INSTRUCTIONS:

This quiz is open-book, open-note, and you may work with your classmates.

GIVEN:

From Quiz 1, the critical element was identified as state of plane stress having normal stress $\sigma_z = 76.4$ MPa and shear stress $\tau_{yz} = 15.3$ MPa.

The pole is made of AISI 1018 steel with yield strength $S_y = 370$ MPa.

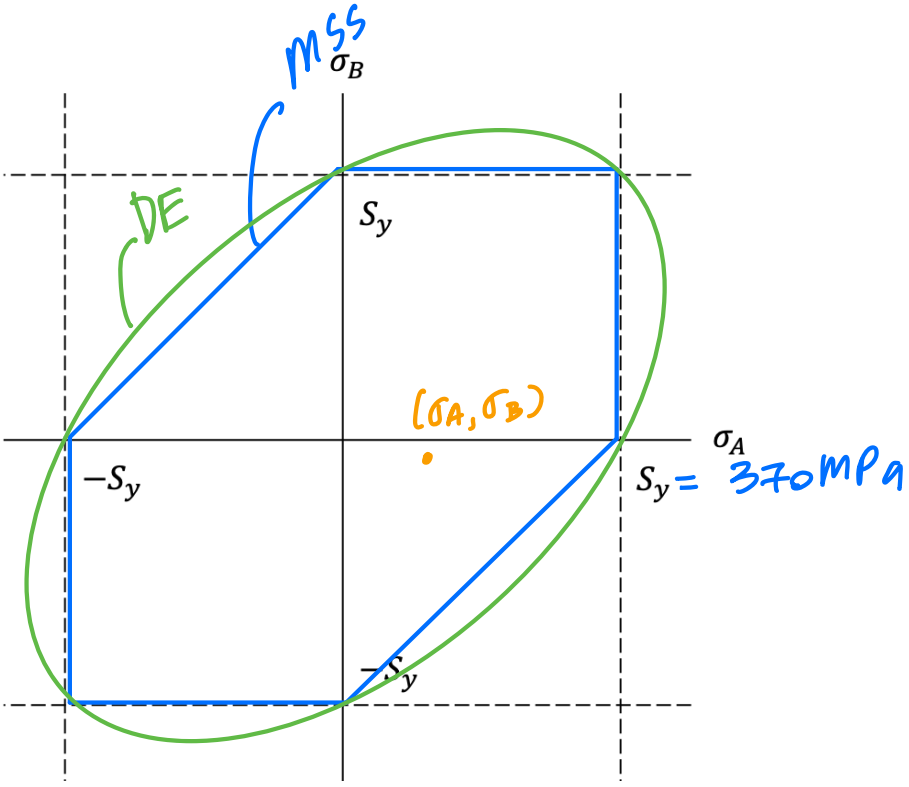
FIND:

a) Sketch and label the maximum shear stress (MSS) and distortion energy (DE) failure envelopes for this material on the axes given.

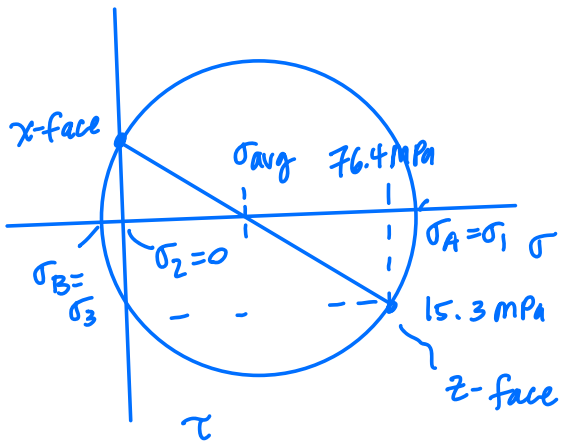
b) Find σ_A and σ_B for the stress state.

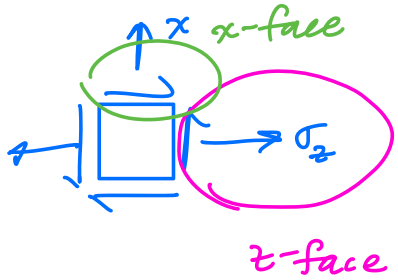
c) Plot σ_A and σ_B relative to the failure envelopes. Predict what the factors of safety will be based on this sketch for both the MSS and the DE theories.

d) Calculate the factors of safety for both the MSS and the DE theories. Are they consistent with your predictions?



b) use Mohr's circle to find σ_A and σ_B.





$\sigma_{avg} = \frac{\sigma_z}{2} = 38.2 \text{ MPa}$

$R = \sqrt{\left(\frac{\sigma_z}{2}\right)^2 + \tau_{xz}^2} = \sqrt{38.2^2 + 15.3^2} = 41.1 \text{ MPa} = \tau_{max}$

$\sigma_A = \sigma_{avg} + R = 38.2 + 41.1 = 79.3 \text{ MPa}$

$\sigma_B = \sigma_{avg} - R = 38.2 - 41.1 = -2.9 \text{ MPa}$

c) factors of safety should be about 3.

d) $n_{MSS} = \frac{S_y'}{\sigma_1 - \sigma_3} = \frac{S_y'}{2\tau_{max}} = \frac{370 \text{ MPa}}{2 \cdot 41.1 \text{ MPa}} = 4.5$

$n_{DE} = \frac{S_y'}{\sigma'} = \frac{370 \text{ MPa}}{\sqrt{\sigma_z^2 + 3\tau_{xz}^2}} = 4.6$