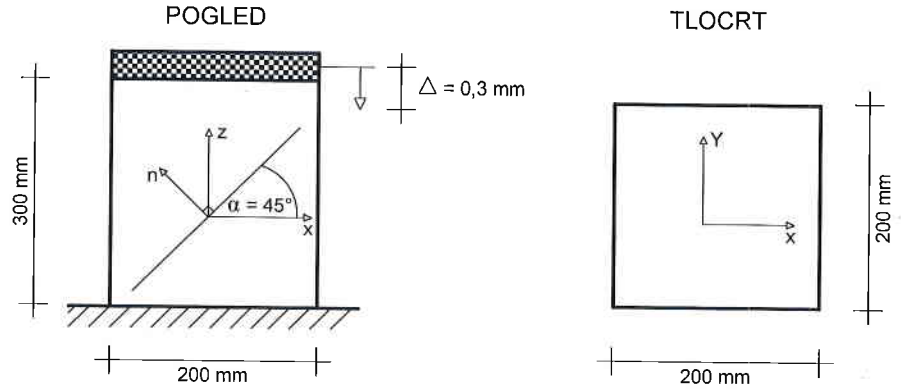
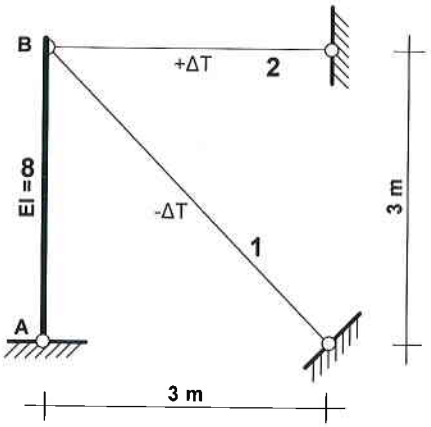
OTPORNOST MATERIJALA I, 1. kolokvij - 12.11.2014.
grupa C

Ime i prezime: RJEŠENJA

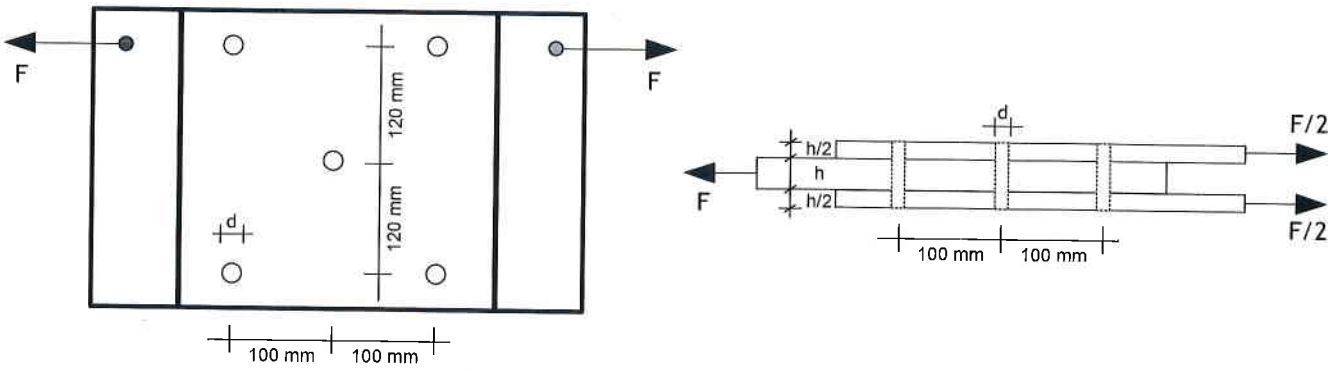
1.] Odredite apsolutnu promjenu volumena čelične prizme i vektor punog (totalnog) naprezanja za ravninu zadanu normalom n, ako se gornja apsolutno kruta ploča (vidi sliku) pomakne za $\Delta = 0{,}3$ mm. Zadano je: $E = 2{,}0 \cdot 10^5$ MPa i $\nu = 0{,}25$.



