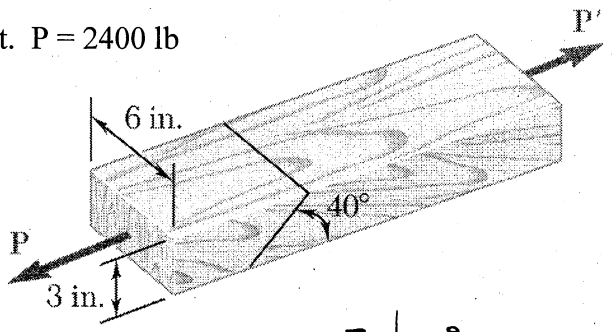
1) GIVEN: Wooden member under tension with scarf joint. P = 2400 lb
REQ'D: Shear and normal stresses in joint.



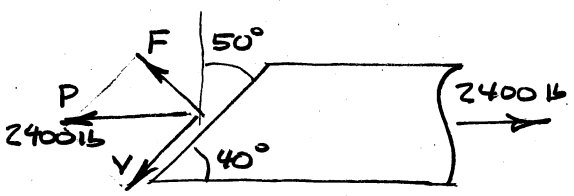
$\theta = 90° - 40° = 50°$

NORMAL AREA:

$A_o = 6in(3in) = 18\ in^2$

$\sigma_\theta = \frac{P}{A_o}\cos^2\theta = \frac{2400lb}{18\ in^2}\cos 50°$

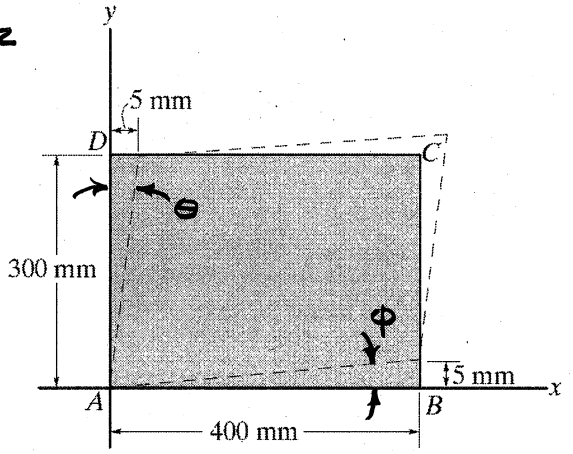
$= \underline{55.1\ psi}$ NORMAL



$\tau_\theta = \frac{P}{A_o}\cos\theta\sin\theta = \frac{2400lb}{18in^2}\cos 50°\sin 50°$

$= \underline{65.7\ psi}$ SHEAR

2) GIVEN: The rectangular plate is deformed into the shape of a parallelogram as shown.
REQ'D: Shear strain at corners A and B.



$\theta \approx \frac{5}{300} = 0.01667\ rad$

$\Phi \approx \frac{5}{400} = 0.01250\ rad$

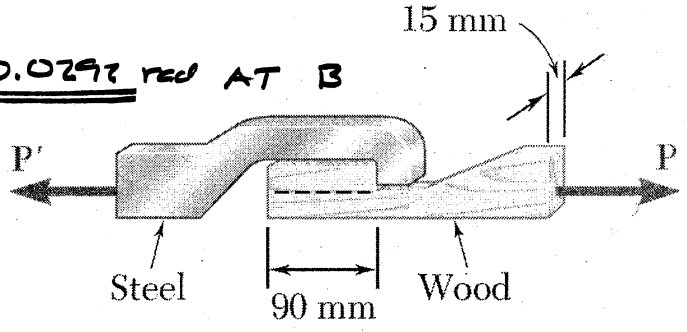
$\gamma_{A\,xy} = \theta + \Phi$

$= 0.01667 + 0.01250\ rad = \underline{0.0292\ rad}$ AT A

$\gamma_{B\,xy} = \theta + \Phi$

$= 0.01667 + 0.01250\ rad = \underline{0.0292\ rad}$ AT B

3) GIVEN: Wooden hook failed in shear along the dashed line when P = 8 kN.
REQ'D: Average shearing stress at failure.



