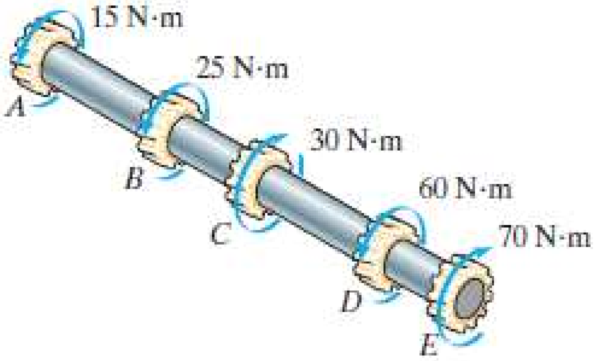
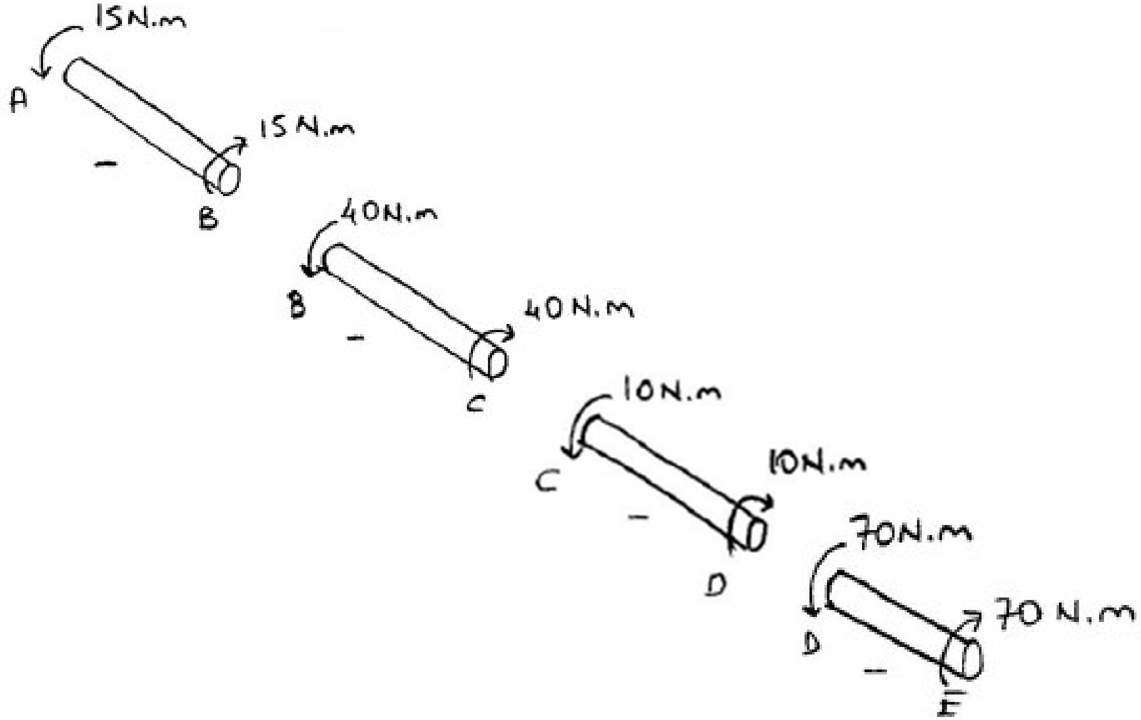
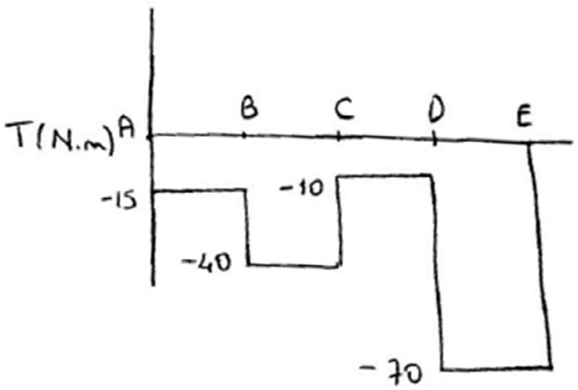
The solid shaft has a diameter of 40 mm. Determine the absolute maximum shear stress in the shaft and sketch the shear-stress distribution along a radial line of the shaft where the shear stress is maximum.



