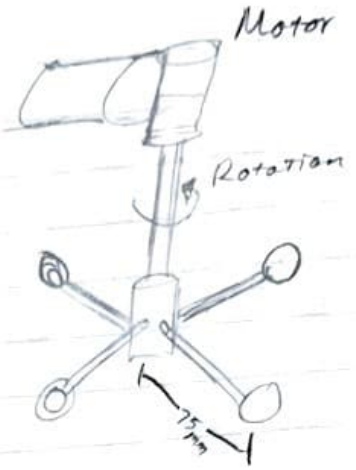
Mason Finn

HW 2.2 Chapter 17



$C_D = 0.41$

$V = \frac{75}{1000} \times \frac{2\pi \times 20}{60} = m/s$

$V = 0.157\ m/s$

$\rho = 1.225\ kg/m^3$

$A = \pi r^2$

$= \frac{\pi}{4} d^2$

$= \frac{\pi}{4} \times (0.025)^2$

$= 4.91 \times 10^{-4}\ m^2$

$F_D = 0.41\left(\frac{1.225 \cdot (0.157)^2}{2}\right) \cdot 4.91 \times 10^{-4}\ m^2$

$= 3.039 \times 10^{-6}\ N \times 4 = 1.215 \times 10^{-5}$

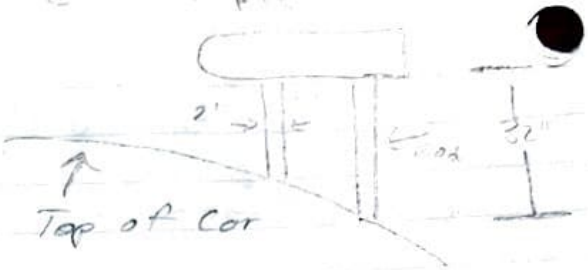
$T = Fd \times \gamma = 1.215 \times 10^{-5} \times 75 = 9.117 \times 10^{-4}\ N \cdot mm$

Total Torque $= 4(1.215 \times 10^{-5}) \cdot 75$

$= \boxed{3.645 \times 10^{-3}\ N \cdot mm}$

Air Temp -20°F @ 150 mph
-23.889 @ 150 mph

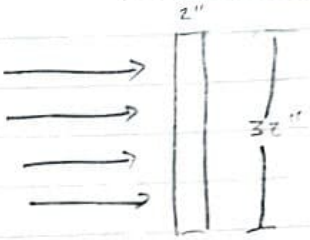
17-14 $F_D = ?$



Total $L = 64"$

Area $= 2 \times 32 = 64 in^2 = 0.04129 m^2$

Rod Force Diagram



$F_D = 2 \cdot \frac{1}{2} \rho v^2 A$

$\rho = 1.3943 \ kg/m^3$

$150 mph = 67.056 \ m/sec$

$F_D = 2 \cdot \frac{1}{2} \times 1.3943 \times (67.056)^2 \times 0.04129 \ m^2$

$= 258.866 \ N$

$= 58.195 \ lb f$

16) $b = 9\text{in}\left(\frac{1\text{ft}}{12\text{in}}\right)$ $b = 0.75\text{ ft}$ C_D = Drag Coefficient

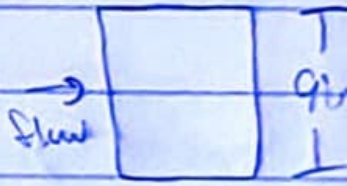
$L = 60\text{in}\left(\frac{1\text{ft}}{12\text{in}}\right)$ $L = 5\text{ ft}$

$V = 100\cancel{\text{mph}}\left(\frac{5280\text{ft}}{1\cancel{\text{mi}}}\right)\left(\frac{1\cancel{\text{hr}}}{3600\text{s}}\right)$ $V = 146.67\text{ ft/sec}$

Design A)

$N_R = \frac{VL}{\nu} \Rightarrow \frac{(146.67\text{ ft/sec})(0.75\text{ ft})}{1.17\times10^{-4}}$ $N_R = 9.401\times10^5$ $C_D = 2.10$

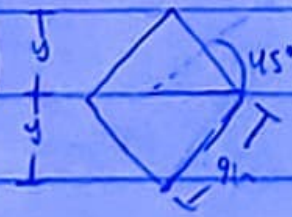
Projected Area of Body: $A = lb$ $A = 5\text{ ft}(0.75\text{ ft})$ $A = 3.75\text{ ft}^2$



