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Studijski program:

**GRAĐEVINARSTVO**

Modul:

**PŽA, HVE, MTI**

Godina/Semestar:

**III godina / V semestar**

Naziv predmeta (šifra):

**Betonske konstrukcije 1**

**(B2S3BK, B2H3BK, B2M3BK, B1S3BK)**

Nastavnik:

**Jelena Dragaš**

Naslov predavanja:

**Centrično naprezanje.**

Datum :

03.11.2022.

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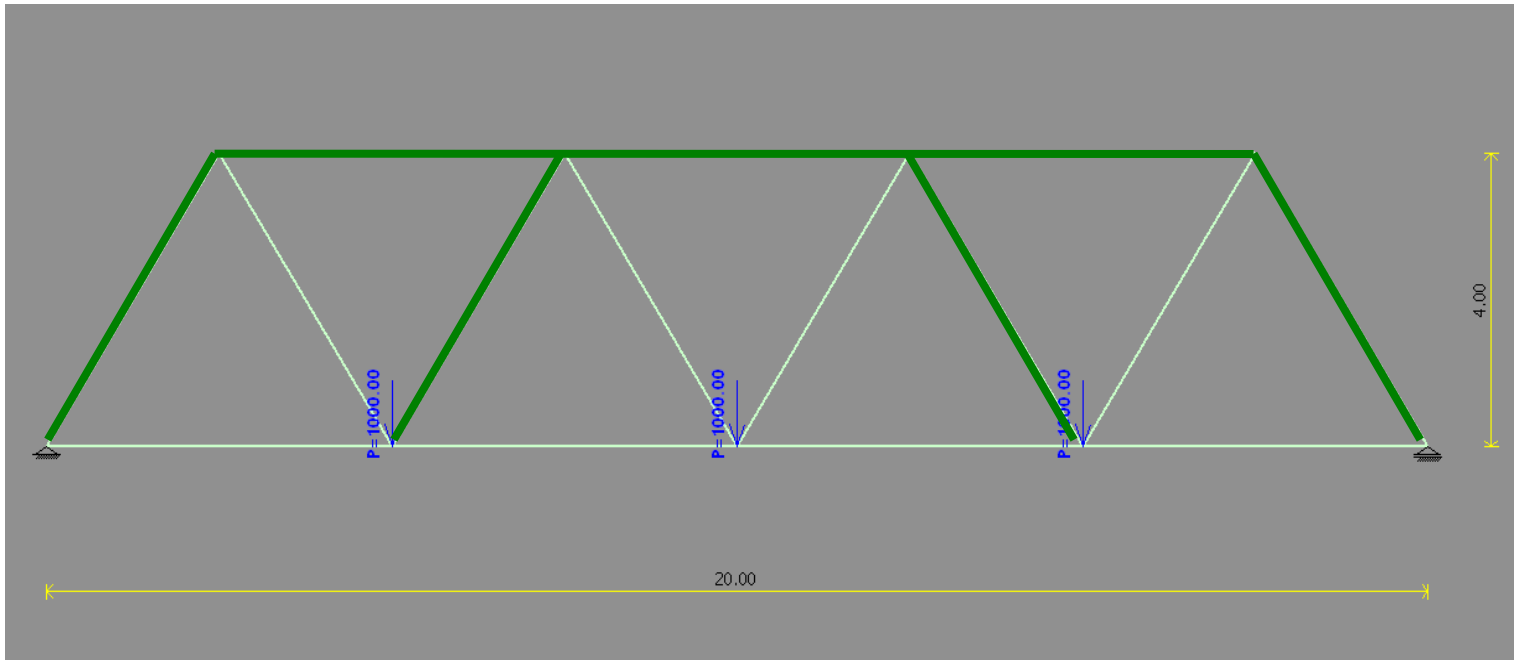
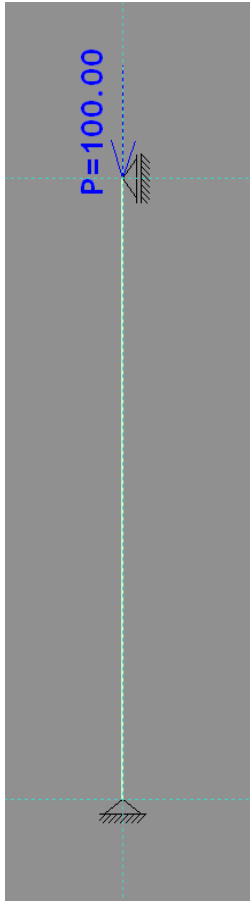
Beograd, 2021.

