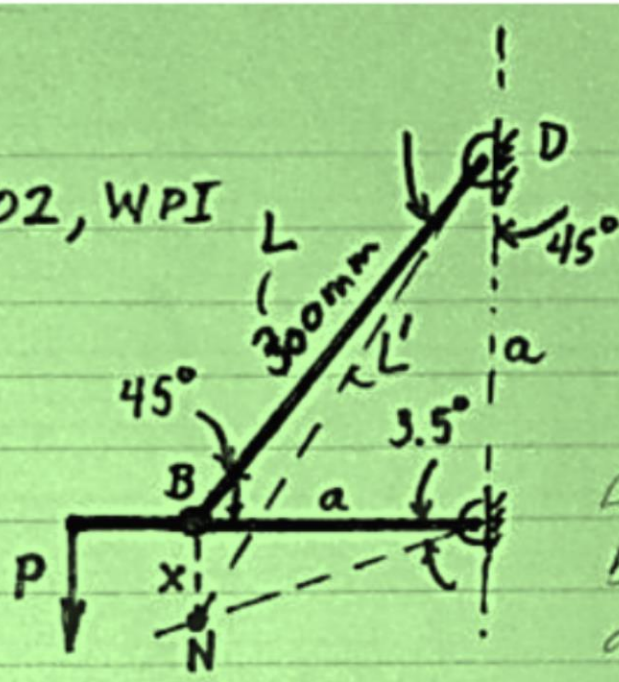
E03-1

ES·2502, WPI



$\sqrt{a^2+a^2} = 300$ mm

$\sqrt{2}\,a = 300$

$a = 212$ mm;

Apply cosine rule between L, x, and common angle of $90°+45° = 135°$.

$\tan 3.5° = \frac{x}{a} \Rightarrow x = 12.97$ mm;

$L' = \sqrt{300^2 + 12.97^2 - 2(300)(12.97)\cos 135°}$

$= 309.307$ mm

(1) $\epsilon_L = \frac{L' - L}{L} = 0.031, \frac{mm}{mm}$

(2) New length $= L' = 309.307$ mm

(3) $\sigma_L = E\,\epsilon_L = 200\times10^9 \cdot 0.031 = 6.2$ GPa

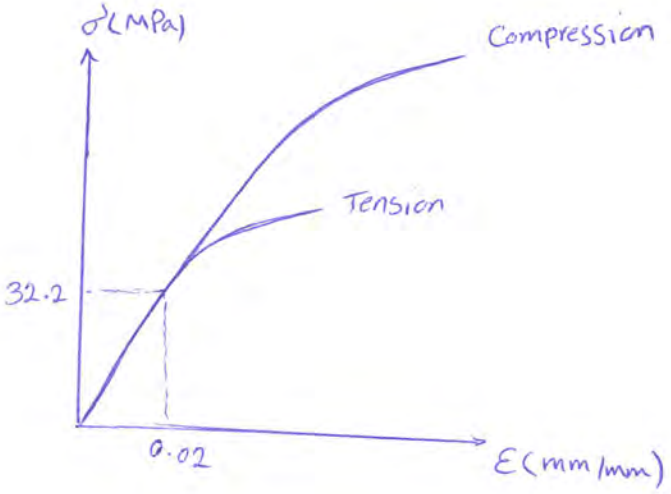
(4) $SF = \frac{\sigma_y}{\sigma_L} = \frac{250\times10^6}{6.2\times10^9} = 0.04$!! $\ll\ll 1$;

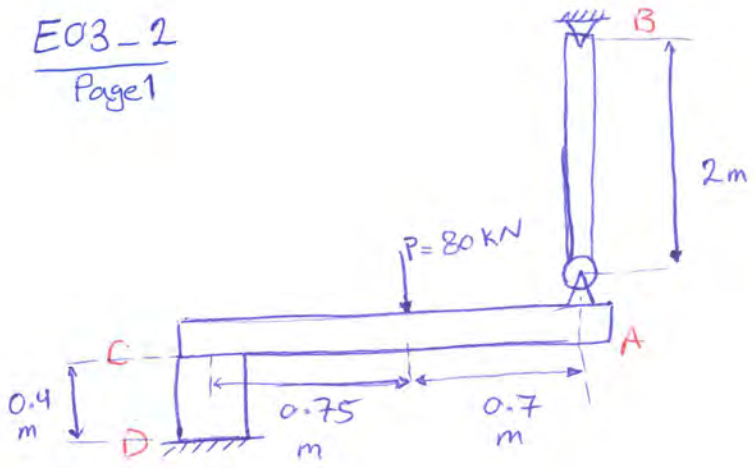
3.10% Rod deforms

- Very high strain (0.031) plastically !! Fail!!
- Very high applied load.

