

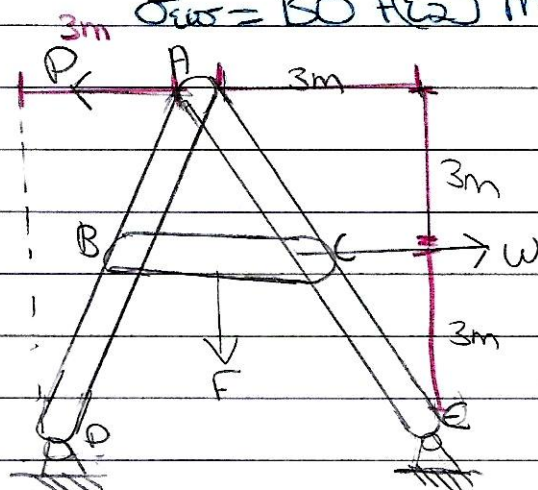
Project 2 AM: 2018050043  
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Problem 1

$$\epsilon_2 = 5$$

$$\epsilon_3 = 15$$

Given:  $P = (50 + \epsilon_2) \text{ kN}$ ,  $F = (110 + \epsilon_3) \text{ kN}$ ,  $W = 80 \text{ kN} + (\epsilon_2) \text{ kN}$   
 $\sigma_{tuss} = 150 + (\epsilon_2) \text{ MPa}$ ,  $\tau_{tuss} = 50 + (\epsilon_3) \text{ MPa}$



DES diagram to change

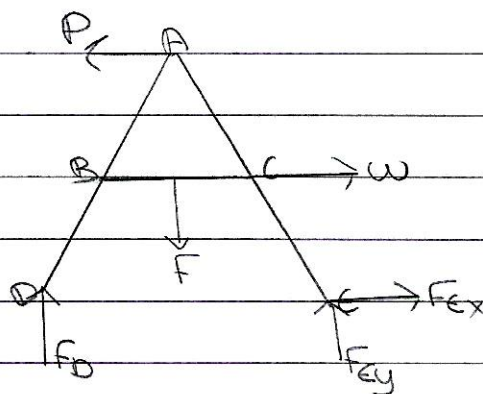
$$\sum F_x = 0$$

$$F_{ex} + W - P = 0$$

$$F_{ex} + 80 + 5 - (50 + 5) = 0$$

$$F_{ex} + 85 - 55 = 0$$

$$F_{ex} = 30 \text{ kN}$$



$$\sum F_y = 0$$

$$F_D + F_{ey} - F = 0$$

$$F_D + F_{ey} - (110 + 15) = 0$$

$$\textcircled{1} F_D + F_{ey} = 125$$

$$F_D = 75 \text{ kN}$$

$$\sum M_D = 0$$

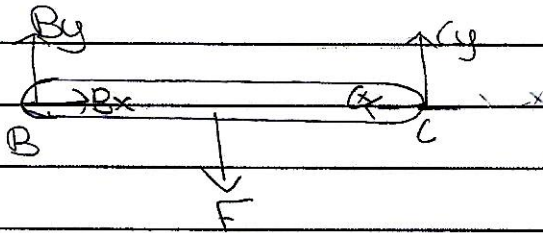
$$F_{ey} \cdot 6 + P \cdot 6 - F \cdot 3 - W \cdot 3 = 0$$

$$6F_{ey} + (55 \cdot 6) - (125 \cdot 3) - (85 \cdot 3) = 0$$

$$6F_{ey} = 300$$

$$F_{ey} = 50 \text{ kN}$$

DES xice BC



$$\sum F_x = 0$$

$$B_x = C_x$$

$$(B_x = 14.5 \text{ kN})$$

$$\sum F_y = 0$$

$$B_y + C_y - F = 0$$

$$(B_y + C_y = 125 \text{ kN})$$

$$B_y + 62.5 = 125 \text{ kN}$$

$$(B_y = 62.5 \text{ kN})$$

$$\sum M = 0$$

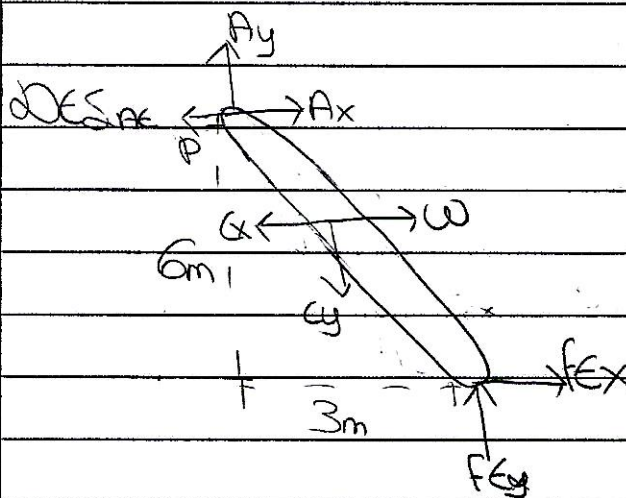
$$C_y \cdot BC - F \cdot \frac{BC}{2} = 0$$