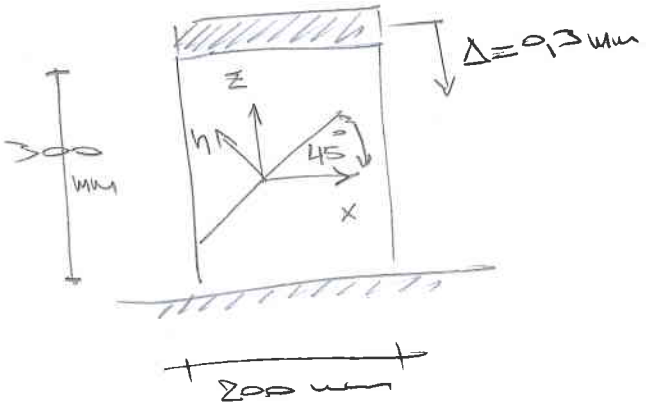
2.] Apsolutno kruta greda AB zglobno je pričvršćena u točkama A i B. Odredite sile u štapovima 1 i 2 te pomak točke B, ako se štap 2 zagrije za $\Delta T_2 = 25$ K, a štap 1 ohladi za $\Delta T_1 = -25$ K. Zadano je: $E_1 = 2 \cdot 10^5$ MPa, $E_2 = 1{,}5 \cdot 10^5$ MPa, $A_1 = 250$ mm^2, $A_2 = 400$ mm^2, $\alpha_{T1} = \alpha_{T2} = 1{,}2 \cdot 10^{-5}$ 1/K.

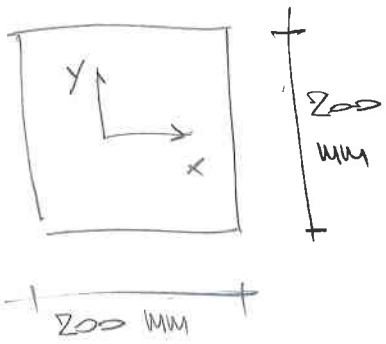


3.] Na spoj čeličnih limova djeluje opterećenje prema slici. Odredite dopušteni iznos opterećenja F, ako je zadano: $\sigma_{odop} = 250$ MPa, $\tau_{dop} = 150$ MPa, d = 20 mm i h = 16 mm.



1. ZADATAK:





$E = 2 \cdot 10^5$ MPa

$\nu = 0{,}25$

$\sigma_x = \sigma_y = 0$

$\varepsilon_z = \frac{\Delta L}{L_0} = \frac{-93}{300} = -0{,}001 \longrightarrow \sigma_z = E \cdot \varepsilon_z = -200$ MPa (tlak)

$\varepsilon_x = \frac{1}{E}\left(\sigma_x - \nu(\sigma_y + \sigma_z)\right) = \frac{-0{,}25 \cdot (-200)}{2 \cdot 10^5} = 2{,}5 \cdot 10^{-4}$

$\varepsilon_y = 2{,}5 \cdot 10^{-4}$

PROMJENA VOLUMENA:

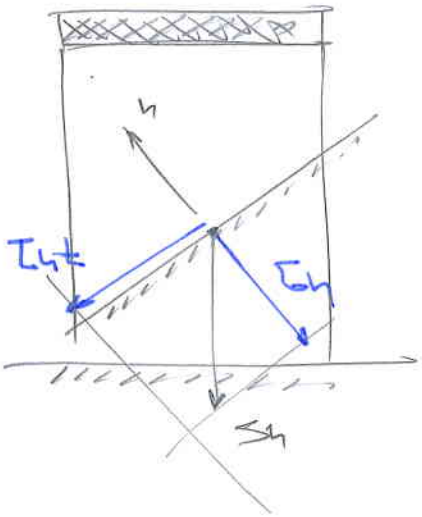
$\varepsilon_V = \frac{\Delta V}{V} = \varepsilon_x + \varepsilon_y + \varepsilon_z = -5 \cdot 10^{-4} \longrightarrow \Delta V = -6000\ \text{mm}^3$

