

Αντοχή των υλικών

ΕΠΙΘΕΤΟ:.....**ΘΕΟΧΑΡΗ**.....
ΟΝΟΜΑ:**ΚΥΡΙΑΚΗ**.....
ΤΜΗΜΑ:**ΜΗΠΕΡ**.....
Α.Μ.:**2018050043**.....
PROJECT:**2^ο**.....

Problema 1

$$AB_{\text{exterior}} = 30 \text{ mm}$$

$$BC_{\text{exterior}} = 30 \text{ mm}$$

$$\sigma_{\text{tubo}} \text{ nom } 30 \times 45 \text{ mm}$$

$$F = 20000 \text{ N}$$

$$P = 4 \text{ kN} + [\epsilon_3] \text{ kN}$$

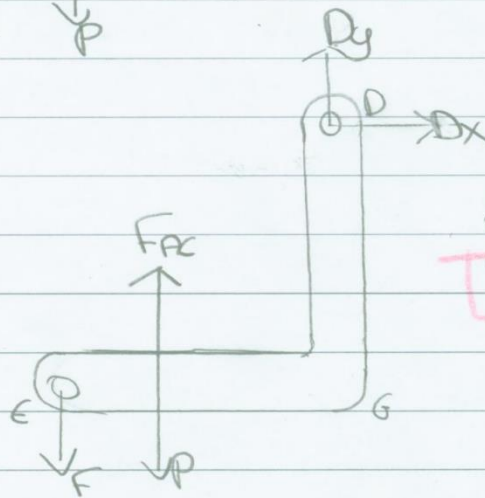
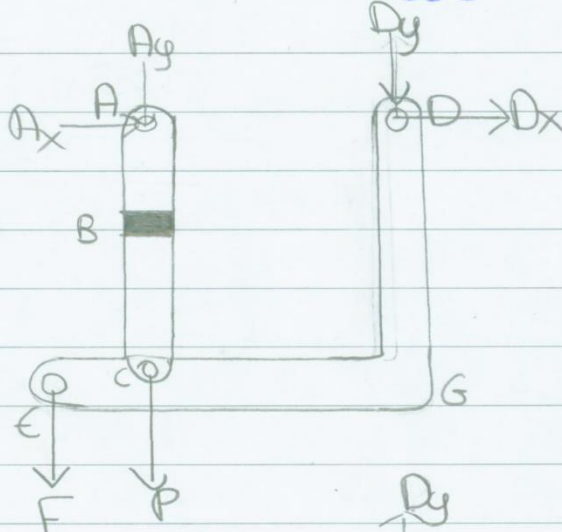
$$\sigma_{\text{ext}} = 150 + [\epsilon_2] \text{ MPa}$$

$$\tau_{\text{ext}} = 50 + [\epsilon_3] \text{ MPa}$$

$$\epsilon_2 = 5$$

$$\epsilon_3 = 15$$

D



$$\sum F_x = 0$$

$$D_x = 0$$

$$\sum F_y = 0$$

$$-D_y + F_{AC} - F - P = 0$$

$$-D_y + F_{AC} - 2 - 19 = 0$$

$$-D_y + F_{AC} = 21$$

$$F = 20000 \cdot 10^{-3} \\ = 20 \text{ kN}$$

$$P = 4 + 15 \\ = 19 \text{ kN}$$

$$\sum M = 0$$

$$F \cdot 0,375 + P \cdot 0,250 - F_{AC} \cdot 0,250 = 0$$

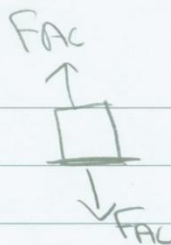
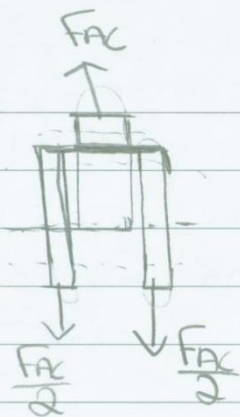
$$2 \cdot 0,375 + 19 \cdot 0,250 - F_{AC} \cdot 0,250 = 0$$

