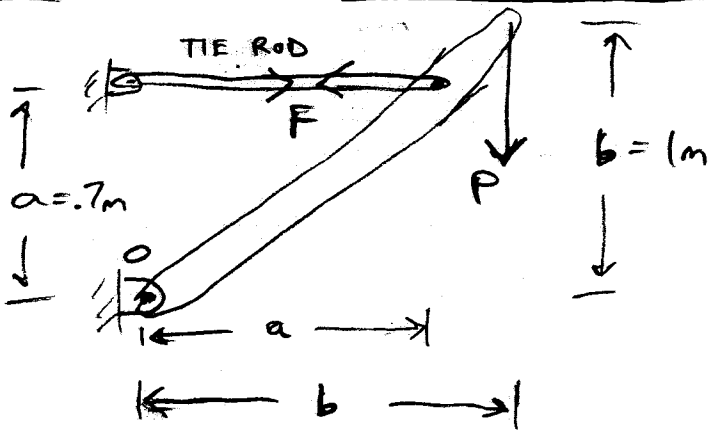
SEE EXAMPLES IN BOOK ALSO (e.g., 5.11) WHERE DIAM IS TO BE SELECTED (UNKNOWN)

Ex. 5.29 Boom & TIE ROD



GIVEN:

STEEL TIE ROD:

dia: $d = 12\,mm$

$S_y = 400\,MPa$

FIND:

SAFETY FACTORS

a.) FOR $P = 6\,kN$ (TIE ROD IN TENSION)

b.) FOR $P = -6\,kN$ (TIE ROD IN COMPRESSION)

AXIAL FORCE IN TIE ROD

$$\Sigma M_O = 0 \Rightarrow F = \frac{b}{a} P = \pm 8.57\,kN$$

a.) TENSION

$$\sigma = \frac{F}{A} \qquad A = \frac{\pi d^2}{4} = 113\,mm^2$$

$$\sigma = 75.8\,MPa \qquad \underbrace{SF}_{\text{SAFETY FACTOR}} = \frac{S_y}{\sigma} \begin{matrix} \leftarrow \text{STRENGTH} \\ \leftarrow \text{STRESS} \end{matrix} = \boxed{5.28}$$

b.) COMPRESSION

FROM FIG 5.25, $L_e = L = a = .7m$ FROM APP B-1a, $\rho = \frac{d}{4} = 3mm$

$$\left(\frac{L_e}{\rho}\right) = 233.3 \qquad \text{APP. C-1} \Rightarrow E = 207\,\overbrace{GPa}^{10^9 Pa}$$

$$\left(\frac{L_e}{\rho}\right)_{tangent} = \sqrt{\frac{2\pi^2 E}{S_y}} = 101$$

$\left(\frac{L_e}{\rho}\right) > \left(\frac{L_e}{\rho}\right)_{tangent} \Rightarrow$ USE EULER FORMULA

$$S_{cr} = \frac{\pi^2 E}{(L_e/\rho)^2} = 37.5\,MPa$$

$\sigma > S_{cr} \Rightarrow$ TIE ROD WILL BUCKLE $\Rightarrow$ NO SAFETY FACTOR!