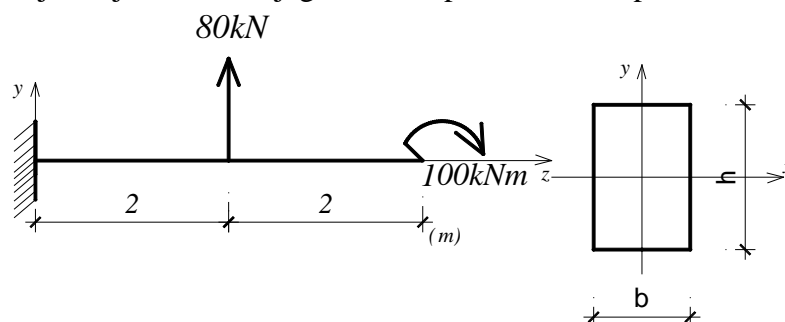


KOLOKVIJUM 2
Mehanika i otpornost materijala
 (grupa I)

ZADATAK 1:

Za nosač opterećen kao na slici:

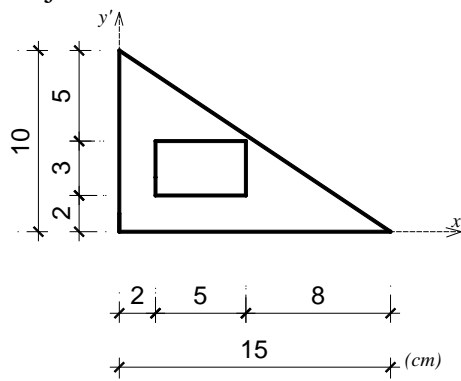
- nacrtati dijagrame presječnih sila (M , T);
- dimenzionisati nosač pravougaonog poprečnog presjeka $h/b=1.5/1$, $\sigma_{dop}=160$ MPa
- za presjek u uklještenju nacrtati dijagrame komponentalnih napona



ZADATAK 2:

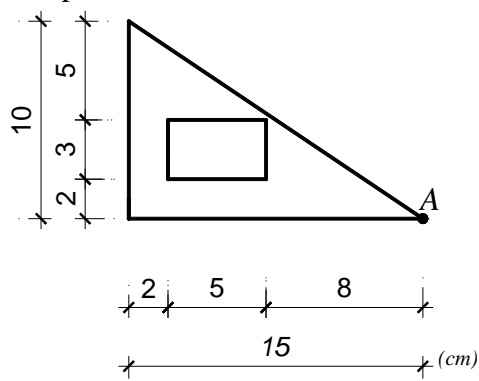
Za poprečni presjek na slici odrediti:

- glavne centralne momente inercije;
- glavne centralne ose inercije.



ZADATAK 3:

Za poprečni presjek na slici opterećen ekscentričnom silom pritiska u tački A $P=100$ kN nacrtati dijagram ekstremnih normalnih napona.

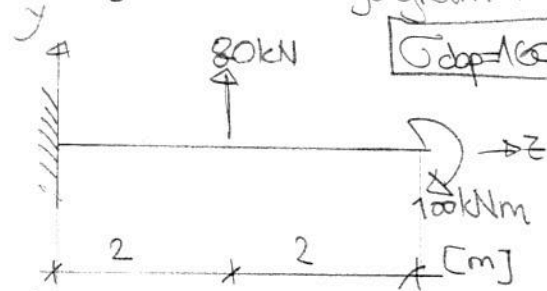
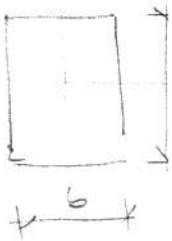


1. Za nosač na slici:

a) nacrtati dijagrame presjornih sila

b) dimenzionirati nosač pravougaonog p.p. $h/b = 1,5/1$

c) nacrtati dijagram komp. napona za presjek u ukraštenju



$\sigma_{dop} = 16 \text{ MPa}$

presjek u ukraštenju:

$$c) \sigma_z = \frac{60 \cdot 10^2}{5826,816} \cdot 9 = 9,2675 \frac{\text{kN}}{\text{cm}^2}$$

$$b = 12 \text{ cm}$$

$$h = 18 \text{ cm}$$

$$I_x = 5826,816 \text{ cm}^4$$

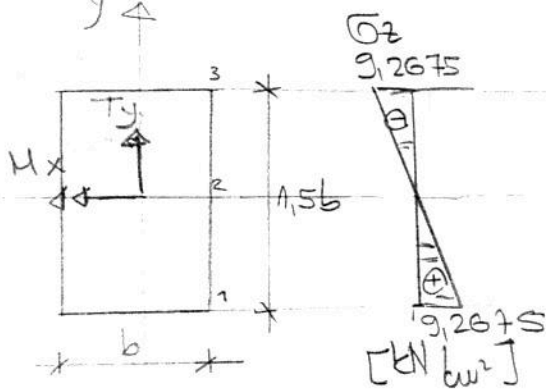
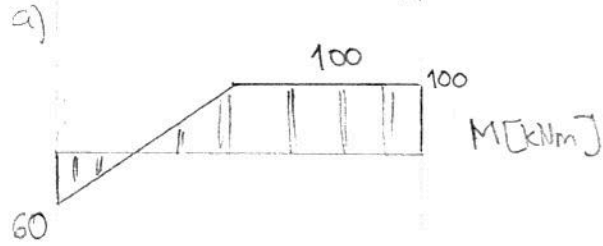
$$1) S_x^{(1)} = 0$$

