}$$

$$k_b^* = \frac{h}{\sqrt{\frac{M_u^*}{b \cdot f_b}}} \Rightarrow M_u^* = (\frac{h}{k^*})^2 \cdot b \cdot f_b = (\frac{0.9 \cdot 55}{1.719})^2 \cdot 30 \cdot 2.05/100 = 509.96 kNm$$

$$\Delta M = M_u - M_u^* = 534 - 509.96 = 24 kNm$$

$$A_{a1} = \bar{\mu}^* \cdot b \cdot h \cdot \frac{f_b}{\sigma_v} + \frac{\Delta M}{(h - a_a) \cdot \sigma_v} = \frac{43.589}{100} \cdot 30 \cdot 49.5 \cdot \frac{2.05}{40} + \frac{24 \cdot 100}{44.55 \cdot 40}$$

$A_{a1} = 33.18 + 1.34 = 34.52 cm^2$ usvojeno $7R\phi 25 (34.3 cm^2)$

$A_{a2} = \frac{\Delta M}{(h - a_a) \cdot \sigma_v} = 1.34 cm^2$ usvojeno $2R\phi 25 (9.8 cm^2)$