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# Centrični pritisak



# Centrični pritisak



## Zadatak 13 – CENTRIČNI PRITISAK

Odrediti potrebnu površinu armature i dimenzije poprečnog preseka, pravougaonog oblika, centrično pritisnutog elementa. Podaci za proračun:

$$N_G = 600 \text{ kN}$$

C25/30

XD1

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

B500 B

$$b = 35 \text{ cm}$$

$$\text{C25/30} \rightarrow f_{cd} = 0.85 \cdot 25 / 1.5 = 14.2 \text{ MPa} = 1.42 \text{ kN/cm}^2$$

$$\text{B500 B} \rightarrow f_{yd} = 500 / 1.15 = 435 \text{ Mpa} = 43.5 \text{ kN/cm}^2$$

## Zadatak 13 – CENTRIČNI PRITISAK

Granična sila pritiska:

$$N_{Ed} = 1.35 \cdot 600 + 1.5 \cdot 800 = 2010 \text{ kN}$$

$$N_{Ed} = N_{Rd} = A_c \cdot f_{cd} + A_s \cdot \sigma_s$$

$$\sigma_s = \varepsilon_s \cdot E_s = 2 \cdot 200 = 400 \text{ MPa} = 40 \text{ kN / cm}^2 \neq f_{yd}$$

$$N_{Rd} = A_c \cdot f_{cd} \cdot \left(1 + \frac{A_s \cdot \sigma_s}{A_c \cdot f_{cd}}\right) = A_c \cdot f_{cd} \cdot \left(1 + \frac{A_s}{A_c} \cdot \frac{\sigma_s}{f_{cd}} \cdot \frac{f_{yd}}{f_{yd}}\right) = A_c \cdot f_{cd} \cdot \left(1 + \omega \cdot \frac{\sigma_s}{f_{yd}}\right)$$

Minimalni geometrijski procenat armiranja:

$$\rho_{l,\min} = 0.3\% \Rightarrow \omega = 0.3 \cdot \frac{43.5}{1.42} = 9.19\%$$

## Zadatak 13 – CENTRIČNI PRITISAK

$$A_{c,pot} = \frac{N_{Ed}}{f_{cd} \cdot \left(1 + \omega \cdot \frac{\sigma_s}{f_{yd}}\right)} = \frac{2010}{1.42 \cdot \left(1 + 0.0919 \cdot \frac{40.0}{43.5}\right)} = 1305 \text{ cm}^2$$

$$h_{pot} = \frac{A_{c,pot}}{b} = \frac{1305}{35} = 37.3 \text{ cm}$$

Usvojeno  $h=40 \text{ cm}$

## Zadatak 13 – CENTRIČNI PRITISAK

Usvajanje površine armature:

$$A_s = \max \left\{ \begin{array}{l} 0.15 \cdot \frac{N_{Ed}}{f_{yd}} = 0.15 \cdot \frac{2010}{43.5} = 6.93 \text{ cm}^2 \\ 0.003 \cdot A_c = 0.003 \cdot 40 \cdot 35 = 4.2 \text{ cm}^2 \\ 4\phi 12 = 4 \cdot 1.12 = 4.48 \text{ cm}^2 \\ \boxed{6\phi 12 \text{ za kružne preseke}} \end{array} \right.$$