$$2) S_x^{(2)} = 12 \cdot 9 \cdot \frac{9}{2} = 486 \text{ cm}^3$$

$$3) S_x^{(3)} = 0$$

$$1) \tau_{z1} = 0$$

$$2) \tau_{z2} = \frac{80 \cdot 486}{5826,816 \cdot 12} = 0,556 \frac{\text{kN}}{\text{cm}^2}$$



$$M_{max} = 100 \text{ kNm}$$

$$\sigma_z = \frac{M_{max}}{I_x} \cdot y_{max}$$

$$I_x = \frac{(1,5b)^3 \cdot b}{12} = 0,281b^4$$

$$y_{max} = 0,75b$$

$$\sigma_z = \frac{100 \cdot 100 \cdot 0,75b}{0,281b^4}$$

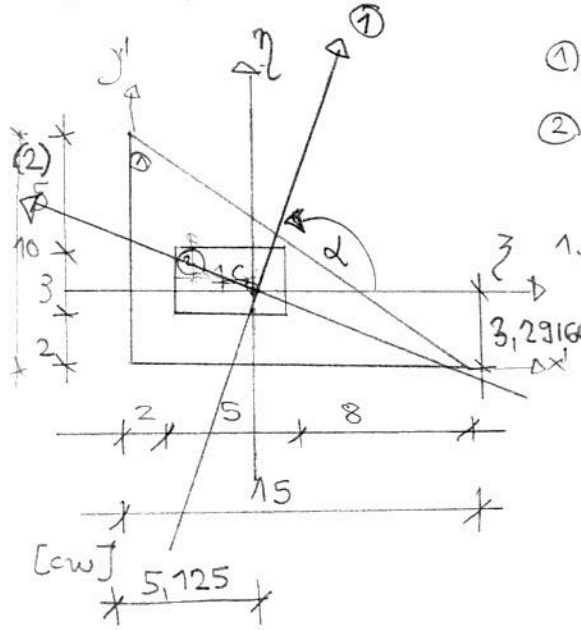
$$\sigma_z = \frac{10000 \cdot 0,75}{0,281b^3} \leq \sigma_{dop}$$

$$\frac{26690,391}{b^3} \leq 16 \frac{\text{kN}}{\text{cm}^2}$$

$$b \geq 11,86 \text{ cm}$$

$$b = 12 \text{ cm} \quad h = 18 \text{ cm}$$

2. Za p.p. na duci su zbirani gl. centralne momente inercije i nastali su
 gl. centralne ose:



- ① $C_1(5, 3.3) A = 75\text{cm}^2$
- ② $C_2(4.5; 3.5) A = 15\text{cm}^2$ $A = 60\text{cm}^2$

1. Težište

$$x_c = \frac{5 \cdot 75 + 4.5 \cdot 15}{60} = 5.125\text{cm}$$

$$y_c = \frac{3 \cdot 75 + 3.5 \cdot 15}{60} = 3.29166\text{cm}$$

$C(5.125; 3.29166)$

* $I_z = I_{z1} - I_{z2} = 0.04167$

$$I_{z1} = \frac{10^3 \cdot 15}{36} + (3 \cdot 3 - 3.29166)^2 \cdot 75 = 416.66 + 0.13025 = 416.797\text{cm}^4$$

$$I_{z2} = \frac{3^3 \cdot 5}{12} + (3.5 - 3.29166)^2 \cdot 15 = 11.90108\text{cm}^4$$

0.20834

$I_z = 404.895\text{cm}^4$

* $I_\eta = I_{\eta1} - I_{\eta2} = -0.125$

$$I_{\eta1} = \frac{15^3 \cdot 10}{36} + (5 - 5.125)^2 \cdot 75 = 937.5 + 1.17187 = 938.6718\text{cm}^4$$

$$I_{\eta2} = \frac{5^3 \cdot 3}{12} + (4.5 - 5.125)^2 \cdot 15 = 31.25 + 5.8594 = 37.10937\text{cm}^4$$