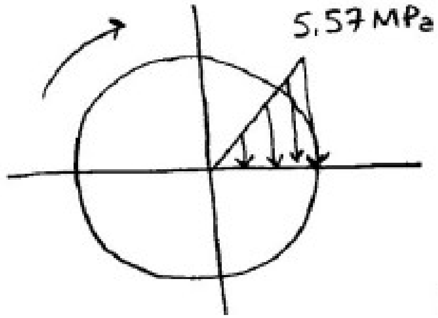




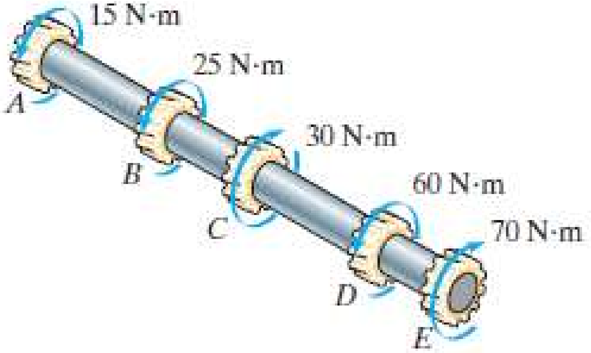
$$\tau_{max} = \frac{T_{DE} \cdot c}{J} = \frac{(70)(0.02)}{\frac{\pi}{2}\, 0.02^4}$$

