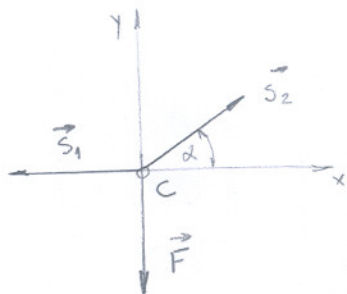
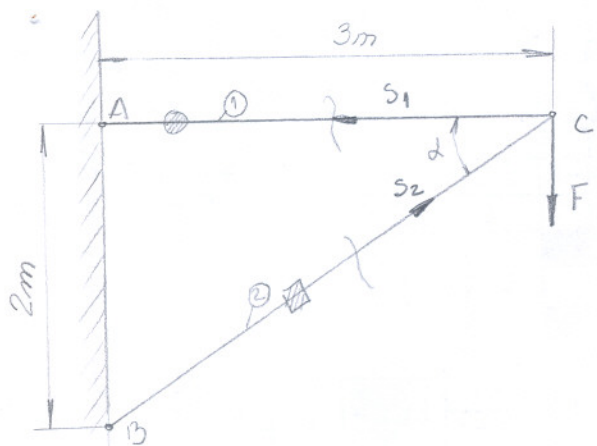


2. Konzola je opterećena silom  $F = 60 \text{ [kN]}$ . Štap AC je od čelika  $\sigma_{doz1} = 16 \text{ [kN/cm}^2]$ , a štap BC od drveta  $\sigma_{doz2} = 0,4 \text{ [kN/cm}^2]$ . Odrediti prečnik kružnog poprečnog presjeka čeličnog štapa, te stranice kvadratnog poprečnog presjeka drvenog stuba, kao i horizontalno i vertikalno pomjerenje zavoja C.  $E_1 = 2 \cdot 10^4 \text{ [kN/cm}^2]$ .  $E_2 = 1 \cdot 10^3 \text{ [kN/cm}^2]$ .

$$U_C = \frac{1 \text{ m}}{2 \text{ cm}}$$



Sile u štapovima

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

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

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

$$d = 33,69^\circ$$

$$S_2 = \frac{F}{\sin d} = \frac{60}{0,5547} = 108,166 \text{ kN}$$

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

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

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

Dimenzionisanje štapova

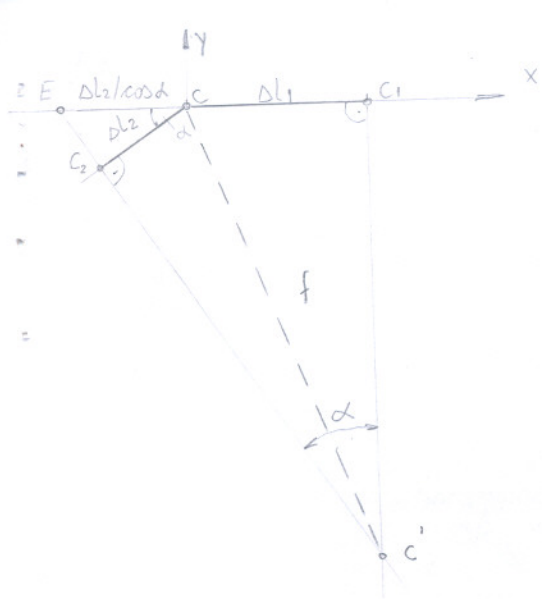
$$\sigma_1 = \frac{S_1}{A_1} \leq \sigma_{doz1} ; \quad A_1 = \frac{d^2 \pi}{4} = \frac{S_1}{\sigma_{doz1}} \Rightarrow d = \sqrt{\frac{4 S_1}{\pi \sigma_{doz1}}} = \sqrt{\frac{4 \cdot 90}{\pi \cdot 16}} = 2,67 \text{ [cm]}$$

$$\sigma_2 = \frac{S_2}{A_2} \leq \sigma_{doz2} ; \quad A_2 = a^2 = \frac{S_2}{\sigma_{doz2}} \Rightarrow a = \sqrt{\frac{S_2}{\sigma_{doz2}}} = \sqrt{\frac{108,166}{0,4}} = 16,44 \text{ [cm]}$$

Deformacije štapova

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

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



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

Horizontalno pomjeranje

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

Vertikalno pomjeranje

$\Delta EC_1C_1'$

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

$$\begin{aligned} f_{cv} &= \left( \Delta l_1 + \frac{\Delta l_2}{\cos \alpha} \right) \cdot \text{ctg } \alpha = \\ &= \left( 0,241 + \frac{0,144}{0,8320502} \right) \cdot \frac{3}{2} \end{aligned}$$

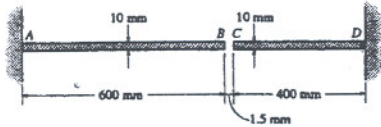
$$f_{cv} = 0,621 \text{ [cm]}$$

Ukupno pomjeranje čvora C:

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

$$f = 0,666 \text{ [cm]}$$

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  $T_1 = 25^\circ\text{C}$ , determine the temperature required to just close the gap. Also, what is the axial force in each plate if the temperature becomes  $T_2 = 100^\circ\text{C}$ ? Assume bending or buckling will not occur.



$$\delta_T = \alpha \Delta T L$$

Require,



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

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

$$T_2 = 85.5^\circ\text{C} \quad \text{Ans}$$

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

$$(\rightarrow) \delta_T - \delta_P = 0.0015$$

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

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

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

From *Mechanics of Materials*, Sixth Edition by R. C. Hibbeler, ISBN 0-13-191345-X.

© 2005 R. C. Hibbeler. Published by Pearson Prentice Hall,

Pearson Education, Inc., Upper Saddle River, NJ. All rights reserved.

This material is protected under all copyright laws as they currently exist. No portion of this material may be reproduced, in any form or by any means, without permission in writing from the publisher.