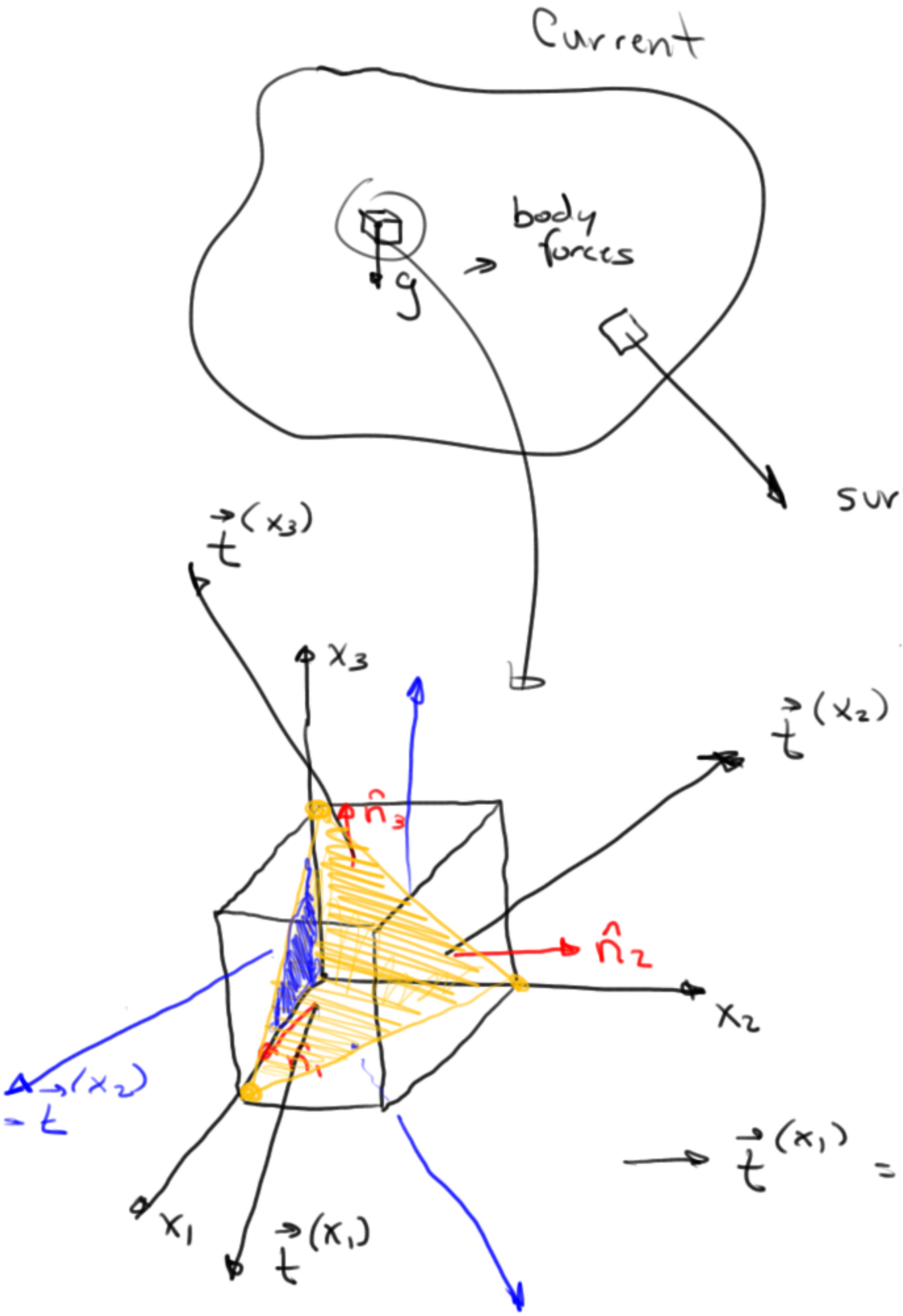
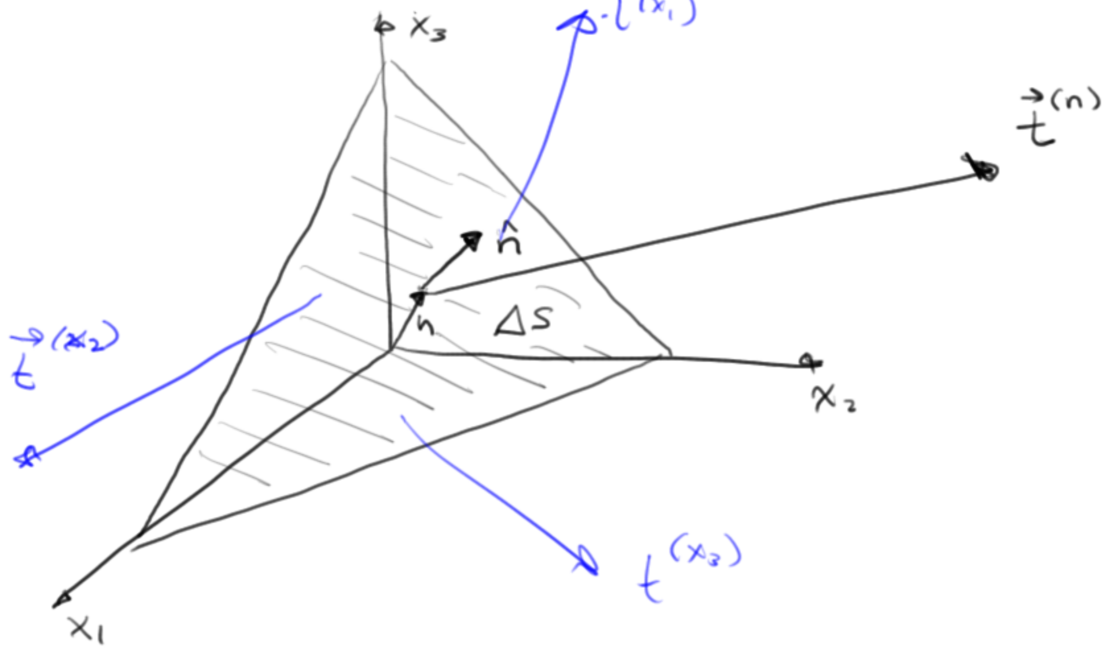
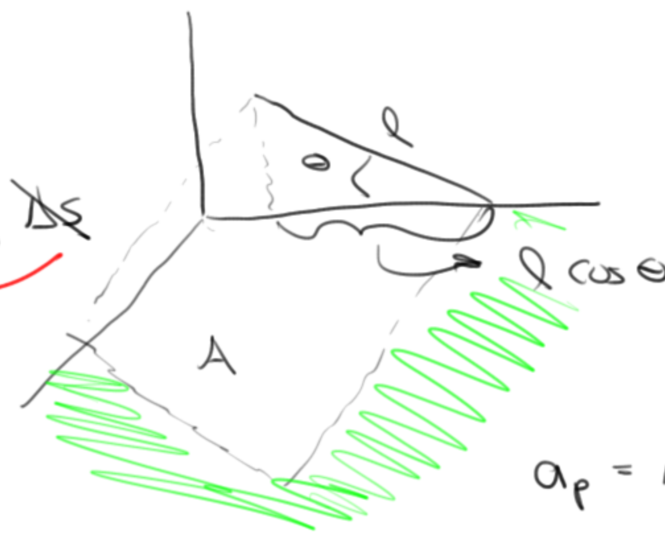