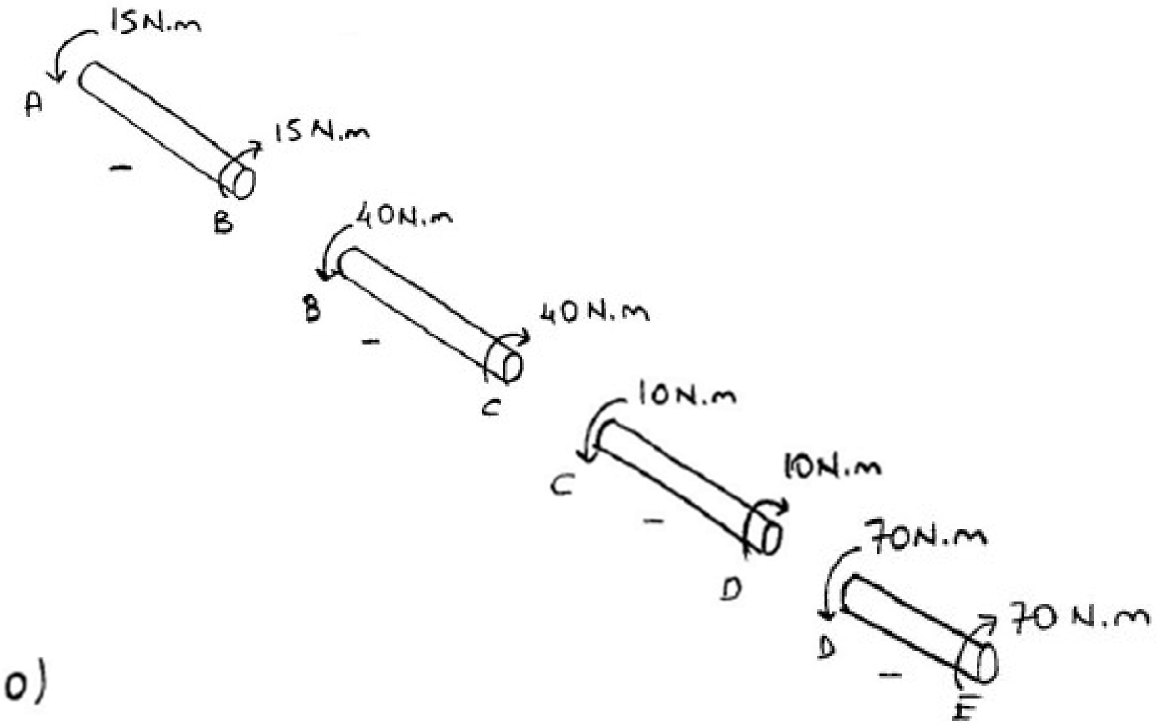
$$= 5.57 \times 10^6 \ Pa$$

$$= 5.57 \ MPa$$



The solid shaft has a diameter of 40 mm. Determine the angle of twist of gear E relative to gear A. Take the length of each shaft as 200 mm and G=30 GPa.

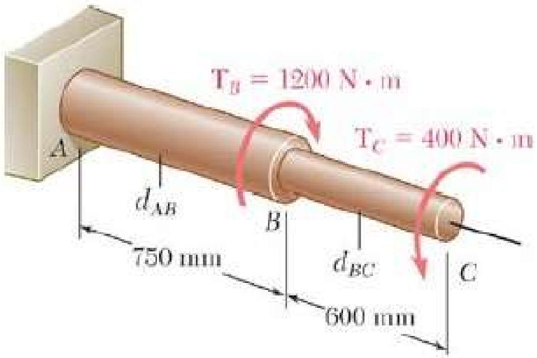




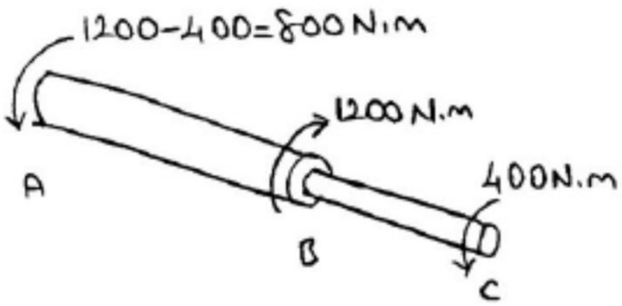
$$\phi_{E/A} = \sum \frac{TL}{JG} = \frac{L}{JG}(-15-40-10-70)$$

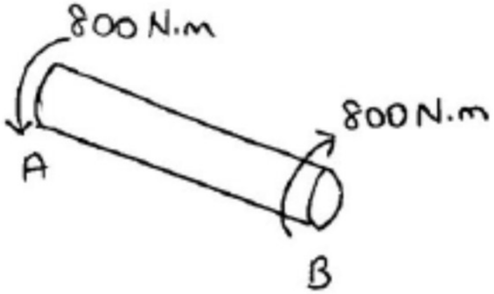
$$= \frac{(0.2)(-135)}{\left(\frac{\pi}{2}\,0.02^4\right)(30\times10^9)} = -0.00358 \text{ rad} \cong 0.205°$$

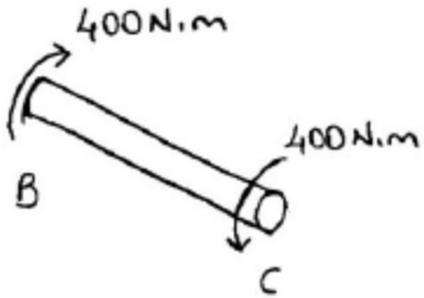
The solid shaft shown is formed of a brass for which the allowable shearing stress is 55 MPa. Neglecting the effect of stress concentrations, determine the smallest diameters d_{AB} and d_{BC} for which the allowable shearing stress is not exceeded.