$$0,75 + 4,75 = 0,250 F_{AC}$$

$$F_{AC} = 22 \text{ kN}$$

$$-D_y + 22 = 21$$

$$D_y = +1 \text{ kN}$$



$$\sigma_{AB} = \frac{F_{AC}}{A_{AB}} \leq \sigma_{zul}$$

$$\frac{22 \cdot 10^3}{0.03 \delta_{AB}} = (150 + 5) \cdot 10^6$$

$$\frac{22 \cdot 10^3}{0.03 \delta_{AB}} = 155 \cdot 10^6$$

$$22 = 4650 \delta_{AB}$$

$$\delta_{AB} = 4.73 \times 10^{-3} \text{ m}$$



$$\sigma_{BC} = \frac{F_{AC}}{2 A_{BC}} \leq \sigma_{zul}$$

$$\frac{22 \cdot 10^3}{2} = 155 \cdot 10^6$$

$$\frac{11}{0.03 \delta_{BC}} = 155 \cdot 10^6$$

$$11 = 4650 \delta_{BC}$$

$$\delta_{BC} = 2.37 \times 10^{-3} \text{ m}$$

2) für A8 $\tau_A = \frac{F_{AC}}{\frac{\pi d_A^2}{4}} \leq \tau_{zul}$

$$\frac{22 \cdot 10^3}{\frac{\pi d_A^2}{4}} = 65 \cdot 10^6$$

$$\frac{22}{\frac{\pi d_A^2}{4}} = 65 \cdot 10^3$$

$$\frac{88}{\pi d_A^2} = 65 \cdot 10^3$$

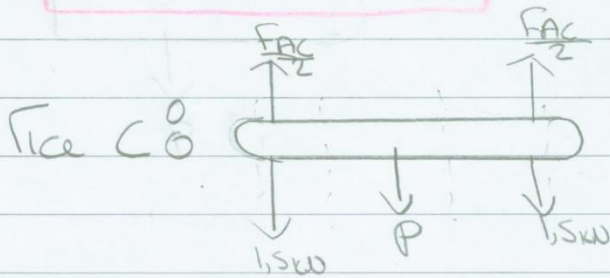
$$88 = 65 \cdot 10^3 \pi d_A^2$$

$$d_A^2 = \frac{88}{65 \cdot 10^3 \pi}$$

$$d_A = 9.5 \times 10^{-2} \text{ m}$$

$$dA^2 = 5,09 \times 10^{-10}$$

$$dA = 2,26 \times 10^{-5} \text{ m}$$



$$\tau = \frac{F_{AC} - 1,5}{2} \leq \tau_{\text{adm}}$$

$$\frac{\pi d_c^2}{4}$$

$$\left(\frac{22 - 1,5}{2} \right) \cdot 10^3 = 65 \cdot 10^3$$

$$\frac{\pi d_c^2}{4}$$

$$38 = 65 \cdot 10^3$$

$$\pi d_c^2$$

$$38 = 65 \cdot 10^3 \cdot \pi d_c^2$$

$$d_c^2 = \frac{38}{65 \cdot 10^3 \pi}$$

$$d_c^2 = 1,86 \times 10^{-4}$$

$$d_c = 0,01 \text{ m}$$

$$M_{ce} D_O \frac{D_y}{\frac{\pi d_o^2}{4}} \leq \tau_{\text{adm}}$$

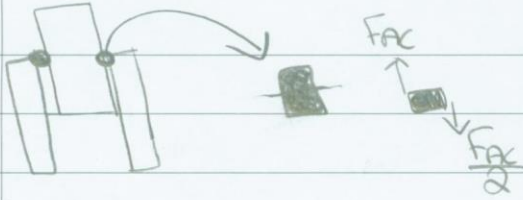
$$\frac{1 \cdot 10^3}{\frac{\pi d_o^2}{4}} = 65 \cdot 10^3$$

$$4 = 65 \cdot 10^3 \pi d_o^2$$

$$d_o^2 = 1,96 \times 10^{-5}$$

$$d_o = 4,43 \times 10^{-3} \text{ m}$$

3)



$$\tau_{avg} = \frac{F_{AC}}{2} \cdot \frac{1}{A_{avg}}$$

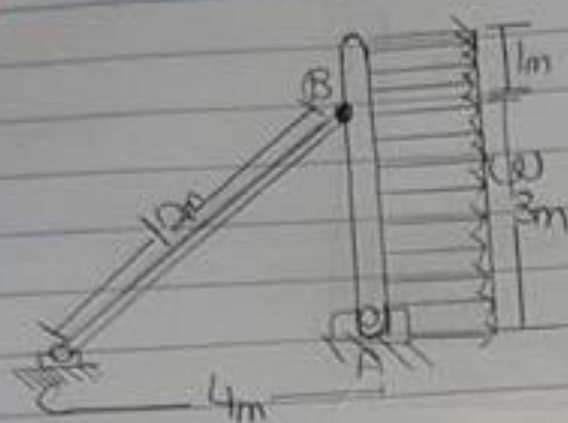
$$A_{avg} = 0,045 \cdot 0,030 = 1,35 \times 10^{-3}$$

