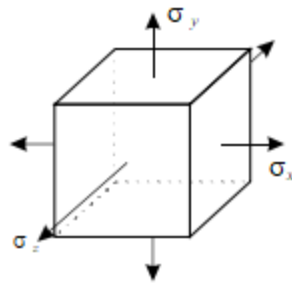
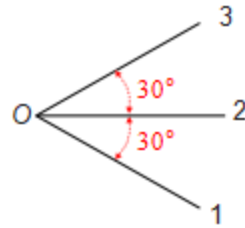


MAE5009: Continuum Mechanics B
Assignment 03: Stress Strain Relations
Due October 22, 2021

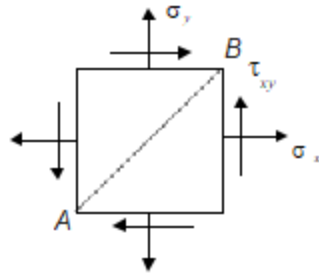
1. Derive the relations between the normal stresses and normal strains by adding the normal stresses on the cube in the following consecutive order: σ_z , σ_y and σ_x .



2. For a given x - y plane, the normal strains at point O in the O -1, O -2 and O -3 directions are respectively $\varepsilon_{O-1} = 10^{-4}$, $\varepsilon_{O-2} = 4 \times 10^{-4}$ and $\varepsilon_{O-3} = 6 \times 10^{-4}$. Given the material properties $E = 30 \text{ GPa}$, $\nu = 0.25$, determine the principal stresses and maximum shear stress at point O and their directions (only consider the stresses and strains in the x - y plane, i.e., a pure 2D problem)



3. A homogeneous and isotropic square plate is loaded as shown, where $\sigma_x = \sigma_y = \tau_{xy} = 15 \text{ MPa}$. If $E = 10 \text{ GPa}$, $\nu = 0.3$, determine the change in length of the diagonal AB .



4. Prove the following relations among various elastic constants:

$$\nu = \frac{3K - E}{6K}$$

$$\lambda = \frac{3K - 2G}{3}$$

$$E = \frac{9K(K - \lambda)}{3K - \lambda}$$

$$G = \frac{3KE}{9K - E}$$

$$K = \frac{EG}{3(3G - E)}$$