FBD:





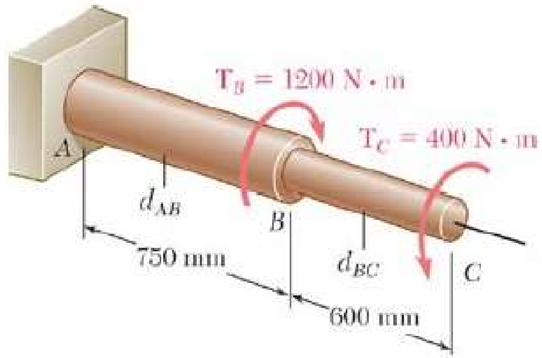


$$\tau_{max} = 55\,MPa = 55 \times 10^6\,Pa$$

$$\tau_{max} = \frac{T.c}{J}$$

$$= \frac{T.c}{\frac{\pi}{2} c^4} = \frac{2T}{\pi c^3}$$

The solid shaft shown is formed of a brass for which the allowable shearing stress is 55 MPa. Neglecting the effect of stress concentrations, determine the smallest diameters d_{AB} and d_{BC} for which the allowable shearing stress is not exceeded.



Shaft AB: $\tau_{max} = \dfrac{2T}{\pi c^3}$

$$55\times10^6 = \frac{2(800)}{\pi c^3}$$

$c = 21\times10^{-3}\,m = 21\ mm$

minimum $d_{AB} = 2c = 42\ mm$

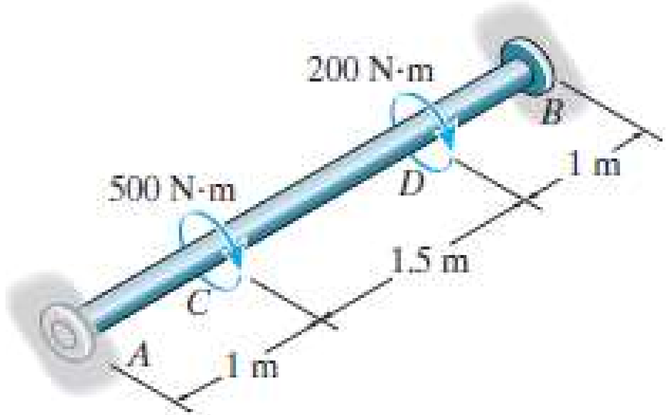
Shaft BC: $\tau_{max} = \dfrac{2T}{\pi c^3}$

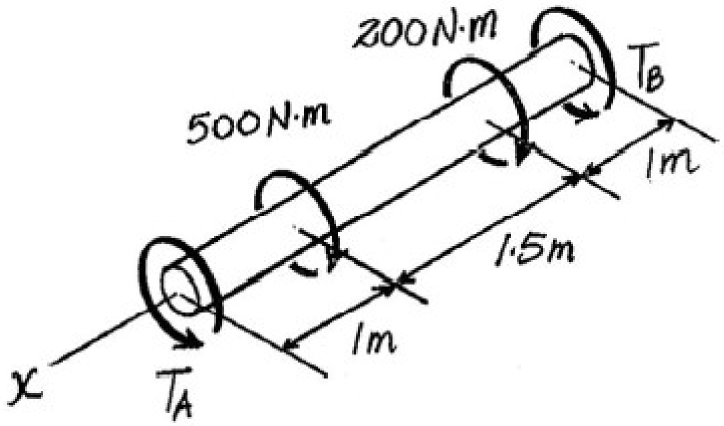
$$55\times10^6 = \frac{2(400)}{\pi c^3}$$

