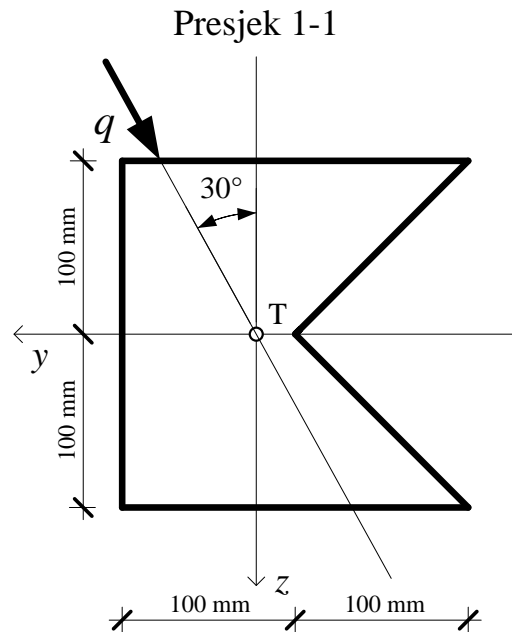
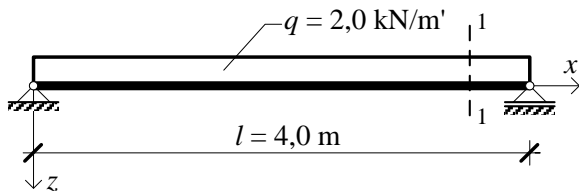


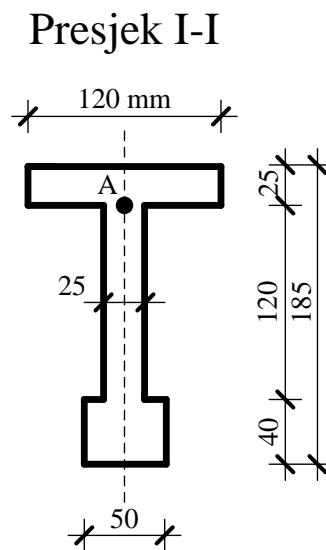
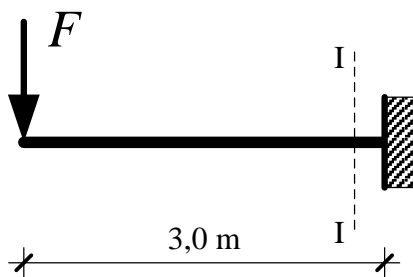
1. klauzurni rad, 14. 04. 2008.

Ime i prezime :

1. Za zadani nosač prema slici treba odrediti najveća normalna naprezanja primjenom jezgre poprečnog presjeka, te nacrtati dijagram normalnih naprezanja u najviše napregnutom presjeku.



2. Konzola zadanog poprečnog presjeka opterećena je silom  $F = 50 \text{ kN}$ . Primjenom IV. teorije čvrstoće treba odrediti koeficijent sigurnosti u točki A presjeka I – I. Granica tečenja  $\sigma_T = 240 \text{ MPa}$ , Poissonov koeficijent  $\nu = 0,3$ .



3. Za sustav prikazan na slici i opterećen silom  $F = 120 \text{ kN}$  treba odrediti dijagrame unutarnjih sila  $M$ ,  $T$ ,  $N$ , ako se temperatura štapa  $\overline{CD}$  promijeni za  $\Delta T = +40 \text{ K}$ .

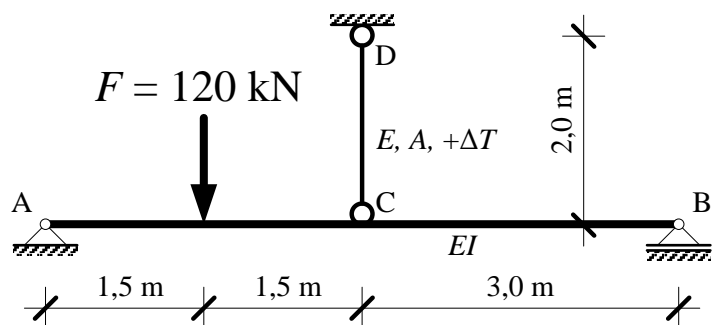
Zadano je:

$$E = 2,1 \cdot 10^5 \text{ MPa}$$

$$I = 2,0 \cdot 10^8 \text{ mm}^4$$

$$A = 120 \text{ mm}^2$$

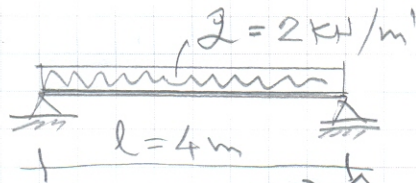
$$\alpha_t = 1,20 \cdot 10^{-5} \text{ 1/K}$$