Usvojeno: **8Ø12** (8.96 cm<sup>2</sup>)

## Zadatak 13 – CENTRIČNI PRITISAK

Maksimalno rastojanje poprečne armature (**EC2**):

$$s_{cl,t\max} = \min \left\{ \begin{array}{l} 20\varnothing_{\min} \\ \min(b, h) \\ 40cm \end{array} \right\} = \min \left\{ \begin{array}{l} 20 \cdot 1.2 = 24cm \\ \min(b, h) = 35cm \\ 40cm \end{array} \right\} = 24cm$$

Maksimalno rastojanje poprečne armature (**EN1992-1-1/NA**):

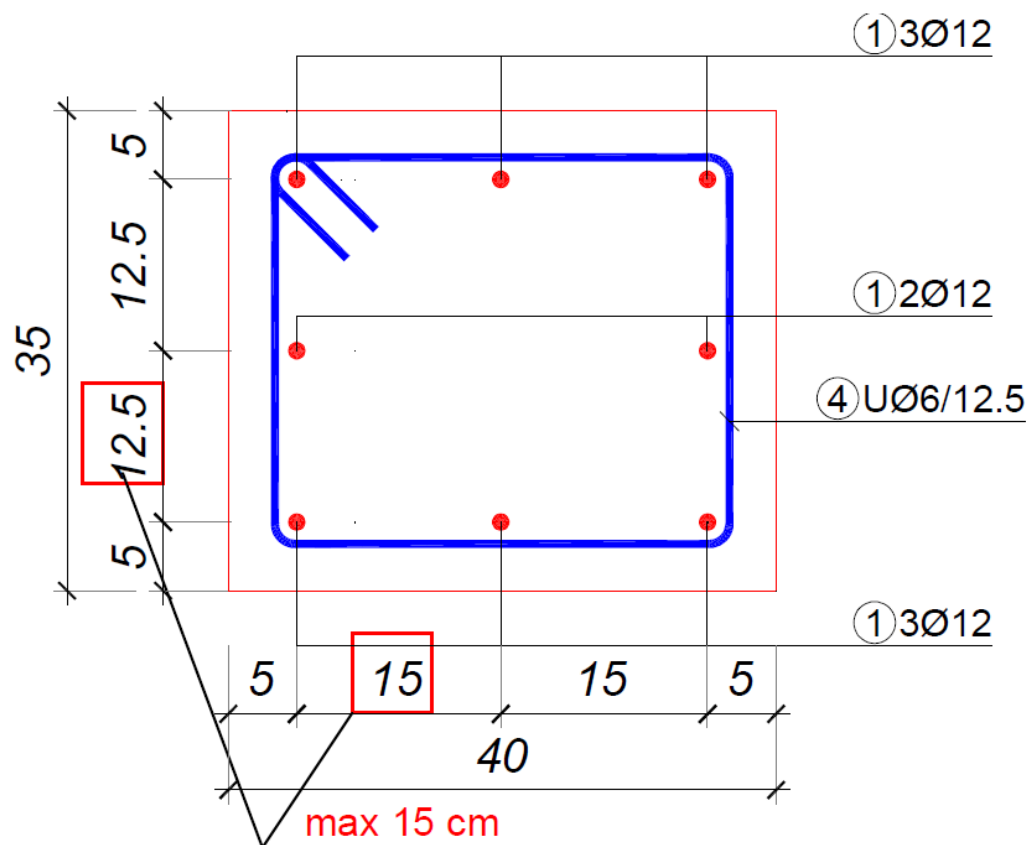
$$s_{cl,t\max} = \min \left\{ \begin{array}{l} 12\varnothing_{\min} \\ \min(b, h) \\ 30cm \end{array} \right\} = \min \left\{ \begin{array}{l} 12 \cdot 1.2 = 14.4cm \\ \min(b, h) = 35cm \\ 30cm \end{array} \right\} = 14.4cm$$



