

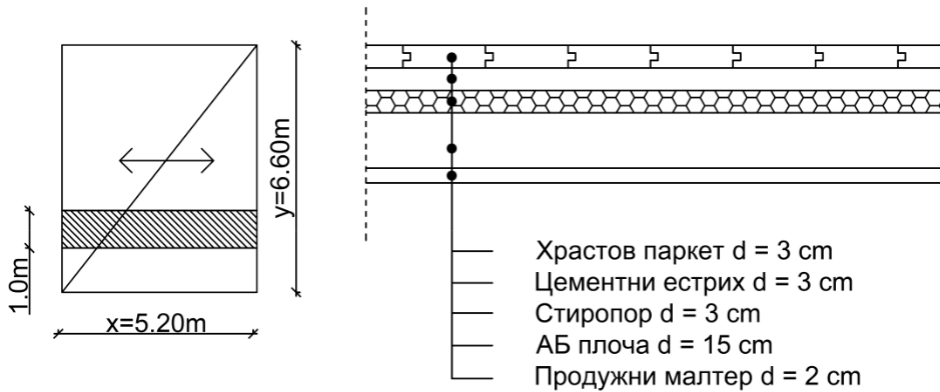
## Proračun AB monolitne ploče

Dimenzionisati AB monolitnu ploču, ako su poznati sledeći parametri:

C30/37, B500B  $c_{nom}=3\text{cm}$

Proračun debljine ploče:  $h_p^{min} = \frac{l}{35} = \frac{520}{35} = 14,85\text{cm}$ , gde je  $l$  raspon u [cm]

Usvojena debljina ploče  $h_p=15\text{cm}$



Analiza opterećenja:

### 1) Stalno opterećenje:

Opis	Debljina (cm)	$\gamma$ (kN/m <sup>3</sup> )	Ukupno (kN/m <sup>2</sup> )
Hrastov parket	3,0(2.2)	6,90	0,207
Cementni estrih	3,0	21,0	0,630
Termoizolacija	3,0	0,50	0,015
Armirani beton	15	25	3,75
Produžni malter	2,0	11,80	0,236
		$\sum g' =$	4,838

Dimenzionisanje ploča se vrši za jedan metar širine ploče:

$$g = \sum g' * 1,00 = 4,838 \frac{\text{kN}}{\text{m}^2} * 1,00\text{m} = 4,838 \frac{\text{kN}}{\text{m}}$$

### 2) Korisno (povremeno) opterećenje:

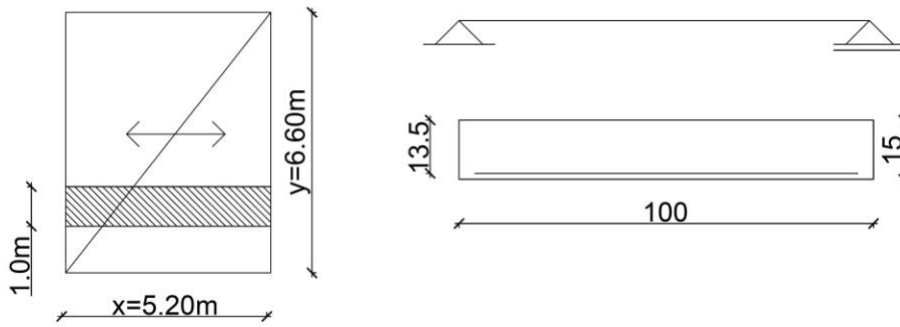
Usvojeno:

$$q_k' = 2,0 \frac{\text{kN}}{\text{m}^2}$$

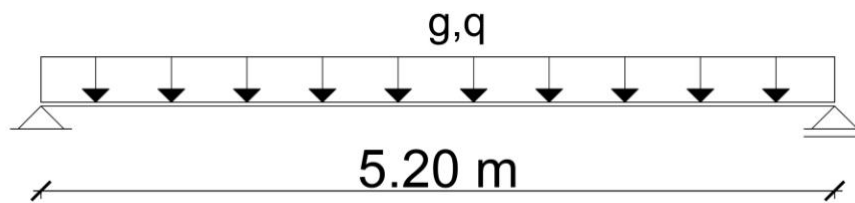
$$q_k = q_k' * 1,00 = 2,0 \frac{\text{kN}}{\text{m}^2} * 1,00\text{m} = 2,0 \frac{\text{kN}}{\text{m}}$$

$$d=0,9 \cdot h \rightarrow d=0,9 \cdot 15=13,5\text{cm}$$

Proračunski model:

