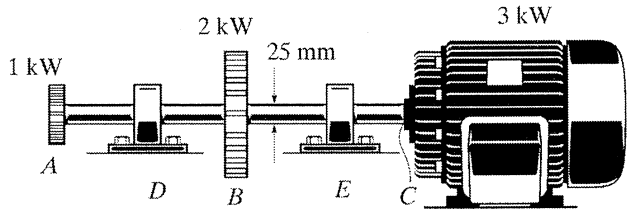
1) GIVEN: A 3 kW motor drives a 25mm shaft at 50 rev/s
Power is drawn from the shaft by gears as shown.
REQ'D: Torque, max shear stress and deflection in each segment of the shaft. (H5.31)



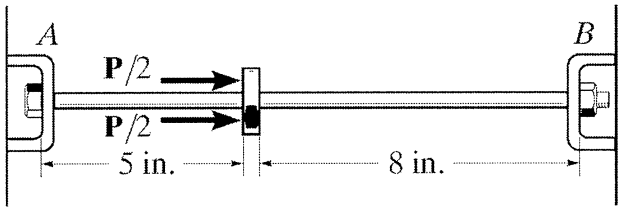
$T_{CB} = \frac{P}{\omega} = \frac{3000\,W}{50\,rps(2\pi)} = 9.549\ N\cdot m$

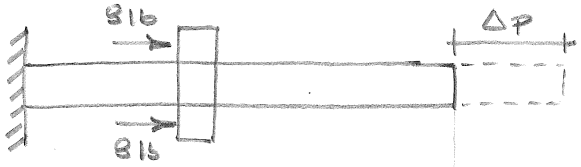
$T_{BA} = \frac{P}{\omega} = \frac{1000\,W}{50\,rps(2\pi)} = 3.183\ N\cdot m$

$\tau_{CB} = \frac{Tc}{J} = \frac{9.549\,N\cdot m(.0125m)}{\frac{\pi}{2}(.0125m)^4} = 3.11\,MPa$

$\tau_{BA} = \frac{Tc}{J} = \frac{3.183\,N\cdot m(.0125m)}{\frac{\pi}{2}(.0125m)^4} = 1.04\,MPa$

2) GIVEN: The nut on the right end of the ∅.5 in aluminum rod is just barely snugged up when T = 70 °F and a load of P = 16 lb is applied.
REQ'D: Reactions at A and B when T = -10 °F
$E_{al} = 10.6 \times 10^6$ psi $\alpha = 12.8\times10^{-6}/°F$





$0 = \Delta_P - \Delta_T + \delta$

$0 = \frac{PL}{AE} - \alpha L \Delta T + \frac{PL}{AE}$

$0 = \frac{16lb(5in)}{\frac{\pi}{4}(.5in)^2(10.6\times10^3)} - 12.8\times10^{-6}/°F(13in)(70-(-10)°F) + \frac{F_B(13in)}{\frac{\pi}{4}(.5in)^2(10.6\times10^3)}$