# Zadatak 13 – CENTRIČNI PRITISAK

Usvojena podužna armatura: 8 Ø12 (8.96 cm<sup>2</sup>)

Usvojena poprečna armatura: Ø6/12.5



## Zadatak 14 – CENTRIČNI PRITISAK

Odrediti potrebnu površinu armature centrično pritisnutog elementa. Podaci za proračun:

$$N_G = 600 \text{ kN}$$

C25/30

XD1

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

B500 B

b/h = 30/35 cm

$$\text{C25/30} \rightarrow f_{cd} = 0.85 \cdot 25 / 1.5 = 14.2 \text{ MPa} = 1.42 \text{ kN/cm}^2$$

$$\text{B500 B} \rightarrow f_{yd} = 500 / 1.15 = 435 \text{ Mpa} = 43.5 \text{ kN/cm}^2$$

## Zadatak 14 – CENTRIČNI PRITISAK

Granična sila pritiska:

$$N_{Ed} = 1.35 \cdot 600 + 1.5 \cdot 800 = 2010 \text{ kN}$$

$$N_{Ed} = N_{Rd} = A_c \cdot f_{cd} + A_s \cdot \sigma_s$$

$$\sigma_s = \varepsilon_s \cdot E_s = 2 \cdot 200 = 400 \text{ MPa} = 40 \text{ kN / cm}^2 \neq f_{yd}$$

$$A_{s,pot} = \frac{N_{Ed} - A_c \cdot f_{cd}}{\sigma_s} = \frac{2010 - 30 \cdot 35 \cdot 1.42}{40} = 12.98 \text{ cm}^2$$

## Zadatak 14 – CENTRIČNI PRITISAK

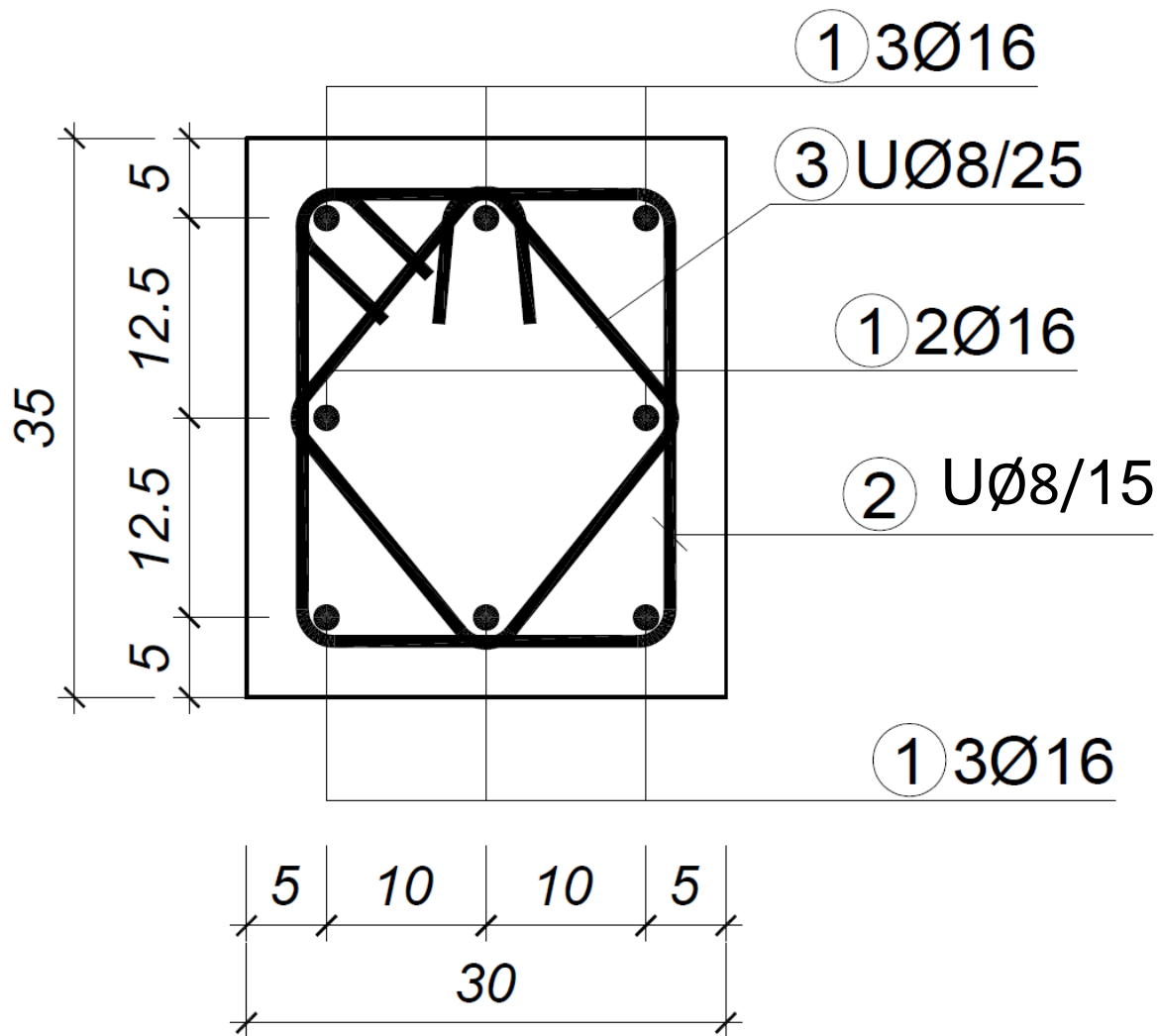
Usvajanje površine armature:

$$A_{s,min} = \begin{cases} 0.15 \cdot \frac{N_{Ed}}{f_{yd}} = 0.15 \cdot \frac{2010}{43.5} = 6.93 \text{ cm}^2 \\ 0.003 \cdot 30 \cdot 35 = 3.15 \text{ cm}^2 \\ 4\emptyset 12 = 4.48 \text{ cm}^2 \end{cases}$$

$$A_{s,min} = 6.93 \text{ cm}^2 < 12.98 \text{ cm}^2$$

Usvojeno: **8Ø16** (16.08 cm<sup>2</sup>)

# Zadatak 14 – CENTRIČNI PRITISAK



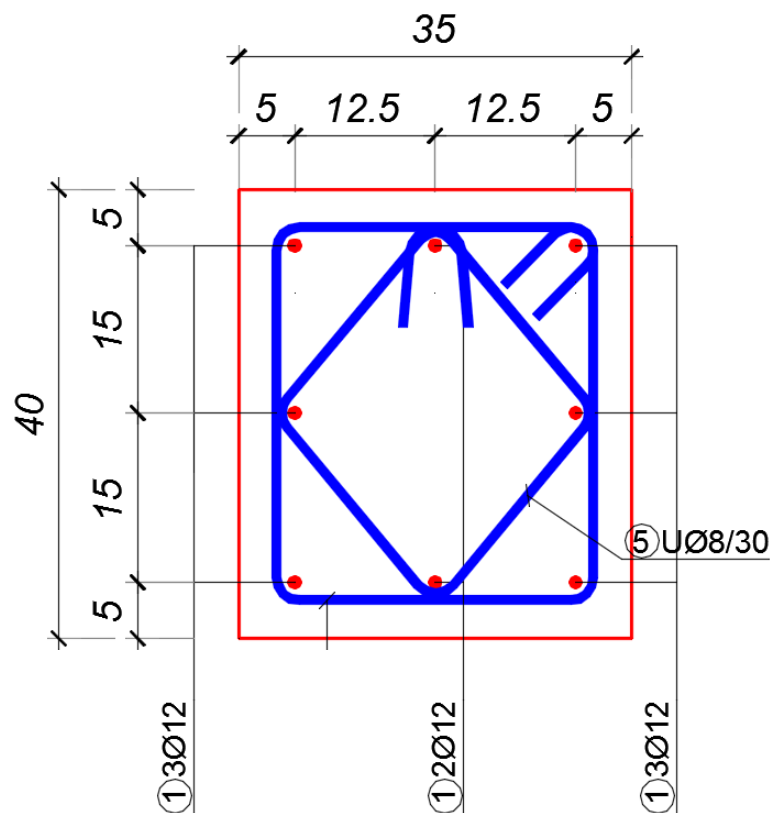
# Zadatak 15 – CENTRIČNI PRITISAK

Odrediti **normalnu silu pritiska usled promenljivog opterećenja**, koju može da prihvati presek na skici. Podaci za proračun:

