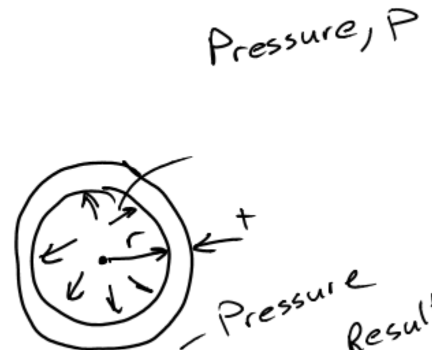
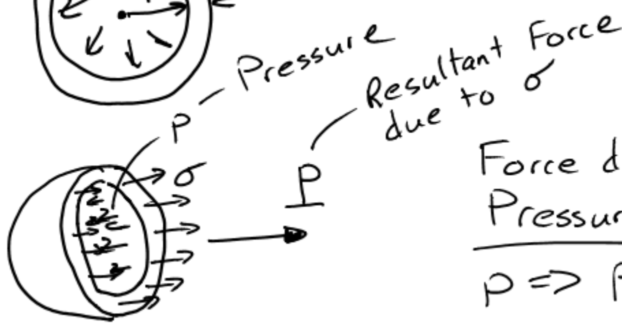
Spherical Pressure Vessels

- Thin-walled (Shell Structure)



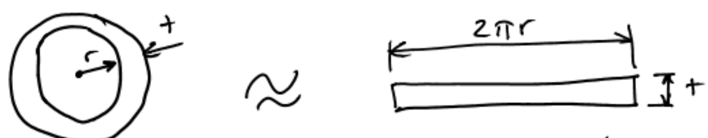

Force due to the Pressure

$p \Rightarrow$ Projected Area $\Rightarrow \pi r^2$

Force $\Rightarrow p \pi r^2$

Force due to $\sigma$

$= \sigma A$




$= \sigma (2\pi r t)$

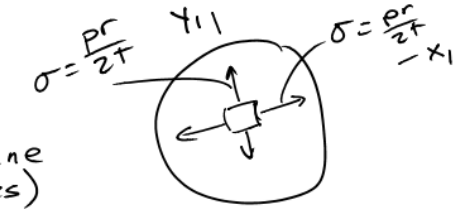
$$p \pi r^2 = \sigma (2 \pi r t)$$

$$\boxed{\sigma = \frac{pr}{2t}}$$

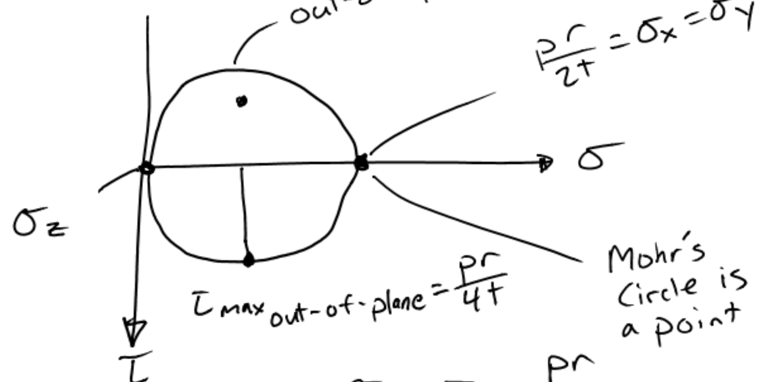
Due to symmetry, any cut through the center will yield the same results

$\underline{\sigma}$

Tangent to the surface (Membrane stresses)




Outer surface => Free of external forces




$\sigma_1 = \sigma_2 = \frac{pr}{2t}$

$\tau_{max\,in\text{-}plane} = 0$

$\sigma_z = 0$

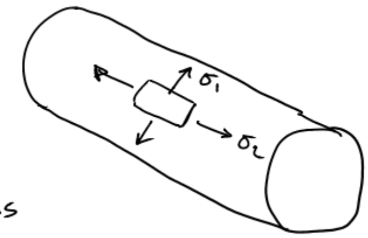
$$\sigma_1 = \sigma_2 = \frac{pr}{2t}$$

$$\tau_{max\,in\text{-}plane} = 0$$

$$\tau_{max\,out\text{-}of\text{-}plane} = \frac{pr}{4t}$$

Cylindrical Pressure Vessels

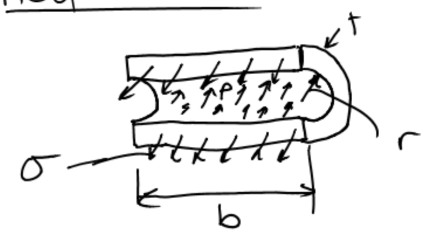
- Also thin-walled




$\sigma_1$ = circumferential or hoop stress

$\sigma_2$ = longitudinal or axial stress

Hoop Stress




P

$= p(2rb)$

$\sigma$

$= \sigma(2bt)$

$$p(2rb) = \sigma(2bt)$$

$$\boxed{\sigma_1 = \frac{pr}{t}}$$

Longitudinal Stress


P

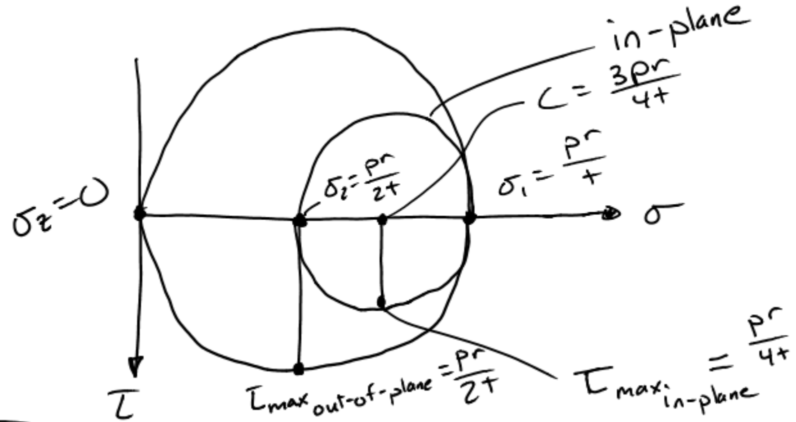
$= p(\pi r^2)$

$\sigma_2$

$= \sigma_2(2\pi r t)$

$$p\pi r^2 = \sigma_2(2\pi r t)$$

$$\boxed{\sigma_2 = \frac{pr}{2t}}$$




$$\sigma_1 = \frac{pr}{t}$$

$$\sigma_2 = \frac{pr}{2t}$$

$$\tau_{max_{in\text{-}plane}} = \frac{pr}{4t}$$

$$\tau_{max_{out\text{-}of\text{-}plane}} = \frac{pr}{2t}$$