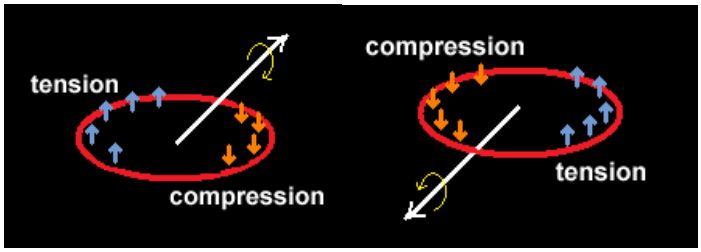
Ambar Mitra

Stresses in a Shaft with Circular Cross-section

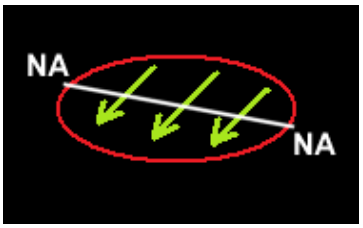
Bending



Normal stress (σ) has the largest magnitude at the end points of the diameter perpendicular to the moment vector.

$$r = radius \quad M = bending\ moment \quad I = \frac{\pi}{4} r^4 \quad \sigma = \frac{Mr}{I}$$

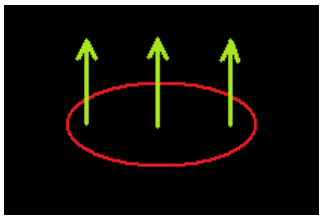
Shear



Shear stress (τ) has the largest magnitude at the diameter perpendicular to the force vector.

$$r = radius \quad V = shear\ force \quad Q = \frac{2}{3} r^3 \quad t = 2r \quad I = \frac{\pi}{4} r^4 \quad \tau = \frac{VQ}{It}$$

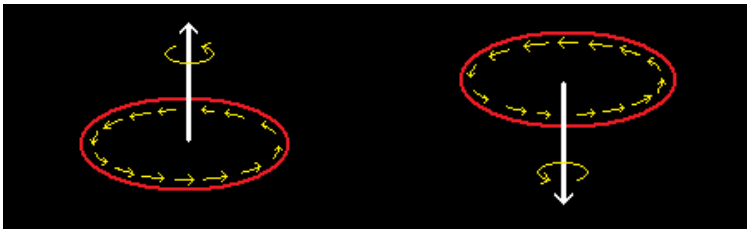
Axial



Normal stress (σ) is constant over the cross-section.

$$r = radius \quad P = axial\ load \quad A = \pi r^2$$

Torsion



Shear stress (τ) is constant over the perimeter.

$$r = radius \quad T = torque \quad J = \frac{\pi}{2} r^4 \quad \tau = \frac{Tr}{J}$$