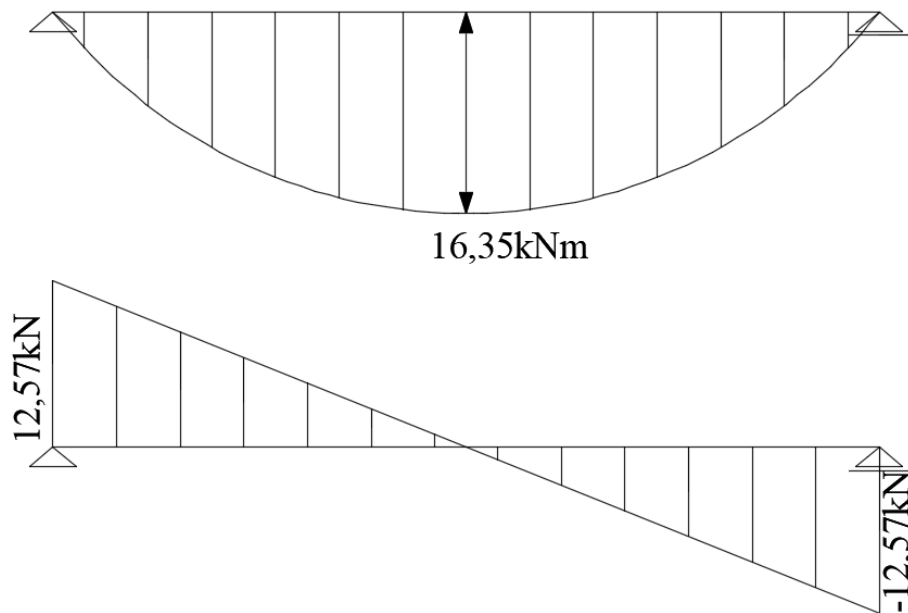


Šema opterećenja:

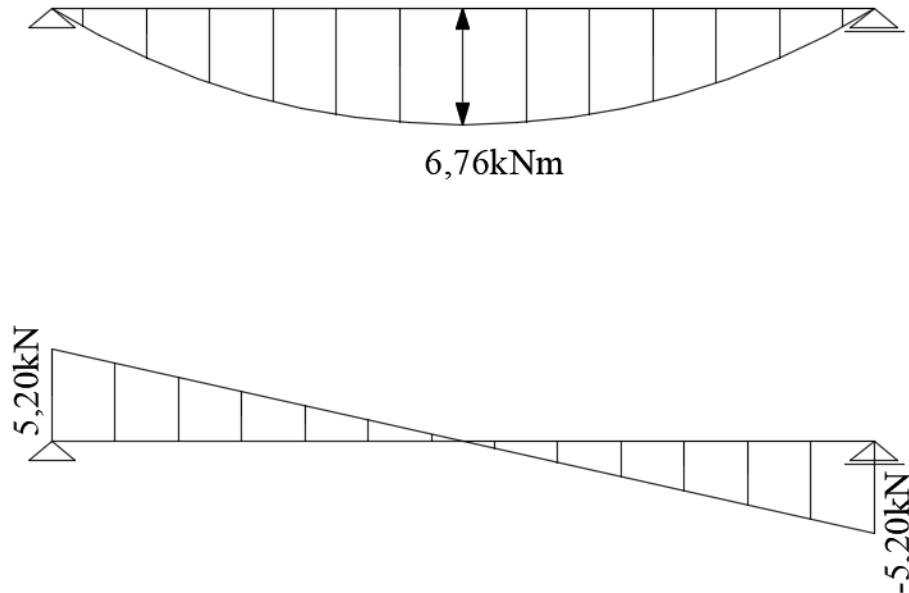


Uticaji:

1) Uticaji usled stalnog opterećenja [g]:



2) Uticaji usled povremenog opterećenja [q<sub>k</sub>]:



Karakteristike materijala:

$$C30/37 \Rightarrow f_{cd} = \alpha_{cc} \cdot \frac{f_{ck}}{\gamma_c} = 1,00 \cdot \frac{30}{1,5} = 20 \text{MPa} = 2,0 \frac{\text{kN}}{\text{cm}^2}$$

$$B500B \Rightarrow f_{yd} = \frac{f_{yk}}{\gamma_s} = \frac{500}{1,15} = 434,78 \text{MPa} = 43,48 \frac{\text{kN}}{\text{cm}^2}$$

### Dimenzionisanje

Statički uticaji:

$$M_{Ed} = 1,35 \cdot M_G + 1,5 \cdot M_Q$$

$$M_{Ed} = 1,35 \cdot 16,35 + 1,5 \cdot 6,76 = 32,21 \text{kNm} = M_{Eds}$$

**Napomena:** premda smo ranije izračunali da je statička visina  $d=13,5\text{cm}$ , s obzirom da ne računamo zaštitni sloj betona do armature, usvajamo da je  **$d=12\text{cm}$** .

(proračun se vrši kao za gredu dimenzija  $b/h/d=100/20/12$ )

$$\mu_{Ed} = \frac{M_{Eds}}{b \cdot d^2 \cdot f_{cd}} = \frac{32,21 \cdot 10^2}{100 \cdot 12^2 \cdot 2} = 0,111 < \mu_{lim} = 0,296$$

Očitano za  $\mu=0,113$ :  $\omega = 0,121$ ;  $\xi = 0,149$ ;  $\zeta = 0,938$ ;

$$A_{s1} = \omega \cdot b \cdot d \cdot \frac{f_{cd}}{f_{yd}}$$

$$A_{s1} = 0,121 \cdot 100 \cdot 12 \cdot \frac{20}{434,78} = 6,68 \text{cm}^2$$

-Minimalna potrebna površina armature za savijanje:

$$A_{s,\min} \geq \max \begin{cases} 0,26 \cdot \frac{f_{ctm}}{f_{yk}} \cdot b \cdot d \\ 0,0013 \cdot b \cdot d \end{cases}$$

C30/37 →  $f_{ctm}=2,9\text{MPa}$  - srednja vrednost čvrstoće betona pri zatezanju (Tabela 3.1.- EC2)

$$A_{s,\min} \geq \max \begin{cases} 0,26 \cdot \frac{2,9}{500} \cdot 100 \cdot 12 = 1,81\text{cm}^2 \\ 0,0013 \cdot 100 \cdot 12 = 1,56\text{cm}^2 \end{cases} \rightarrow A_{s,\min}=1,81\text{cm}^2$$

-Maksimalna površina armature za savijanje:

$$A_{s,\max} = 0,04 \cdot b \cdot h$$

$$A_{s,\max} = 0,04 \cdot 100 \cdot 15 = 60\text{cm}^2$$

-Glavna armatura:

Usvojeno 10RØ12(11,31 cm<sup>2</sup>) → RØ12/10cm  
(armaturni profili se postavljaju na međusobnom rastojanju od 10cm)

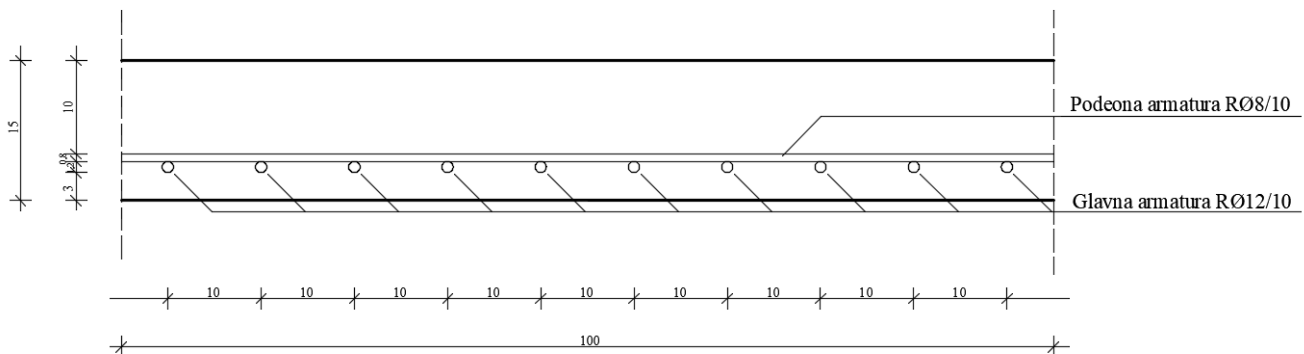
-Podeona armatura:

$$A_{\text{pod}}=30\% \cdot A_{s1}=30\% \cdot 11,31=3,39\text{cm}^2 > A_{s,\min}=1,81\text{cm}^2$$

Usvojeno 10RØ8(5,03 cm<sup>2</sup>) → RØ8/10cm

Napomena: podeona armatura se postavlja ortogonalno u odnosu na glavnu armaturu, u zoni glavne armature (u ovom primeru, u donjoj zoni).

