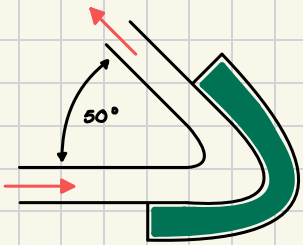
Homework 9

Problem 16-6

H_2O @ 180°F, 130° angle, entering velocity 22 ft/s, a in kept const, 2.95 in^2



Find force exerted on the H_2O by the vane

We consider from the book neglecting weight:

$R_x = \rho Q v_1 + P\cancel{A_1}$ $\quad R_y = \rho Q v_2 + P\cancel{A_2}$

cancel these terms b/c they will remain constant

$A = 2.95 in^2$ or $.02048\ ft^2$

$Q = .02048(22) \Rightarrow .45056$

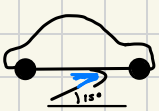
$\rho = 1.88$ ~~lbm/ft³~~ or ~~60.48 lb/ft²~~

$R_x = \frac{1.88}{\cancel{60.48}}(.45056)(22\cos 50 + 22) \Rightarrow$ ~~477.99 lb~~ 36.62 lb → +

$R_y = \frac{1.88}{\cancel{60.48}}(.45056)(22\sin 50) \Rightarrow -4.889$ lb (opp dir) ↑ +

Problem 16-20

$V = 30\ m/s$, $\varnothing = 200\ mm$ or $.2\ m$



Find force on vehicle a) if it stationary
b) if it moves @ $12\ m/s$

a)

$Q = \frac{\pi .2^2}{4} \times 30 \Rightarrow .942\ m^3/s$

$R_x = (1000)(.942)(30 + \underbrace{22.74}_{-30\cos 15}) \Rightarrow 4973$ kN $\quad \sqrt{49.73^2 + 18.38^2} \Rightarrow$ 53.02 kN

$R_y = (1000)(.942)(+\underbrace{19.51}_{30\sin 15}) \Rightarrow 18.38$ kN

b)

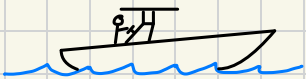
$Ve_1 = -30\cos 15 + 12 \Rightarrow 34.74$ $\quad \sqrt{34.74^2 + 22.74^2}$

$Ve_2 = -30\cos 15 \Rightarrow 22.74$

$\Rightarrow$ 41.54 N

Problem 17-26

- $R_{ts}/\Delta = .06$ (.006), displace 125 long ton, 50 ft/s, T = 77°F
- Find total ship resistance & power required to overcome drag



1 long ton = 2240 lb so $\Delta = 125(2240) \Rightarrow 280S$

then $R_{ts} = .006(280S) \Rightarrow R_{ts} = 1680$ lb

$Power_R = R_{ts}(V) \rightarrow 1680(50) \Rightarrow 8.4E4$ lb·ft/s

Problem 17-30

chord length = 1.4m, span = 6.8m

Determine lift & drag @ an angle of attack of 10°. Perform calculation @ a speed of 200 km/h @ a) 200m & b) 10,000 m

$V = 200$ km/h or 55.5 m/s

$\alpha = 10°$

$A = 1.4(6.8) \Rightarrow 9.52\ m^2$

$C_L = .8$, $C_D = .05$ from lift

a) $\rho_{@200} = 1.202$

$$F_D = .05\left(\frac{1.202 \cdot 55.6^2}{2}\right) 9.52 \Rightarrow 884.36\ N$$

$$F_L = .8\left(\frac{1.202 \cdot 55.6^2}{2}\right) 9.52 \Rightarrow 14.15\ kN$$

b) $\rho_{@10,000} = .414$

$$F_D = .05\left(\frac{.414 \cdot 55.6^2}{2}\right) 9.52 \Rightarrow 304.60\ N$$

$$F_L = .8\left(\frac{.414 \cdot 55.6^2}{2}\right) 9.52 \Rightarrow 4.87\ kN$$