

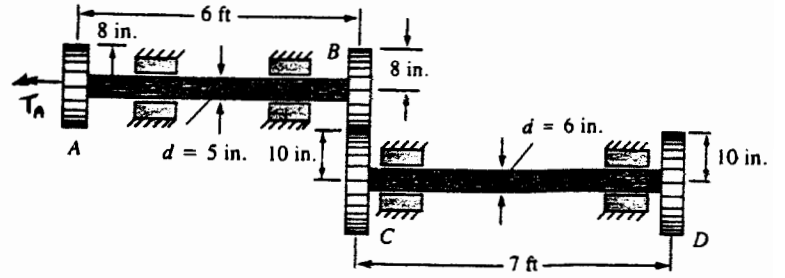
Examples

Torsion: Transmission Shafts & Gears

Example:

Given:

The system of gears shown
 The two solid steel shaft
 ($G = 12000 \text{ ksi}$)
 Shaft AB rotates at 330 rpm
 Maximum allowable $\tau = 12 \text{ ksi}$



Req'd:

The maximum horsepower that can be safely transmitted from gear A to gear D

Soln.:

$$Hp = \frac{nT}{63000}$$

$$= \frac{330}{63000} T = \frac{11}{2100} T$$

Assum τ_{max}^{AB} controls. (Why?!)

$$\tau = \frac{T\gamma}{J} \Rightarrow \tau_{max}^{AB} = \frac{T_{max}^{AB} (2.5)}{\frac{\pi}{2} (2.5)^4} \equiv 12$$

$$\Rightarrow T_{max}^{AB} = 294.5 \text{ in-k}$$

In FBD ①, $\sum M_o = 0 \Rightarrow T_{AB} - 8F = 0 \Rightarrow F = \frac{294.5}{8} = 36.82 \text{ k}$

In FBD ②, $\sum M_o = 0 \Rightarrow T_{CD} - 10F = 0 \Rightarrow T_{CD} = 10(36.82) = 368.2 \text{ in-k}$

Now, check τ_{max}^{CD} : $\tau_{max}^{CD} = \frac{T_{max}^{CD} \gamma_{max}}{J_{CD}} = \frac{368.2 (3)}{\frac{\pi}{2} (3)^4} = 8.68 \text{ ksi} < 12 \Rightarrow \underline{\underline{OK}}$

$\Rightarrow T_{max}^{AB} = 294.5 \text{ in-k}$

$\Rightarrow Hp_{max} = \frac{11}{2100} T_{max} = \frac{11}{2100} (294500) \Rightarrow$

$Hp_{max} = 1543$

