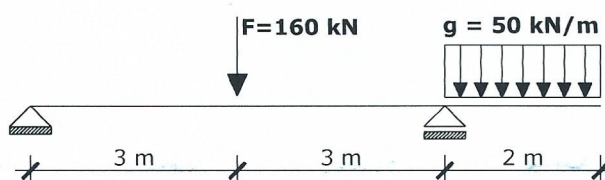
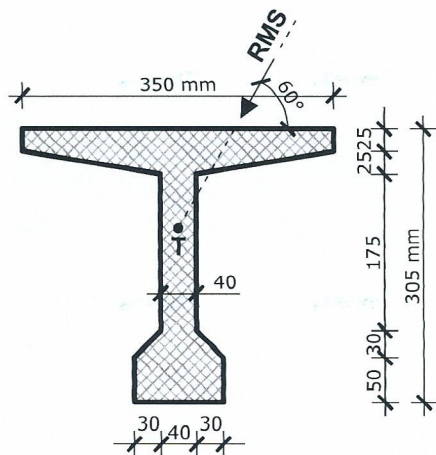


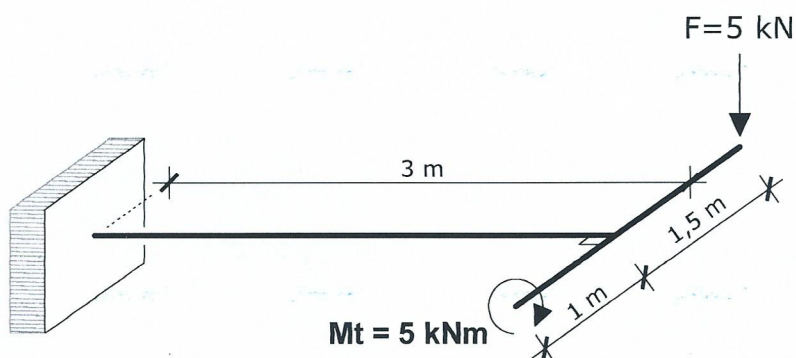
Ime i prezime:

Janko Kozek

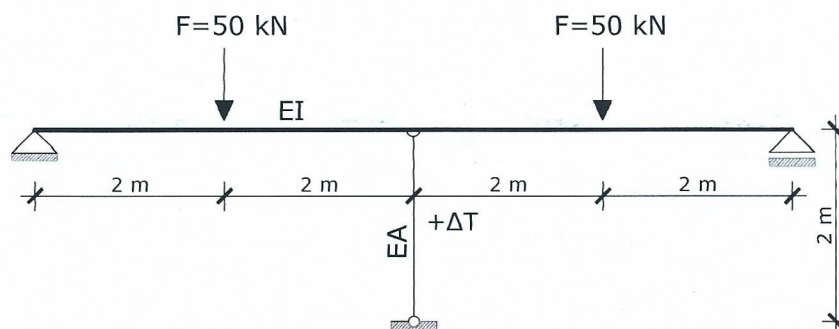
1.] Za zadani poprečni nosač opterećen prema slici treba primjenom jezgre poprečnog presjeka odrediti najveća normalna naprezanja te nacrtati njihov dijagram.



2.] Štap prikazan na slici okruglog je poprečnog presjeka i promjera $d = 120$ mm. Odredite koeficijente sigurnosti u kritičnom presjeku štapa po 3. i 5. teoriji čvrstoće. Zadano je: $\sigma_T = 235$ MPa. **Označite točku u kritičnom presjeku za koju ste odredili koeficijent sigurnosti!**



