5-31 • Internal torque;

$$W = 2700 \frac{rev}{min}\left(\frac{2\pi\ rad}{1\ rev}\right)\frac{1\ min}{60\ s}$$

$$= 90\pi\ rad/sec$$

$$P = 35\ hp\left(\frac{550\ ft\ lb/s}{1\ hp}\right)$$

$$= 19250\ ft\cdot lb$$

$$\therefore T = \frac{P}{W} = \frac{19250}{90\pi} = 68.08\ lb\cdot ft$$

• Allowable shear stress

$$\tau_{max} = \tau_{allow} = \frac{T\cdot c}{J}$$

$$10(10^3) = \frac{68.08(12)(1.25)}{\frac{\pi}{2}\left[1.25^4 - \left(\frac{d}{2}\right)^4\right]}$$

$$d_2 = 2.483\ (in)$$

use $d_2 = 2\frac{3}{8}$ in

5-40 • Internal torque;

$$P = 500\ hp\left(\frac{550\ ft\cdot lb/s}{1\ hp}\right)$$

$$= 275,000\ ft\ lb/sec$$

$$T = \frac{P}{W} = \frac{275,000}{W}$$

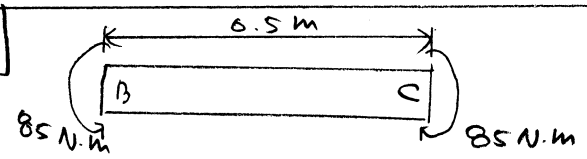
• Allowable shear stress.

$$\tau_{max} = \tau_{allow} = \frac{T\cdot c}{J}$$

$$25(10^3) = \frac{\frac{275\times10^3}{W}(12)(1)}{\frac{\pi}{2}(1^4 - 0.92^4)}$$

$$W = 296\ rad/sec$$

5-47

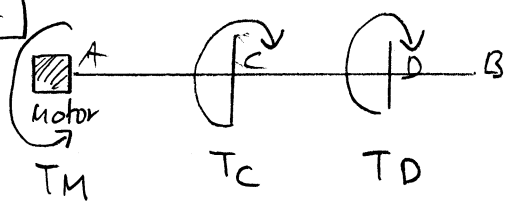


$$\theta_{BC} = \frac{T_{BC}\cdot L_{BC}}{J_{BC}\cdot G_{BC}}$$

$$= \frac{85(0.5)}{\frac{\pi}{2}(0.02^4)75(10^9)}$$

$$= 0.002255\ (rad) = 0.129^\circ$$

5-52



$$T_M = T_C + T_D,\quad T = \frac{P}{2\pi f}$$

$$T_M = \frac{40(550)}{2\pi(20)} = 175.07\ lb\cdot ft$$

$$T_C = \frac{25(550)}{2\pi(20)} = 109.42\ lb\cdot ft$$

$$T_D = \frac{15(550)}{2\pi(20)} = 65.65\ lb\cdot ft$$

• Maximum torque occurs at [AC]

$$\tau_{max} = \frac{T_C\cdot c}{J_C} = \frac{175.07(12)(0.75)}{\frac{\pi}{2}(0.75^4)}$$

$$= 3.17\ (ksi)$$

• $\theta_{CD} = \frac{T_{CD}\cdot L_{CD}}{J_{CD}\cdot G} = \frac{65.65(12)(8)}{\frac{\pi}{2}(0.75^4)(11)(10^6)}$

$$= 0.001153\ (rad) = 0.0661^\circ$$