$F_D = C_D\left(\frac{\rho V^2}{2}\right)A$ $F_D = 2.10\left(\frac{2.80\times10^{-3}\text{slugs/ft}^3 \cdot 146.67\text{ ft/sec}}{2}\right)3.75\text{ ft}^2$

$F_D = 237.17\text{ lb}$

Design B)



$\sin 45 = \frac{y}{9}$ $y = 9(\sin(45))$ $y = 6.363\text{in}\left(\frac{1\text{ft}}{12\text{in}}\right) = 0.5302\text{ ft}$ $C_D = 1.6$

$F_D = 1.6\left(\frac{2.80\times10^{-3}(146.67)^2}{2}\right)5.302$

$F_D = 255.48\text{lb}$ most resistance

Design C)

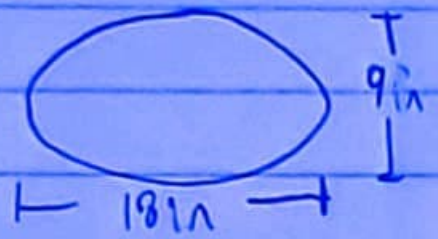
$N_R = \frac{146.67 \times 0.75}{1.17 \times 10^{-4}}$ $N_R = 9.401 \times 10^5$

$A = (5ft)(0.75ft)$ $A = 3.75 ft^2$ $C_D = 0.3$

$f_D = 0.4\left(\frac{2.80 \times 10^{-3}(146.67)^2}{2}\right) 3.75$ $f_D = 45.175\ lb$

Design D)

$\frac{L}{b} = \frac{18}{9} = \frac{2}{1}$



$A = lb$ $A = (5ft)(0.75ft)$
$A = 3.75 ft^2$

2:1 ratio

$N_R = \frac{146.67 \cdot 0.75}{1.17 \times 10^{-4}}$ $N_R = 1.88 \times 10^6$ $C_D = 0.35$

$f_D = 0.35\left(\frac{2.80 \times 10^{-3}(146.67)^2}{2}\right) 3.75$ $f_D = 39.529\ lb$ least resist

26)

Specific Resistance Ratio $(0.006)\Delta$

Velocity of Boat: 50 ft/sec

Temp of sea water: 77°F

Displacement of boat = 125 long tons

$$\text{Power} = R_t(V)$$

$$R_{ts} = (0.006\ (125)(2240)) \qquad R_{ts} = 16800\ \text{lb}$$

$$P = 16800\ \text{lb}\ (50\ \text{ft/sec}) \qquad \text{Power} = 840{,}000\ \text{lb}\cdot\text{ft/sec}\left(\frac{1\ \text{hp}}{550\ \text{lb ft/sec}}\right)$$

$$\text{Power} = 1527.27\ \text{hp}$$

30) Chord Length of airfoil: 1.4m ℓ

Span of the airfoil: 6.8 m b

Speed $V = 200 \text{km/h}\left(\frac{1000\text{m}}{1\text{km}}\right)\left(\frac{1\text{h}}{3600\text{s}}\right)$ $V = 55.55\text{m/s}$

$\alpha = 10°$ Altitude 200m - h $\rho = 1.202\text{kg/m}^3$

$A_{wing} = \ell b$ $A = (1.4\text{m})(6.8\text{m})$ $A = 9.52\text{m}^2$ $C_D = 0.05$ $C_L = 0.9$

$f_D = 0.05\left(\frac{1.202\text{kg/m}^3(55.55\text{m/s})^2}{2}\right) 9.52\text{m}^2$ $f_D = 882.77\text{N}$

$f_L = (0.9)\left(\frac{1.202\text{kg/m}^3(55.55\text{m/s})^2}{2}\right) 9.52\text{m}^2$ $f_L = 15,889.9\text{N} \Rightarrow 15.8891\text{kN}$

Altitude @ 10,000m

$f_D = (0.05)\left(\frac{0.4135\text{kg/m}^3(55.55\text{m/s})^2}{2}\right) 9.52\text{m}^2$ $f_D = 305.683\text{N}$

$f_L = (0.9)\left(\frac{0.4135\text{kg/m}^3(55.55\text{m/s})^2}{2}\right) 9.52\text{m}^2$ $f_L = 5466.29\text{N} \Rightarrow 5.4663\text{kN}$