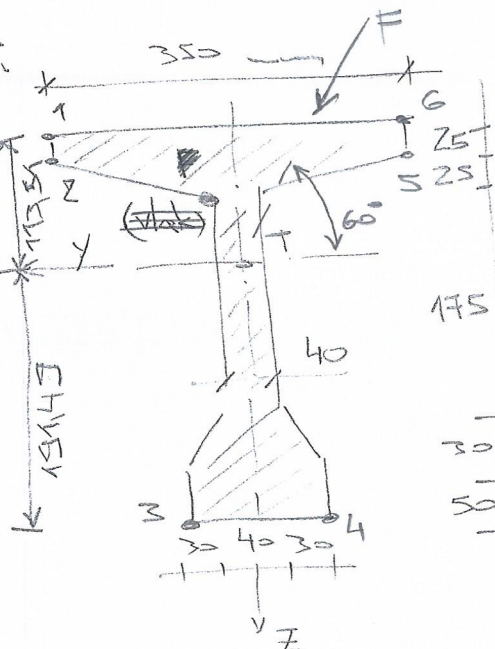
3.] Za sistem prikazan na slici treba odrediti i nacrtati dijagrame unutarnjih sila (M , T , N) ako je zadano: $E = 2 \cdot 10^5$ MPa, $I = 2,2 \cdot 10^8$ mm⁴, $A = 220$ mm², $\alpha_T = 1,2 \cdot 10^{-5}$ K⁻¹, $\Delta T = +40$ K (štap se zagrijava).



ZADATAK:

$$F = 725 \text{ kN}$$

$$Z_T = 191,49 \text{ mm}$$



$$I_y = 317,03 \cdot 10^4 \text{ mm}^4$$

$$I_z = 120,65 \cdot 10^4 \text{ mm}^4$$

$$A = 27725 \text{ mm}^2$$

$$I_y^2 = 11434,81 \text{ mm}^2$$

$$I_z^2 = 4351,67 \text{ mm}^2$$

NEUTRALNA OS:

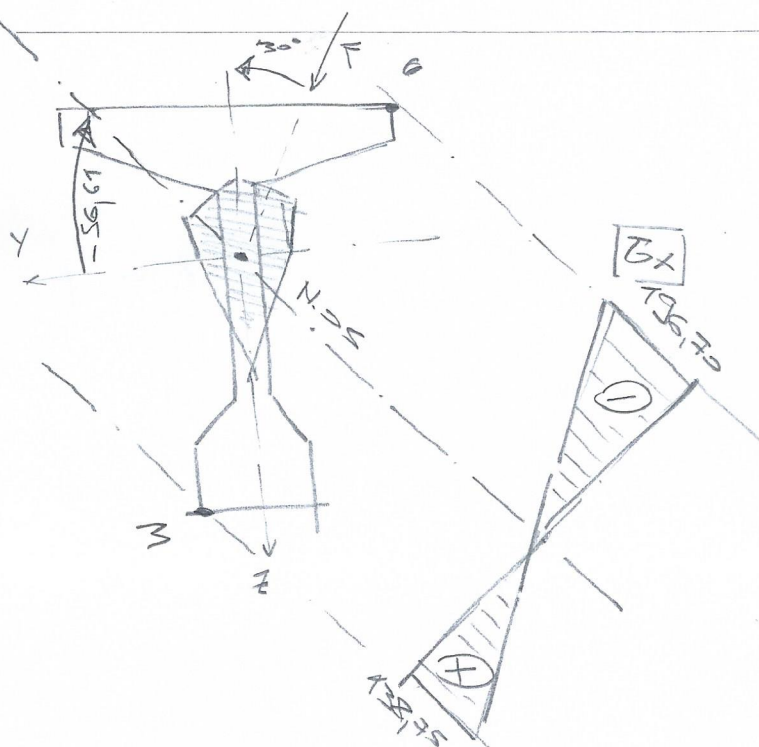
$$\tan p = -\frac{I_y}{I_z} \cdot \tan k = -\frac{317,03}{120,65} \cdot \tan 20^\circ$$

$$p = -56,609^\circ$$

$$\alpha_y = -\frac{I_z^2}{e_y}$$

$$\alpha_z = -\frac{I_y^2}{e_z}$$

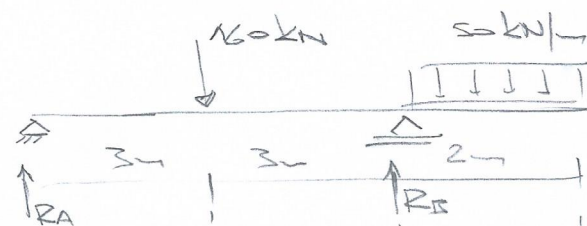
TOČKA:	e_y	e_z	α_y	α_z
1	175	-113,51	-24,87	100,74
2	175	-88,51	-24,87	129,19
3	50	191,49	-87,03	-59,71
4	50	191,49	-87,03	-59,71



