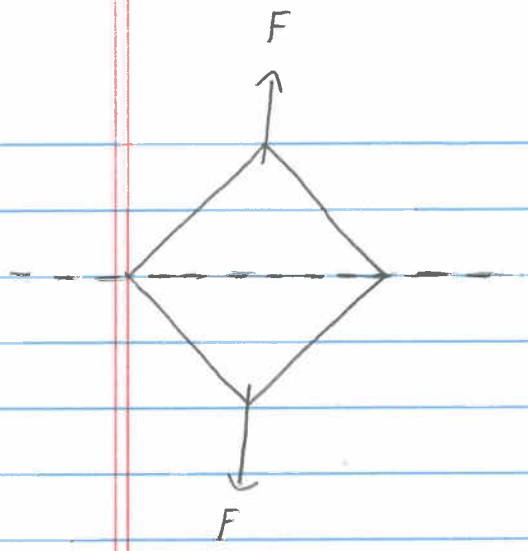
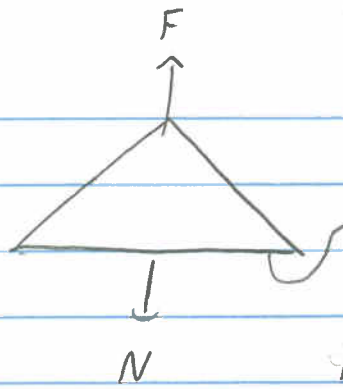
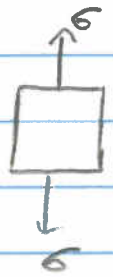
Sectioned at diagonal:



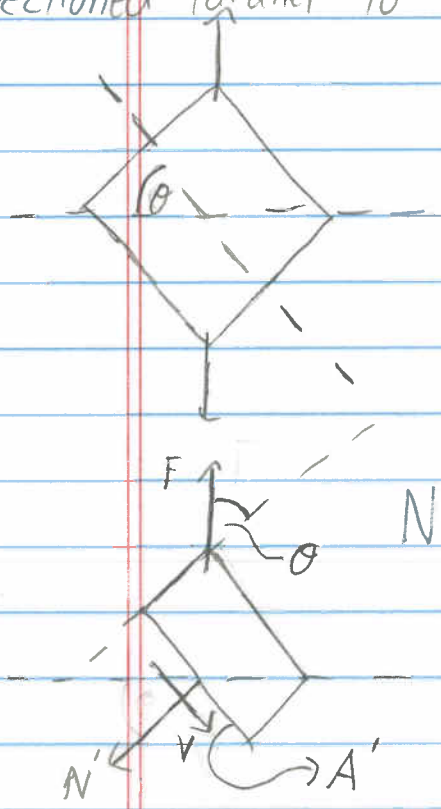


$N = F \quad \sigma = \frac{N}{A} = \frac{F}{A}$

Small element of sectioned area:



Sectioned Parallel to sides

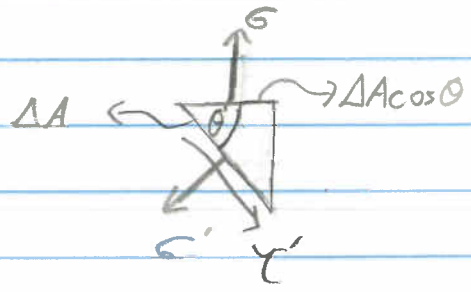


$N' = F\cos\theta$

$A' = A\cos\theta$

$\therefore \quad \sigma' = \frac{N'}{A'} = \frac{F\cos\theta}{A\cos\theta} = \frac{F}{A} = \sigma$

Stress Transformation by Force Balance



$\sum F_{\nearrow} = \sigma \Delta A \cos\theta \cos\theta - \sigma' \Delta A$

$\sigma' = \sigma\cos^2\theta$

$\sigma \neq \sigma\cos^2\theta$

Stress Transformation Equation

$$\sigma_x' = \frac{\sigma_x+\sigma_y}{2} + \frac{\sigma_x-\sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta$$

$$= \frac{\sigma_x}{2} + \frac{\sigma_x}{2}\cos 2\theta$$

Trig Identity

$$= \sigma_x\left(\frac{1+\cos 2\theta}{2}\right)$$

$$\cos^2\theta = \frac{1+\cos 2\theta}{2}$$

$$\therefore \quad \sigma_x' = \sigma_x \cos^2\theta$$