-0.625

$I_\eta = 901.5624\text{cm}^4$

$$I_{z\eta} = I_{z\eta1} - I_{z\eta2}$$

$$I_{z\eta1} = -\frac{10^2 \cdot 15^2}{72} + (0.04167 \cdot (-0.125)) \cdot 75 = -312.5 - 0.39065 = -312.891\text{cm}^4$$

$$I_{z\eta2} = 0 + (0.20834 \cdot (-0.625)) \cdot 15 = -1.953\text{cm}^4$$

$I_{z\eta} = -310.937\text{cm}^4$

$$\tan 2\alpha = \frac{-2 \cdot (-310.9376)}{404.8958 - 901.5624} = -1.2520978$$

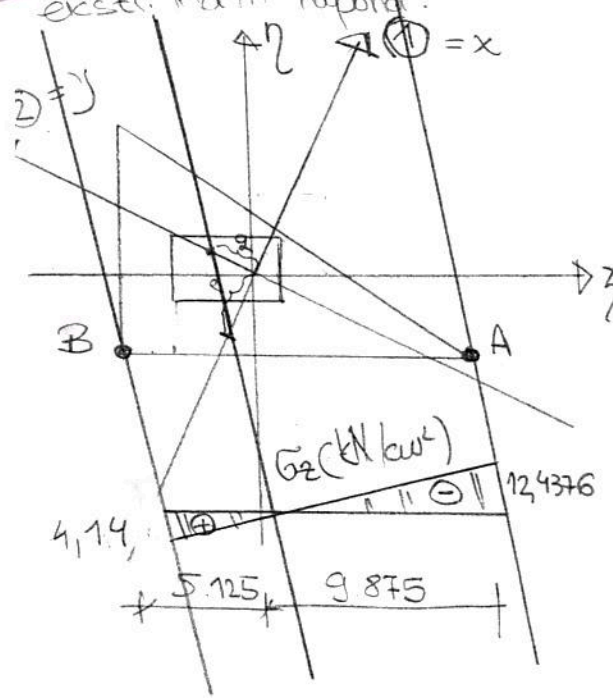
$\Gamma_0 \quad -496.66'$

$I_{1,2} = 653.223 \pm 397.9342$
 $I_1 = 1051.163\text{cm}^4$
 $I_2 = 255.295\text{cm}^4$

$\alpha = 0.5 \arctan(-1.252) + 90^\circ = 64.3065^\circ$

$\sigma_1 = \frac{1}{2} \sqrt{\sigma_{xx}^2 + 4\tau_{xy}^2}$ (pritiska)

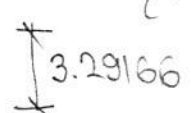
3) Za rasčun pop. pr na slici opterećenog ekspritska $P = 100 \text{ kN}$ uvertati dijagram
 exstr. na m. napond.



$$\alpha = 64,3065^\circ$$

* koordinate napredne točke A u sistemu gl. centralnih osa:

$$A(z, \eta) = A(9,875; -3,29166)$$



$$a = 9,875 \cdot \cos \alpha + (-3,29166) \cdot \sin \alpha = 4,2814 - 2,9662 = 1,3152 \text{ cm}$$

$$a = 4,2814 - 2,9662 = 1,3152 \text{ cm}$$

$$b = -9,875 \cdot \sin \alpha + (-3,29166) \cdot \cos \alpha = -8,8986 - 1,4271 = -10,3257 \text{ cm}$$

$$b = -8,8986 - 1,4271 = -10,3257 \text{ cm}$$

$$A(a, b) = (1,3152; -10,3257)$$

$$I_x^2 = \frac{1051,163}{60} = 17,5194 \text{ cm}^4$$

$$p = \frac{-4,255}{1,3152} = -3,2352 \text{ cm}$$

$$I_y^2 = \frac{255,295}{60} = 4,255 \text{ cm}^4$$

$$q = \frac{-17,5194}{-10,3257} = 1,6967 \text{ cm}$$

$$B(z, \eta) = B(-5,125; -3,29166)$$

$$B(x_B, y_B);$$

$$x_B = -5,125 \cdot \cos \alpha - 3,29166 \cdot \sin \alpha = -2,222 - 2,9662 = -5,1882 \text{ cm}$$

$$y_B = +5,125 \cdot \sin \alpha - 3,29166 \cdot \cos \alpha = 4,61827 - 1,4271 = 3,1911 \text{ cm}$$

$$B(-5,1882; 3,1911)$$

$$\sigma_z^A = -\frac{100}{60} \cdot \left[1 + \frac{-10,3257}{17,5194} \cdot (-10,3257) + \frac{1,3152}{4,255} \cdot 1,3152 \right] = -1,66 \cdot (4,086 + 0,40652) = -12,4376 \text{ kN/cm}^2$$

$$\sigma_z^B = -\frac{100}{60} \cdot \left[1 - 0,5894 \cdot 3,1911 + 0,30309 \cdot (-5,1882) \right] = -1,66 \cdot (0,8209 - 1,60362) = 4,14068 \text{ kN/cm}^2$$