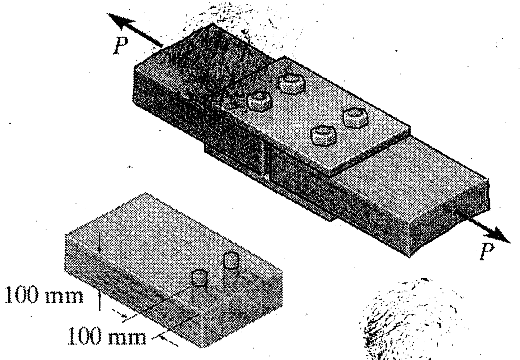
ENGR 3131 SI Session Worksheet 2/9/16 T Name:

1) GIVEN: Joint shown subjected to an axial force of 9kN
REQ'D: Average shear stress developed in each of the 6-mm
Average shear stress developed on shaded planes in wood.



$$\tau_B = \frac{P_s}{A_s} = \frac{9000\text{ N}}{\frac{\pi}{4}(6\text{ mm})^2 \times 2 \times 2}$$

DOUBL SHEAR

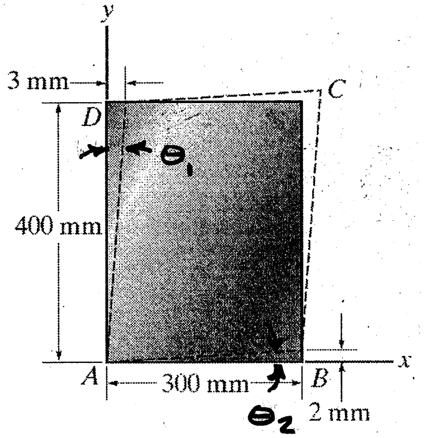
2 BOLTS

$$= \underline{\underline{79.57\text{ MPa}}}$$

$$\tau_W = \frac{P_s}{A_s} = \frac{9000\text{ N}}{(100\text{ mm})^2 \times 4} = .225\text{ MPa}$$

$$\Rightarrow \underline{\underline{225\text{ kPa}}}$$

2) GIVEN: The piece of rubber is originally rectangular and subjected to the deformation shown by the dashed lines.
REQ'D: Average shear strain at A and C if the corners B and D are subjected to the displacements shown.



$$\theta_1 = \frac{3}{400} = .00750\text{ rad}$$

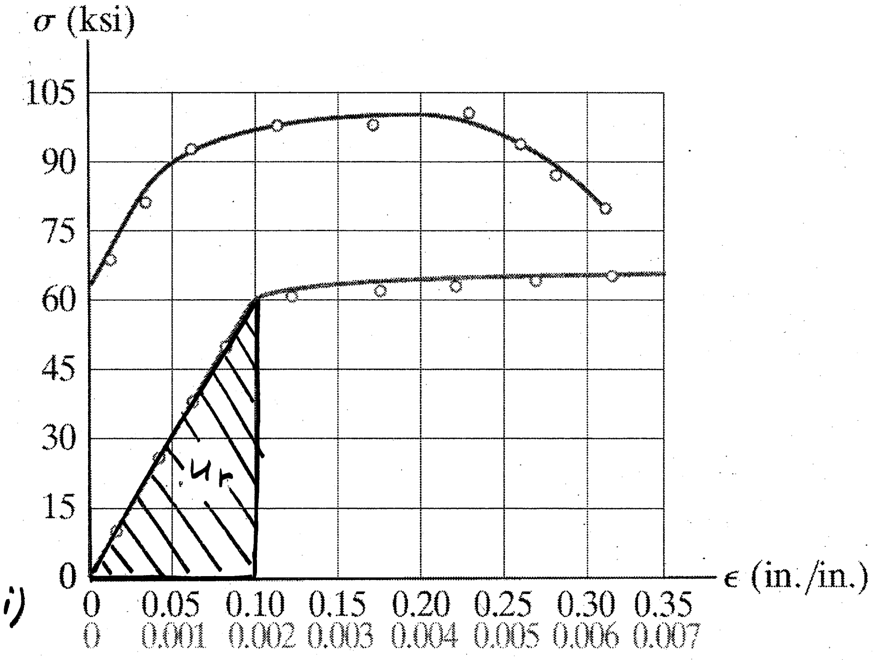
$$\theta_2 = \frac{2}{300} = .00667\text{ rad}$$

$$\gamma_{xy} = \theta_1 + \theta_2$$

$$= .00750 + .00667\text{ rad}$$

$$= \underline{\underline{.01417\text{ rad}}}$$ SAME AT ALL CORNERS

3) GIVEN: Stress-strain Diagram for a steel specimen.
REQ'D: Modulus of resilience modulus of toughness



$$U_r = \frac{1}{2}(.002)(60 \text{ ksi})$$

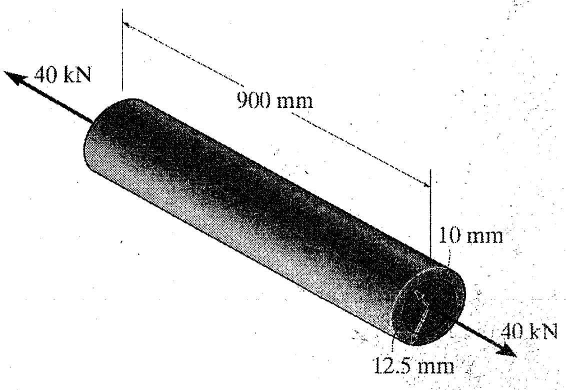
$$= \underline{\underline{.60}} \; \frac{in \cdot lb}{in^3} \; (psi)$$

~ 39 SQUARS

$$U_t = 39(.05)(15 \text{ ksi})$$

$$= \underline{\underline{29.25 \times 10^3}} \; \frac{in \cdot lb}{in^3} \; (psi)$$

4) GIVEN: The thin-walled tube elongates 3 mm and its circumference decreases by 0.09 mm when it is subjected to an axial force of 40 kN.
REQ'D: Modulus of elasticity, Poisson's ratio, and shear modulus.
Note: The material behaves elastically.



$$\Delta L = \frac{PL}{AE} \Rightarrow E = \frac{PL}{A \Delta L}$$

$$E = \frac{(40000N)(900mm)}{\pi(12.5^2 - 10^2)(3mm)} = 67.91 \times 10^3 \text{ MPa}$$

$$= \underline{\underline{67.91 \text{ GPa}}}$$

ORIGINAL CIRCUMFERANCE:

$$C_0 = 2\pi(12.5 \text{ mm}) = 78.53982 \text{ mm}$$

FINAL CIRCUMFERANCE:

$$C_f = 78.53982 \text{ mm} - .09 \text{ mm}$$

$$= 78.4498 \text{ mm}$$

FINAL ϕ = $C_f / 2\pi$ = 12.48568 mm

$$\varepsilon_{LAT} = \frac{r - r_0}{r_0} = -\frac{12.5 - 12.48568}{12.5} = -1.1459 \times 10^{-3}$$

$$\nu = -\frac{\varepsilon_{LAT}}{\varepsilon_{LONG}} \qquad G = \underline{\frac{E}{2(1+\nu)}}$$