$c = 16.67\times10^{-3}\,m = 16.67\ mm$

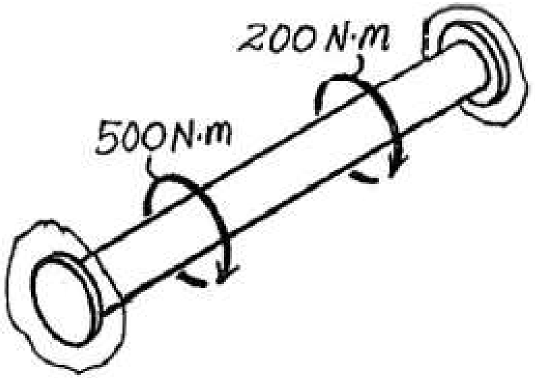
minimum $d_{BC} = 2c = 33.34\,mm$

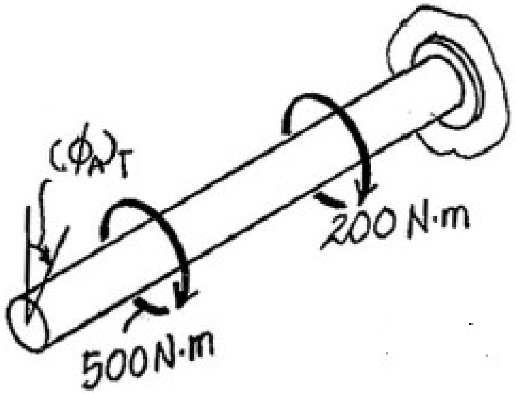
The A992 steel shaft has a diameter of 60 mm and is fixed at its ends A and B. If it is subjected to the torques shown, determine the absolute maximum shear stress in the shaft.

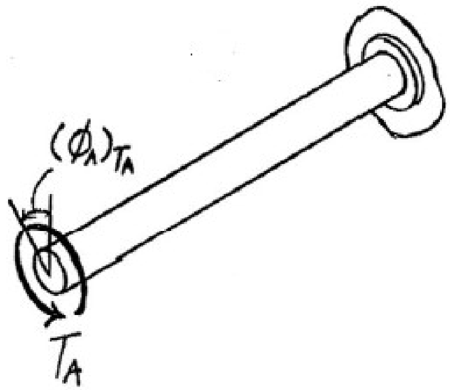




$$\Sigma M_x = 0; \quad T_A + T_B - 500 - 200 = 0$$







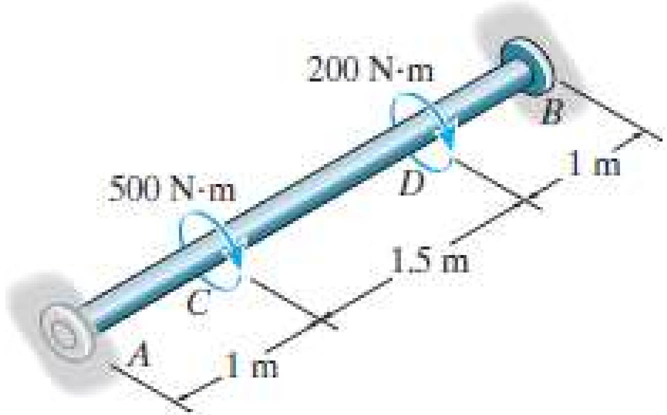
$$\phi_A = (\phi_A)_{T_A} - (\phi_A)_T$$

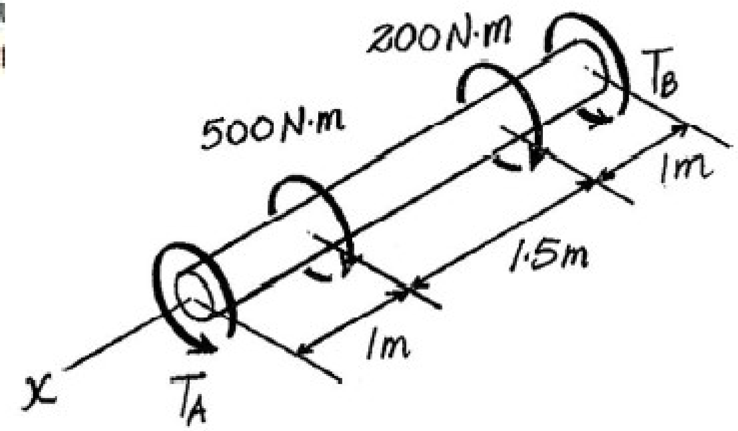
$$0 = \frac{T_A(3.5)}{JG} - \left[\frac{500\,(1.5)}{JG} + \frac{700\,(1)}{JG}\right]$$

