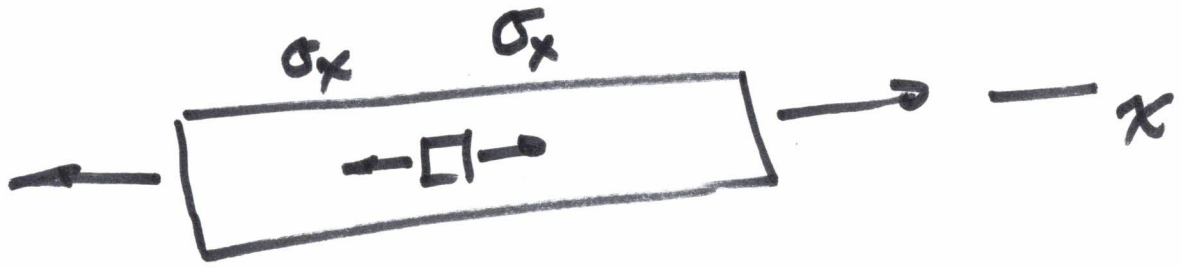
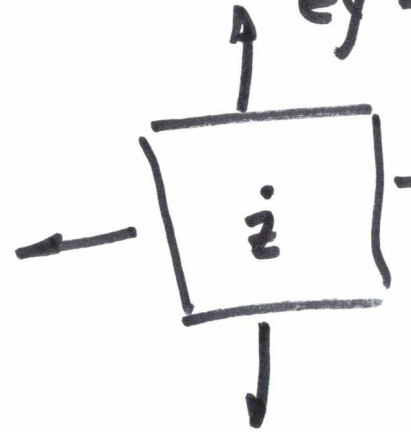
F. 3-D Hooke's Law (Generalized Hooke's Law)

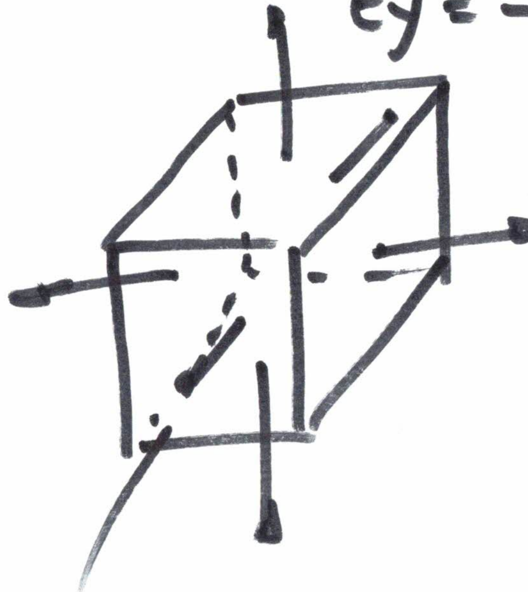
$\sigma_{axial} = E\,\epsilon_{axial}$ (1-D Hooke's Law)



strains



$$\epsilon_y = -\nu\frac{\sigma_x}{E} + \frac{\sigma_y}{E} - \frac{\nu\sigma_z}{E}$$



$$\epsilon_x = \frac{\sigma_x}{E} - \frac{\nu\sigma_y}{E} - \frac{\nu\sigma_z}{E}$$

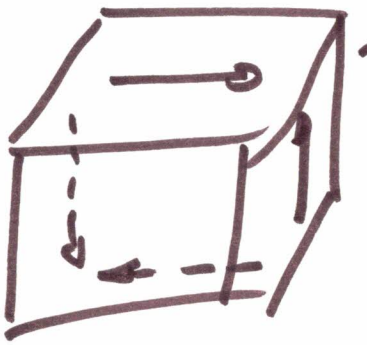
$$\epsilon_z = -\nu\frac{\sigma_x}{E} - \frac{\nu\sigma_y}{E} + \frac{\sigma_z}{E}$$

$$\epsilon_x = \frac{\sigma_x}{E} - \frac{\nu\sigma_y}{E} - \frac{\nu\sigma_z}{E} + \alpha\Delta T = \frac{\Delta L_x}{L_{x_0}}$$

$$\epsilon_y = \frac{\sigma_y}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_z}{E} + \alpha\Delta T$$

$$\epsilon_z = \frac{\sigma_z}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_y}{E} + \alpha\Delta T$$

$$\tau = G\gamma$$



$$\gamma_{xy} = \frac{\tau_{xy}}{G}$$

$$\gamma_{xz} = \frac{\tau_{xz}}{G}$$

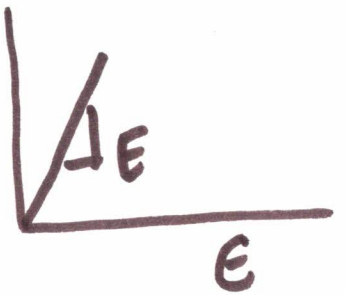
$$\gamma_{yz} = \frac{\tau_{yz}}{G}$$

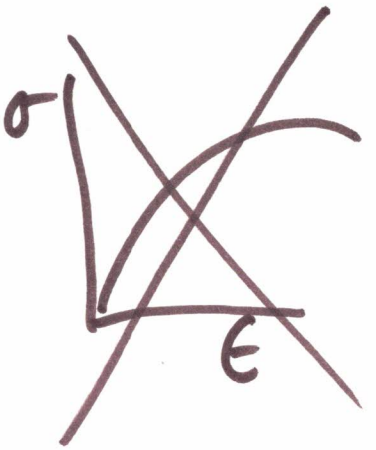
3-D Hooke's Law

Note:

$$G = \frac{E/2}{1+\nu}$$

- Isotropic material
- Linear material (not yielded)





$$\epsilon_x = \frac{\sigma_x}{E} - \frac{\nu\sigma_y}{E} - \frac{\nu\sigma_z}{E} + \alpha\Delta T \qquad \gamma_{xy} = \tau_{xy}/G$$

$$\epsilon_y = \frac{\sigma_y}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_z}{E} + \alpha\Delta T \qquad \gamma_{xz} = \tau_{xz}/G$$

$$\epsilon_z = \frac{\sigma_z}{E} - \frac{\nu\sigma_x}{E} - \frac{\nu\sigma_y}{E} + \alpha\Delta T \qquad \gamma_{yz} = \tau_{yz}/G$$

STRESS = FORCE / AREA

$$\sigma = \frac{F}{A}, \quad \tau = \frac{V}{A}, \quad \sigma_{inc} = \frac{F_n}{A_{inc}}, \quad \tau_{inc} = \frac{F_s}{A_{inc}}$$

$$\epsilon^{thermal} = \alpha\Delta T$$

$$\epsilon = \frac{\Delta L}{L_0} \qquad \gamma = \frac{\pi}{2} - \theta^*$$

Resultant force = Volume of stress distribution

$$SF = \frac{\sigma_{FAIL}}{\sigma_{ACTUAL}}$$

$$\sigma = E\epsilon \qquad \tau = G\gamma \qquad \epsilon_{transverse} = -\nu\,\epsilon_{axial}$$

- statics structures
- units
- stress on inclined plane
- stress - strain curve
- double - shear