surface forces → tractions → $\frac{\text{force}}{\text{area}}$

$$\rightarrow \vec{t}^{(x_1)} = \begin{Bmatrix} t_1^{(x_1)} \\ t_2^{(x_1)} \\ t_3^{(x_1)} \end{Bmatrix}$$



$$\hat{n} = \begin{cases} \cos(\hat{n}, x_1) \to n_1 \\ \cos(\hat{n}, x_2) \to n_2 \\ \cos(\hat{n}, x_3) \to n_3 \end{cases}$$



$$a_p = A\cos\theta$$

$$\Sigma F = \underbrace{\vec{t}^{(n)} \cancel{\Delta S} - t^{(x_2)} n_2 \cancel{\Delta S} - t^{(x_3)} n_3 \cancel{\Delta S} - t^{(x_1)} n_1 \cancel{\Delta S}}$$

$$= m \vec{a} \cancelto{0}{a}$$

lim $h \to 0$

$$= \rho \frac{1}{3} \cancel{h} \cancel{\Delta S}$$

$$\vec{t}^{(n)^T} = \vec{t}^{(x_1)^T} n_1 + \vec{t}^{(x_2)^T} n_2 + \vec{t}^{(x_3)^T} n_3$$

$$\vec{t}^{(n)^T} = \begin{bmatrix} n_1 & n_2 & n_3 \end{bmatrix} \underbrace{\begin{bmatrix} \vec{t}^{(x_1)^T} \\ \vec{t}^{(x_2)^T} \\ \vec{t}^{(x_3)^T} \end{bmatrix}}$$

