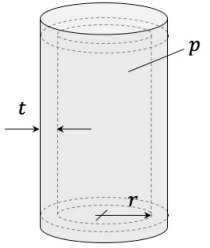
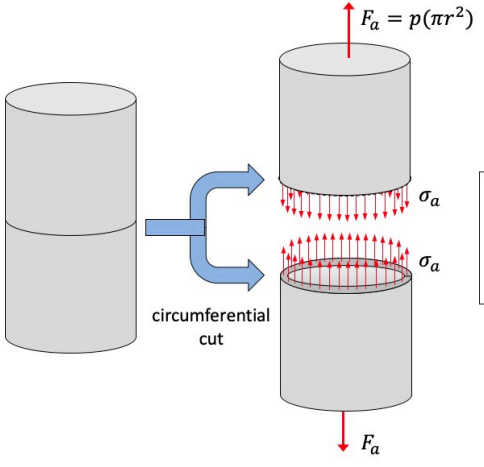
Axial and hoop stresses in thin-walled pressure vessels

Consider a closed, cylindrical, thin-walled pressure vessel having an inner radius of *r* and wall thickness *t* and with an internal pressure of *p*.



Axial component of stress

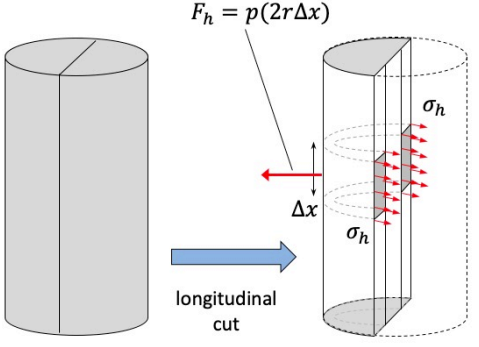
The axial component of normal stress, σ_a, in the sidewall of the pressure vessel is seen through a mathematical cut around the circumference of the vessel. The axial force F_a is distributed over a circumferential strip at the cut. The axial component is not seen in an open tank.



$$\sigma_a = \frac{F_a}{A} = \frac{\pi r^2 p}{[\pi(r+t)^2 - \pi r^2]} \approx \frac{pr}{2t}$$

Hoop component of stress

The hoop component of normal stress, σ_h, in the sidewall of the pressure vessel is seen through a mathematical cut along the longitudinal axis of the vessel. The hoop force F_h is distributed over a longitudinal strip at the cut.



$$\sigma_h = \frac{F_h}{A} = \frac{p(2r\Delta x)}{2t\Delta x} = \frac{pr}{t}$$