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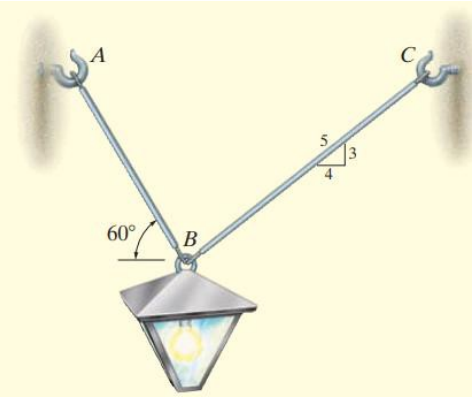
Assignment No (1)

MECHANICS OF MATERIALS

1. The 80-kg lamp is supported by two rods AB and BC as shown in Fig. below. If AB has a diameter of 10 mm and BC has a diameter of 8 mm, determine the average normal stress in each rod.



$$\sum F_x = 0 \quad \Rightarrow \quad F_{BC}\left(\frac{4}{5}\right) - F_{BA}\cos 60 = 0$$

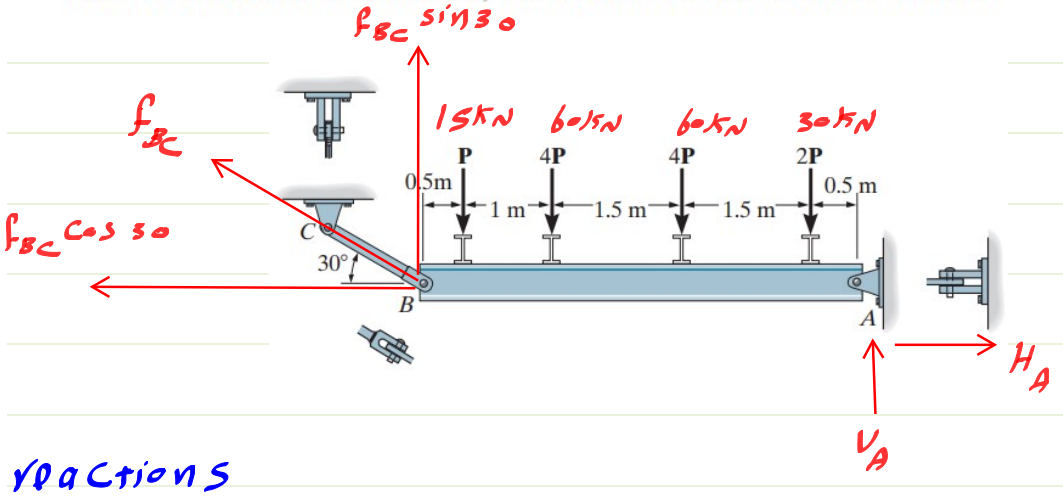
$$\sum F_y = 0 \quad \Rightarrow \quad F_{BC}\left(\frac{3}{5}\right) + F_{BA}\sin 60 - 784.8 = 0$$

$$F_{BC} = 395.2\,N \qquad F_{BA} = 632.4\,N$$

$$\sigma_{BC} = \frac{F_{BC}}{A_{BC}} = \frac{F_{BC}}{\frac{\pi}{4}d_{BC}^2} = \frac{395.2}{\frac{\pi}{4}(8)^2} = 7.86\,\text{MPa}$$

$$\sigma_{BA} = \frac{F_{BA}}{A_{BA}} = \frac{F_{BA}}{\frac{\pi}{4}d_{BA}^2} = \frac{632.4}{\frac{\pi}{4}(10)^2} = 8.05\,\text{MPa}$$

2- The beam is supported by a pin at A and a short link BC. If P = 15 KN, determine the average shear stress developed in the pins at A, B, and C. All pins are in double shear as shown, and each has a diameter of 18 mm