$$= \frac{22 \cdot 10^3}{1,35 \times 10^{-3}}$$

$$= 8148148,15 \frac{N}{m^2}$$

$$\tau_{avg} = 8,15 MPa$$

Problem 2

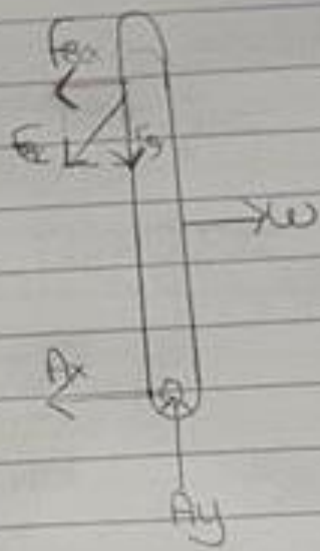
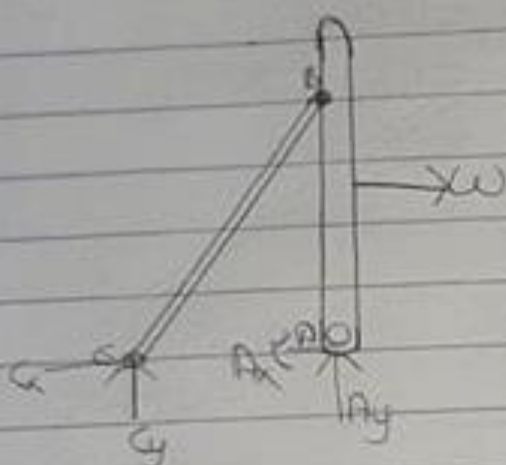


$$E_2 = 5 \quad E_3 = 15$$

$$\tau_{xy} = 80 \text{ MPa} + 6 \text{ MPa}$$

$$\sigma_{xy} = 10 \text{ MPa} + 6 \text{ MPa}$$

$$\tan^{-1} \frac{3}{4} \Rightarrow \hat{\phi} = 36,87^\circ$$



$$\sum F_x = 0$$

$$4w - F_{ex} - A_x = 0$$

$$F_{ex} + A_x = 4w$$

$$F_{ex} + \frac{4}{3}w = 4w$$

$$F_{ex} = \frac{8}{3}w$$

$$F_{ex} \cos(36,87) = \frac{8}{3}w$$

$$F_{ex} = \frac{\frac{8}{3}w}{\frac{4}{5}}$$

$$F_{ex} = 2,13w$$

$$\sum F_y = 0$$

$$A_y - F_{ey} = 0$$

$$A_y - F_{ey}$$

$$A_y = 1,70w$$

$$\sum M_B = 0$$

$$3A_x - 4w = 0$$

$$3A_x = 4w$$

$$A_x = \frac{4}{3}w$$

$$\sigma_{\text{ad}} = 120 + 15$$

$$= 135 \text{ MPa}$$

$$\sigma_{\text{e}} = \frac{F_{\text{BC}}}{A_{\text{BC}}} \leq \sigma_{\text{ad}}$$

$$\frac{2,13w}{\frac{0,012^2 \pi}{4}} = 135 \cdot 10^6$$

$$8,52w = 19440$$

$$w = 2281,69 \text{ W}$$

$$w = 2,28 \text{ kW}$$

Moduli A

$$A_x = \frac{4}{3} w$$

$$= \frac{4}{3} \cdot 2,28$$

$$A_y = 1,70w$$

$$= 1,70 \cdot 2,28$$

$$= 3,88 \text{ kW}$$

$$= 3,04 \text{ kW}$$

$$A = \sqrt{A_x^2 + A_y^2}$$

$$= \sqrt{3,04^2 + 3,88^2}$$

$$= 4,93 \text{ kW}$$

$$\tau_{\text{a}} = \frac{\frac{A}{2}}{A_{\text{a}}} \leq \tau_{\text{ad}}$$

$$\tau_{\text{ad}} = 80 + 5$$

$$= 80 + 5$$

$$= 85 \text{ MPa}$$

$$\tau_{\text{a}} = \frac{\left(\frac{4,93}{2}\right) \cdot 10^3}{\frac{0,012^2 \pi}{4}}$$

$$\tau_{\text{a}} = 21795385,26 \text{ Pa}$$

$$= 21,80 \text{ MPa}$$

Moduli B

$$\tau_{\text{b}} = \frac{\frac{F_{\text{BC}}}{2}}{A_{\text{BC}}} \leq \tau_{\text{ad}}$$

$$\tau_{\text{b}} = \frac{\left(\frac{2,13 \cdot 2,28}{2}\right) 10^3}{\frac{0,012^2 \pi}{4}}$$

$$= 21470001,82 \text{ Pa}$$

$$= 21,47 \text{ MPa}$$

$$\text{Μαγνι} \text{C} \text{O} \tau_c = \frac{F_{BC}}{2} \leq \tau_{\text{αδ}}$$

$$ABC$$

$$= \frac{(213228)}{2} 10^3$$

$$\frac{0,012^2 \cdot \pi}{4}$$

$$= 21470001,82 \text{ Pa}$$

$$= 21,47 \text{ MPa}$$

Αρα δεν έχουμε πρόβλημα γιατί η τιμή στα μεταξόνια δεν ξεπερνά την απόδοση