NAPREZANJE:

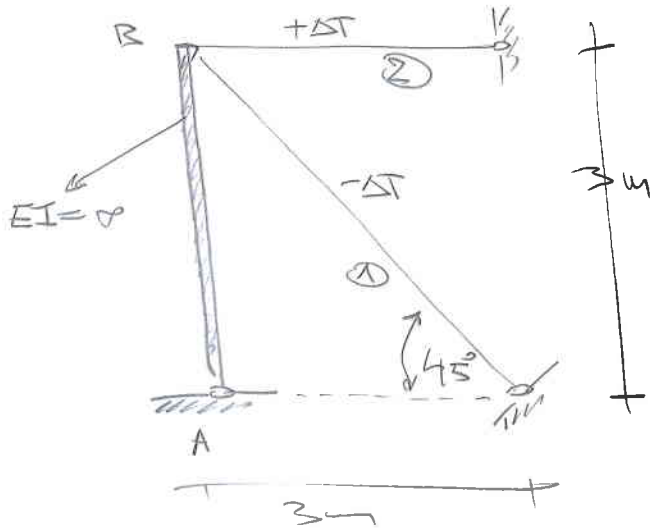
$\sigma_h = \sigma_z \cdot \sin^2(135°) = -100$ MPa

$\tau_{ht} = \frac{\sigma_z}{2} \cdot \sin(270) = 100$ MPa

$S_h = 141{,}42$ MPa



2. ZADATAK:



$\Delta T = 25\ K$

$E_1 = 2 \cdot 10^5\ MPa$

$E_2 = 1{,}5 \cdot 10^5\ MPa$

$A_1 = 250\ mm^2$

$A_2 = 400\ mm^2$

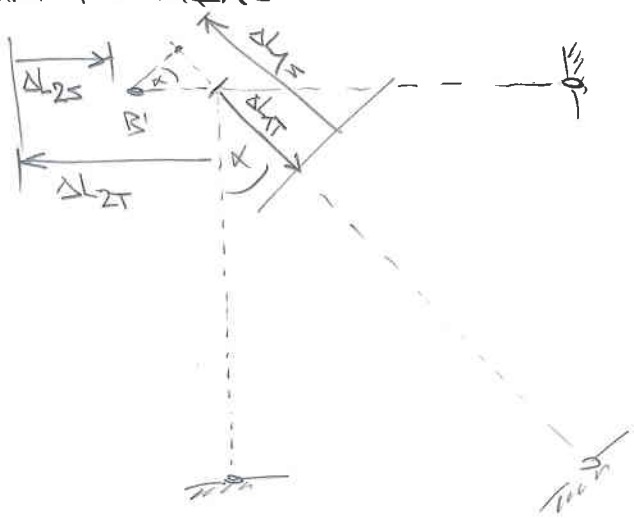
$\alpha_T = 1{,}2 \cdot 10^{-5}\ 1/K$

$L_1 = 4{,}243\ m$

$\sum M_A = 0$

$S_2 \cdot 3 = S_1 \cdot \sin 45° \cdot 3 \rightarrow S_2 = 0{,}707\, S_1$

PLAN POMAKA:



$$\sin\alpha = \frac{\Delta L_{1S} - \Delta L_{1T}}{\Delta L_{2T} - \Delta L_{2S}}$$

$$\frac{S_1 \cdot L_1}{E_1 \cdot A_1} - \alpha_T \cdot \Delta T \cdot L_1 = \sin 45° \left(\alpha_T \cdot \Delta T \cdot L_2 - \frac{0{,}707\, S_1 \cdot L_2}{E_2 \cdot A_2} \right)$$

