Torsion Formulas

Circular Shaft in Pure Torsion

Free Body Diagram of Left Section

Cross-Section of Shaft
\[ \tau = \frac{T_x e}{J_x} \]

- \( \tau \): Shear stress acting on cross-section in the y-z plane caused by the internal torque \( T \).

- \( T_x \): Internal torque about the x-axis of the shaft. It is usually found from a free body diagram or a torque diagram.

- \( e \): Distance measured radially from the x-axis.

- \( J_x \): Polar moment of inertia of the shaft cross-section taken about the x-axis. Some books call this \( J_p \).
\[ \phi_x = \frac{T_j L}{J_x G} \]

- \( \phi_x \) is the angle of twist of the shaft as shown.

- \( L \) is the length of the shaft.

- \( J_x \) is defined on page 2. Sometimes called \( J_P \).

- \( G \) is the shear modulus of material.