

① VERIFICATION OF FBD:

HORIZONTAL DRAG FORCE (AXIAL & PERPENDICULAR COMPONENT DETERMINATION)

$$(AXIAL) \quad D_x = (\cos 7.66^\circ) 2001b = 1981b$$

$$D_y = (\sin 7.66^\circ) 2001b = 271b$$

STATICS EQUATIONS

$$\sum F_x = 0; 20001b - 1981b + C_x = 0 \rightarrow C_x = 18021b$$

$$\sum F_y = 0; 271b - B_y + C_y = 0$$

$$\cancel{\sum F_z = 0; 0 = 0} \quad (\text{TRIVIAL})$$

$$\sum M_x = 0; 4800 \text{ in-lb} = 4800 \text{ in-lb}$$

$$\cancel{\sum M_y = 0; 0 = 0} \quad (\text{TRIVIAL})$$

$$\sum M_z = 0; 271b(60 \text{ in}) - B_y(54 \text{ in}) = 0 \rightarrow B_y = \frac{271b(60 \text{ in})}{54 \text{ in}} = 301b$$

$$\text{USING } \sum F_y = 0; C_y = 301b - 271b = 31b$$

FBD MISSING $C_y = 31b$ ② SHEAR, MOMENT, AXIAL & TORSIONAL LOAD DIAGRAMS (SEE NEXT PAGE)③ MARGIN OF SAFETY CALCULATION:

$$d = \left\{ \frac{32N_f}{\pi} \left[\frac{\sqrt{(K_f M_a)^2 + \frac{3}{4}(K_{fs} T_a)^2}}{S_e} + \frac{\sqrt{(K_t M_m)^2 + \frac{3}{4}(K_{ts} T_m)^2}}{S_{ut}} \right] \right\}^{1/3} \quad (\text{EQN 9.8, TEXT})$$

$$N_f = \frac{d^3}{\left\{ \frac{32}{\pi} \left[\frac{\sqrt{(K_f M_a)^2 + \frac{3}{4}(K_{fs} T_a)^2}}{S_e} \right] \right\}} = \frac{(1.5 \text{ in})^3}{\left\{ \frac{32}{\pi} \left[\frac{\sqrt{(1.235(162 \text{ in-lb}))^2 + \frac{3}{4}(1.09(4800 \text{ in-lb}))^2}}{25,900 \text{ psi}} \right] \right\}}$$

$$\text{USING: } K_f = 1 + 0.94(1.25 - 1) = 1.235$$

$$N_f = 1.89$$

$$\text{MARGIN OF SAFETY} = \text{FACTOR OF SAFETY} - 1 = N_f - 1 = 1.89 - 1 = 0.89$$

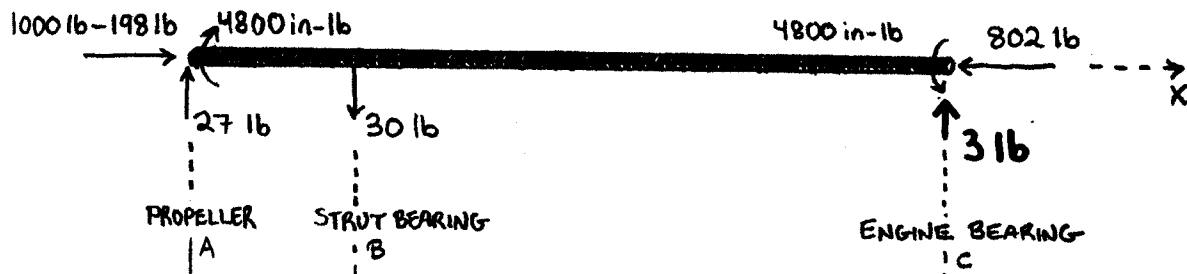
QUIZ #1 SOLUTION (CONT'D)

Free Body Diagram of Propeller Shaft:

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Shear, Moment, Axial, and Torsional Load Diagrams:

