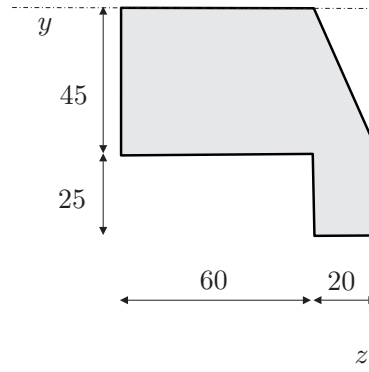


TRDNOST (OG-VSŠ) - 2. KOLOKVIJ (22. 12. 2011)

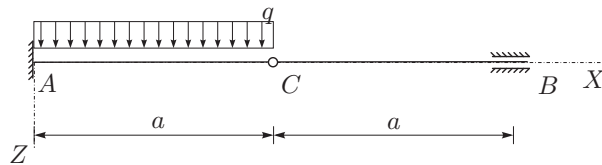
Pazljivo preberite besedilo vsake naloge!  
Pišite čitljivo! Uspešno reševanje!

1. Izračunajte geometrijske karakteristike ( $A$ ,  $y_T$ ,  $z_T$ ,  $I_y$ ,  $I_z$ ,  $I_{yz}$ ,  $I_y^T$ ,  $I_z^T$ ,  $I_{yz}^T$ ) lika na sliki! (25%)  
Podatki so v centimetrih.

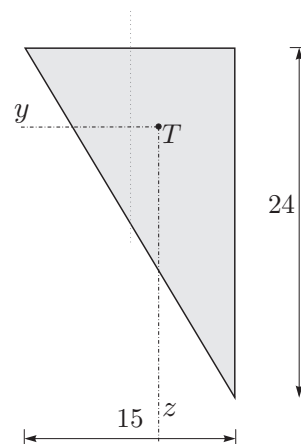


2. Za konstrukcijo na sliki izrazite upogibnico, notranje sile in določite vertikalni pomik v točki  $C$ ! Rezultate notranjih statičnih količin prikažite z diagrami! (50%)

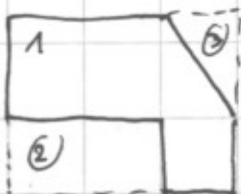
Podatki:  $a = 3$  m,  $q = 10$  kN/m,  
 $E = 20000$  kN/cm<sup>2</sup>,  
 $A = 100$  cm<sup>2</sup>,  $I_y = 10000$  cm<sup>4</sup>.



3. Prerez na sliki je obremenjen z osno silo  $N_x = 10$  kN in upogibnim momentom  $M_y = 15$  kNm. Določite vrednosti normalne napetosti  $\sigma_{xx}$  v ogliščih prereza (25%)  
Podatki za prerez so v centimetrih.



1. NALOGA



① - ② - ③

$$A = 3650 \text{ cm}^2$$

$$y_T = 39.82 \text{ cm}$$

$$z_T = 28.31 \text{ cm}$$

$$I_y = 4003960 \text{ cm}^4$$

$$I_z = 7703330 \text{ cm}^4$$

$$I_{yz} = -3450420 \text{ cm}^4$$

$$I_y^T = 1078540 \text{ cm}^4$$

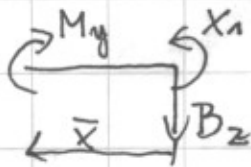
$$I_z^T = 1916540 \text{ cm}^4$$

$$I_{yz}^T = 664043 \text{ cm}^4$$

# TRDNOST - VSŠ

## 2. NALOGA

polje ②



$$\bar{x} = a - x$$

$$-M_y - B_z \cdot \bar{x} + X_1 = 0$$

$$M_y = X_1 - B_z \bar{x} = X_1 - \frac{X_1}{a} (a - x)$$

$$\boxed{M_y = X_1 \cdot \frac{x}{a}}$$

$$\frac{d^2 w^{\text{II}}}{dx^2} = - \frac{X_1 x}{EI_y a}$$

$$\frac{dw^{\text{II}}}{dx} = - \frac{1}{EI_y} \left( \frac{X_1}{a} \frac{x^2}{2} + D_1 \right)$$

$$w^{\text{II}}(x) = - \frac{1}{EI_y} \left( \frac{X_1}{a} \frac{x^3}{6} + D_1 x + D_2 \right)$$