SHEARED AREA:

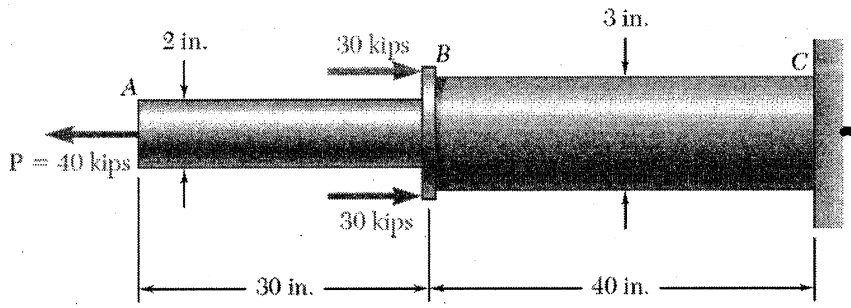
$A_s = 90\,mm(15mm) = 1350\ mm^2$

SHEAR STRESS AT FAILURE:

$\tau_{AVG} = \frac{P}{A_s} = \frac{8000\,N}{1350\,mm^2} = 5.925\ N/mm^2$

$\Rightarrow \underline{5.93}$ MPa @ FAILURE

4) GIVEN: Cylindrical rods AB and BC are welded together at B and loaded as shown.



20 kips REACTION

REQ'D: A) Average normal stress in section AB.

$$A_{AB} = \frac{\pi}{4} D^2 = \frac{\pi}{4}(2\text{in})^2 = 3.142\ \text{in}^2$$

$$\sigma_{AB} = \frac{P}{A} = \frac{40\ \text{kips}}{3.142\ \text{in}^2} = \underline{12.73\ \text{ksi}}\ (T)$$ IN SECTION AB

B) Average normal stress in section BC.

LOAD IN BC: $\underline{40\text{kips}} - \underline{2(30\text{kips})} = \underline{-20\ \text{kips}}$ COMPRESSION

$$A_{BC} = \frac{\pi}{4} D^4 = \frac{\pi}{4}(3\text{in})^2 = 7.069\ \text{in}^2$$

$$\sigma_{BC} = \frac{P_{BC}}{A_{BC}} = \frac{-20\ \text{kips}}{7.069\ \text{in}^2} = \underline{-2.83\ \text{ksi}}\ (C)$$ IN SECTION BC

C) Also, find the axial strain in each segment if $\Delta L_{AB} = 0.0127$ in and $\Delta L_{BC} = 0.00377$ in.

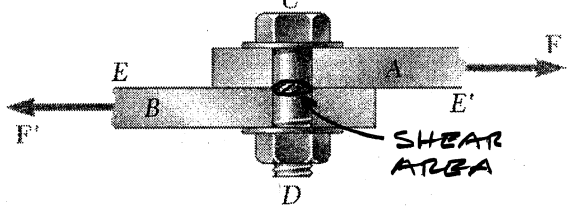
$$\epsilon = \frac{\Delta L}{L}$$

$$\epsilon_{AB} = \frac{\Delta L_{AB}}{L_{AB}} = \frac{0.0127\ \text{in}}{30\ \text{in}} = \underline{0.000423\ \text{in/in}}$$

$$\epsilon_{BC} = \frac{\Delta L_{BC}}{L_{BC}}$$

COMPRESSION $= \frac{-0.00377\ \text{in}}{40\ \text{in}} = \underline{-0.0000943\ \text{in/in}}$ COMP.

5) GIVEN: ∅ 0.5 in bolt connecting two 0.5 in thick plates.
REQ'D: Bearing and shear stresses if F = 1000 lbs.



$$\sigma_B = \frac{F}{A_B} = \frac{1000\ \text{lb}}{0.5\text{in}(0.5\text{in})} = \underline{4000\ \text{psi}}$$

∅ OF BOLT; THICKNESS OF PLATE

$$\tau = \frac{F}{A_S} = \frac{1000\ \text{lb}}{\frac{\pi}{4}(0.5\text{in})^2 \times 1 \times 1} = \underline{5093\ \text{psi}}$$ SHEAR IN BOLT

SINGLE SHEAR; ONE BOLT