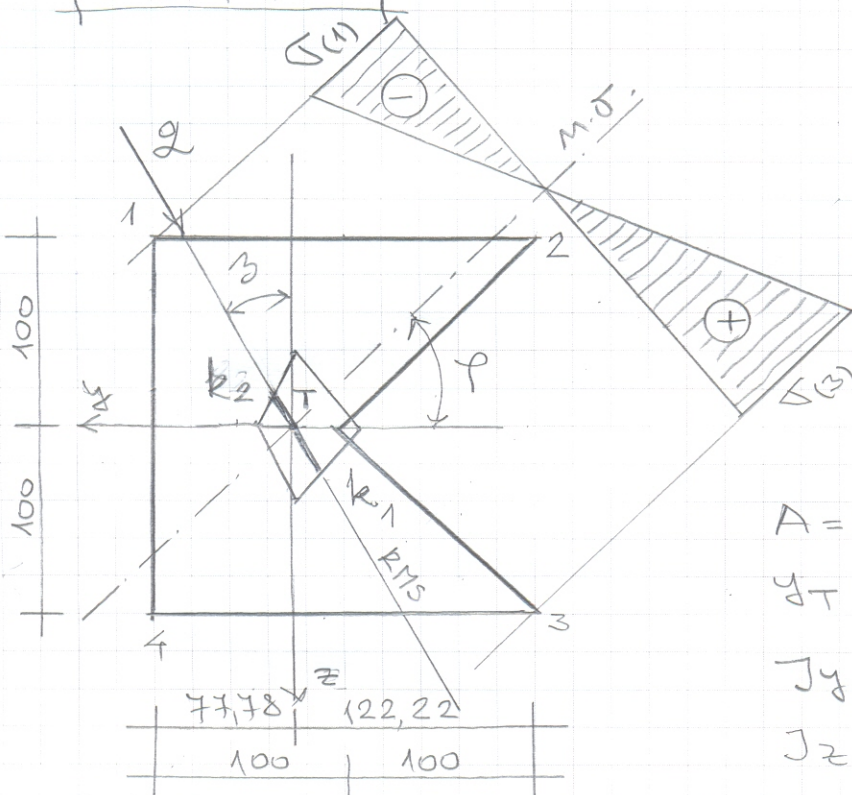
OTPORNOST MATERIJALA 2

1. KOLOKVIJ - GRUPA (A)

1. ZADATAK



$$M_{max} = \frac{q \cdot l^2}{8} = 4,0 \text{ kNm}$$



očitanje!

$$k_1 = 26 \text{ mm}$$

$$k_2 = 20 \text{ mm}$$

$$A = 30000 \text{ mm}^2$$

$$y_T = 77,78 \text{ mm}$$

$$J_y = 116,67 \cdot 10^6 \text{ mm}^4$$

$$J_z = 68,52 \cdot 10^6 \text{ mm}^4$$

$$i_y = \sqrt{\frac{J_y}{A}} = 62,36 \text{ mm} \quad i_y^2 = 3889 \text{ mm}^2$$

$$i_z = \sqrt{\frac{J_z}{A}} = 47,79 \text{ mm} \quad i_z^2 = 2284 \text{ mm}^2$$

$$\text{TOČKA} \quad y(\text{mm}) \quad z(\text{mm}) \quad a_y = -\frac{i_z^2}{y} \quad a_z = -\frac{i_y^2}{z}$$

$$1 \quad 77,78 \quad -100 \quad -29,36 \quad +38,89$$

$$2 \quad -122,22 \quad -100 \quad +18,69 \quad +38,89$$

$$\tan \varphi = -\frac{J_y}{J_z} \cdot \tan \alpha = +0,98306 \rightarrow \varphi = 44,5^\circ$$

$$\sigma(1) = \frac{M_{max}}{A \cdot k_1} = \underline{\underline{-5,12 \text{ MPa}}} \quad \sigma(3) = \frac{M_{max}}{A \cdot k_2} = \underline{\underline{+6,67 \text{ MPa}}}$$