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(20)

$$w^{\text{II}}(0) = 0 \Rightarrow C_2 = 0$$

$$w^{\text{II}}(a) = 0 \Rightarrow X_1 \frac{a^2}{6} + D_1 a + D_2 = 0 \Rightarrow \boxed{X_1 = - \frac{3ga^2}{16}} = -1687 \text{ KNm}$$

$$\frac{dw^{\text{II}}}{dx} \Big|_{x=0} = 0 \Rightarrow C_1 = 0$$

$$\frac{dw^{\text{II}}}{dx} \Big|_{x=a} = 0 \Rightarrow X_1 \frac{a}{2} + D_1 = 0 \Rightarrow D_1 = -X_1 \frac{a}{2}$$

$$w^{\text{II}}(a) = w^{\text{II}}(0) \Rightarrow X_1 \frac{a^2}{2} + g \frac{a^4}{4} - \frac{X_1 a^2}{6} - g \frac{a^4}{6} + \frac{ga^4}{24} = -D_2 \Rightarrow D_2 = -\frac{X_1 a^2}{3} - \frac{ga^4}{8}$$

$$\boxed{D_1 = \frac{3ga^3}{32}}$$

$$\boxed{D_2 = -\frac{ga^4}{16}}$$

(5)

$$w^{\text{II}}(0) = \frac{ga^4}{16EI_y} = 2.53 \text{ cm}$$

$$\textcircled{1}: M_y = \frac{5ga^2}{16} - \frac{3ga}{16}x + gax - \frac{gx^2}{2} = \frac{5ga^2}{16} + \frac{13}{16}gax - \frac{gx^2}{2}$$

$$\boxed{M_y = -28.125 + 24.375x - 5x^2} \quad M_y(3) = 0 \quad \checkmark \text{ KONTROLA}$$

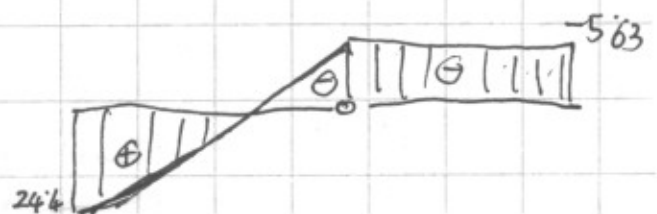
$$N_z = 24.375 - 25x$$

$$\textcircled{2} \quad \boxed{M_y = -\frac{3ga}{16}x = -5.63x} \Rightarrow N_z = -5.63$$

(10)



[Nz]



### 3. NALOGA

$$y_T = 5 \text{ cm}$$

$$z_T = 8 \text{ cm}$$

$$\sigma_{xx} = \frac{N_x}{A_x} - \frac{M_z I_y - M_y I_{yz}}{I_y I_z - I_{yz}^2} y + \frac{M_y I_z - M_z I_{yz}}{I_y I_z - I_{yz}^2} z$$

$$N_x = 10 \text{ kN}$$

$$M_y = 1500 \text{ kNcm}$$

$$A_x = 180 \text{ cm}^2$$

$$I_y^T = \frac{bh^3}{36} = \frac{15 \cdot 24^3}{36} = 5760 \text{ cm}^4$$

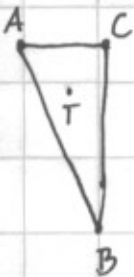
$$I_z^T = \frac{hb^3}{36} = \frac{24 \cdot 15^3}{36} = 2250 \text{ cm}^4$$

$$I_{yz}^T = \frac{15^2 \cdot 24^2}{72} = 1800 \text{ cm}^4$$

$$I_y I_z - I_{yz}^2 = 972 \cdot 10^6 \text{ cm}^8$$

$$\sigma_{xx} = \frac{10 \cdot 10^3}{180 \text{ cm}^2} + \frac{1500 \cdot 10^3 \cdot 1800 \text{ cm}^4}{972 \cdot 10^6 \text{ cm}^8} y + \frac{1500 \cdot 2250 \cdot 10^3}{972 \cdot 10^6 \text{ cm}^8} z$$

$$\sigma_{xx} = 55.56 + 277.78 y + 347.22 z \quad [\text{N/cm}^2]$$



$$\sigma_{xx}(0,0) = 55.56 \text{ N/cm}^2 \text{ (TEŽIŠČE)}$$

$$\sigma_{xx}(A) = \sigma_{xx}(-10, -8) = 55.56 \text{ N/cm}^2$$

$$\sigma_{xx}(B) = \sigma_{xx}(-5, 16) = 4222.2 \text{ N/cm}^2$$

$$\sigma_{xx}(C) = \sigma_{xx}(-5, -8) = -4111.1 \text{ N/cm}^2$$