**Prob. 1** A ceramic rod is subjected to a compressive axial force $P$ and a torque $T$. The diameter of rod $d = 1.5$ in. and $T = 13.3$ kip-in. The tensile and compressive ultimate strengths of the ceramic material are $f_t = 25$ ksi and $f_c = 95$ ksi, respectively. The factor of safety = 1.22. Using Coulomb-Mohr failure theory to calculate the axial force $P$.

**Prob. 2** For a concrete material with uniaxial compressive strength 5000 psi and uniaxial tensile strength of 600 psi, using Coulomb-Mohr failure theory
   
   (a) Determine the biaxial compressive strength, $\sigma_2 = \sigma_3 = ?$ with $\sigma_1 = 0$.
   
   (b) Determine the triaxial compressive strength $\sigma_3 = ?$ with $\sigma_1 = \sigma_2 = -1500$ psi.

**Prob. 3** For CVEN 5161 students

A concrete material with $\sigma_0 = 5000$ psi (uniaxial compressive strength), using the octahedral failure theory shown below (consider: compression as positive)

(a) Determine the biaxial compressive strength, $\sigma_1 = \sigma_2 = ?$ with $\sigma_3 = 0$.

(b) Determine the triaxial compressive strength $\sigma_1 = ?$ with $\sigma_2 = \sigma_3 = 1500$ psi.

Octahedral failure theory

$$\frac{\tau_{oct}}{\sigma_0} - \psi \left[ A + B \frac{\sigma_{oct}}{\sigma_0} \right] \frac{1}{1-(1-\psi) \left(1- \frac{\sigma_{oct}}{6\sigma_0}\right)} = 0$$

where $\psi = 0.686$, $A = 0.2261$, and $B = 0.736$ for $\frac{\sigma_{oct}}{\sigma_0} \leq 1.75$

where $\psi = 0.635 + 0.435 \frac{\sigma_{oct}}{\sigma_0}$, $A = 0.4076$, and $B = 0.5851$ for $\frac{\sigma_{oct}}{\sigma_0} > 1.75$