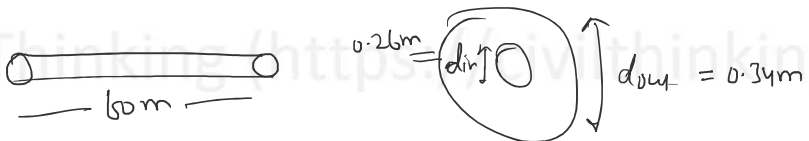


Torsion in Shafts. Question 5-47 Solution

Tuesday, 11 March, 2025 05:25 PM

5-47. The propellers of a ship are connected to a A-36 steel shaft that is 60 m long and has an outer diameter of 340 mm and inner diameter of 260 mm. If the power output is 4.5 MW when the shaft rotates at 20 rad/s, determine the maximum torsional stress in the shaft and its angle of twist.

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$$\frac{\tau}{R} = \frac{T}{J} = \frac{C\theta}{L} \quad \text{--- ①}$$


Power = 4.5×10^6 watt, $\omega = 20 \text{ rad/s}$

$\tau_{\max} = ? \quad \theta = ?$

$$\frac{\tau_{\max}}{\frac{0.34}{2} \text{ m}} = \frac{4.5 \times 10^6 / 20}{\frac{\pi}{2} \left[\left(\frac{0.34}{2} \right)^4 - \left(\frac{0.26}{2} \right)^4 \right]}$$

$$\Rightarrow \tau_{\max} = 44.3 \text{ MPa} \quad \text{Ans.}$$

from ①:

$$\frac{\tau_{\max}}{R} = \frac{C\theta}{L} \Rightarrow \frac{44.3 \times 10^6 \text{ N/m}^2}{\frac{0.34}{2} \text{ m}} = \frac{75 \times 10^9 \times \theta}{60 \text{ m}}$$

$$\Rightarrow \theta = 0.2085 \text{ rad}$$

$$= 11.9^\circ \quad \text{Ans.}$$

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