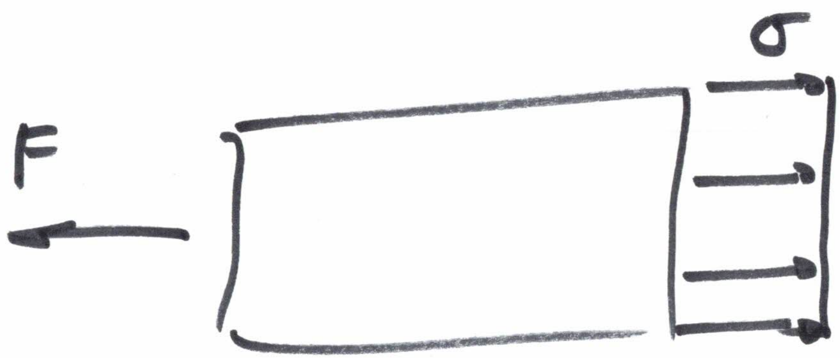
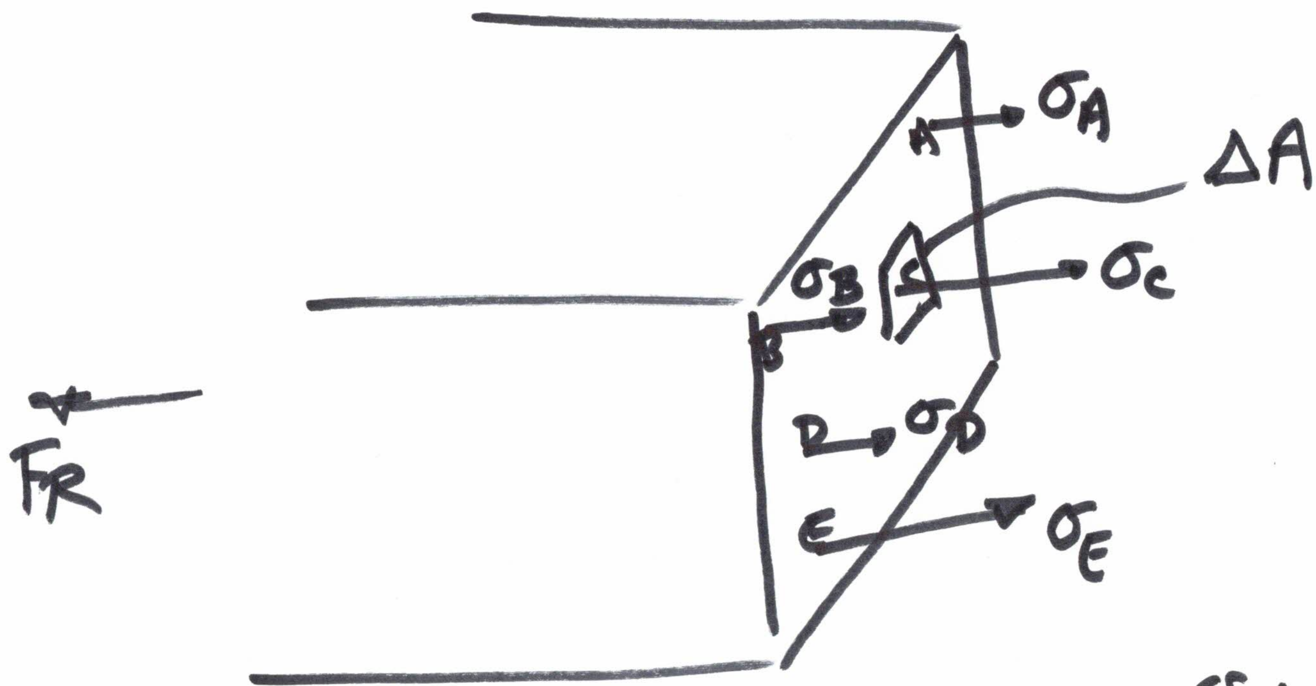
E. Stress & Strain at a point

1. stress

$\sigma = \frac{F}{A}$, $\tau = \frac{V}{A}$ give a <u>uniform</u> stress distribution