End of Solution. ICF

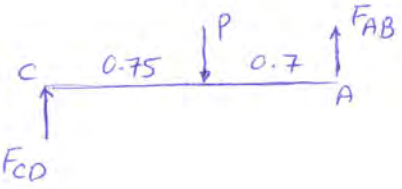
E03_2
Page1





$$E = \frac{32.2 \times 10^6}{0.02} = 1.61 \text{ GPa}$$

$+\circlearrowleft \sum M_A = 0 \quad P \times 0.7 - F_{CD} \times 1.45 = 0 \quad F_{CD} = 38.62 \text{ KN}$



$+\circlearrowright \sum M_C = 0 \quad F_{AB} \times 1.45 - P \times 0.75 = 0 \quad F_{AB} = 41.38 \text{ KN}$

$$A_{AB} = \frac{\pi d_{AB}^2}{4} = \frac{\pi}{4}(0.04^2) = 1.256 \times 10^{-3} \ m^2$$

$$A_{CD} = \frac{\pi dc^2}{4} = \frac{\pi}{4}(0.06)^2 = 2.826 \times 10^{-3} \ m^2$$

First Method:

$$\delta_{AB} = \frac{F_{AB} L_{AB}}{A_{AB} E} = \frac{41.38 \times 10^3 \times 2}{1.256 \times 10^{-3} \times 1.61 \times 10^9} = 0.0409 \text{ m} \downarrow$$

$$\delta_{CD} = \frac{F_{CD} L_{CD}}{A_{CD} E} = \frac{38.62 \times 10^3 \times 0.4}{2.826 \times 10^{-3} \times 1.61 \times 10^9} = 0.0034 \text{ m} \downarrow$$

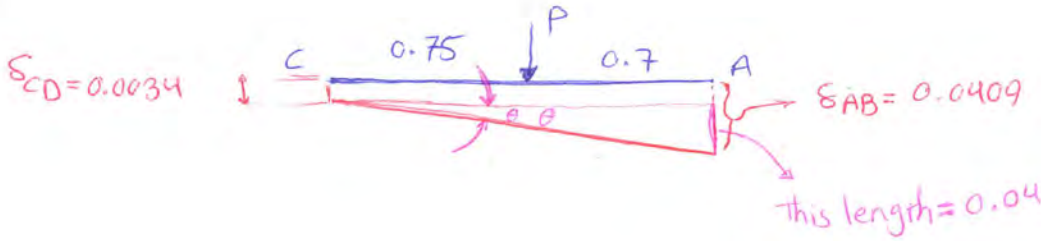
Second Method:

$$\sigma_{AB} = \frac{F_{AB}}{A_{AB}} = \frac{41.38 \times 10^3}{1.256 \times 10^{-3}} = 32.94 \text{ MPa}$$

$$\varepsilon_{AB} = \frac{\sigma_{AB}}{E} = \frac{32.94 \times 10^6}{1.61 \times 10^9} = 0.0204 \ \frac{m}{m}$$

$$\sigma_{DC} = \frac{F_{DC}}{A_{DC}} = \frac{38.62 \times 10^3}{2.826 \times 10^{-3}} = 13.66 \text{ MPa}$$

$$\varepsilon_{CD} = \frac{\sigma_{CD}}{E} = \frac{13.66 \times 10^6}{1.61 \times 10^9} = 0.0085 \ \frac{m}{m}$$



$$\text{Tilting Angle} = \theta = \tan^{-1}\left(\frac{0.0375}{1.45}\right) = 1.48^\circ = \theta$$