Plan armiranja:



Kontrola na smicanje:

Ploče debljine do 20cm ne mogu se osiguravati na smicanje, ali mora biti ispunjen uslov da je

$$V_{Ed} < V_{Rd,c}$$

Maksimalna proračunska nosivost:

$$V_{Rd,c} = \max \left\{ \left[ C_{Rd,c} \cdot k \cdot (100 \cdot \rho_i \cdot f_{ck})^{\frac{1}{3}} + k_1 \cdot \sigma_{cp} \right] \cdot b_w \cdot d \right. \\ \left. (V_{min} + k_1 \cdot \sigma_{cp}) \cdot b_w \cdot d \right.$$

$$g=4,838 \frac{\text{kN}}{\text{m}'}$$

$$q=2,0 \frac{\text{kN}}{\text{m}'}$$

$$V_g = g \cdot \frac{l}{2} = 4,838 \cdot \frac{5,20}{2} = 12,57 \text{ kN}$$

$$V_q = q \cdot \frac{l}{2} = 2,0 \cdot \frac{5,20}{2} = 5,20 \text{ kN}$$

$$V_{Ed,1} = 1,35 \cdot 12,57 + 1,5 \cdot 5,20 = 24,73 \text{ kN}$$

$$\Delta V_{Ed} = (1,35 \cdot g + 1,5 \cdot q) \cdot \left( \frac{b_{sup}}{2} + d \right) \quad b_{sup} - \text{računska širina ploče (1,0m)}$$

$$\Delta V_{Ed} = (1,35 \cdot 4,838 + 1,5 \cdot 2,0) \cdot \left( \frac{1,0}{2} + 0,12 \right) = 5,91 \text{ kN}$$

$$V_{Ed}^* = V_{Ed,1} - \Delta V_{Ed} = 24,73 - 5,91 = 18,82 \text{ kN}$$

$$C_{Rd,c} = \frac{0,18}{\gamma_c} = \frac{0,18}{1,5} = 0,12$$

$$k = 1 + \sqrt{\frac{200}{d}} = 1 + \sqrt{\frac{200}{120}} = 2,29 > 2,0 \rightarrow k = 2,0 \quad d - \text{statička visina [mm]}$$

$A_{s1} = 10R\emptyset 12 = 11,31 \text{ cm}^2$  (Površina armature u **jednom** metru širine ploče)

$$\rho_i = \frac{A_{s1}}{b_w \cdot d} = \frac{11,31}{100 \cdot 12} = 0,009 \leq 0,02 \rightarrow \rho_i = 0,009 \quad b_w - \text{računska širina ploče [cm]}$$

$k_1 = 0,15$  - preporučena vrednost

$$N_{Ed} = 0 \rightarrow \sigma_{cp} = \frac{N_{Ed}}{A_c} = 0$$

$$f_{ck} = 30,0 \text{ MPa}$$

$$V_{min} = 0,035 \cdot k^{3/2} \cdot f_{ck}^{1/2} = 0,035 \cdot 2,0^{3/2} \cdot 30^{1/2} = 0,542$$

$$V_{Rd,c} = \max \left\{ \left[ 0,12 \cdot 2,0 \cdot (100 \cdot 0,009 \cdot 30)^{\frac{1}{3}} + 0,15 \cdot 0 \right] \cdot 1000 \cdot 120 \cdot 10^{-3} = 86,40 \text{ kN} \right. \\ \left. (0,542 + 0,15 \cdot 0) \cdot 1000 \cdot 120 \cdot 10^{-3} = 65,0 \text{ kN} \right.$$

Vrednosti  $b_w$  i  $d$  u [mm]

$$V_{Rd,c} = 86,40 \text{ kN} > V_{Ed} = 18,82 \text{ kN} \rightarrow \text{Uslov je ispunjen!}$$