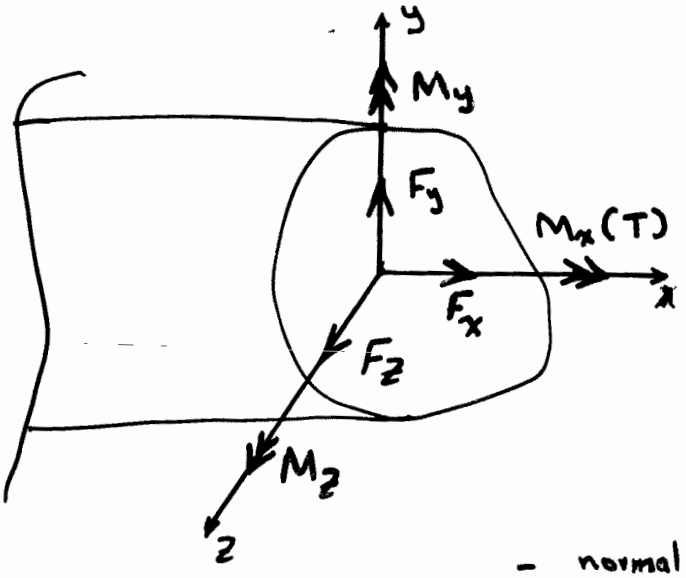
Compound Stresses

Forces which cause normal stresses: F_x, M_y, M_z

Forces which cause shearing stresses: F_y, F_z, M_x (T)



- normal
- shear

Linear elastic behavior is assumed. ⇒

Superposition principle can be utilized to compute the compound stresses.

Normal Stress:

$$\sigma_x = \sigma_{x_1} + \sigma_{x_2} + \sigma_{x_3} \quad \leftarrow \text{scalar}$$

$$= \frac{F_x}{A} - \frac{M_z y}{I_z} + \frac{M_y z}{I_y}$$

(each term: ±)

Be careful about signs (±)!

Shearing Stress:

$$\vec{\tau} = \vec{\tau}_{xy} + \vec{\tau}_{xz} + \vec{\tau}_{xs} \quad \leftarrow \text{vector}$$

$\vec{\tau}_{xy} \leftrightarrow V_y$; $\vec{\tau}_{xz} \leftrightarrow V_z$; $\vec{\tau}_{xs} \leftrightarrow M_x(T)$

$$\tau_{xy} = \frac{V_y Q_z}{I_z b_z} \quad ; \quad \tau_{xz} = \frac{V_z Q_y}{I_y b_y} \quad ; \quad \tau_{xs} = \frac{T r}{J}$$

↓

for circular section

(It depends on section)