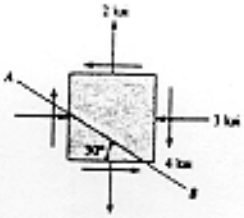
***9–4.** The state of stress at a point in a member is shown on the element. Determine the stress components acting on the inclined plane AB. Solve the problem using the method of equilibrium described in Sec. 9.1.



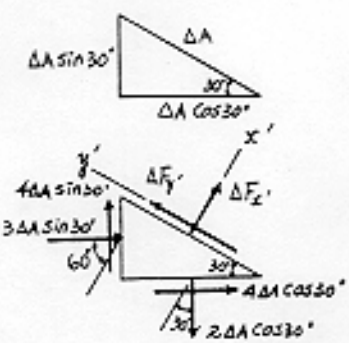
Force Equilibrium : For the sectioned element,

$$\nearrow + \Sigma F_{y'} = 0: \quad \Delta F_{y'} - 3(\Delta A \sin 30°)\sin 60° + 4(\Delta A \sin 30°)\sin 30° - 2(\Delta A \cos 30°)\sin 30° - 4(\Delta A \cos 30°)\sin 60° = 0$$

$$\Delta F_{y'} = 4.165\ \Delta A$$

$$\nwarrow + \Sigma F_{x'} = 0: \quad \Delta F_{x'} + 3(\Delta A \sin 30°)\cos 60° + 4(\Delta A \sin 30°)\cos 30° - 2(\Delta A \cos 30°)\cos 30° + 4(\Delta A \cos 30°)\cos 60° = 0$$

$$\Delta F_{x'} = -2.714\ \Delta A$$



Normal and Shear Stress : For the inclined plane,

$$\sigma_{x'} = \lim_{\Delta A \to 0} \frac{\Delta F_{x'}}{\Delta A} = -2.71 \text{ ksi} \qquad \text{Ans}$$

$$\tau_{x'y'} = \lim_{\Delta A \to 0} \frac{\Delta F_{y'}}{\Delta A} = 4.17 \text{ ksi} \qquad \text{Ans}$$

Negative sign indicates that the sense of $\sigma_{x'}$ is opposite to that shown on FBD.