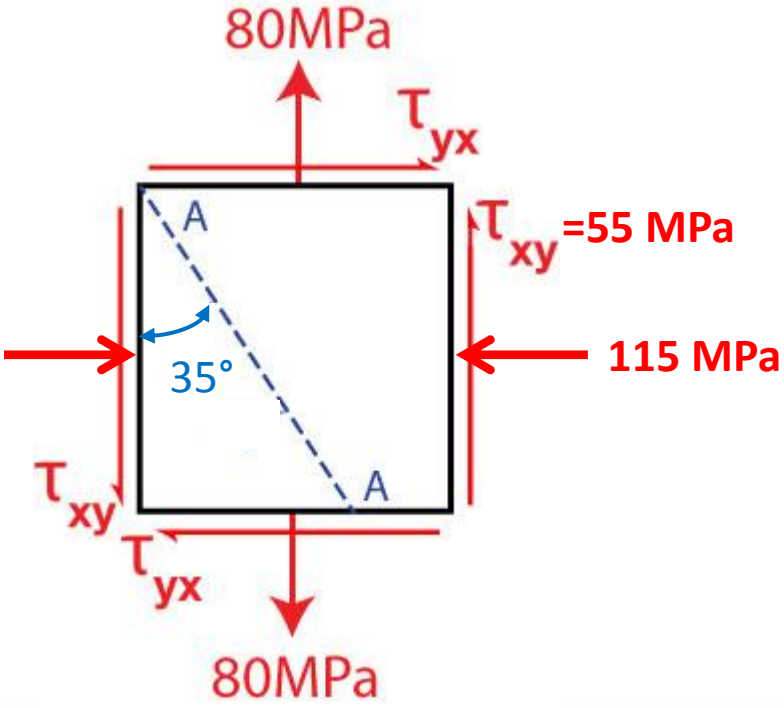
MOOC – "Mechanics of Materials I"
Week Three Quiz

Problem 1) Use the plane stress transformation equations to find the normal stress and the magnitude of the shear stress on plane A-A for the stress acting at a point in a machine component shown below.



$$\sigma_n = \frac{\sigma_x+\sigma_y}{2} + \frac{\sigma_x-\sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta$$

$$\sigma_n = \left(\frac{-115+80}{2}\right) + \left(\frac{-115-80}{2}\right)\cos[2(35°)] + 55\sin[2(35°)]$$

$$\sigma_n = 0.836\ MPa\ (T)$$ ANS

$$\tau_{nt} = -\left(\frac{\sigma_x-\sigma_y}{2}\right)\sin 2\theta + \tau_{xy}\cos 2\theta$$

$$\tau_{nt} = -\left(\frac{-115-80}{2}\right)\sin[2(35°)] + 55\cos[2(35°)]$$

$$|\tau_{nt}| = 110\ MPa$$ ANS

$$\sigma_n = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta$$

$$\sigma_n = \left(\frac{-115+80}{2}\right) + \left(\frac{-115-80}{2}\right)\cos[2(35°)] + 55\sin[2(35°)]$$

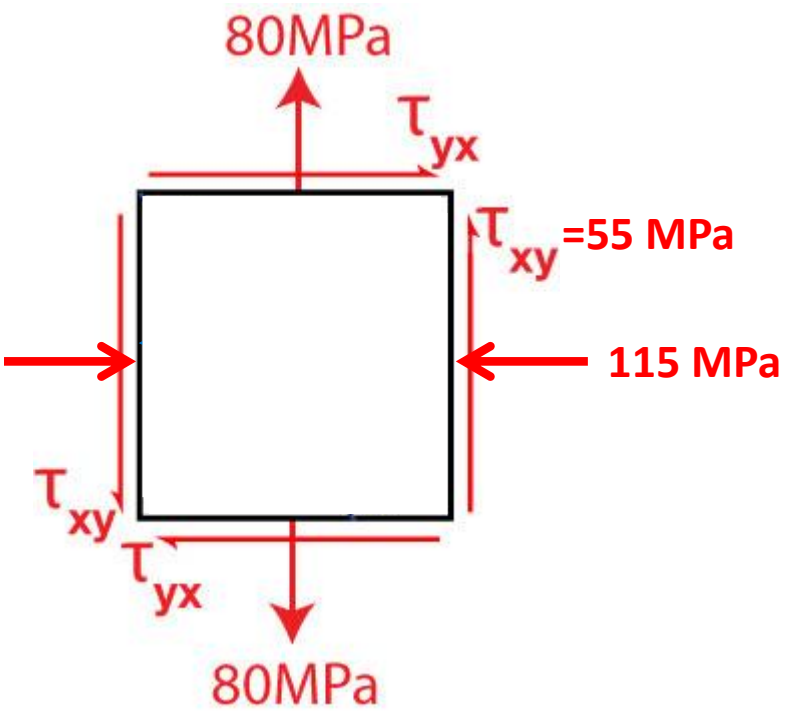
$$\underline{\sigma_n = 0.836\ MPa\ (T)} \quad \text{ANS}$$

$$\tau_{nt} = -\left(\frac{\sigma_x - \sigma_y}{2}\right)\sin 2\theta + \tau_{xy}\cos 2\theta$$

$$\tau_{nt} = -\left(\frac{-115-80}{2}\right)\sin[2(35°)] + 55\cos[2(35°)]$$

$$\underline{|\tau_{nt}| = 110\ MPa} \quad \text{ANS}$$

Problem 2) Find the principal stresses and the maximum in-plane shear stress for the stress condition acting at a point in a machine component shown below.



$$\sigma_1, \sigma_2 = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\sigma_1, \sigma_2 = \left(\frac{-115 + 80}{2}\right) \pm \sqrt{\left(\frac{-115 - 80}{2}\right)^2 + (55)^2}$$

$$\sigma_1 = -17.5 \pm 111.9$$

$\sigma_1 = 94.4$ MPa (T) ANS $\quad \sigma_2 = 129$ MPa (C) ANS

$$\tau_{MAX} = \left(\frac{\sigma_1 - \sigma_2}{2}\right) = \frac{94.4 - (-129.4)}{2} = 112 \text{ MPa}$$ ANS

Problem 3) Show a Mohr's Circle plot depicting the principal stresses and the maximum in-plane shear stress for the stress condition acting at a point in an engineering structural member shown below.