12-331 Solid Mechanics

HW #4 Due: 9/26/2000

3-29

- Modulus of Elasticity

$$E = \frac{400 \times 10^6}{0.002} = 200 \text{ GPa}$$

- Normal stress;

$$\sigma = \frac{P}{A} = \frac{50 \times 10^3}{\frac{\pi}{4}(0.013^2)} = 376.10 \text{ MPa}$$

- Normal strain:

$$\varepsilon_{long} = \frac{376.10 \times 10^6}{200 \times 10^9} = 1.8835 \times 10^{-3} \text{ (mm/mm)}$$

$$\varepsilon_{lat} = \frac{d - d_o}{d_o} = \frac{12.99265 - 13}{13} = -0.56538 \times 10^{-3} \text{ (mm/mm)}$$

- Poisson's ratio

$$\upsilon = \frac{\varepsilon_{lat}}{\varepsilon_{long}} = \frac{0.56538 \times 10^{-3}}{1.8835 \times 10^{-3}} = 0.3$$

3-31

- Modulus of Rigidity

$$G = \frac{50}{0.004} = 12.5(10^3) \text{ ksi}$$

- $G = \frac{E}{2(1+\upsilon)} \rightarrow E = 2(1+\upsilon)G$

$$E = 2(1+0.3)12.5(10^3) = 32.5 \times 10^3 \text{ (ksi)}$$

- Yielding shear; $\tau_y = 50$ ksi

$$V_y = \tau_y \cdot A$$

$$V_y = 50 \times \frac{\pi}{4}(0.25^2) = 2.45 \text{ (kip)}$$

3-41

- Fracture of strut AB

$$(\sigma_f)_{AB} = \frac{F_{AB}}{A_{AB}}$$

$$50(10^6) = \frac{P/2}{\frac{\pi}{4}(0.012^2)}$$

$$P = 11.3 \text{ kN}$$

- Fracture of post CD

$$(\sigma_f)_{CD} = \frac{F_{CD}}{A_{CD}}$$

$$95(10^6) = \frac{P/2}{\frac{\pi}{4}(0.04^2)}$$

$$P = 238.8 \text{ kN}$$

So $P = 11.3 \text{ (kN)}$