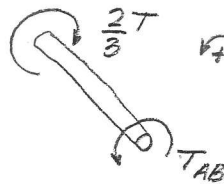


5-51

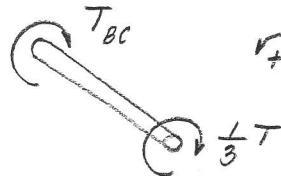
A-B:



$$\sum M = 0, \quad -\frac{2}{3}T + T_{AB} = 0$$

$$T_{AB} = \frac{2}{3}T$$

B-C:



$$\sum M = 0, \quad -T_{BC} - \frac{1}{3}T = 0$$

$$T_{BC} = -\frac{1}{3}T$$

$$\tau_{max} = \frac{T_{max} C}{J} \rightarrow 80,000 \frac{\text{kN}}{\text{m}^2} = \frac{\frac{2}{3}T (0.030 \text{ m})}{\frac{\pi}{2} (0.030 \text{ m})^4}$$

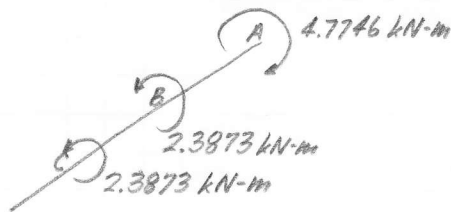
$$T = 5.089 \text{ kN-m or } \boxed{5.09 \text{ kN-m}}$$

$$\begin{aligned} \phi_{AC} &= \sum \frac{TL}{JG} = \frac{T_{AB} L_{AB}}{JG} + \frac{T_{BC} L_{BC}}{JG} = \frac{(1.20 \text{ m})}{\frac{\pi}{2} (0.030 \text{ m})^4 (26 \times 10^6 \frac{\text{kN}}{\text{m}^2})} \left(\frac{2}{3}T - \frac{1}{3}T \right) \\ &= 0.06153 \text{ rad} \\ &\text{or } (0.06153 \text{ rad}) \left(\frac{360^\circ}{2\pi \text{ rad}} \right) = \boxed{3.53^\circ} \end{aligned}$$

5-62

$$P = 2\pi f T$$

$$T = \frac{P}{2\pi f} = \frac{300 \frac{\text{kN-m}}{\text{s}}}{2\pi \frac{\text{rad}}{\text{rev}} \left(\frac{600 \text{ rev}}{\text{min}} \right) \left(\frac{1 \text{ min}}{60 \text{ s}} \right)} = 4.7746 \text{ kN-m}$$

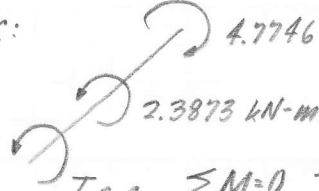


A-B:



$$\sum M = 0, \quad T_{A-B} = 4.7746 \text{ kN-m}$$

B-C:



$$\sum M = 0, \quad T_{B-C} = 2.3873 \text{ kN-m}$$

$\tau_{max} \rightarrow T_{max}$ occurs A-B

$$\begin{aligned} \tau_{max} &= \frac{T C}{J} = \frac{4.7746 \text{ kN-m} (0.050 \text{ m})}{\frac{\pi}{2} (0.050 \text{ m})^4} \\ &= 24,317.1 \frac{\text{kN}}{\text{m}^2} \\ &\text{or } \boxed{24.3 \text{ MPa}} \end{aligned}$$

$\phi_{D/A} = \sum \frac{TL}{JG}$

$$\begin{aligned} &= \frac{1}{\frac{\pi}{2} (0.050 \text{ m})^4 (75 \times 10^6 \frac{\text{kN}}{\text{m}^2})} \left((4.7746 \text{ kN-m})(1.5 \text{ m}) + (2.3873 \text{ kN-m})(2 \text{ m}) \right) \\ &= 0.016211 \text{ rad} \\ &\text{or } \boxed{0.929^\circ} \end{aligned}$$

(5-67) $P = T\omega$
for given P , ω is min when T is max

$$\phi = \frac{TL}{JG} \rightarrow T = \frac{\phi JG}{L} \quad T \text{ is max when } \phi \text{ is max}$$

$$T = \frac{(1^\circ) \left(\frac{2\pi \text{ rad}}{360^\circ}\right) \frac{\pi}{2} (0.025\text{m})^4 (75 \times 10^6 \frac{\text{kN}}{\text{m}^2})}{(3\text{m})} = 0.26773 \text{ kN-m}$$

$$\omega = \frac{P}{T} = \frac{35 \frac{\text{kN-m}}{\text{s}}}{0.26773 \text{ kN-m}} = 130.7 \frac{\text{rad}}{\text{s}} \text{ or } \boxed{131 \frac{\text{rad}}{\text{s}}}$$