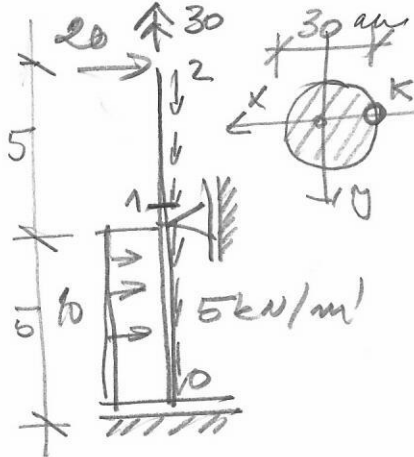


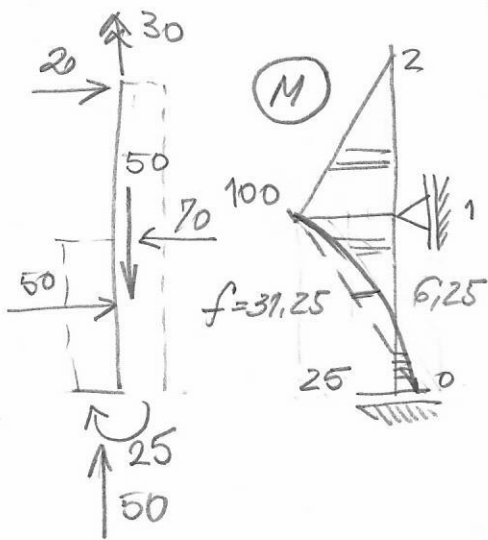
05.09.2020.

OTPORNOST MATERIJALA 1

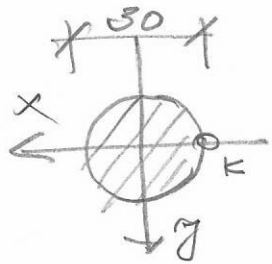


ZA NOSAČ I OPREĐENJE NA SKICI TREBA:

- a) SKICUNATI I NACRTATI DIAGRAME KOMPONENTALNIH NAPONA U PRESEKU 1 DESNO
- b) IZVRŠITI ANALIZU STANJA NAPONA U TAČKI K PRESEKA 1 DESNO I NACRTATI KODU KRUG NAPONA.
- c) INTEGRACIJOM DIF. JED. ODREDITI v_1, w_1, φ_1 ZA AKO JE $E=30GPa, \nu=0,25$
- d) MOR. MAKSU. ANALOGIJOM ODREDITI v_2, φ_2
- e) SKICIRATI DEFORMISANU OBU NOSAČA



$$f = 10 \cdot \frac{\pi^2}{8} = 31,25 \text{ kNm}$$



$$M_{x,1d} = -100 \text{ kNm}$$

$$T_{y,1d} = 20 \text{ kN}$$

$$N_{1d} = -25 \text{ kN}$$

$$M_{t,1d} = 30 \text{ kNm}$$

$$F = \frac{30^2 \pi}{4} = 706,86 \text{ cm}^2$$

$$J_x = \frac{15^4 \pi}{4} = 39760,78 \text{ cm}^4$$

$$J_o = \frac{15^4 \pi}{2} = 79521,56 \text{ cm}^4$$

$$\sigma_z(N) = \frac{-25 \cdot 10^{-3}}{706,86 \cdot 10^{-4}} = -0,354 \text{ MPa}$$

