Mechanics of Materials II:

Thin-Walled Pressure Vessels and Torsion

Dr. Wayne Whiteman
Senior Academic Professional and Director of the Office of Student Services
Woodruff School of Mechanical Engineering

Georgia Institute of Technology

Mechanics of Materials II: Thin-Walled Pressure Vessels and Torsion

- ✓ Thin-Walled Pressure Vessels - Internal Pressure
- ✓ Torsional Shearing Stress and Strain
- ✓ Elastic Torsion Formula
- ❑ Elastic Torsion of Straight, Cylindrical Shafts
- ❑ Inelastic Torsion of Straight, Cylindrical Shafts
- ❑ Statically Indeterminate Torsion Members

Module 15 Learning Outcome

- Solve for the maximum shear stress for elastic torsion of a straight cylindrical shaft

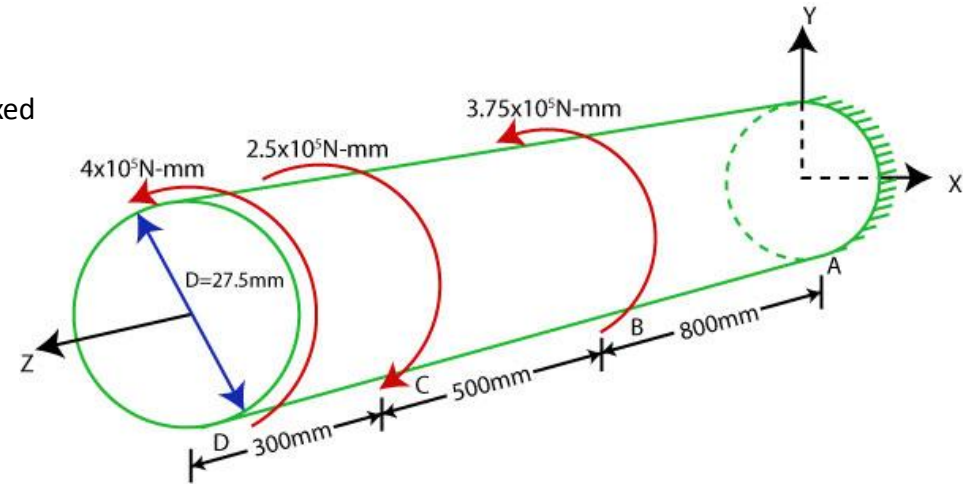
Elastic Torsion of Straight Cylindrical Shafts

Worksheet:

The steel bar to the right is subject to torques as shown.

a) Determine the maximum shear stress in the structure.

b) Determine the angle of twist if the free end with respect to the fixed end.



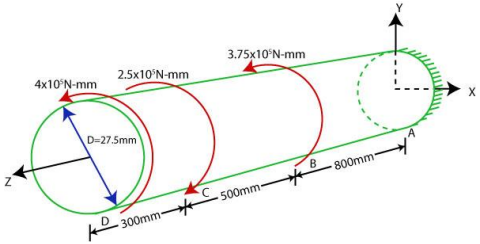
Elastic Torsion of Straight Cylindrical Shafts

Worksheet:

The steel bar to the right is subject to torques as shown.

a) Determine the maximum shear stress in the structure.

b) Determine the angle of twist if the free end with respect to the fixed end.



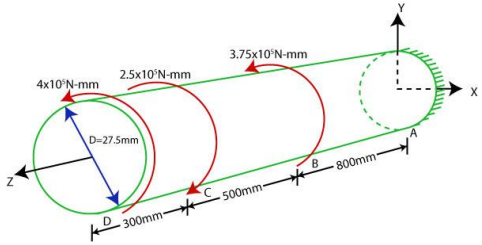
Elastic Torsion of Straight Cylindrical Shafts

Worksheet:

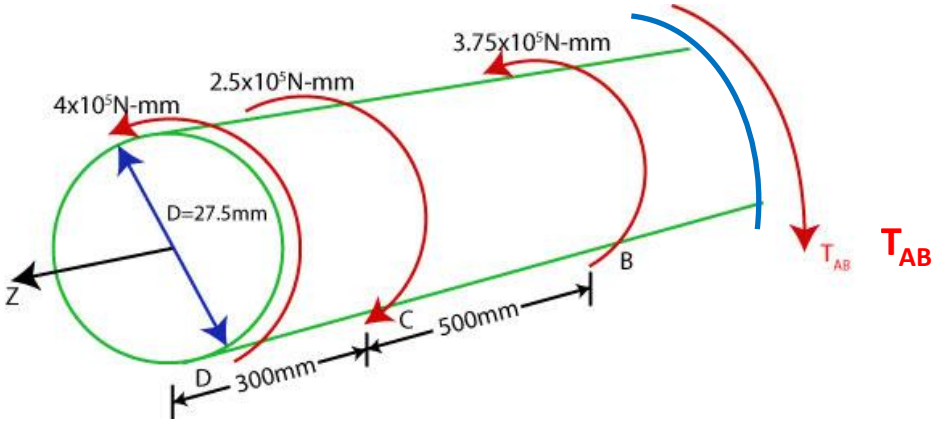
The steel bar to the right is subject to torques as shown.

a) Determine the maximum shear stress in the structure.

b) Determine the angle of twist if the free end with respect to the fixed end.



FBD



T_{AB}

$$\sum M_z = 0$$

$$4\,X\,10^5 - 2.5\,X\,10^5 + 3.75\,X\,10^5 - T_{AB} = 0$$

$$T_{AB} = 5.25\,X\,10^5 \;\; N-mm$$

$$T_{CD} = 4\,X\,10^5 \;\; N-mm$$

$$T_{BC} = 1.5\,X\,10^5 \;\; N-mm$$

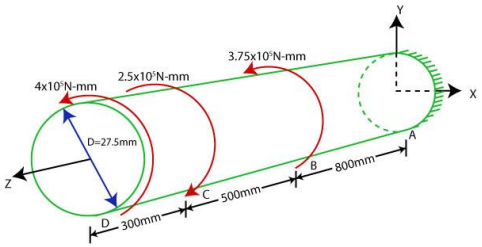
Elastic Torsion of Straight Cylindrical Shafts

Worksheet:

The steel bar to the right is subject to torques as shown.

a) Determine the maximum shear stress in the structure.

b) Determine the angle of twist if the free end with respect to the fixed end.



$$\tau = \frac{T\,\rho}{J}$$

$$\rho = 13.75\ mm$$

$$T_{AB} = 5.25\,X\,10^{5}\ \ N-mm$$

Solid Circular Cross Section

$$J = \frac{\pi\, r^{4}}{2} = \frac{\pi\left(\frac{D}{2}\right)^{4}}{2} = \frac{\pi\, D^{4}}{32}$$