More generally, stress can change from point-to-point



SMALL AMOUNT of force @ C

$$\Delta F_C = \sigma_C \Delta A$$

$$\sigma_{pt} = \frac{\Delta F}{\Delta A}$$

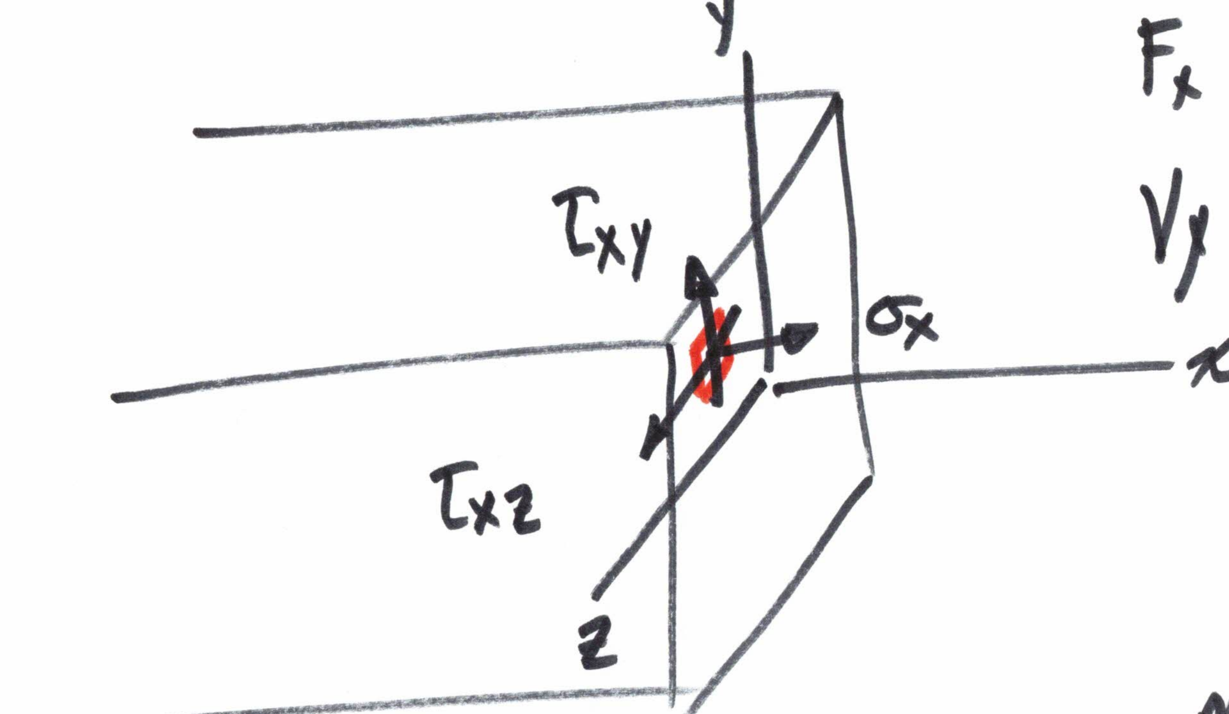
$$\sigma_{pt} = \lim_{\Delta A \to 0} \frac{\Delta F}{\Delta A} = \frac{dF}{dA}$$