**OTPORNOST MATERIJALA 2**

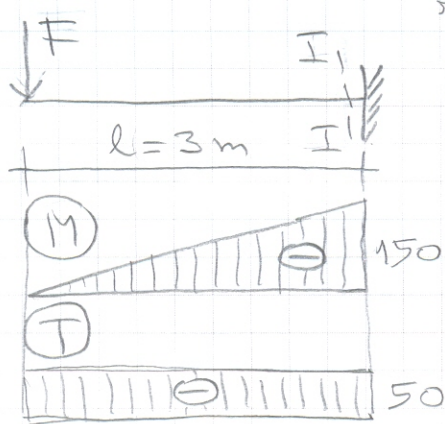
**1. KOLOKVIJ - GRUPA (A)**

**2. ZADATAK**

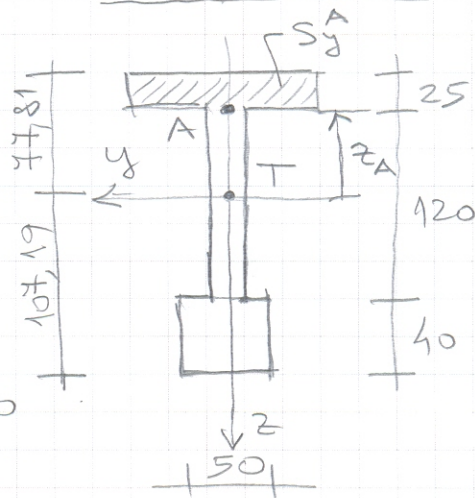
$F = 50 \text{ kN}$

$\sigma_T = 240 \text{ MPa}$

$\nu = 0,30$



**PRESJEK I-I**



$A = 8000 \text{ mm}^2$

$z_T = 107,19 \text{ mm}$

$J_y = 32,178 \cdot 10^6 \text{ mm}^4$

$S_y^A = 195930 \text{ mm}^3$

$M_{I-I} = -150 \text{ kNm}$

$T_{I-I} = -50 \text{ kN}$

$\sigma_x^A = \frac{M_{I-I}}{J_y} \cdot z_A = +246,20 \text{ MPa}$

$\tau_A = \frac{T_{I-I} \cdot S_y^A}{J_y \cdot b} = -12,18 \text{ MPa}$

$\sigma_{1,2}^A = \frac{\sigma_x^A}{2} \pm \frac{1}{2} \sqrt{(\sigma_x^A)^2 + 4\tau_A^2} = 123,10 \pm 123,70$

$\sigma_1^A = 246,80 \text{ MPa}$

→ IV. TEORIJA ČVRSTOĆE

$\sigma_2^A = -0,60 \text{ MPa}$

$\sigma_{ek}^A = \sqrt{\sigma_1^2 + \sigma_2^2 - \nu \sigma_1 \cdot \sigma_2} = 246,89 \text{ MPa}$

