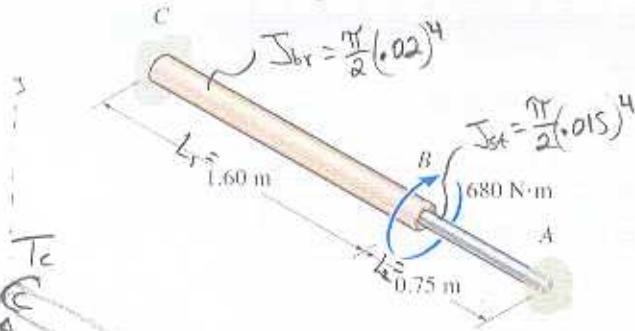


Name Solution by Pedro A. Romero Date _____

1. A rod is made from two segments: the steel segment(AB) has a 30mm diameter and the brass segment(BC) has a 40mm diameter. It is fixed at its ends and subjected to a torque of $T=680\text{N}\cdot\text{m}$. a) Determine the reactions at the ends. b) Determine the angle of twist of point B relative to point C. c) Determine the absolute maximum shear stress in the shaft. d) Draw the stress distribution for a cross section in the brass portion.
- $G_{st} = 75\text{GPa}$, $G_{br} = 39\text{GPa}$.



(a)

Equilibrium

$$\sum F_x = T_A - 680\text{N}\cdot\text{m} + T_C = 0$$

compatibility

$$\phi_{A/C} = \phi_{B/C} + \phi_{A/B} = 0$$

$$= -\frac{T_C L_1}{J_{br} G_{br}} + \frac{(680 - T_C) L_2}{J_{st} G_{st}} = 0$$

$$\frac{T_C L_1}{J_{br} G_{br}} + \frac{T_C L_2}{J_{st} G_{st}} = \frac{(680\text{N}\cdot\text{m}) L_2}{J_{st} G_{st}}$$

$$T_C = \frac{(680\text{N}\cdot\text{m}) L_2}{\left(\frac{L_1}{J_{br} G_{br}} + \frac{L_2}{J_{st} G_{st}}\right)}$$

$$T_C = 295.90\text{N}\cdot\text{m}$$

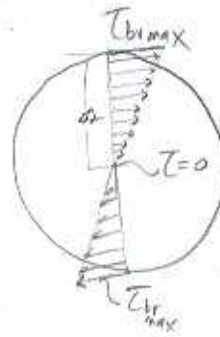
$$T_A = 384.10\text{N}\cdot\text{m}$$

$$\phi_{B/C} = \frac{-T_C L_1}{J_{br} G_{br}} = -0.0483\text{rads}$$

$$\tau_{br,max} = \frac{T_C (0.02)}{J_{br}} = 23.547\text{MPa}$$

$$\tau_{st,max} = \frac{T_A (0.015)}{J_{st}} = 72.452\text{MPa} = \tau_{max}$$

(d)



same for every radial line