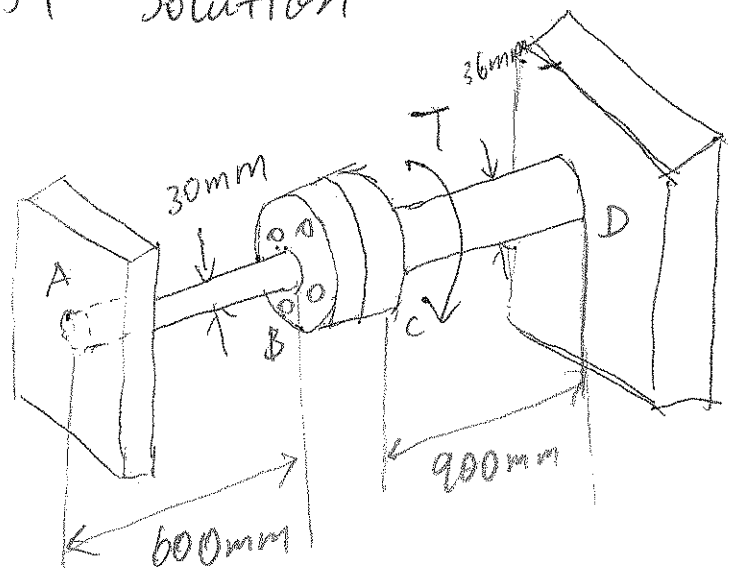
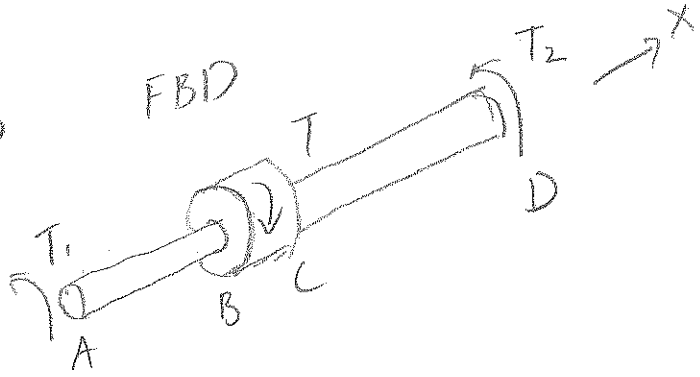
10.59 Solution



FBD



$\Sigma M_x = 0 \Rightarrow T_{AB} + T_{CD} - T = 0$ (1)

Polar Moments of Inertia

$J_{AB} = \frac{\pi}{2} c_1^4 = \frac{\pi}{2}(0.03\text{m}/2)^4 = 0.0795 \times 10^{-6}\,\text{m}^4$

$J_{CD} = \frac{\pi}{2} c_2^4 = \frac{\pi}{2}(0.036\text{m}/2)^4 = 0.1649 \times 10^{-6}\,\text{m}^4$

Angle of Twist

one is right hand helix
one is left hand helix

$\phi_{AB} = \phi_{CD}$

$\phi_{AB} = \frac{T_{AB} L_{AB}}{J_{AB} G}$

$\phi_{CD} = \frac{T_{CD} L_{CD}}{J_{CD} G}$

So $\frac{T_{AB} L_{AB}}{J_{AB}} = \frac{T_{CD} L_{CD}}{J_{CD}}$ (2)

① and ②

$T_{AB} = 209.84\ N \cdot m$

$T_{CD} = 290.16\ N \cdot m$

τ_{max} in AB : $\tau_{max_1} = \frac{T_{AB} C_{AB}}{J_{AB}} = \frac{209.84\ N \cdot m \cdot 0.015\ m}{0.0795 \times 10^{-6}\ m^4}$

$= 39.6\ MPa$

τ_{max} in CD : $\tau_{max_2} = \frac{T_{CD} C_{AB}}{J_{CD}} = \frac{290.16\ Nm \cdot 0.018\ m}{0.1649 \times 10^{-6}\ m^4}$

$= 31.67\ MPa$