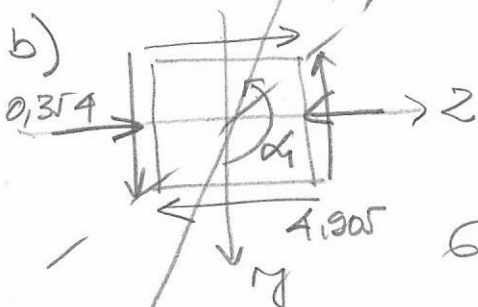
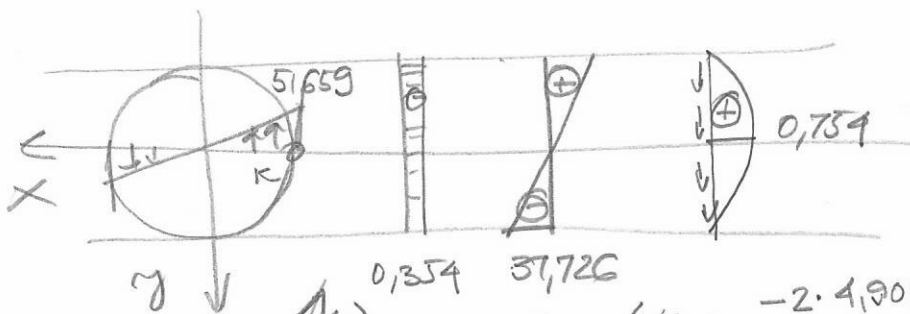
$$\sigma_z(M_x) = \frac{-100 \cdot 10^{-3} \cdot 0,15}{39760,78 \cdot 10^{-8}} = -37,726 \text{ MPa}$$

$$S_{x,K} = \frac{30^2 \pi}{4} \cdot \frac{4 \cdot 15^3}{3 \pi} = 4500 \text{ cm}^3$$

$$W_t = \frac{J_o}{r} = \frac{79521,56}{15} = 5301,44 \text{ cm}^3$$

$$\tau_{zy}(T_y) = \frac{20 \cdot 10^{-3} \cdot 4500 \cdot 10^{-6}}{39760,78 \cdot 10^{-8} \cdot 0,3} = 0,754 \text{ MPa}$$

$$\tau_{zy}(M_t) = \frac{30 \cdot 10^{-3}}{5301,44 \cdot 10^{-6}} = 5,659 \text{ MPa}$$



$$135 < \alpha < 180^\circ$$

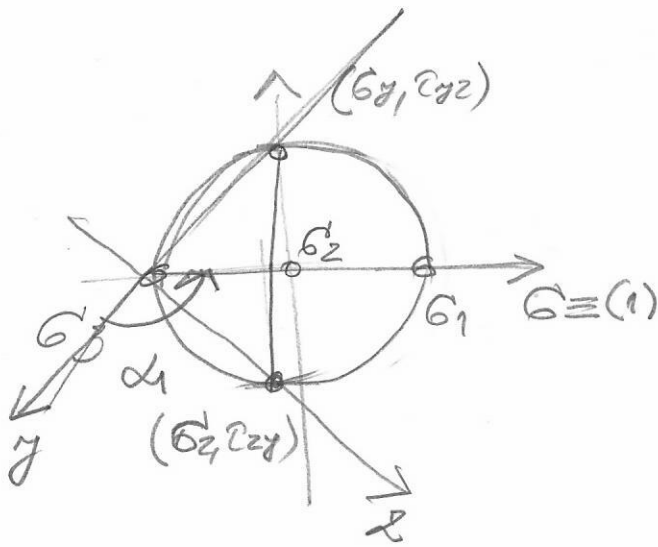
$$\tan 2\alpha = \frac{-2 \cdot 4,905}{0 - (-0,354)} = \frac{(-)}{(+)} 27,711$$

$$2\alpha + \theta = 360^\circ$$

$$\alpha = 180 - \frac{1}{2} \arctan 27,711 = 136,03^\circ$$

$$\sigma_{\max/\min} = \frac{-0,354}{2} \pm \sqrt{\left(\frac{-0,354}{2}\right)^2 + 4,905^2} =$$

$$= \begin{cases} 4,731 = \sigma_1 \\ 0 = \sigma_2 \\ -5,085 = \sigma_3 \end{cases}$$



$$c) \quad M_{x_1} = 25 - 10 \cdot \frac{z^2}{2} = 25 - 5z^2$$

$$EJ_x v_1'' = -25 + 5z^2$$

$$EJ_x v_1' = C_1 - 25z + 5 \frac{z^3}{3} \quad EJ_x v_1'(0) = C_1 = 0$$

$$EJ_x v_1 = C_2 - 25 \frac{z^2}{2} + 5 \frac{z^4}{12}$$

$$EJ_x v_1(5) = C_2 - 25 \cdot \frac{5^2}{2} + 5 \frac{5^4}{12} = 0 \quad C_2 = 52,083$$