$$F_R = \sum \Delta F_i$$

$$dF = \sigma \, dA$$

$$F = \int_A \sigma \, dA$$

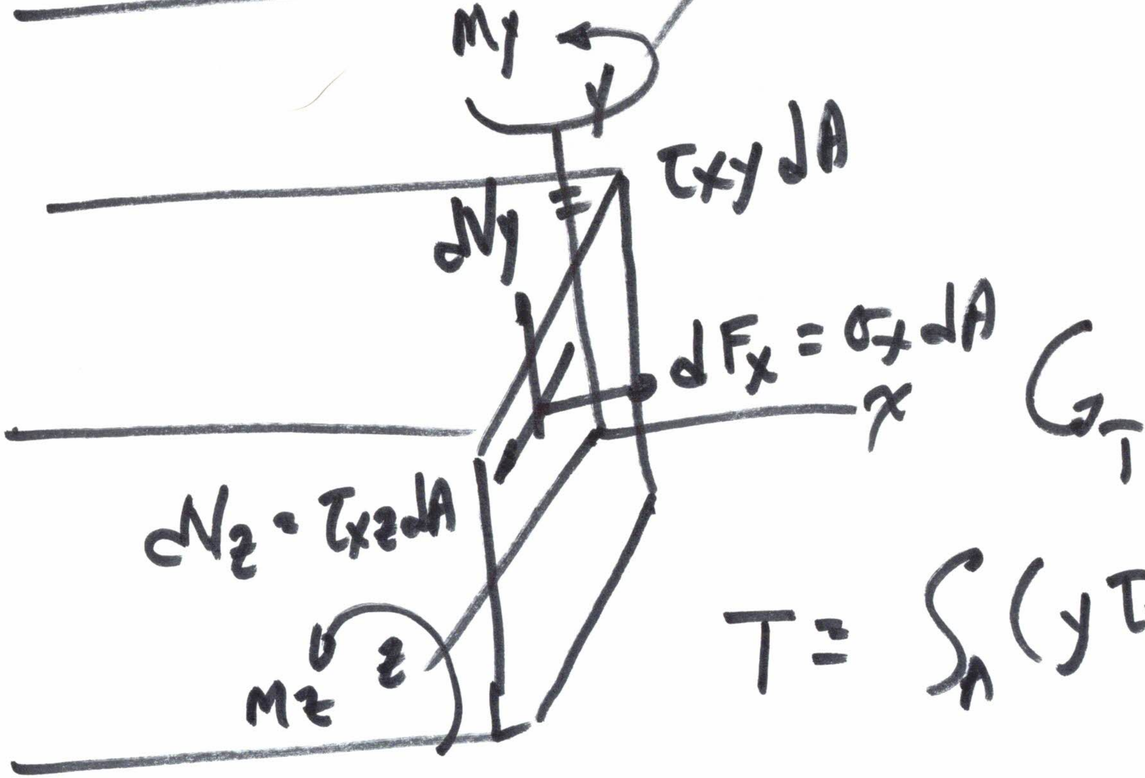
(σ ← stress distribution)



$$F_x = \int_A \sigma_x \, dA$$

$$V_y = \int_A \tau_{xy} \, dA$$

$$V_z = \int_A \tau_{xz} \, dA$$



$$M_y = \int_A z \, \sigma_x \, dA$$

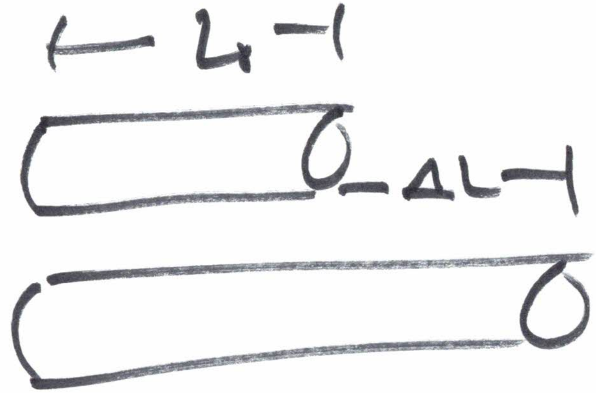
$$M_z = -\int_A y \, \sigma_x \, dA$$

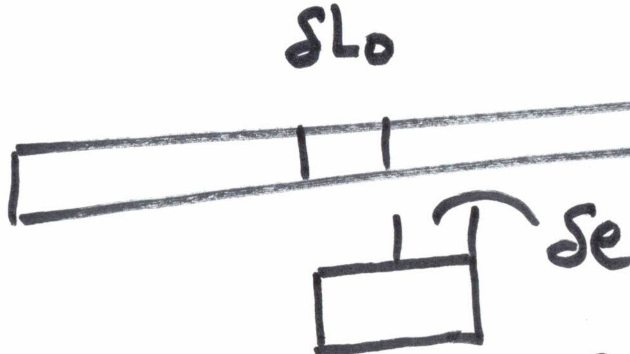
$$T = \int_A (y \, \tau_{xz} - z \, \tau_{xy}) \, dA$$

2. Strains

$$\epsilon = \frac{\Delta L}{L_0}$$

↑ average strain





$$\epsilon_{pt} = \lim_{\delta L_0 \to 0} \frac{\delta e}{\delta L_0} = \frac{de}{dL}$$

$$de = \epsilon \, dL$$

$$\Delta L_{total} = e_{total} = \int_0^L \epsilon \, dL$$