$$\sigma_1 = \pm \frac{M}{I \cdot A}$$

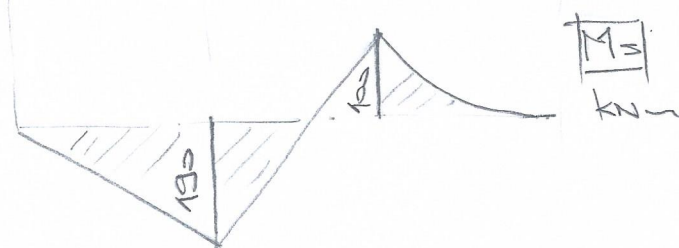
$$I_3 = 4939 \text{ mm}^4$$

$$I_6 = 34,84 \text{ mm}^4$$



$$-R_A \cdot 6 + 160 \cdot 3 - 50 \cdot 2 = 0$$

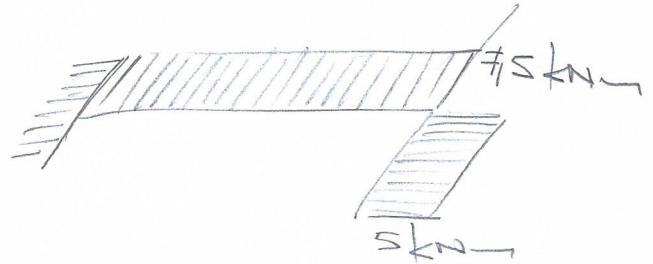
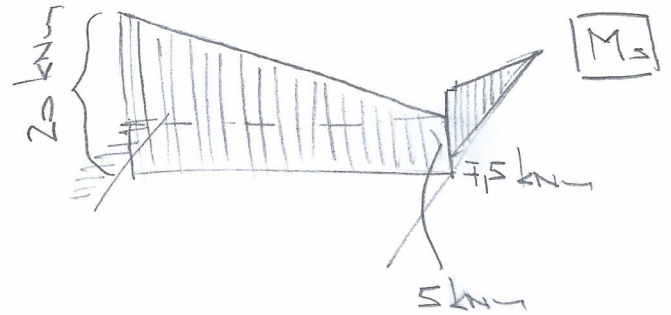
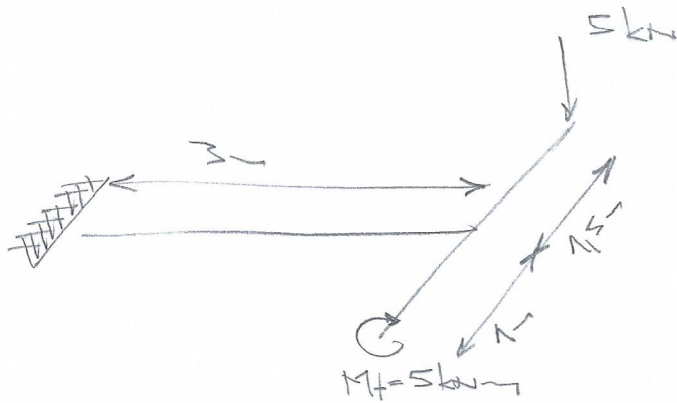
$$R_A = 63,33 \text{ kN}$$



$$\sigma_3 = \frac{190 \cdot 10^6}{4939 \cdot 27725} = 138,75 \text{ MPa (vlak)}$$

$$\sigma_6 = \frac{-190 \cdot 10^6}{34,84 \cdot 27725} = -196,70 \text{ MPa (vlak)}$$

