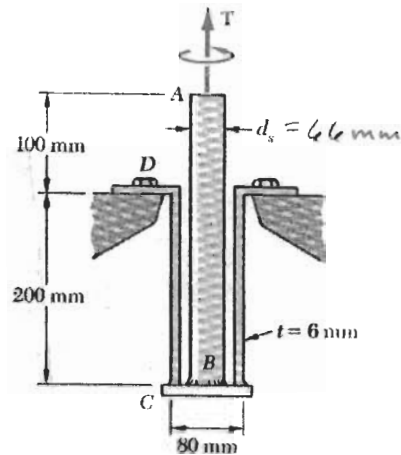


TORSION EXAMPLE PROBLEM

Given:

A solid spindle passes through the sleeve CD and is welded at C.
 τ_{all} for both is 60 MPa.



Required: Determine the largest torque T which may be applied.

Assumptions:

Solution: Torque applied to shaft which is resisted by the end plate, which in turn applies the torque T to the sleeve at the bottom.

a) Spindle



$$r_s = 33 \text{ mm} = 0.033 \text{ m}$$

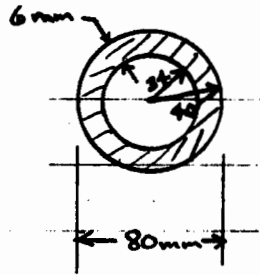
$$\tau_{max} = \frac{T r_s}{J} ; \text{ Set } \tau_{max} = \tau_{all} = 60 \text{ MPa} = 60 \times 10^6 \text{ Pa}$$

$$T = \frac{\tau_{max} J}{r_s} ; \quad J = \frac{1}{2} \pi r_s^4$$

$$J = \frac{\pi}{2} (0.033 \text{ m})^4 = 1.843 \times 10^{-6} \text{ m}^4$$

$$T =$$

(b) sleeve



$$J = \frac{\pi}{2} [(0.040 \text{ m})^4 - (0.030 \text{ m})^4] = 1.92 \times 10^{-6} \text{ m}^4$$

$$T =$$

The lower of the 2 controls.

Summary of Answers

$$T_{\max} = 2.88 \text{ kN} \cdot \text{m}$$