SOLUTION

ME 323: Mechanics of Materials **_Homework H27_**

Summer 2025 **_Assigned/due: July 24/July 29_**

Consider the states of plane stress A and B (in *xy*-plane) shown below. For each state of stress:

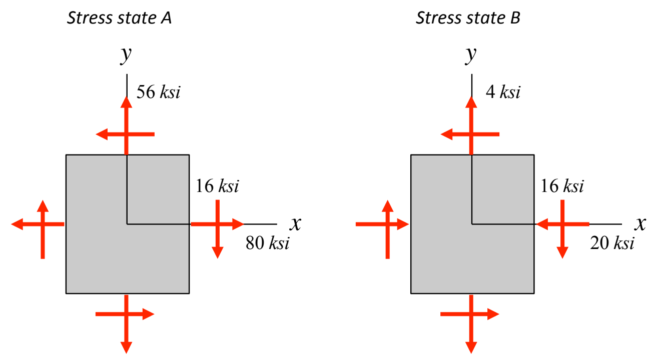
a) Calculate the σ_{ave} and R parameters.

b) Use these two parameters to draw the in-plane Mohr's circle for the state of stress.

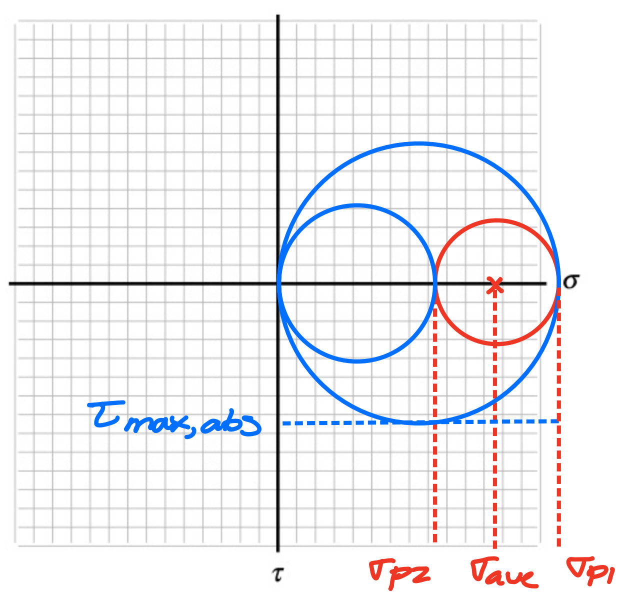
c) Add the two out-of-plane Mohr's circles to your drawings.

d) What are the two principal components of stress and the magnitude of the maximum in-plane shear stress?

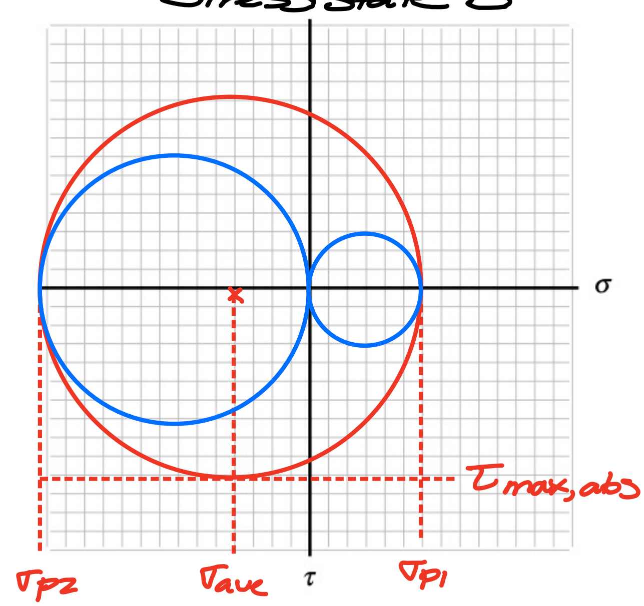
e) What is the absolute maximum shear stress for this state of stress?



Stress state A



Stress state B



Stress state A

$\sigma_x = 80$ ksi
$\sigma_y = 56$ ksi
$\tau_{xy} = -16$ ksi

a) $\sigma_{ave} = \dfrac{\sigma_x + \sigma_y}{2} = 68$ ksi

$$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \sqrt{\left(\frac{80-56}{2}\right)^2 + (-16)^2} = 20 \text{ ksi}$$

d) $\sigma_{p1} = \sigma_{ave} + R = 68 + 20 = 88$ ksi
$\sigma_{p2} = \sigma_{ave} - R = 68 - 20 = 48$ ksi
$\tau_{max,inplane} = R = 20$ ksi
$\tau_{max,abs} = \dfrac{\sigma_{p1}}{2} = 44$ ksi

Stress state B

$\sigma_x = -20$ ksi
$\sigma_y = 4$ ksi
$\tau_{xy} = -16$ ksi

a) $\sigma_{ave} = \dfrac{\sigma_x + \sigma_y}{2} = -8$ ksi

$$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \sqrt{\left(\frac{-20-4}{2}\right)^2 + (-16)^2} = 20 \text{ ksi}$$

d) $\sigma_{p1} = \sigma_{ave} + R = -8 + 20 = 12$ ksi
$\sigma_{p2} = \sigma_{ave} - R = -8 - 20 = -28$ ksi
$\tau_{max,inplane} = R = 20$ ksi
$\tau_{max,abs} = R = 20$ ksi