$$8{,}485 \cdot 10^{-5} S_1 - 1{,}273 = 0{,}1364 - 2{,}4996 \cdot 10^{-5} S_1$$

$S_1 = 17382{,}5\ N$

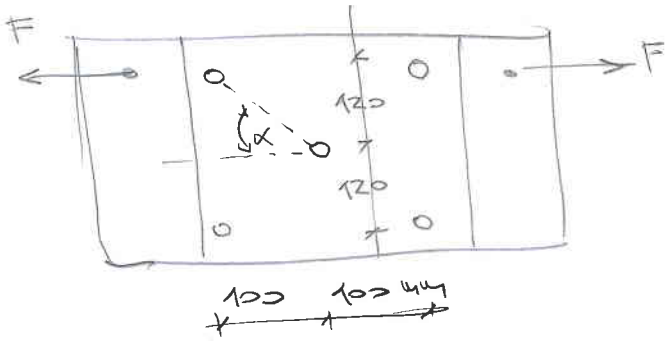
$S_1 = 17{,}4\ kN$ (vlak)

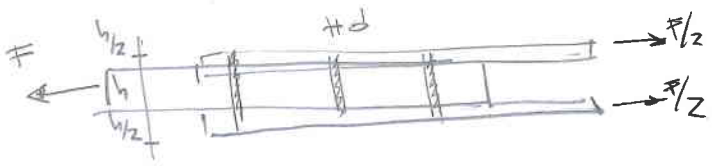
$S_2 = 12{,}3\ kN$ (tlak)

$$\Delta_B = \alpha_T \cdot \Delta T \cdot L_2 - \frac{S_2 \cdot L_2}{E_2 \cdot A_2}$$

$\Delta_B = 0{,}9 - 0{,}615 = 0{,}285\ mm$

3. ZADATAK





$\tau_{dop} = 250$ MPa

$\tau_{dop} = 150$ MPa

$d = 20$ mm

$h = 16$ mm

$F = ?$

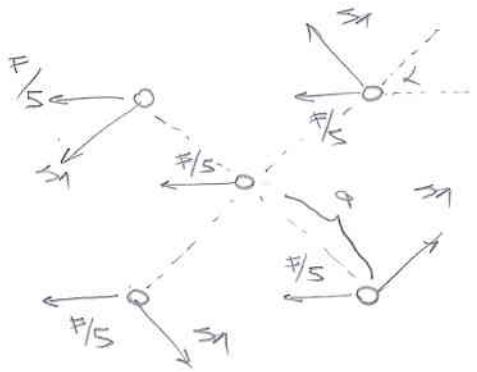
$a = 156,2$ mm ; $\alpha = 50,19°$

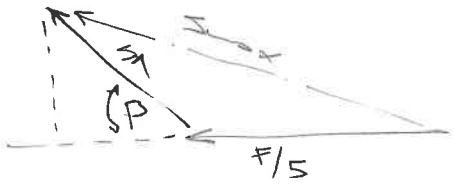
$\beta = 39,81°$

$\Sigma M_4 = 0$

$F \cdot 120 = S_1 \cdot 156,2 \cdot 4$

$S_1 = 0,192F$





$$S_{max} = \sqrt{\left(\frac{F}{5} + 0,192F \cdot \cos 39,81\right)^2 + \left(0,192F \cdot \sin(39,81)\right)^2}$$

$$S_{max} = \sqrt{(0,1284F + 0,0151)F^2} = 0,369F$$

DIMENZIONIRANJE (sila):

$$\sigma_o = \frac{0,369F}{h \cdot d} \leq 250 \text{ MPa} \rightarrow F \leq 21,68 \text{ kN}$$

odabrano.

$$\tau = \frac{0,369F}{2 \cdot \frac{d^2\pi}{4}} \leq 150 \text{ MPa} \rightarrow F \leq 25,4 \text{ kN}$$