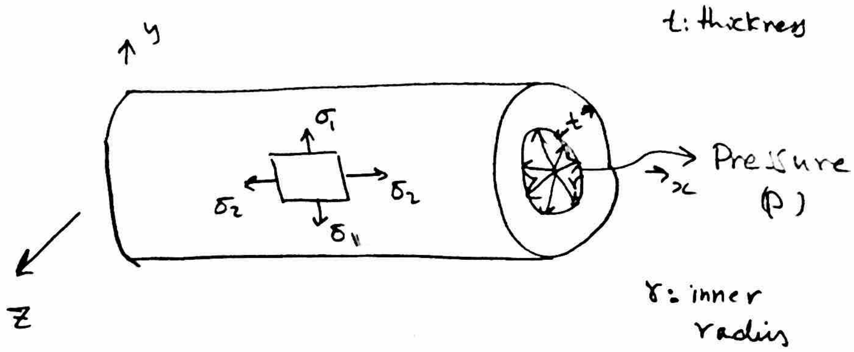
* Thin-walled Cylinders

$\sigma_1 = \sigma_H$: hoop stress

$\sigma_2 = \sigma_L$: Longitudinal stress



Two types of thin-walled cylinders

- → Open end (water pipe)
- → Closed end (gas cylinder)

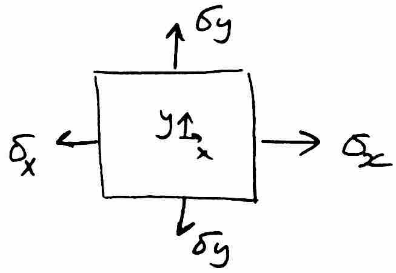
For closed end

$$\sigma_H = \frac{Pr}{t} \quad , \quad \sigma_L = \frac{Pr}{2t}$$

Open end

$$\sigma_H = \frac{Pr}{t} \quad , \quad \sigma_L = 0$$

* Remember Hooke's Law



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

E : Elastic modulus

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

$$\nu = -\frac{\epsilon_y}{\epsilon_x} \qquad \text{poisson's ratio}(\nu) = \frac{\text{lateral strain}}{\text{axial strain}}$$

In thin-walled cylinders

$$\sigma_H = \sigma_y \; , \; \sigma_L = \sigma_x$$

$$\epsilon_H = \epsilon_y \; , \; \epsilon_L = \epsilon_x$$

Thus,

$$\left.\begin{aligned} \epsilon_H &= \frac{\sigma_H}{E} - \nu \frac{\sigma_L}{E} \\ \epsilon_L &= \frac{\sigma_L}{E} - \nu \frac{\sigma_H}{E} \end{aligned}\right\} \text{closed end}$$

For open end $\sigma_L = 0$

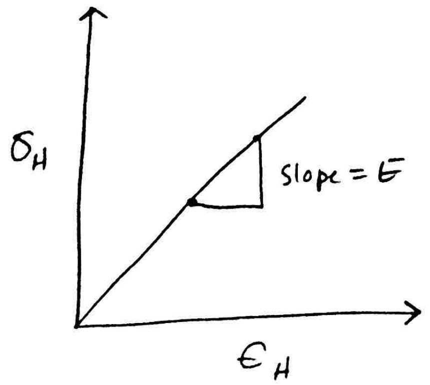
$$\epsilon_H = \frac{\sigma_H}{E}$$

$$\epsilon_L = -\nu \frac{\sigma_H}{E}$$

* What will we do in the lab?

(1) Open end cylinder → apply P → calculate σ_H / → measure ϵ_H → $E = \frac{\sigma_H}{\epsilon_H}$

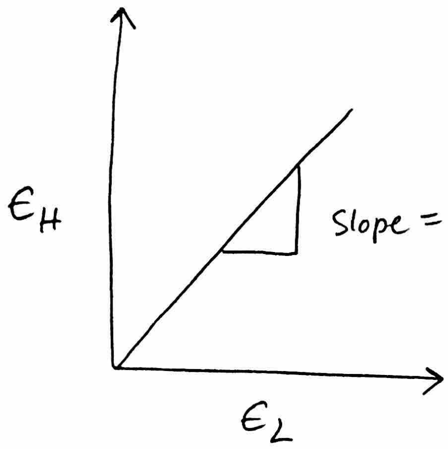
plot σ_H, ϵ_H



(2) Open end cylinder → apply P → Calculate $\sigma_H = \frac{Pr}{t}$

→ measure ϵ_L and ϵ_H

plot ϵ_L, ϵ_H



$\nu = \frac{-\epsilon_H}{\epsilon_L}$ " $\frac{\text{lateral}}{\text{axial}}$ "