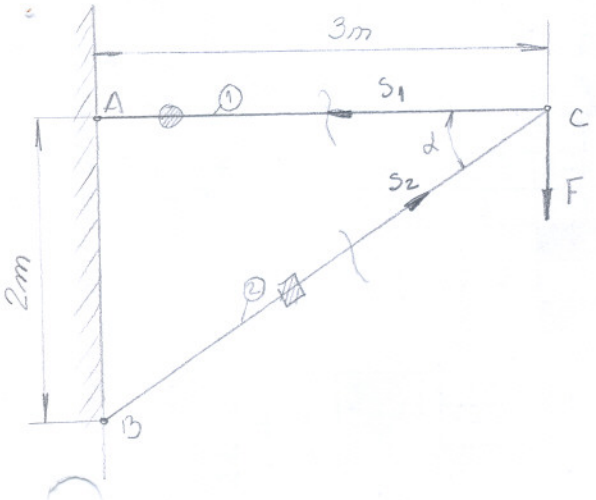
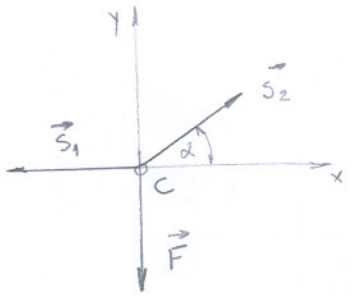
2. Konzola je opterećena silom $F = 60\,[kN]$. Štap AC je od čelika $\sigma_{doz_1} = 16\,[kN/cm^2]$, a štap BC od drveta $\sigma_{doz} = 0{,}4\,[kN/cm^2]$. Odrediti prečnik kružnog poprečnog presjeka čeličnog štapa, te stranicu kvadratnog poprečnog presjeka drvenog stuba, kao i horizontalno i vertikalno pomjeranje čvora C. $E_1 = 2 \cdot 10^4\,[kN/cm^2]$. $E_2 = 1 \cdot 10^3\,[kN/cm^2]$.

$$U_L = \frac{1\,m}{2\,cm}$$





Sile u štaporima

$$\Sigma F_{yi} = 0$$

$$S_2 \sin\alpha - F = 0$$

$$\sin\alpha = \frac{2}{\sqrt{2^2+3^2}} = 0{,}5547$$

$$S_2 = \frac{F}{\sin\alpha} = \frac{60}{0{,}5547} = 108{,}166\,kN \qquad \alpha = 33{,}69°$$

$$\Sigma F_{xi} = 0$$

$$-S_1 + S_2 \cos\alpha = 0$$

$$S_1 = S_2 \cos\alpha = 108{,}166 \cdot \frac{3}{\sqrt{3^2+2^2}} = 89{,}9995 \cong 90\,[kN]$$

Dimenzionisanje štapova

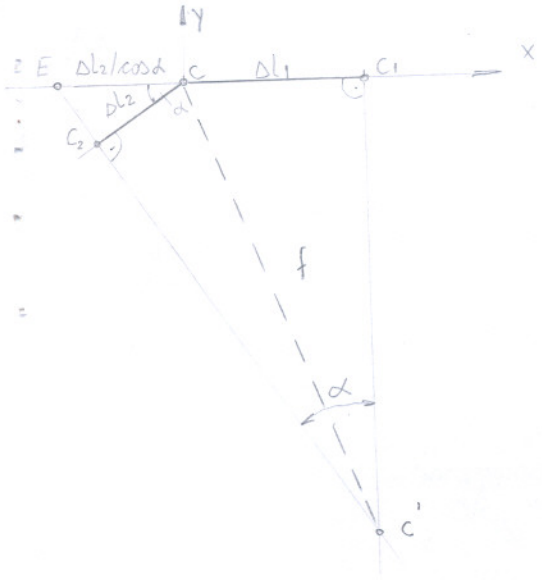
$$\sigma_1 = \frac{S_1}{A_1} \leq \sigma_{doz_1} \; ; \qquad A_1 = \frac{d^2\pi}{4} = \frac{S_1}{\sigma_{doz_1}} \Rightarrow d = \sqrt{\frac{4S_1}{\pi\,\sigma_{doz_1}}} = \sqrt{\frac{4 \cdot 90}{\pi \cdot 16}} = 2{,}67\,[cm]$$

