***Example 15.2***

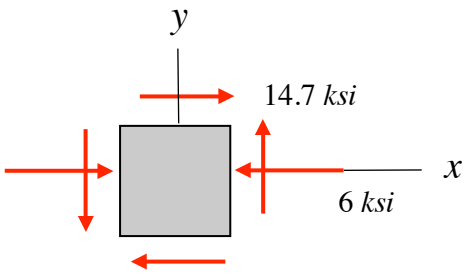
Consider the state of stress shown below in a component made up of a ductile material with a shear strength of $\sigma_Y = 36ksi$. Does the maximum shear stress theory predict failure for the material? Does the maximum distortional energy theory predict failure of the material?

Given

$\sigma_x = -6\ ksi$

$\sigma_y = 0$

$\tau_{xy} = 14.7\ ksi$




$\therefore$

$$\sigma_{ave} = \frac{\sigma_x + \sigma_y}{2} = \frac{-6+0}{2} = -3\ ksi$$

$$R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \sqrt{\left(\frac{-6-0}{2}\right)^2 + (14.7)^2} = 15\ ksi$$

and:

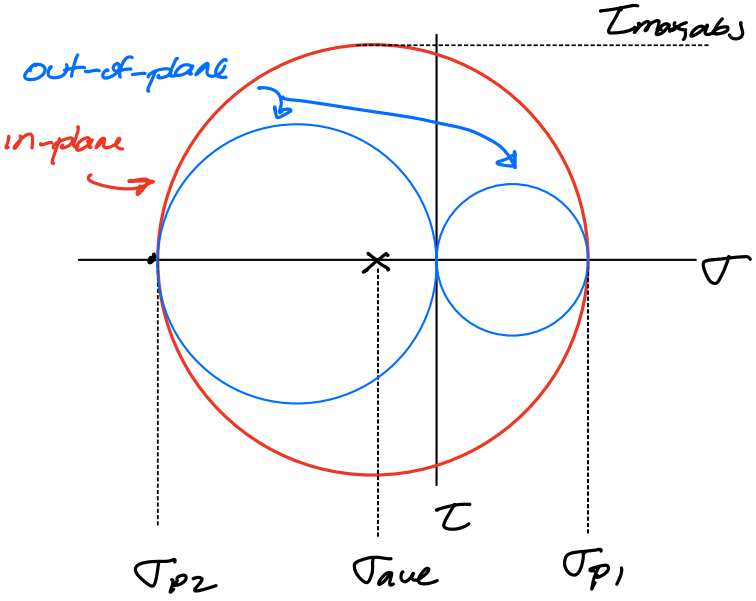
$$\sigma_{p1} = \sigma_{ave} + R = -3 + 15 = 12\ ksi$$

$$\sigma_{p2} = \sigma_{ave} - R = -3 - 15 = -18\ ksi$$

Mohr's circles

Since radius of in-plane circle is the largest:

$$\tau_{max,abs} = R = 15\ ksi$$




- For MSS

$$\tau_{failure} = \frac{\sigma_Y}{2} = 18\ ksi$$

Since $\tau_{failure} > \tau_{max,abs} \Rightarrow$ NO failure by MSS

- For MDE: Since MSS is more conservative than MDE $\Rightarrow$ NO failure by MDE