$F_B = 2125\ lb$

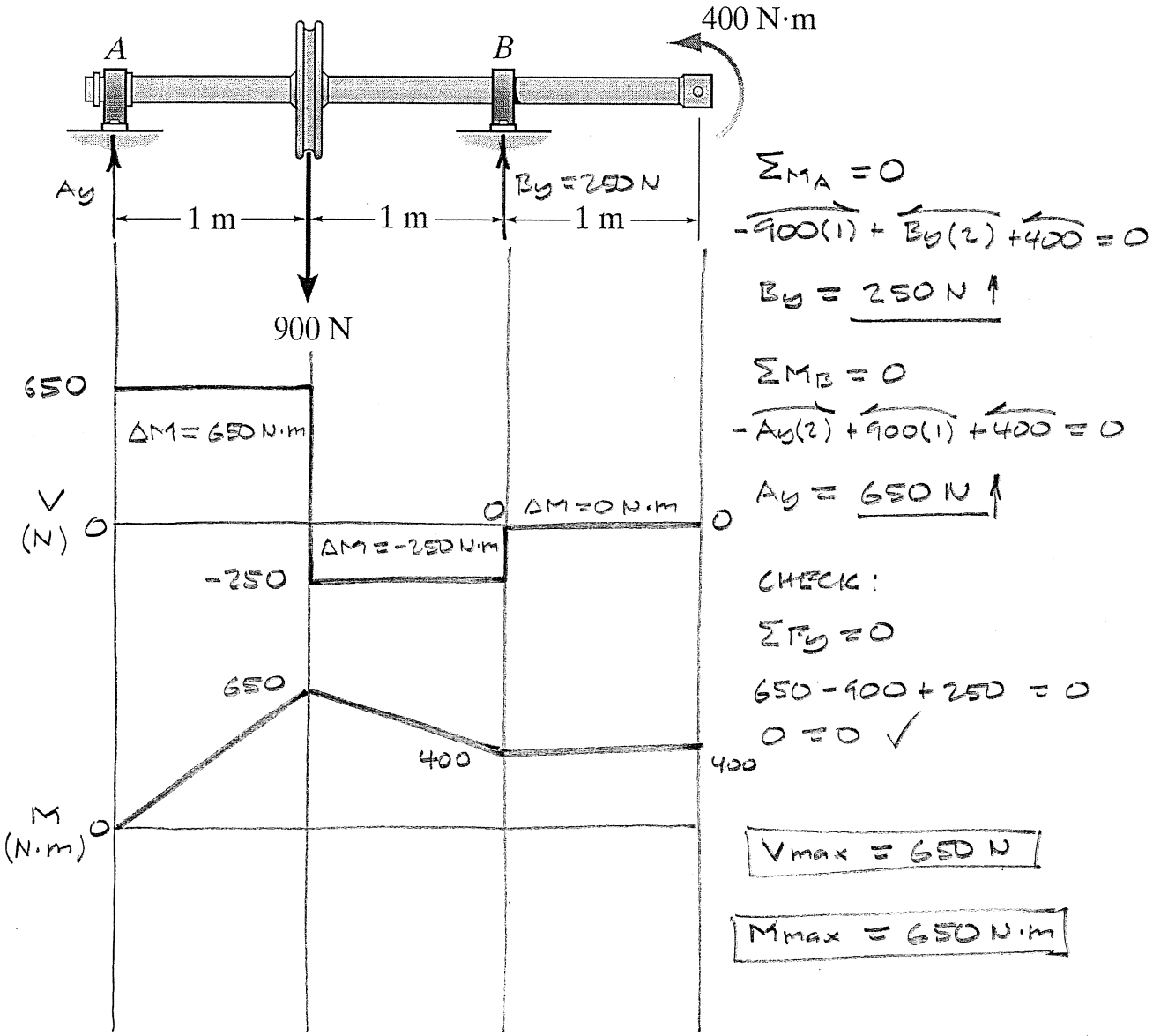
$\Sigma F_x = 0$

$16\,lb + 2125\,lb - F_A = 0$

$F_A = 2141\,lb$

3) GIVEN: The shaft is supported by a smooth thrust bearing at A and smooth journal bearing at B.

REQ'D: Draw the shear and moment diagrams for the shaft and indicate the maximum shear and moment. (H6.33)



$\Sigma M_A = 0$

$-900(1) + B_y(2) + 400 = 0$

$B_y = 250\ N \uparrow$

$\Sigma M_B = 0$

$-A_y(2) + 900(1) + 400 = 0$

$A_y = 650\ N \uparrow$

CHECK:

$\Sigma F_y = 0$

$650 - 900 + 250 = 0$

$0 = 0$ ✓

$V_{max} = 650\ N$

$M_{max} = 650\ N \cdot m$