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98280176910 27602668536 40749271290 13186151.58 236474265 31575780.209302 49172655584 63640975.105263 14232814560 29596198083 34616770.771429 34117797777 554708612.33333 40760171.309524 75627791.565217 127451002432



**18.** A rope drive transmits 75 kW through a 1.5 m diameter, 45° grooved pulley rotating at 200 r.p.m. The coefficient of friction between the ropes and the pulley grooves is 0.3 and the angle of lap is 160°. Each rope has a mass of 0.6 kg/m and can safely take a pull of 800 N. Taking centrifugal tension into account determine : 1. the number of ropes required for the drive, and 2. initial rope tension.  
**[Ans. 9 ; 510.2 N]**

$P = 75\text{kW} = 75000\text{W}$      $d_1 = 1.5\text{m}$      $2\beta = 45^\circ$      $N_1 = 200 \text{ r.p.m}$      $\mu = 0.3$   
 $\theta = 160^\circ \times \frac{\pi}{180} = 2.79\text{rad}$      $m = 0.6\text{kg per meter}$      $T = 800\text{N}$      $n = ?$      $T_o = ?$

**Solution:**

$$v = \frac{\pi d_1 N_1}{60} = \frac{\pi \times 1.5 \times 200}{60} = 15.7\text{m/s}$$

$$\frac{T_1}{T_2} = e^{\mu \theta \times \frac{1}{\sin \beta}} = e^{0.3 \times 2.79 \times \frac{1}{\sin 22.5}} = 8.91 \dots \dots a$$

$$T_c = mv^2 = 0.6 \times (15.7)^2 = 148.04\text{N}$$

$$T_1 = T - T_c = 800 - 148.04 = 651.955\text{N} \dots \dots b$$

sub a in b :

$$\frac{T_1}{T_2} = 8.91 \rightarrow T_2 = \frac{651.955}{8.91} = 73.056\text{N}$$

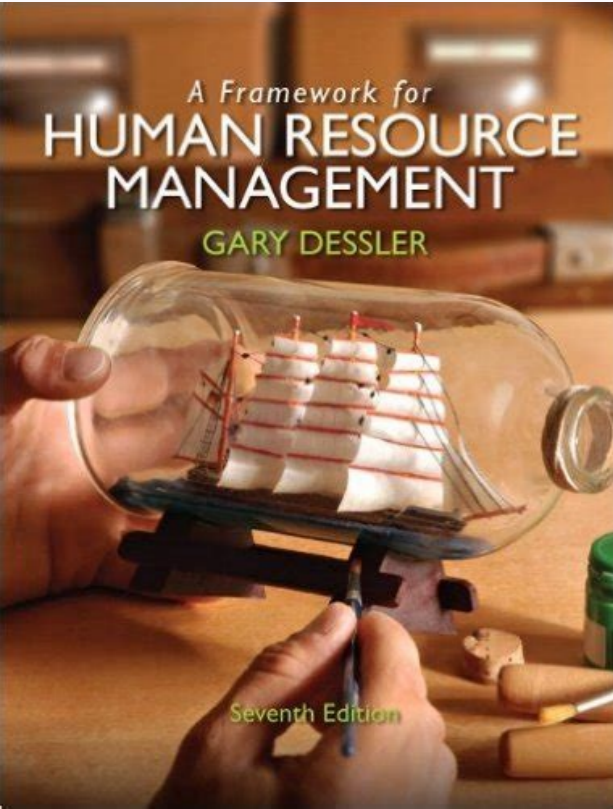
$$P = (T_1 - T_2) \times v \rightarrow P = (651.955 - 73.056) \times 15.7 = 9088.714\text{W} = 9.09\text{kW}$$

$$n = \frac{\text{Total power}}{\text{Power per belt}} = \frac{75}{9.09} = 8.25 = 9 \text{ belts}$$

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90)  $\sum_{i=1}^n M_i = 0$   
 $-10(15,000) - 3,000 = 0$   
 $R_1 = -173.4 \text{ kN}$   
 $\sum_{i=1}^n F_i = 0$   
 $-173.4 - 400 + R_2 = 0$   
 $R_2 = 573.4 \text{ kN}$

$M_1 = -173.4(1) = -168.7 \text{ kN} \cdot \text{m}$   
 $M_2 = -168.7 - 173.4(1) = -342 \text{ kN} \cdot \text{m}$   
 $M_3 = -342 + 800(1) = 0 \text{ check!}$

91) Break at A  
 $R_1 = V_1 = \frac{1}{2}(800) = 400 \text{ kN}$

$\sum_{i=1}^n M_i = 0$   
 $10(100) - 100R_2 + 120(5) = 0$   
 $R_2 = 302 \text{ kN}$

$\sum_{i=1}^n F_i = 0$   
 $-100 + 302 - 120 + R_3 = 0$   
 $R_3 = 120 \text{ kN}$

$M_1 = \frac{1}{2}(800)(1) = 320 \text{ kN} \cdot \text{m}$   
 $M_2 = 320 - \frac{1}{2}(800)(1) = 0 \text{ check! (hinge)}$   
 $M_3 = 0 - 800(1) = -800 \text{ kN} \cdot \text{m}$   
 $M_4 = -800 + 920(1) = 120 \text{ kN} \cdot \text{m}$   
 $M_5 = 120 - 120(1) = 0 \text{ check!}$



[illegible]

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