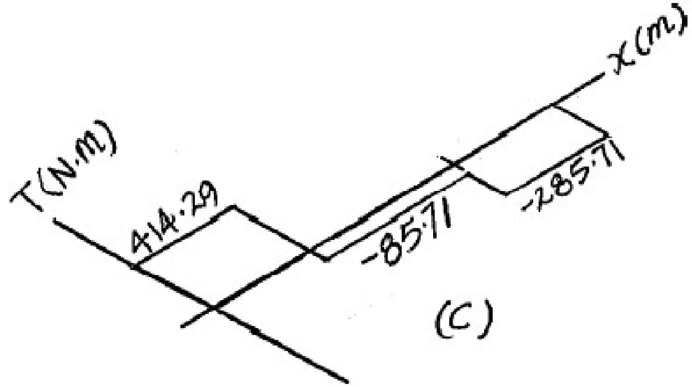
$$T_A = 414.29\ \mathrm{N \cdot m}$$

$$T_B = 285.71\ \mathrm{N \cdot m}$$

The A992 steel shaft has a diameter of 60 mm and is fixed at its ends A and B. If it is subjected to the torq[ue] shown, determine the absolute maximum shear stress in [the] shaft.

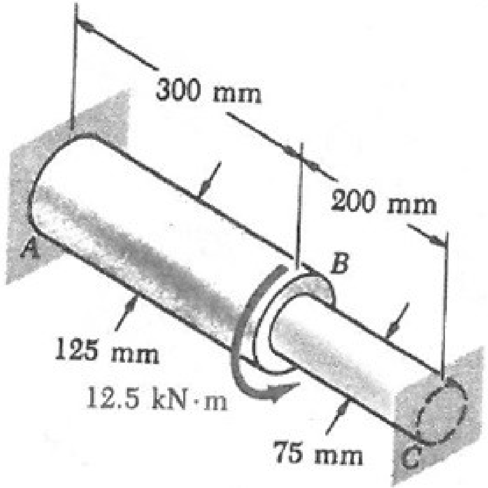




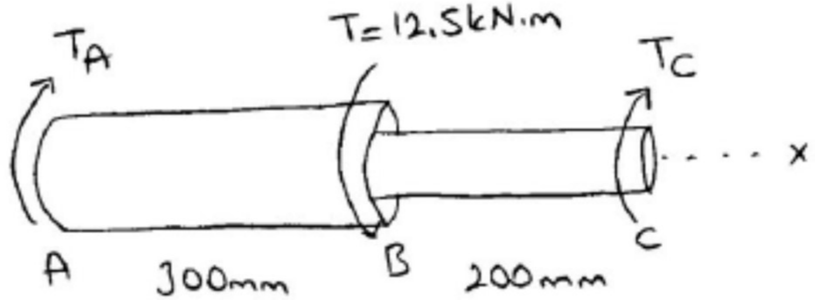


$$\tau_{\substack{\text{abs}\\ \text{max}}} = \frac{T_{AC}\,c}{J} = \frac{414.29\,(0.03)}{\frac{\pi}{2}(0.03)^4} = 9.77\ \text{MPa}$$

Two solid cylinders AB and BC are bonded together at B and attached to fixed supports at A and C. AB is made of aluminum ($G = 26\ GPa$) and BC of brass ($G = 39\ GPa$), determine the maximum shearing stresses in each shaft.



