IN-CLASS QUIZ 2 SOLUTION

$\sigma_z = 1650$ psi

$\tau_{zy} = 137.5$ psi

τ^{cw} (psi)

$(0; 137.5)$

R

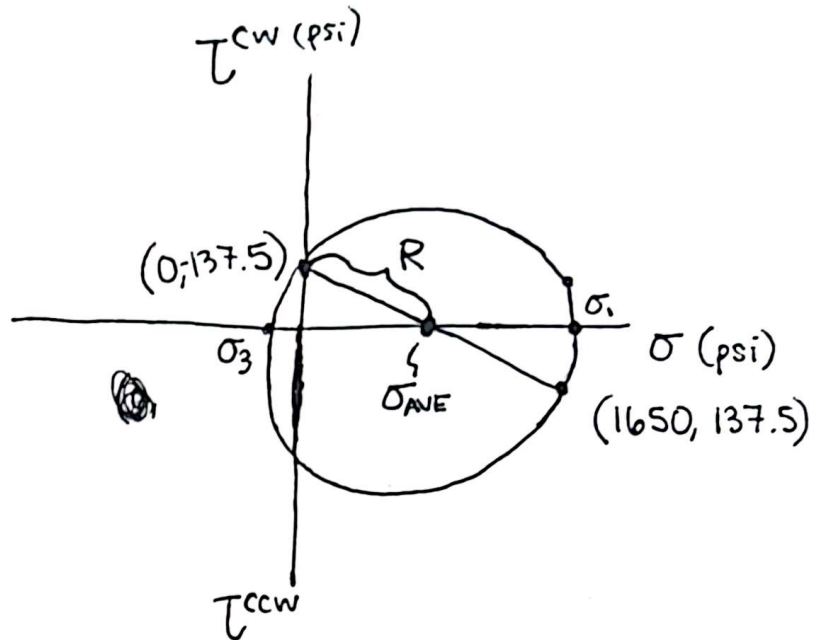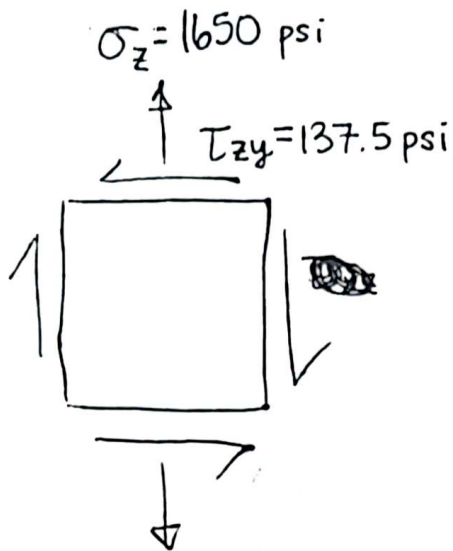σ_1

σ_3

σ (psi)

σ_{AVE}

$(1650, 137.5)$

τ^{ccw}

$$R = \sqrt{\left(\frac{1650}{2}\right)^2 + (137.5)^2}$$

$$= 836 \text{ psi}$$

$$\sigma_{AVE} = \frac{1650 + 0}{2} = 825 \text{ psi}$$

$$\sigma_1 = \sigma_{AVE} + R = 1660 \text{ psi}$$

$$\sigma_3 = \sigma_{AVE} - R = -11.4$$

$$(\sigma_2 = 0)$$

$$\tau_{max} = R = 836 \text{ psi}$$

1) $S_y = 50$ ksi

DE: $\sigma' = \sqrt{\dfrac{(1660)^2 + (11.4)^2 + (1671)^2}{2}}$

$= 1666$ psi

$$n = \frac{S_y}{\sigma_1} = \frac{50,000}{1666} = \boxed{30}$$

MSS: $n = \dfrac{S_y}{2\tau_{max}}$

$$= \frac{50,000}{2(836)} = \boxed{29.9}$$

2) $S_{ut} = 30$ ksi, $S_{uc} = 130$ ksi

BCM: $n = \left[\dfrac{1660}{30,000} + \dfrac{11.4}{130,000}\right]^{-1}$

$$= \boxed{17.9}$$

MM: $\sigma_A \geq 0 \geq \sigma_B$ AND $\left|\dfrac{\sigma_B}{\sigma_A}\right| \leq 1$

$$n = \frac{S_{ut}}{\sigma_A} = \frac{S_{ut}}{\sigma_1} = \boxed{18.1}$$

BONUS: $K_I = \beta \sigma_z \sqrt{\pi a}$

$= 1.1 (1650 \text{ psi}) \sqrt{\pi (0.005 \text{ in})}$

$= 227$ psi$\sqrt{\text{in}}$

$$n = \frac{K_{IC}}{K_I} = \frac{45,500 \text{ psi}\sqrt{\text{in}}}{227 \text{ psi}\sqrt{\text{in}}} = \boxed{200}$$