

ENGR 350 - Mechanics of Materials, Fall 2013

Homework #9

Due: Wednesday, Oct. 29

1. Problem P8.2, p. 276
2. Problem P8.3, p. 276
3. Problem P8.4, p. 276

(all problems are from the textbook).

8.2) <Given>

Bent steel tube

$$E = 200 \text{ GPa}$$

$$d_o = 80 \text{ mm}$$

$$d_i = 74 \text{ mm}$$

$$P = 52 \text{ m (radius of curvature)}$$

<Goal>

Find the max. bending stress

<Solution>

$$\sigma_x = -\frac{E}{P} y$$

$$= \frac{-200,000 \text{ MPa}}{52 \text{ m} (1,000 \text{ mm/m})} (\pm 30 \text{ mm/2})$$

$$= \pm 153.8 \text{ MPa}$$

$$\sigma_x = \boxed{153.8 \text{ MPa}}$$

8.3) <Given>

Band saw blade wraps around a pulley of $d = 450 \text{ mm}$

$$E = 200 \text{ GPa}$$

$$W = 12 \text{ mm}$$

$$t = 1 \text{ mm}$$

<Goal>

Maximum bending stress in the blade

<Solution>

$$D = \frac{450 \text{ mm}}{2} + \frac{1 \text{ mm}}{2}$$
$$= 225.5 \text{ mm}$$

$$\sigma_x = -\frac{E}{\rho} y$$

$$= -\frac{200,000 \text{ MPa}}{225.5 \text{ mm}} (\pm 0.5 \text{ mm})$$

$$= \pm 443.5 \text{ MPa}$$

$$= \boxed{443 \text{ MPa}}$$

8.4) <Given>

Boards bent into a circular shape of $r_i = 10\text{ m}$

$$E_{\text{wood}} = 12\text{ GPa}$$

<Goal>

• t_{max} if $\sigma_n \leq 7\text{ MPa}$ for boards

<Solution>

$$\rho = 10,000\text{ mm} + \frac{t}{2}$$

$$\sigma_x = -\frac{E}{\rho} y$$

$$= \frac{-12,000\text{ MPa}}{(10,000\text{ mm} + \frac{t}{2})} \left(\frac{t}{2}\right) \leq 7\text{ MPa}$$

$$12,000\text{ MPa} \left(\frac{t}{2}\right) \leq 7\text{ MPa} (10,000\text{ mm} + \frac{t}{2})$$

$$6000 t \leq 70,000 + 3.5 t$$

$$t \leq 11.67\text{ mm}$$