HW-3B: STRESS STATE, MOHR DIAGRAMS, AND COULOMB FAILURE

PT	σ_1(MPa)	σ_3 (MPa)	$\dfrac{\sigma_1 + \sigma_3}{2}$	$\dfrac{\sigma_1 - \sigma_3}{2}$
A	13	7		
	15	7		
	17	7		
	19	7		
B	21	7		

Consider the following compression experiment. The maximum principal stress (σ_1) is increased while the least principal stress (σ_3) is held constant.
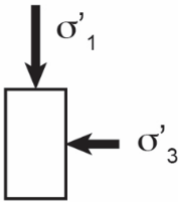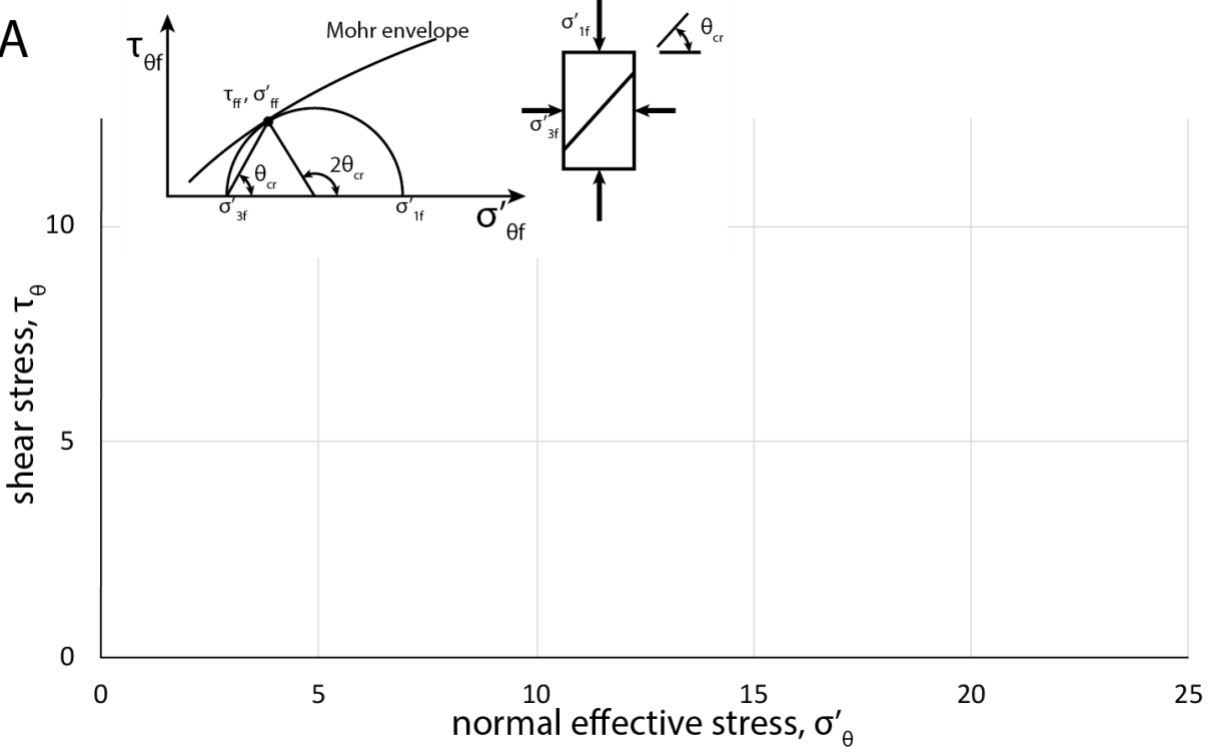

Figure 1: Sketch of experiment. The maximum principal stress is increased while the least principal stress is held constant.

1) Plot this evolving stress state on a Mohr Diagram (Figure 2 top). Label the maximum shear stress. What is the angle of the plane to the maximum principal stress that carries the maximum shear stress?

2) Plot this evolving stress state on an average stress (s) vs. maximum shear stress plot (t) (Figure 2 bottom).

3) The rock fails when σ_1 reaches 21 MPa.
   a. Plot the Coulomb failure surface on Figure 2, top. Calculate the friction angle (ϕ). Calculate the angle of this failure surface relative to the orientation of σ_1.
   b. On Figure 2, bottom. Draw a line from the origin to Pt. B. Calculate the slope of this line and determine the friction angle.
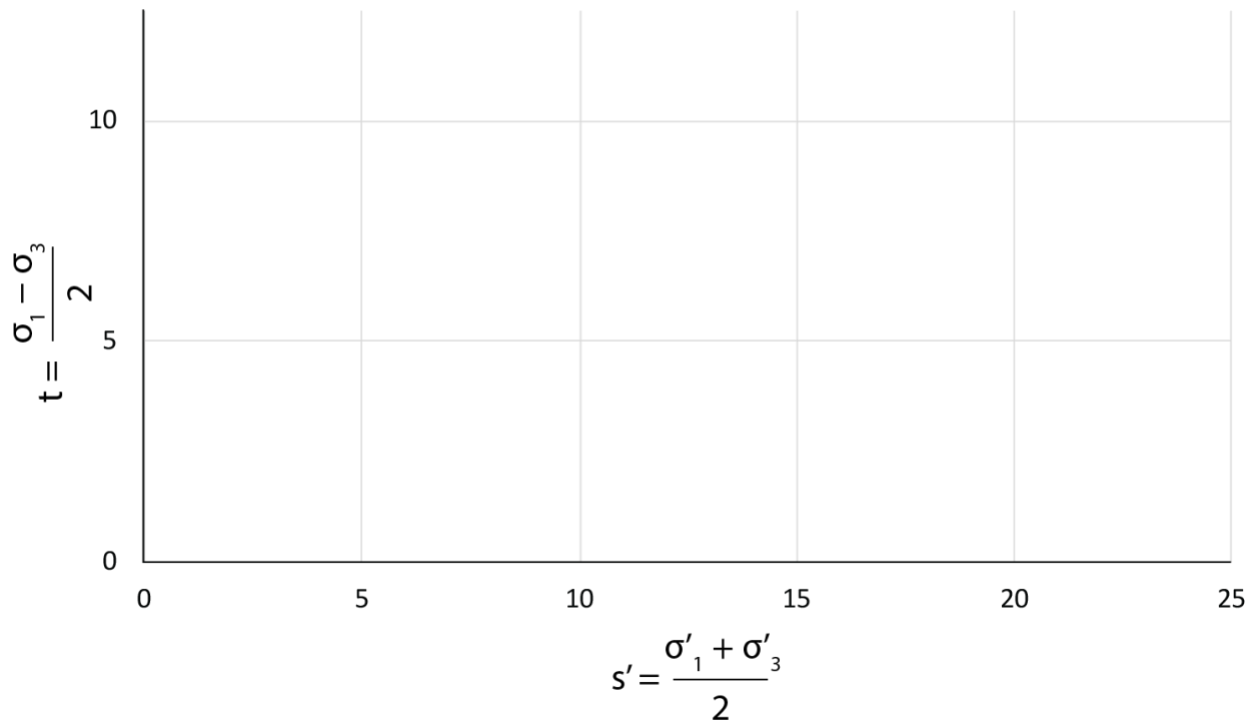
$$\frac{t}{s} = sin\phi$$

A

B

Figure 2: Mohr Diagram.

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