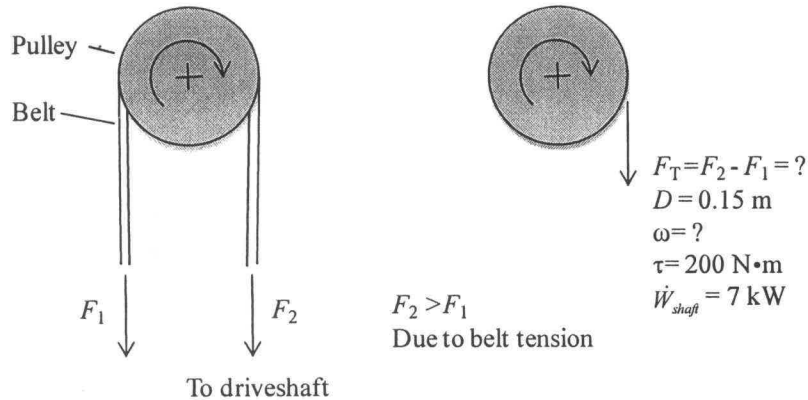


## PROBLEM 2.36

Known: Pulley turns a belt rotating the driveshaft of a power plant pump with known torque and power transmitted.

Find: Determine the net force applied by the belt on the pulley, in kN, and the rotational speed of the driveshaft, in RPM.

Schematic and Given Data:



Engineering Model:

- (1) The rotational speed of the pulley and drive shaft are assumed to be equal.
- (2) Net tangential force ( $F_T$ ) on the pulley is due to belt tension (see schematic).

Analysis:

The net force, in kN, applied by the belt on the pulley is calculated using the torque and the diameter of the pulley as follows

$$\tau = F_T \left( \frac{D}{2} \right) \text{ or } F_T = \frac{2\tau}{D} = \frac{2(200 \text{ N}\cdot\text{m})}{0.15 \text{ m}} \left| \frac{1 \text{ kN}}{1000 \text{ N}} \right| = 2.67 \text{ kN} \quad \leftarrow$$

Using Eq. 2.20, the rotational speed of the driveshaft, in RPM, is determined using assumption 1, power transmitted, and torque as follows:

$$\dot{W}_{\text{shaft}} = \tau \omega \quad \text{or} \quad \omega = \frac{\dot{W}_{\text{shaft}}}{\tau} = \frac{7 \text{ kW}}{200 \text{ N}\cdot\text{m}} \left| \frac{1000 \text{ J}}{1 \text{ kW}} \right| \left| \frac{1 \text{ N}\cdot\text{m}}{1 \text{ J}} \right| \left| \frac{60 \text{ s}}{1 \text{ min}} \right| \left| \frac{\text{rev}}{2\pi \text{ radians}} \right| = 334.2 \text{ RPM} \quad \leftarrow$$