

### Homework problems 36-38

**Due in class, Friday, 13 November 2020**

36. A pressure-vessel head is fabricated by welding the circular plate to the end of the vessel as shown. If the vessel sustains an internal pressure of 450 kPa, determine the average shear stress in the weld and the state of stress in the wall of the vessel.

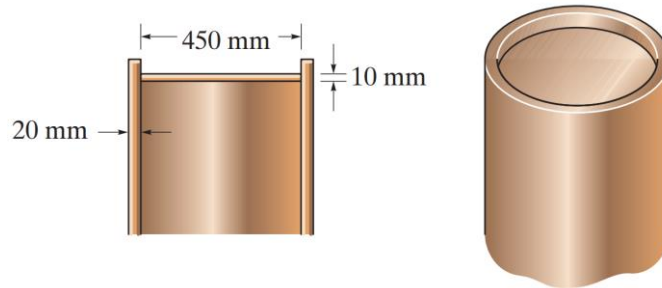


Figure 36

#### SOLUTION

$$+\uparrow \Sigma F_y = 0; \quad \pi(0.225)^2 450(10^3) - \tau_{\text{avg}} (2\pi)(0.225)(0.01) = 0;$$

$$\tau_{\text{avg}} = 5.06 \text{ MPa}$$

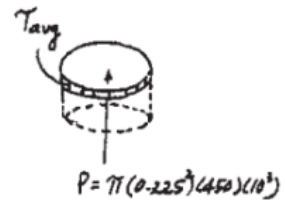
Ans.

$$\sigma_1 = \frac{p r}{t} = \frac{450(10^3)(0.225)}{0.02} = 5.06 \text{ MPa}$$

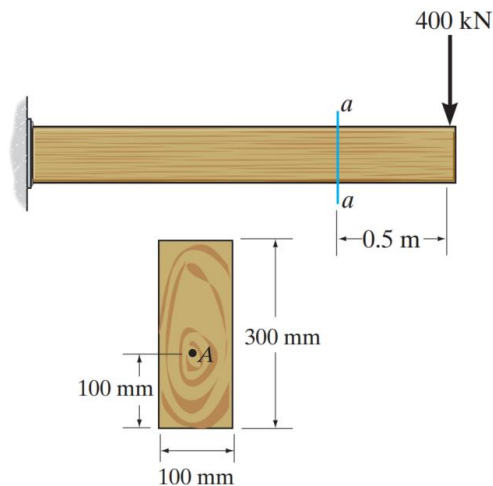
Ans.

$$\sigma_2 = \frac{p r}{2 t} = \frac{450(10^3)(0.225)}{2(0.02)} = 2.53 \text{ MPa}$$

Ans.



37. Determine the state of stress at point A on the cross section at section a-a of the cantilever beam. Show the results in a differential element at the point.



Section a-a

Figure 37

$$+\uparrow \sum F_y = 0; \quad V - 400 = 0 \quad V = 400 \text{ kN}$$

$$\zeta + \sum M_A = 0; -M - 400(0.5) = 0 \quad M = -200 \text{ kN} \cdot \text{m}$$

$$I = \frac{1}{12} (0.1)(0.3^3) = 0.225(10^{-3}) \text{ m}^4$$

Bottom segment

$$\sigma_A = \frac{M_y}{I} = \frac{[200(10^3)](-0.05)}{0.225(10^{-3})}$$

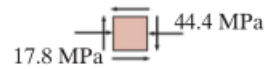
$$= -44.44 \text{ MPa} = 44.4 \text{ MPa (C)}$$

Ans.

$$Q_A = y' A' = 0.1(0.1)(0.1) = 1(10^{-3}) \text{ m}^3$$

$$\tau_A = \frac{VQ}{It} = \frac{400(10^3)[1(10^{-3})]}{0.225(10^{-3})(0.1)} = 17.8 \text{ MPa}$$

Ans.



38. The frame supports the distributed load shown. Determine the state of stress acting at point D. Show the results on a differential element at this point.

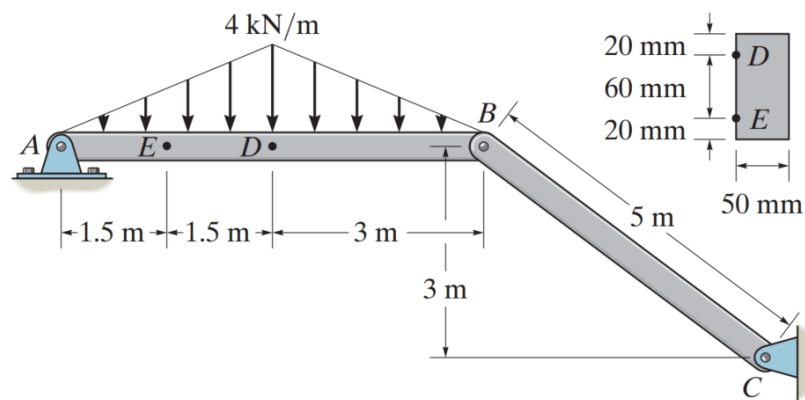


Figure 38

### SOLUTION

$$\sigma_D = -\frac{P}{A} - \frac{My}{I} = -\frac{8(10^3)}{(0.1)(0.05)} - \frac{12(10^3)(0.03)}{\frac{1}{12}(0.05)(0.1)^3}$$

$$\sigma_D = -88.0 \text{ MPa}$$

$$\tau_D = 0$$

Ans.

Ans.

