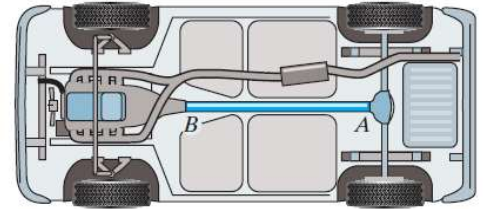


Torsion in Shafts. Question 5-44 Solution

Tuesday, 11 March, 2025 09:40 AM

*5-44. The drive shaft AB of an automobile is made of a steel having an allowable shear stress of $\tau_{\text{allow}} = 8 \text{ ksi}$. If the outer diameter of the shaft is 2.5 in. and the engine delivers 200 hp to the shaft when it is turning at 1140 rev/min, determine the minimum required thickness of the shaft's wall.



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$$\frac{\tau}{R} = \frac{T}{J} \Rightarrow \frac{\tau_{\text{allow}}}{\frac{\text{diameter}_{\text{outer}}}{2}} = \frac{\text{Power in Ib, inch}}{2\pi N / 60 \text{ rev/s}} \cdot \frac{\pi}{2} (r_o^4 - r_i^4)$$

$$\Rightarrow \frac{8 \times 10^3}{2.5/2} = \frac{200 \times 550}{2\pi \times 1140 / 60} \cdot \frac{\pi}{2} \left[\left(\frac{2.5}{2} \right)^4 - r_i^4 \right]$$

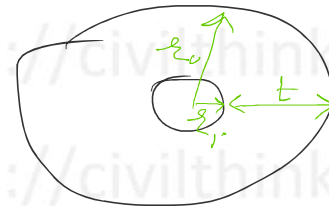
$$\Rightarrow r_i = 1.0762 \text{ inch}$$

$$r_i + t = r_o$$

$$\Rightarrow t = r_o - r_i$$

$$\Rightarrow t = \frac{2.5}{2} - 1.0762 = 0.174$$

$$\Rightarrow t = 0.174 \text{ inch} \quad \text{Ans.}$$



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