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.

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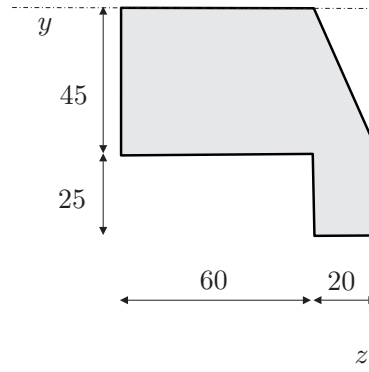
2. Za konstrukcijo na sliki izrazite upogibnico, notranje sile in določite vertikalni pomik v točki C! Rezultate notranjih statičnih količin prikažite z diagrami! (50%)
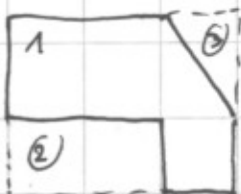Podatki: $a = 3\,\text{m}$, $q = 10\,\text{kN/m}$,
$E = 20000\,\text{kN/cm}^2$,
$A = 100\,\text{cm}^2$, $I_y = 10000\,\text{cm}^4$.

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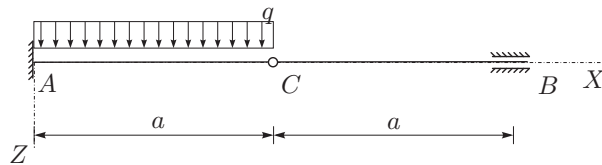
3. Prerez na sliki je obremenjen z osno silo $N_x = 10\,\text{kN}$ in upogibnim momentom $M_y = 15\,\text{kNm}$. Določite vrednosti normalne napetosti σ_{xx} v ogliščih prereza (25%)
Podatki za prerez so v centimetrih.
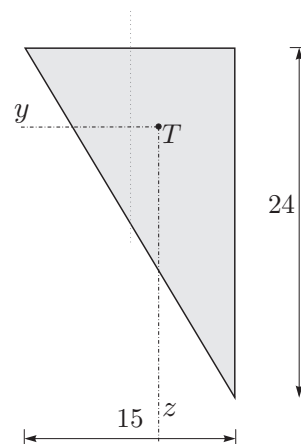
1. NALOGA

$A = 3650 \ cm^2$

$y_T = 39{\cdot}82 \ cm$

$x_T = 28{\cdot}31 \ cm$

$I_y = 4\,003\,960 \ cm^4$

$I_z = 7\,703\,330 \ cm^4$

$I_{yz} = -3\,450\,420 \ cm^4$

$I_y^T = 1\,078\,540 \ cm^4$
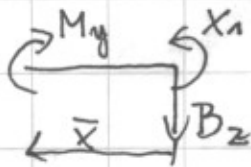
$I_z^T = 1\,916\,548 \ cm^4$

$I_{yz}^T = 664\,043 \ cm^4$

TRDNOST - VSŠ

2. NALOGA

polje ②

$\bar{x} = a - x$

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

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

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

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

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

$$w^②(x) = -\frac{1}{EI_y}\left(\frac{X_1}{a}\frac{x^3}{6} + D_1 x + D_2\right)$$

ROBNI POGOJI   (20)

$w^②(0) = 0 \Rightarrow C_2 = 0$

$w^②(a) = 0 \implies X_1 \frac{a^2}{6} + D_1 \cdot a + D_2 = 0 \Rightarrow \boxed{X_1 = -\frac{3q a^2}{16}} = -16.87$ kNm

$\frac{dw^②}{dx}\Big|_{x=0} = 0 \Rightarrow C_1 = 0$

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

$w^②(a) = w^②(0) \Rightarrow X_1 \cdot \frac{a^2}{2} + q\frac{a^4}{4} - \frac{X_1 a^2}{6} - q\frac{a^4}{6} + \frac{q a^4}{24} = -D_2 \Rightarrow D_2 = -\frac{X_1 a^2}{3} - \frac{q a^4}{8}$

$$\boxed{D_1 = \frac{3q a^3}{32}} \qquad \boxed{D_2 = -\frac{q a^4}{16}}$$

$$\boxed{w^②(x) = \frac{q}{EI_y}\left(\frac{x^4}{24} - \frac{ax^3}{6} + \frac{ax^3}{32} + \frac{5}{32}a^2 x^2\right)} \quad (5)$$

$$\boxed{w^②(x) = \frac{q a}{32 EI_y}\left(x^3 - 3a^2 x + 2a^3\right)}$$

$w^②(0) = \frac{q a^4}{16 EI_y} = 2.53$ cm

① : $M_y = \frac{-5}{16}q a^2 - \frac{3q a}{16} x + q a x - \frac{q x^2}{2} = \frac{-5 q a^2}{16} + \frac{13}{16} q a x - \frac{q x^2}{2}$

$$\boxed{M_y = -28.125 + 24.375 x - 5 x^2} \qquad M_y(3) = 0 \checkmark \text{ (KONTROLA)}$$
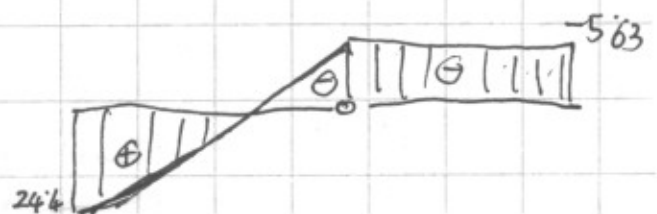
$N_z = 24.375 - 25 x$

② $\boxed{M_y = -\frac{3q a x}{16} = -5.63 x} \Rightarrow N_z = -5.63$

(10)

$[M_y]$

−28.1   −16.9

$[N_z]$

−5.63

24.6

3. NALOGA

$y_T = 5 cm$

$z_T = 8 cm$

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

$N_x = 10 kN$

$M_y = 1500 \, kNcm$

$A_x = 180 \, cm^2$
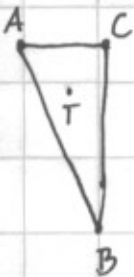
$I_y^T = \frac{bh^3}{36} = \frac{15 \cdot 24^3}{36} = 5760 \, cm^4$

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

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

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

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

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

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

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

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

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