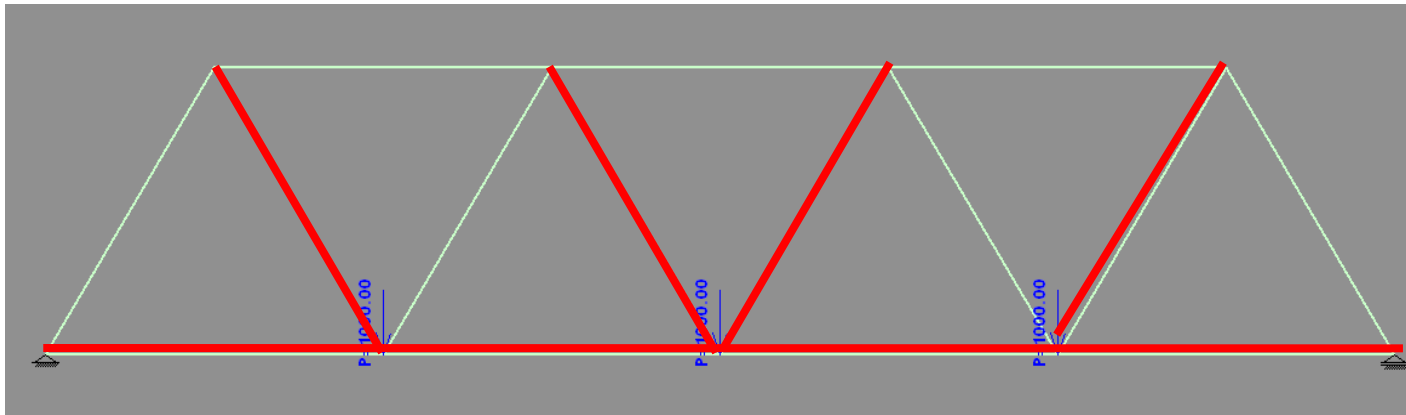
$$N_G = 600 \text{ kN}$$

C25/30

B500B



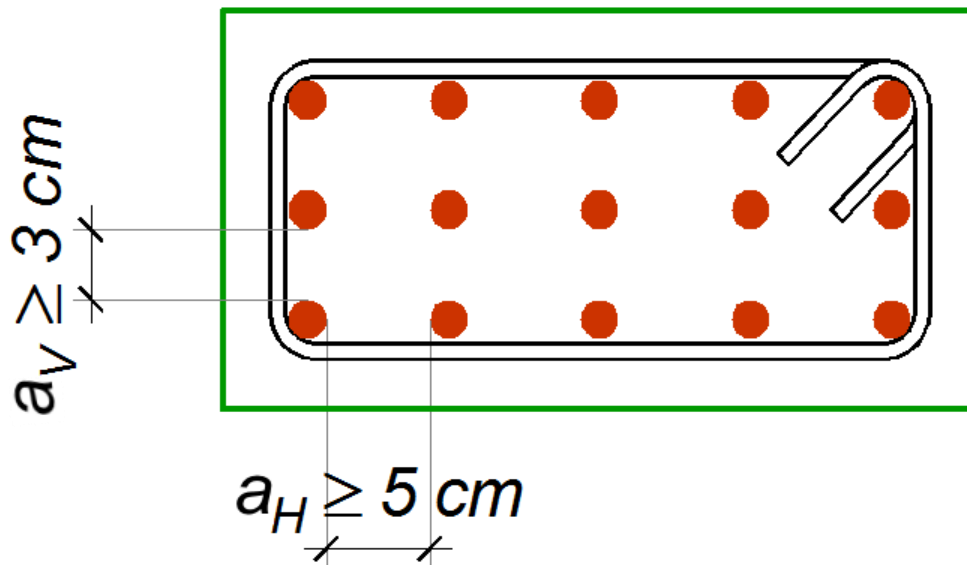
# Centrično zatezanje



# Centrično zatezanje

$$b \geq 2c_{\text{nom}} + 2\varnothing_s + m \times \varnothing + (m-1) \times a_H$$

$$h \geq 2c_{\text{nom}} + 2\varnothing_s + n \times \varnothing + (n-1) \times a_V$$





## Zadatak 16 – **CENTRIČNO ZATEZANJE**

Odrediti potrebnu površinu armature i oblikovati poprečni presek, pravougaonog oblika, centrično zategnutog elementa. Podaci za proračun:


