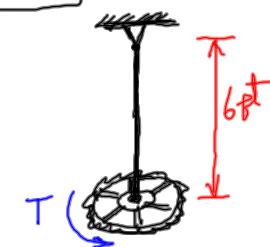


3.60



$$G = 11.2 \times 10^6 \text{ psi} \quad k_x = 4.27 \text{ lb} \cdot \text{ft}/\text{rad}$$

$d = ?$

$$T = k_x \phi = \underline{k_x \left(\frac{TL}{JG} \right)}, \quad J = \frac{\pi}{2} r^4$$

$$k_x = \frac{JG}{TL} \cdot T = \frac{JG}{L}$$

$$4.27 \text{ (12)} = \frac{\frac{\pi}{2} r^4 (11.2 \times 10^6)}{6 \text{ (12)}}$$

$$\therefore r = \square$$

$$d = 2r$$

$$d = \square \text{ in.}$$

(in.) (lb)
rad

3.66 $T_{\text{ave}} = 50 \text{ MPa}$, Power = 15 kW, (a) $f = 30 \text{ Hz}$, $d = ?$

$$1 \text{ Hz} = 1 \text{ cycle/s} = 2\pi \text{ rad/s}, \quad \omega = 30(2\pi \text{ rad/s}) = 60\pi \text{ rad/s}$$

$$T\omega: \quad N \cdot \text{m} \cdot \text{rad/s} = N \cdot \text{m/s} = \text{Joule/s} = \text{Watt} = \text{power}$$

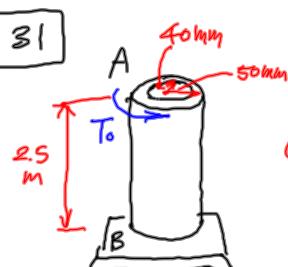
$$T\omega = 15 \times 10^3, \quad T(60\pi) = 15 \times 10^3, \quad T = \square \text{ N.m}$$

$$T_{\text{ave}} = \frac{Tc}{J_o}: \quad 50 \times 10^6 = \frac{T(d/2)}{\frac{\pi}{2}(d/2)^4}, \quad \therefore d = \square \text{ m} \quad d = \square \text{ mm}$$

$$\boxed{\text{Power} = T\omega}$$

$\omega = \text{angular velocity of the shaft}$
 $T = \text{torque applied to the shaft}$

3.31



$$G = 27 \text{ GPa}, \quad T_o = ?, \quad \phi = 2^\circ$$

(a) $T_o = ?$ (b) $\phi = ?$

$$(a) \phi = \frac{TL}{JG}: \quad \text{(m), (N)}$$

$$\frac{2^\circ (\pi)}{180^\circ} = \frac{T_o (2.5)}{\frac{\pi}{2} [(0.05)^4 - (0.04)^4] (27 \times 10^9)}$$

$$\therefore T_o = \square \text{ N.m}$$

$$(b) \pi [(0.05)^2 - (0.04)^2] = \pi r^2, \quad r = \square \text{ m}$$

$$\phi = \frac{T_o (2.5) \text{ rad}}{\frac{\pi}{2} (r^4) (27 \times 10^9)} = \square \text{ rad} \quad \boxed{\phi = \square \text{ degrees}}$$