2. ZADATOK: $l = 12\text{ m}$ $E_T = 235\text{ MPa}$



$$W_y = \frac{I_z}{32} = 169646,00\text{ mm}^3$$

$$\sigma = \frac{M_z}{W_y} = 117,89\text{ MPa}$$

$$\tau = \frac{M_t}{2W_y} = 22,10\text{ MPa}$$

$$\sigma_{1,2} = \frac{\sigma}{2} \pm \frac{1}{2} \sqrt{\sigma^2 + 4\tau^2}$$

$$\sigma_{1,2} = 58,95 \pm 62,95$$

$$\sigma_1 = 121,90\text{ MPa}$$

$$\sigma_2 = -4,00\text{ MPa}$$

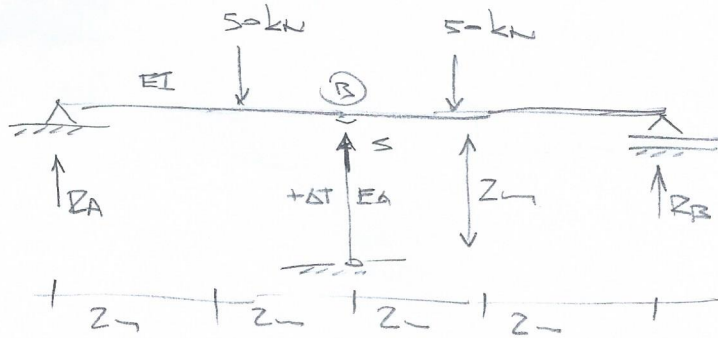
$$|\sigma_{\text{ek}}^{(3)}| = |\sigma_1 - \sigma_2| = 125,9\text{ MPa}$$

$$k_3 = \frac{\sigma_T}{\sigma_{\text{ek}}^{(3)}} = 1,87$$

$$|\sigma_{\text{ek}}^{(5)}| = \sqrt{\sigma_1^2 + \sigma_2^2 - \sigma_1 \sigma_2} = 123,95\text{ MPa}$$

$$k_5 = \frac{\sigma_T}{\sigma_{\text{ek}}^{(5)}} = 1,90$$

3. ZADATAKI:



$$E = 2 \cdot 10^5 \text{ MPa}$$

$$I = 22 \cdot 10^8 \text{ mm}^4$$

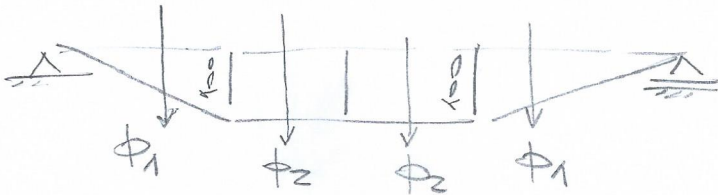
$$A = 220 \text{ mm}^2$$

$$\alpha_T = 1,2 \cdot 10^{-5} \frac{1}{K}$$

$$\Delta T = +40 K$$

$$R_A = R_B = 50 \text{ kN}$$

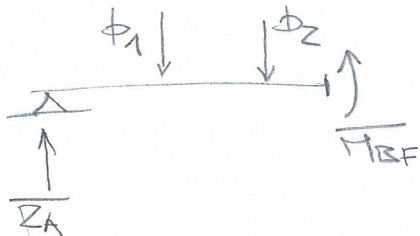
WBF



$$\phi_1 = \frac{100 \cdot 2}{2} = 100 \text{ kNm}^2$$

$$\phi_2 = 200 \text{ kNm}^2$$

$$\bar{R}_A = \bar{R}_B = 300 \text{ kNm}^2$$



$$\bar{M}_{BF} = \bar{R}_A \cdot 4 - \phi_1 \cdot (2 + \frac{1}{3} \cdot 2) - \phi_2 \cdot 1$$

$$\bar{M}_{BF} = 733,33 \text{ kNm}^2$$

$$W_{BF} = \frac{733,33 \cdot 10^{12}}{2 \cdot 10^5 \cdot 22 \cdot 10^8} = 16,67 \text{ mm}$$

$$W_{BS} = \frac{S \cdot L^3}{48EI} = \frac{S \cdot 6000^3}{48EI}$$

UVJET DEFORMACIJA:

$$W_{BF} - W_{BS} = \frac{S \cdot h}{E \cdot A} - \alpha_T \cdot \Delta T \cdot h$$

$$16,67 - 2,424 \cdot 10^{-4} S = 4,545 \cdot 10^{-5} S \Rightarrow 90$$

$$2,8785 \cdot 10^{-4} S = 17,63$$

$$S = 61,25 \text{ kN}$$