$$2C_y \cdot BC - F \cdot BC = 0$$

$$2C_y = F$$

$$C_y = \frac{125}{2}$$

$$(C_y = 62.5 \text{ kN})$$



$$(\pm) \sum F_x = 0$$

$$A_x + W + F_{ex} = P$$

$$\sum M_A =$$

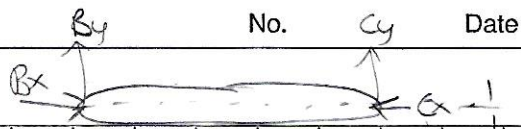
$$3W + 6F_{ex} = 3G_x$$

$$3 \cdot 85 + 6 \cdot 30 = 3G_x$$

$$3G_x = 435$$

$$(G_x = 145 \text{ kN})$$

Гіа ербачев BC



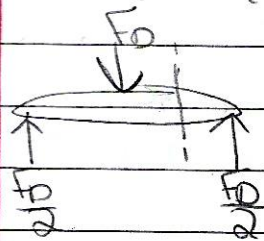
$\sigma_{\text{ср}} 7,5$

$$155 \cdot 10^6 = \frac{Cx \cdot 10^3}{A_{BC}}$$

$$\frac{155 \cdot 10^6}{155 \cdot 10^6} = \frac{145 \cdot 10^3}{155 \cdot 10^6}$$