Reactions

$$\Sigma M_A = 30*0.5 + 60*2 + 60*3.5 + 15*4.5 - f_{BC}\sin 30 * 5 = 0$$

$$f_{BC} = 165\ kN$$

$$\Sigma f_x = -\cancel{f_{BC}}^{165}\cos 30 + H_A = 0 \Rightarrow H_A = 142.9\ kN$$

$$\Sigma f_y = \cancel{f_{BC}}^{165}\sin 30 - 15 - 60 - 60 - 30 + V_A = 0$$

$$V_A = 82.5\ kN$$

$$f_A = \sqrt{V_A^2 + H_A^2} = \sqrt{82.5^2 + 142.9^2} = 165\ kN$$

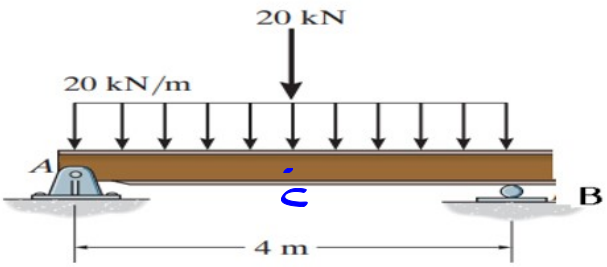
$$\tau_A = \frac{f_A}{2A} = \frac{165*10^3}{2*\frac{\pi}{4}*(18)^2} = 324.2\ MPa$$

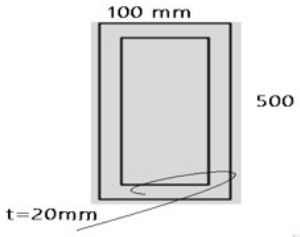
$$\tau_B = \tau_C = \frac{F_{BC}}{2A} = \frac{165 * 10^3}{2 * \frac{\pi}{4} * 182} = 324 \text{ MPa}$$

average shear stress = 324 MPa

3. The simply supported steel beam has a cross-section as shown below.

Determine the maximum bending stress





$$\sigma_C = \frac{My}{I}$$

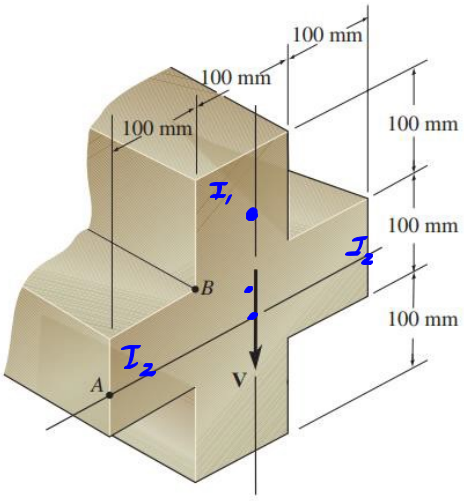
$$M = \frac{wL^2}{8} + \frac{PL}{4} = \frac{20 * 10^3 * 4^2}{8} + \frac{20 * 10^3 * 4}{4} = 60000 \text{ N.m}$$

$$y = 250 \text{ mm}$$

$$I = \frac{100 * 500^3}{12} - \frac{60 * 460^3}{12} = 554986666.7 \text{ mm}^4$$

$$\sigma_C = \frac{60000 * 10^3 * 250}{554986666.7} = 27.03 \text{ MPa}$$

4. Determine the shear stress at points A and B on the beam if it is subjected to a sheer force of V=600 kN



$$I = I_1 + I_2 + I_2$$

$$= \frac{100 * 300^3}{12} + \frac{2 * 100 * 100^3}{12}$$

$$= 241666666.7\ mm^4$$

$$Q_A = \bar{y} A' = 25 * 50 * 300 + 100 * 100 * 100$$

$$Q_A = 1375000\ mm^3$$

$$\tau_A = \frac{V Q_A}{I t} = \frac{600 * 10^3 * 1375000}{241666666.7 * 300} = 11.38\ MPa$$

$$Q_B = 100 * 100 * 100 = 10^6\ mm^3$$

$$\tau_B = \frac{600 * 10^3 * 10^6}{241666666.7 * 100} = 24.83\ MPa$$