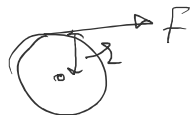
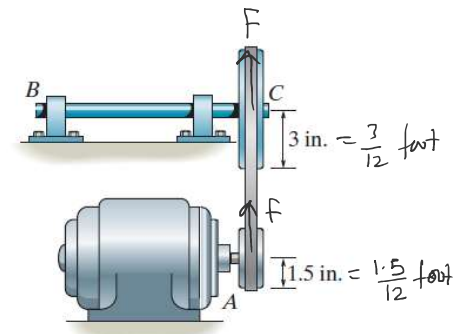


5-46. The motor delivers 15 hp to the pulley at A while turning at a constant rate of 1800 rpm. Determine to the nearest $\frac{1}{8}$ in. the smallest diameter of shaft BC if the nearest 8 allowable shear stress for steel is $\tau_{\text{allow}} = 12$ ksi. The belt does not slip on the pulley.



$$T = F \times r \Rightarrow F = \frac{T}{r}$$

$$T = \frac{\text{Power}}{\text{Ang. velocity}} = \frac{15 \text{ hp} \times 550}{2\pi \times \frac{1800}{60}} = \frac{275}{2\pi} \text{ lb}\cdot\text{ft}$$

$$\Rightarrow F = \frac{T}{r_A} = \frac{275/2\pi}{1.5/12} = \frac{1100}{\pi} \text{ lb}$$

$$T_C = F \times r_C = \frac{1100}{\pi} \times \frac{3}{12} = \frac{275}{\pi} \text{ lb}\cdot\text{ft} \times 12 = \boxed{1050.42 \text{ lb}\cdot\text{inch}}$$

$$\frac{\tau_{BC}}{r_{BC}} = \frac{T_C}{J_{BC}}$$

$$\Rightarrow \frac{12 \times 10^3}{d/2} = \frac{1050.42}{\frac{\pi}{2} \left(\frac{d}{2}\right)^4}$$

$$\Rightarrow d = 0.764 \text{ inch} = \text{Minimum dia.}$$

have to see d_{min} in $\frac{1}{8}$ in factor.

$$\frac{6}{8} = 0.75 < 0.764 \Rightarrow \text{NOT good}$$

$$\frac{7}{8} = 0.875 > 0.764 \Rightarrow \text{good}$$

$\therefore \frac{7}{8}$ inch is the correct answer.

i know this solution is hard to understand if you are a beginner. contact Civil Thinking if you need more help!

This problem was solved by Civil Thinking (<https://civilthinking.com>)

If you need solutions for **Strength of Materials** or any other **Civil Engineering** subject, contact us at:


solutions@civilthinking.com

Or submit your problem directly here:

 <https://civilthinking.com/getproblemsolutions>

Other Subjects We Cover:

- ☒ Structural Analysis
- ☒ Fluid Mechanics
- ☒ Geotechnical Engineering
- ☒ Transportation Engineering
- ☒ Construction Management
- ☒ Finite Element Analysis (FEA)
- ☒ Engineering Software (ANSYS, ETABS, MATLAB, Revit)

Let us help you solve your engineering challenges! 

NOTE:

The solution provided in this document is the intellectual property of Civil Thinking and is protected by copyright. Any reproduction, distribution, or publication of this content, in whole or in part, is strictly prohibited without prior written permission from <https://civilthinking.com>.