$$N_G = - 400 \text{ kN}$$

C25/30

XD1

$$N_Q = - 500 \text{ kN}$$

B500 B

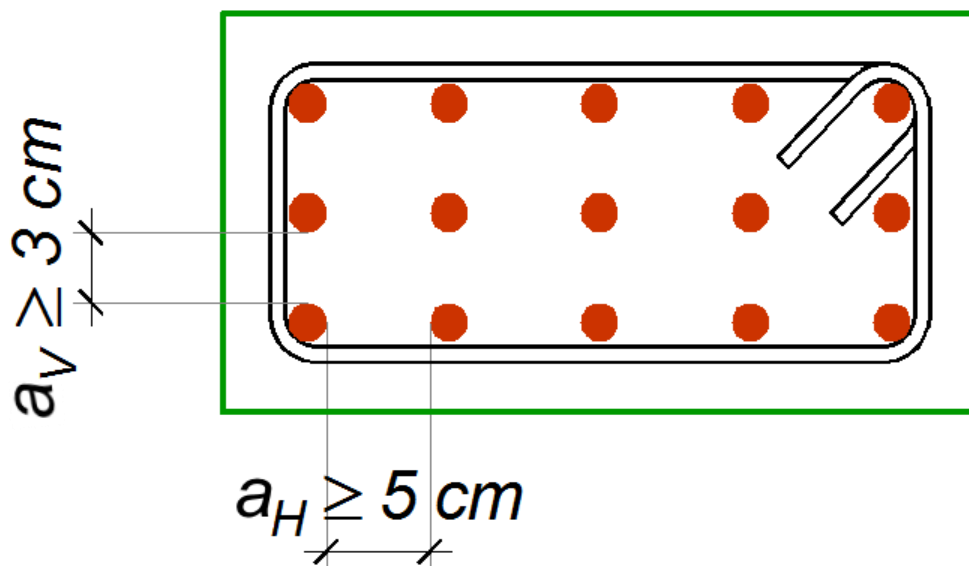
C25/30   $f_{cd} = 0.85 \cdot 25 / 1.5 = 14.2 \text{ MPa} = 1.42 \text{ kN/cm}^2$

B500 B   $f_{yd} = 500 / 1.15 = 435 \text{ Mpa} = 43.5 \text{ kN/cm}^2$

# Zadatak 16– CENTRIČNO ZATEZANJE

$$b \geq 2c_{\text{nom}} + 2\varnothing_s + m \times \varnothing + (m-1) \times a_H$$

$$h \geq 2c_{\text{nom}} + 2\varnothing_s + n \times \varnothing + (n-1) \times a_V$$