$k_A = \frac{\sigma_T}{\sigma_{ek}^A} = 0,97$



## OTPORNOST MATERIJALA 2

### 1. KOLOKVIJ - GRUPA (A)

### 3. ZADATAK

$$F = 120 \text{ kN}$$

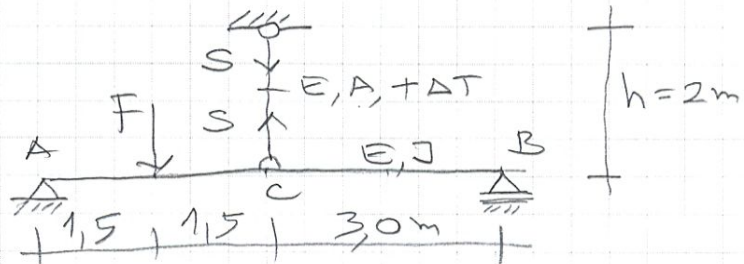
$$\Delta T = +40 \text{ K}$$

$$E = 2,1 \cdot 10^5 \text{ MPa}$$

$$J = 2 \cdot 10^8 \text{ mm}^4$$

$$A = 120 \text{ mm}^2$$

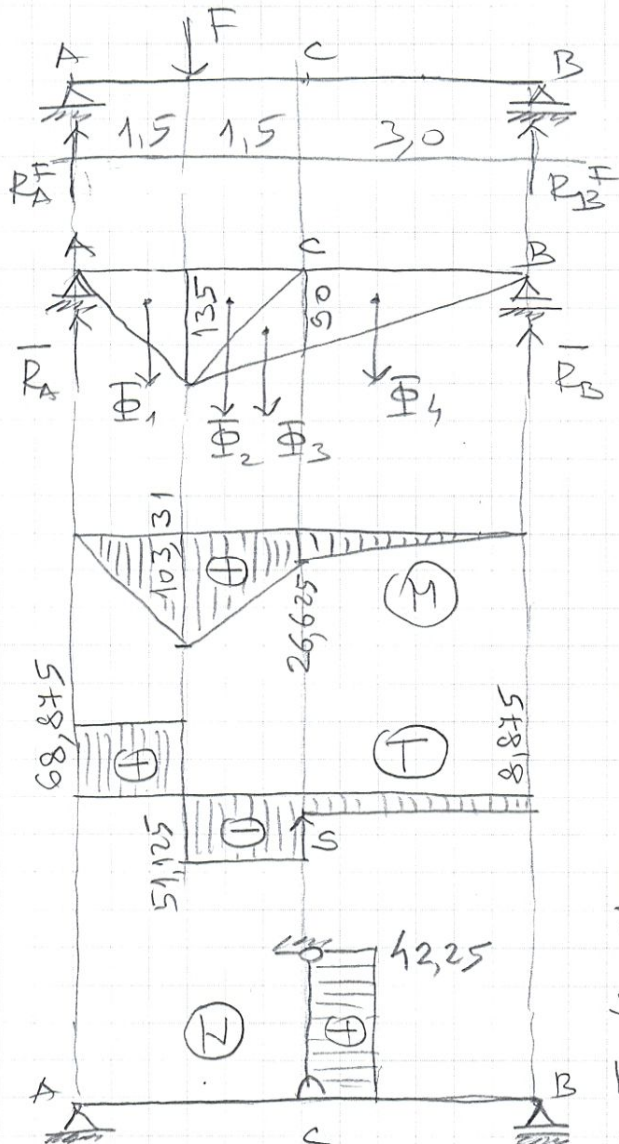
$$\alpha_T = 1,2 \cdot 10^{-5} / \text{K}$$



$$f_c^F - f_c^S = \Delta h$$

$$f_c^F = \frac{M_c^F}{EJ} \quad f_c^S = \frac{S \cdot l^3}{48EJ}$$

$$\Delta h = \frac{S \cdot h}{EA} + \alpha_T \Delta T \cdot h$$



$$R_A^F = F \cdot \frac{1,5}{3} = 90 \text{ kN}$$

$$R_B^F = F \cdot \frac{1,5}{3} = 30 \text{ kN}$$

$$\Phi_1 = 101,25 \text{ kNm}^2$$

$$\Phi_2 = 101,25 \text{ kNm}^2$$

$$\Phi_3 = 67,50 \text{ kNm}^2$$

$$\Phi_4 = 135,0 \text{ kNm}^2$$

$$\sum M_A = \phi \rightarrow \bar{R}_B = 168,75 \text{ kNm}^2$$

$$\sum M_B = \phi \rightarrow \bar{R}_A = 236,25 \text{ kNm}^2$$

$$\bar{M}_c^F = \bar{R}_B \cdot 3 - \Phi_4 \cdot 1 = 371,25 \text{ kNm}^3$$

$$f_c^F - f_c^S = \Delta h$$

$$\frac{\bar{M}_c^F}{EJ} - \frac{S \cdot l^3}{48EJ} = \frac{S \cdot h}{EA} + \alpha_T \Delta T \cdot h$$

$$S = \underline{42,25 \text{ kN}}$$

$$R_A = 68,875 \text{ kN}$$

$$R_B = 8,875 \text{ kN}$$