$$\sigma_2 = \frac{S_2}{A_2} \leq \sigma_{doz_2} \; ; \qquad A_2 = a^2 = \frac{S_2}{\sigma_{doz_2}} \Rightarrow a = \sqrt{\frac{S_2}{\sigma_{doz}}} = \sqrt{\frac{108{,}166}{0{,}4}} = 16{,}44\,[cm]$$

Deformacije štapova

$$\Delta L_1 = \frac{S_1 \cdot L_1}{E_1 \cdot A_1} = \frac{90 \cdot 300}{2{,}1 \cdot 10^4 \cdot \frac{2{,}67^2 \cdot \pi}{4}} = 0{,}241\,[cm]$$

$$\Delta L_2 = \frac{S_2 L_2}{E_2 A_2} = \frac{108{,}166 \cdot \sqrt{300^2+200^2}}{1 \cdot 10^3 \cdot 16{,}44^2} = 0{,}144\,[cm]$$



$$U_L = \frac{0,241\ [cm]}{2,41\ [cm]} = \frac{1\ [cm]}{10\ [cm]}$$

Horizontalno pomjeranje

$$f_{cH} = \Delta l_1 = 0,241\ [cm]$$

Vertikalno pomjeranje

$\Delta EC_1C'$

$$ctg\,\alpha = \frac{f_{cv}}{\Delta l_1 + \Delta l_2 / \cos\alpha}$$

$$f_{cv} = \left(\Delta l_1 + \frac{\Delta l_2}{\cos\alpha}\right) \cdot ctg\,\alpha =$$

$$= \left(0,241 + \frac{0,144}{0,8320502}\right) \cdot \frac{3}{2}$$

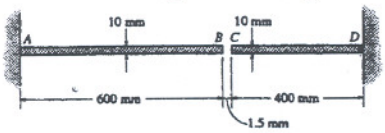
$$f_{cv} = 0,621\ [cm]$$

Ukupno pomjeranje čvora C:

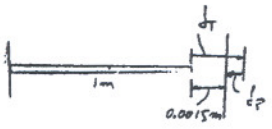
$$f = \sqrt{f_{cH}^2 + f_{cv}^2} = \sqrt{0,241^2 + 0,621^2}$$

$$f = 0,666\ [cm]$$

4-75. A thermo gate consists of a 6061-T6-aluminum plate AB and an Am-1004-T61-magnesium plate CD, each having a width of 15 mm and fixed supported at their ends. If the gap between them is 1.5 mm when the temperature is $T_1 = 25°C$, determine the temperature required to just close the gap. Also, what is the axial force in each plate if the temperature becomes $T_2 = 100°C$? Assume bending or buckling will not occur.



$\delta_T = \alpha \Delta T L$



Require,

$$\delta_T = 0.0015 \text{ m} = \delta_{B/A} + \delta_{C/D}$$

$$0.0015 = 24(10^{-6})(T_2 - 25)(0.6) + 26(10^{-6})(T_2 - 25)(0.4)$$

$$T_2 = 85.5° \text{ C} \quad \textbf{Ans}$$

The problem is equivalent to that shown in the diagram. Require,

$$(\overset{+}{\rightarrow}) \quad \delta_T - \delta_P = 0.0015$$

$$\Sigma(\alpha \Delta T L) - \Sigma\left(\frac{FL}{AE}\right) = 0.0015$$

$$24(10^{-6})(100 - 25)(0.6) + 26(10^{-6})(100 - 25)(0.4) - \frac{F(0.6)}{(0.01)(0.015)(68.9)(10^9)} - \frac{F(0.4)}{(0.01)(0.015)(44.7)(10^9)} = 0.0015$$

$$F = 3.06 \text{ kN} \quad \textbf{Ans}$$