$$EJ_x = 30 \cdot 10^3 \cdot 39760,78 \cdot 10^8 = 11,928 \text{ MNm}^2$$

$$v_1(0) = \frac{52,083 \cdot 10^{-3}}{11,928} = 4,366 \cdot 10^{-3} \text{ m} = 4,366 \text{ mm}$$

$$N(z) = -50 + 5z \quad EF = 30 \cdot 10^3 \cdot 706,86 \cdot 10^{-9} = 2120,58 \text{ MN}$$

$$EF w_1'(z) = -50 + 5z$$

$$EF w_1(z) = C_1 - 50z + \frac{5}{2} z^2 \quad EF w_1(0) = C_1 = 0$$

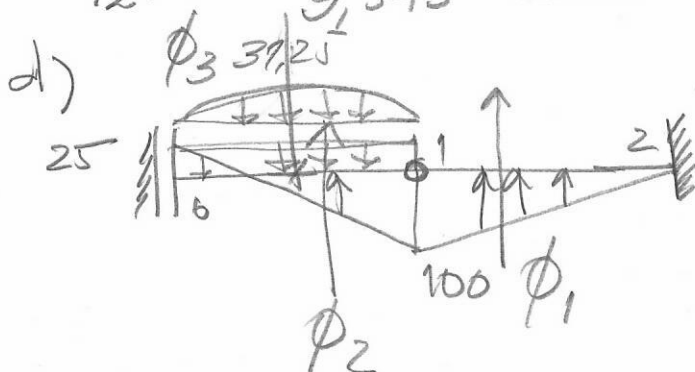
$$w_1(5) = \frac{-50 \cdot 5 + \frac{5}{2} \cdot 5^2}{2120,58 \cdot 10^3} = -0,088 \cdot 10^{-3} \text{ m} = -0,088 \text{ mm}$$

$$G = \frac{30}{2(140,25)} = 126 \text{ Pa} \quad GJ_t = 12 \cdot 10^3 \cdot 7952156 \cdot 10^{-8} = 9,543 \text{ MNm}^2$$

$$GJ_t \varphi_2'(z) = 30$$

$$GJ_t \varphi_2(z) = C_1 + 30z \quad GJ_t \varphi_2(0) = C_1 = 0 \checkmark$$

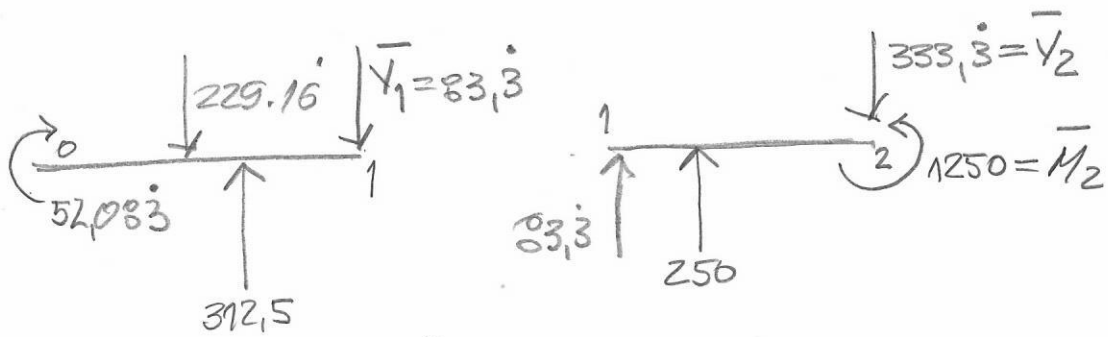
$$\varphi_2(5) = \frac{30 \cdot 5 \cdot 10^{-3}}{9,543} = 15,719 \cdot 10^{-3} \text{ rad.}$$



$$\phi_1 = \frac{100 \cdot 5}{2} = 250$$

$$\phi_2 = \frac{125 \cdot 5}{2} = 312,5$$

$$\phi_3 = (25 + \frac{2}{3} \cdot 31,25) \cdot 5 = 229,16$$



$$v_2 = \frac{1250 \cdot 10^{-3}}{11.928} = 104,80 \cdot 10^{-3} \text{ m} = 104,80 \text{ mm}$$

$$\varphi_2 = \frac{333,3 \cdot 10^{-3}}{11.928} = 27,945 \cdot 10^{-3} \text{ rad.}$$