XD1  $\Rightarrow c_{\text{nom}} = 35 + 10 = 45 \text{ mm}$

Pretp.  $\Rightarrow \varnothing_s = 8 \text{ mm}$

Oznaka klase izloženosti	Minimalni zaštitni slojevi iz uslova trajnosti, $c_{\text{min,dur}}$ , za klasu konstrukcija S4									
	10	15	20	25	30	35	40	45	50	55
X0	10	15	20	25	30	35	40	45	50	55
XC1	15	20	25	30	35	40	45	50	55	
XC2	20	25	30	35	40	45	50	55		
XC3	25	30	35	40	45	50	55			
XC4	30	35	40	45	50	55				
XD1	35	40	45	50	55					
XD2	40	45	50	55						
XD3	45	50	55							
XS1	40	45	50	55						
XS2	35	40	45	50	55					
XS3	30	35	40	45	50	55				

## Zadatak 16 – **CENTRIČNO ZATEZANJE**

Granična sila **zatezanja**:

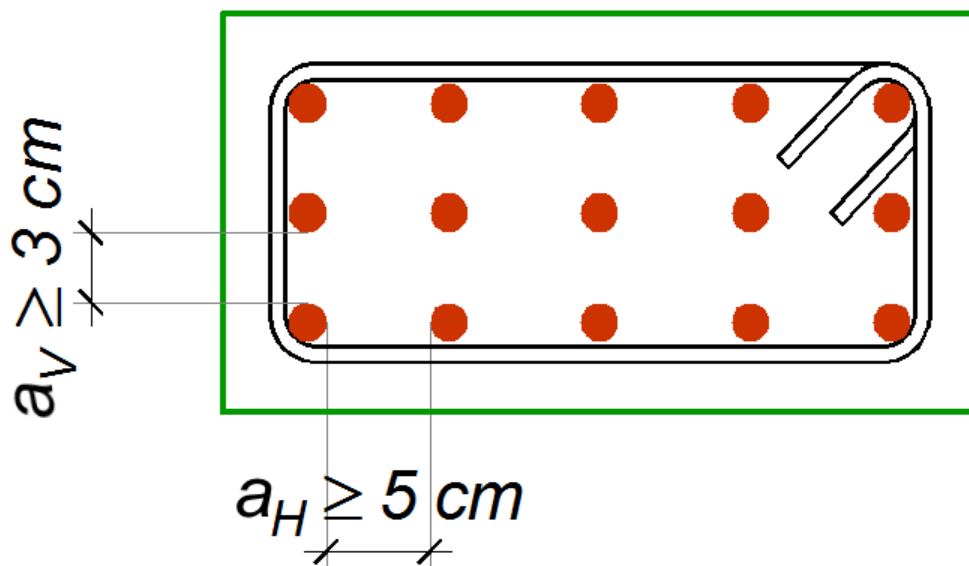
$$N_{Ed} = 1.35 \cdot (-400) + 1.5 \cdot (-500) = -1290 \text{ kN}$$

$$A_{S1} = \frac{N_{Ed}}{f_{yd}} = \frac{1290}{43.5} = 29.7 \text{ cm}^2$$

Usvojeno: **15Ø16** (30.15 cm<sup>2</sup>)

# Zadatak 16 – CENTRIČNO ZATEZANJE

$$b \geq 2c_{\text{nom}} + 2\varnothing_s + m \times \varnothing + (m-1) \times a_H$$
$$h \geq 2c_{\text{nom}} + 2\varnothing_s + n \times \varnothing + (n-1) \times a_V$$



$$b \geq 2 \times 4.5 + 2 \times 0.8 + 5 \times 1.6 + (5-1) \times 5.0 = 38.6 \text{ cm} \Rightarrow b = 40 \text{ cm}$$

$$h \geq 2 \times 4.5 + 2 \times 0.8 + 3 \times 1.6 + (3-1) \times 3.0 = 21.4 \text{ cm} \Rightarrow h = 25 \text{ cm}$$

# Zadatak 16 – CENTRIČNO ZATEZANJE