$\sigma \to$ Cauchy stress tensor

tractions in the coord. directions

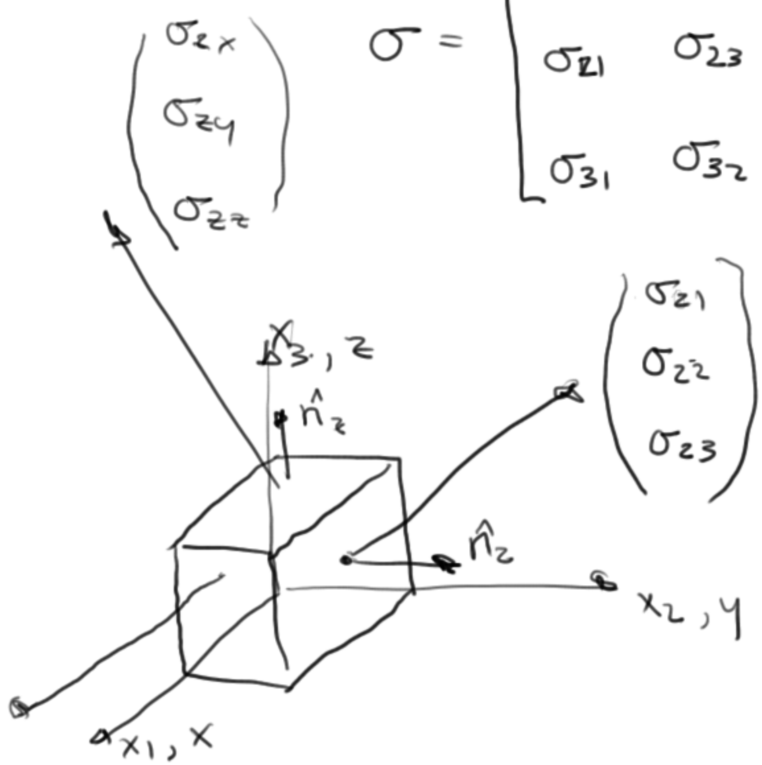
$$\boxed{\vec{t}^T = n^T \sigma}$$

$$\vec{t}^T = n^T \sigma$$

$$\boxed{\vec{t} = \sigma^T \hat{n}} \longrightarrow \text{Cauchy stress equation}$$

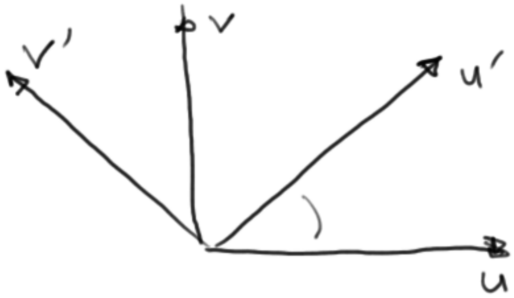
$$t_i = \sigma_{ji} \, n_j$$

$$\sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{23} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix} = \begin{bmatrix} \sigma_{xx} & \sigma_{xy} & \sigma_{xz} \\ \sigma_{yx} & \sigma_{yy} & \sigma_{yz} \\ \sigma_{zx} & \sigma_{zy} & \sigma_{zz} \end{bmatrix}$$



$$1 \to x \,,\; 2 \to y \,,\; 3 \to z$$

$$-t = \sigma(-n)$$



$$u' = Ru$$

$$v' = Rv$$

$$\underbrace{\vec{v} = T\,\vec{u}} \rightarrow \quad v' = T'u'$$

$$R^{-1}Rv = R^{-1}T'Ru$$

$$Iv = R^{-1}T'Ru$$

$$v = R^{-1}T'Ru$$

$$\underbrace{v = R^{T}T'Ru}$$

$$T = R^{T}T'R$$

$$T' = RTR^{T}$$

$$T' = R\,T\,R^T$$

$$\sigma' = R\,\sigma\,R^T = \begin{bmatrix} \sigma_I & 0 & 0 \\ 0 & \sigma_{II} & 0 \\ 0 & 0 & \sigma_{III} \end{bmatrix}$$

$$\sigma_I > \sigma_{II} > \sigma_{III}$$

$$Q\,\Lambda\,Q^T = D$$

$$\det(\sigma - \lambda I) = 0$$

$$-\lambda^3 + I_1 \lambda^2 + I_2 \lambda + I_3 = 0$$

$$\lambda_1,\ \lambda_2,\ \lambda_3$$

$$(\sigma - \lambda_1 I)\vec{v}_1 = \vec{0}$$

$$(\sigma - \lambda_2 I)\vec{v}_2 = \vec{0}$$

$$(\sigma - \lambda_3 I)\vec{v}_3 = \vec{0}$$

$$Q = [\,v_2 \quad v_1 \quad v_3\,]$$

$$\vec{Q} = [\,\vec{v}_1,\ \vec{v}_2,\ \vec{v}_3\,]$$

$$\Lambda = \begin{bmatrix} \lambda_2 & & \\ & \cancel{\lambda}_1 & \\ & & \lambda_3 \end{bmatrix}$$

$$\Lambda = \begin{bmatrix} \lambda_1 & & \\ & \lambda_2 & \\ & & \lambda_3 \end{bmatrix}$$