FBD of AC:

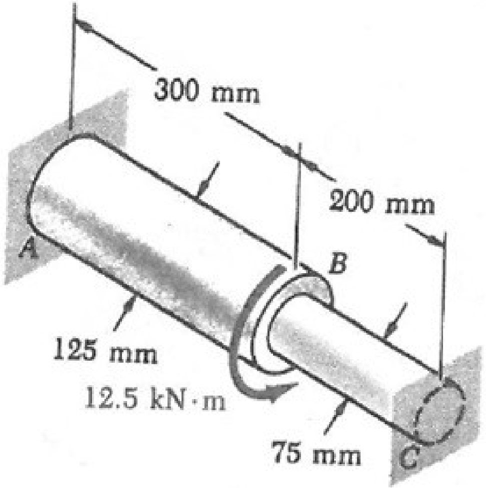


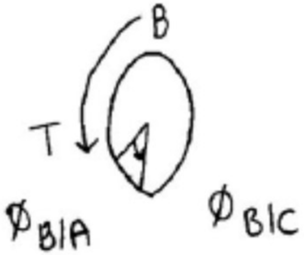
$$\Sigma M_x = 0$$

$$T_A + T_C = 12.5\ kN.m \quad \cdots (1)$$

Problem is statically Indeterminate

Two solid cylinders AB and BC are bonded together at B and attached to fixed supports at A and C. AB is made of aluminum ($G = 26\ GPa$) and BC of brass ($G = 39\ GPa$), determine the maximum shearing stresses in each shaft.





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

$$\left(\frac{TL}{JG}\right)_{AB} = \left(\frac{TL}{JG}\right)_{BC}$$

$$\frac{T_{AB}\,(0.3)}{\frac{\pi}{2}\left(\frac{0.125}{2}\right)^4 (26\times10^9)} = \frac{T_{BC}\,(0.2)}{\frac{\pi}{2}\left(\frac{0.075}{2}\right)^4 (39\times10^9)}$$

$$T_{AB} = 3.43\ T_{BC} \quad \ldots(2)$$

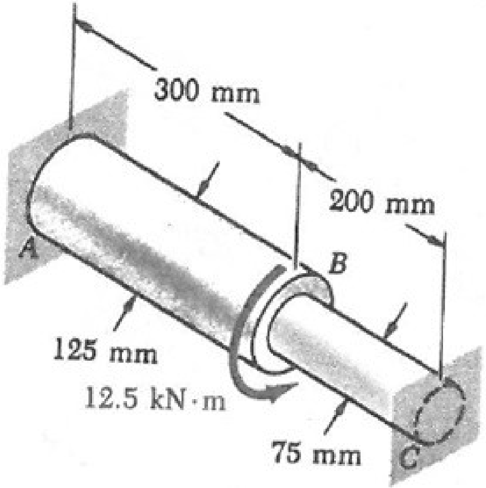
From equations (1) & (2)

$$(3.43+1)\ T_{BC} = 12.5\ kN.m$$

$$T_{BC} = 2.822\ kN.m$$

$$T_{AB} = 12.5 - 2.822 = 9.678\ kN.m$$

Two solid cylinders AB and BC are bonded together at B and attached to fixed supports at A and C. AB is made of aluminum ($G = 26\ GPa$) and BC of brass ($G = 39\ GPa$), determine the maximum shearing stresses in each shaft.



Maximum stress in AB:

$$\tau_{max} = \frac{T_{AB} \cdot C_{AB}}{J_{AB}}$$

$$= \frac{(9.678 \times 10^3)\left(\frac{0.125}{2}\right)}{\frac{\pi}{2}\left(\frac{0.125}{2}\right)^4}$$

$$= 25.2 \times 10^6\ Pa$$

$$= 25.2\ MPa$$

Maximum stress in BC:

$$\tau_{max} = \frac{T_{BC} \cdot C_{BC}}{J_{BC}}$$

$$= \frac{(2.822 \times 10^3)\left(\frac{0.075}{2}\right)}{\frac{\pi}{2}\left(\frac{0.075}{2}\right)^4}$$

$$= 34.1 \times 10^6\ Pa$$

$$= 34.1\ MPa$$