$$A_{BC} = 9,35 \cdot 10^{-4} \text{ m}^2$$

2) Για προτύπων D



Area τμήμα 1-1

τμήμα 1-1

$$65 \cdot 10^6 = F_D$$

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

$$65 \cdot 10^6 = \frac{75 \cdot 10^3}{2}$$

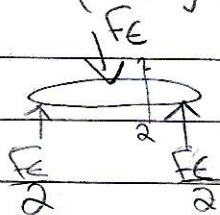
$$\frac{\pi d_D^2}{4}$$

$$65 \cdot 10^6 = \frac{37500}{2}$$

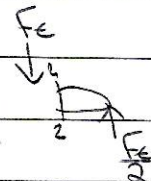
$$\frac{\pi d_D^2}{4}$$

$$d_D = 0,027 \text{ m}$$

Για προτύπων E



Area τμήμα 2-2



$$F_E = \sqrt{F_{Ex}^2 + F_{Ey}^2}$$

$$= \sqrt{30^2 + 50^2}$$

$$= 58,31 \text{ kN}$$

Γ\_50, T\_ε

$$65 \cdot 10^6 = F_E$$

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

$$65 \cdot 10^6 = \frac{58,3 \cdot 10^3}{2}$$

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

$$d_E = 0,024 \text{ m}$$

## Problem 2

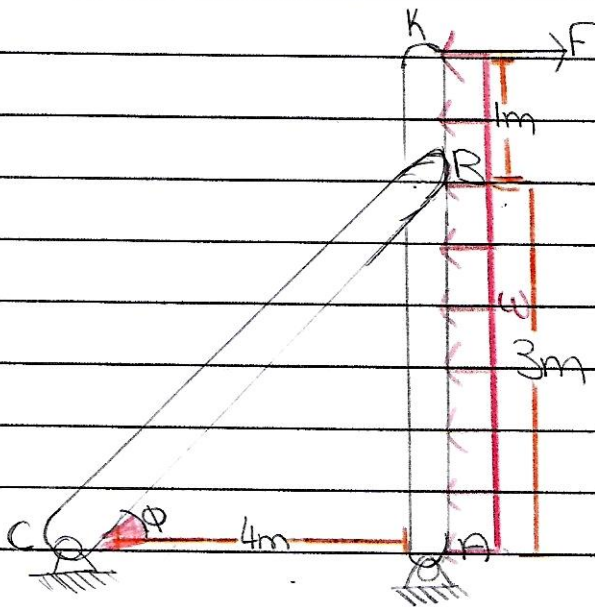
Design

$$\tau_{xy} = (120 + \varepsilon_3) \text{ MPa}$$

$$\sigma_{xy, BC} = (120 + \varepsilon_2) \text{ MPa}$$

$$F = (100W + \varepsilon_3) \text{ kN} \quad d_{AB} = 18 \text{ mm}$$

$$\varepsilon_3 = 15 \quad \varepsilon_2 = 5$$



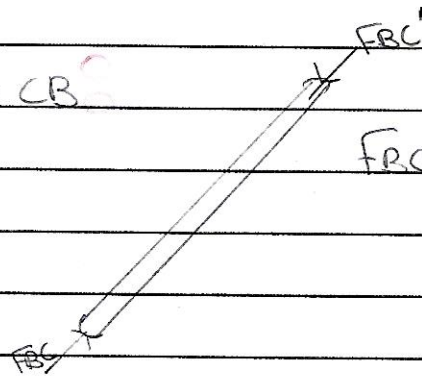
Free service  $\hat{\phi}$

$$\tan \hat{\phi} = \frac{3}{4}$$

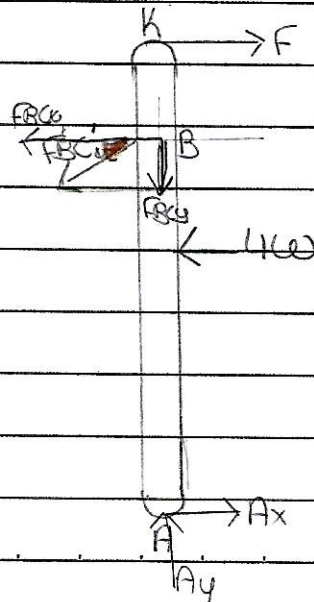
$$\hat{\phi} = 36.87^\circ$$

DES like CB

$$F_{BC} = F_{BC'} \text{ (compatibility)}$$



DES like AB



$$\sum F_x = 0$$

$$F + Ax - F_{BC}'x - 4w = 0$$

$$115 + Ax - F_{BC}' \cos(36,87^\circ) - 4w = 0$$

$$115 + Ax - 0,8 F_{BC}' - 4w = 0$$

$$\sum F_y = 0$$

$$A_y - F_{BC}'y = 0$$

$$A_y = F_{BC}' \sin 36,87^\circ$$

$$A_y = 0,6 F_{BC}'$$

$$\sum M_A = 0$$

$$3 F_{BC}'x + 4 \cdot 2w - 4F = 0$$

$$24 F_{BC}' + 8w = 460$$

Για εμβαδόν BC

$$\sigma_{\text{μεσ}} = \frac{F_{BC}'}{A}$$

$$125 \cdot 10^6 = \frac{F_{BC}'}{\frac{\pi \cdot 0,013^2}{4}}$$

$$F_{BC}' = 31803,63 \text{ N}$$

$$F_{BC}' = 31,80 \text{ kN}$$

$A_{\text{μεσ}}$

$$A_y = 0,6 \cdot 31,80$$

$$A_y = 19,08 \text{ kN}$$

$$24 \cdot 31,80 + 8w = 460$$

$$8w = 383,68$$

$$w = 47,96 \text{ kN}$$

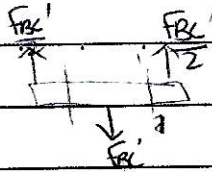
$$115 + Ax - 0,8 F_{BC}' - 4w = 0$$

$$115 + Ax - 0,8 \cdot 31,80 - 4 \cdot 47,96 = 0$$

$$Ax = 25,44 - 115 + 191,84$$

$$Ax = 102,28 \text{ kN}$$

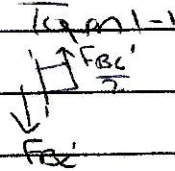
Μετατόνιση Β



$T_c \leq T_{ew}$

$$\frac{F_{BC}'}{2} \leq 125 \cdot 10^6$$

$$\frac{11008^2}{4}$$



$$\frac{31,80 \cdot 10^3}{2} \leq 125 \cdot 10^6$$

$$\frac{11 \cdot 0,018^2}{4}$$

$$62,48 \cdot 10^6 \leq 125 \cdot 10^6$$

Άρα είναι OK το μετατόνιση Β

Μετατόνιση C

$T_c \leq T_{ew}$

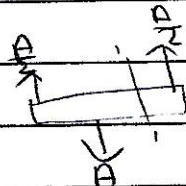
$$\frac{F_{BC}'}{2} \leq 125 \cdot 10^6$$

$$\frac{31,80 \cdot 10^3}{2} \leq 125 \cdot 10^6$$

$$\frac{11 \cdot 0,018^2}{4}$$

$$62,48 \cdot 10^6 \leq 125 \cdot 10^6 \text{ OK}$$

Μετατόνιση Α



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

$$= \sqrt{102,28^2 + 19,08^2}$$

$$= 104,04 \text{ kW}$$

Τομή 1-1  $T_A \leq T_{ew}$

$$\frac{F_A}{2} \leq T_{ew}$$

$$\frac{11008^2}{4}$$

$$\frac{10,404 \cdot 10^3}{2} \leq T_{ew}$$

$$\frac{11 \cdot 0,018^2}{4}$$

$$204 \cdot 10^6 \leq T_{ew}$$

No.

Date

Από διαμετρο κωλύσεων και ράβδων Βέλη με  
18mm η κατασκευή δεν μπορεί να αντέξει το μέγιστο φορτίο  
ω συν είναι 100 με 47,46kW