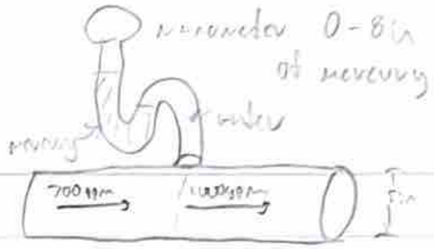


9) 5in type K Copper Tube $\quad$ 700gpm → 1000gpm

Temp 77°F

manometer 0in - 8in scale

$V_{min} = \frac{Q_{min}}{A}$ $\quad D_{nozzle} = 4.805in$ $\quad A = 0.1259\ ft^2$

$700gpm = \frac{0.1336 \times 700}{60}\ ft^3/s = Q_{min}$ $\quad V_{min} = \frac{\frac{0.1336 \times 700}{60}\ ft^3/sec}{0.1259\ ft^2}$ $\quad V_{min} = 12.37\ ft/sec$ ✓

$N_R = \frac{vD}{\nu}$ $\quad$ kinematic viscosity $= 3.84 \times 10^{-4}\ ft^2/s$ $\quad S_w = 58\ lb/ft^3$ $\quad 4.805in \rightarrow 0.400ft$

$N_R = \frac{12.37 \cdot 0.400}{3.84 \times 10^{-4}}$ $\quad N_R = 12{,}854.16$ $\quad C_D = 0.955$

$1000gpm = \frac{0.1336 \times 1000}{60}\ ft^3/sec = Q_{max}$ $\quad A = 0.1259\ ft^2$

$V_{max} = \frac{\frac{0.1336 \times 1000}{60}}{0.1259}$ $\quad V_{max} = 17.68\ ft/sec$

$N_R = \frac{vD}{\nu}$ $\quad$ kinematic viscosity $= 3.84 \times 10^{-4}\ ft^2/sec$ $\quad 4.805in \Rightarrow 0.400ft$

$N_R = \frac{17.68 \cdot 0.400}{3.84 \times 10^{-4}}$ $\quad N_R = 18{,}416.6$ $\quad C_D = 0.961$

$\gamma_m = 844.9\ lb/ft^3$ $\quad \gamma_w\ 58\ lb/ft^3$ $\quad h: 8in \rightarrow 0.667ft$ $\quad g = 32.2\ ft/s^2$

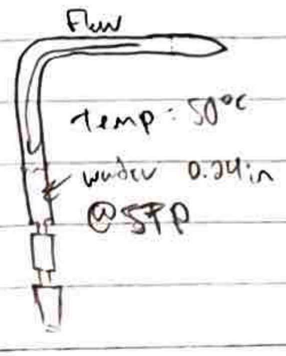
$A_1 = \frac{A}{\sqrt{\frac{2gh(\gamma_m/\gamma_w - 1)(C)^2}{V_{max}^2} + 1}} \Rightarrow \frac{0.1259}{\sqrt{\frac{2(32.2)(0.667)(844.9/58)(0.961)^2}{(17.68)^2} + 1}}$ $\quad A_1 = 0.07454\ ft^2$

$A_1 = \frac{\pi}{4}(d)^2$ $\quad d = \sqrt{\frac{A_1 \times 4}{\pi}}$ $\quad d = \sqrt{\frac{0.07454 \cdot 4}{\pi}}$ $\quad d = 3.697\ in$

15) $T = 50°C = 122°F$ $\quad$ manometer $= 0.24\ in\ (h)$ $\quad \gamma = 1.184\ lb/ft^3$ $\quad \gamma_{water} = 62.4\ lb/ft^3$

$0.24in \rightarrow 0.02ft$

$V_1 = \sqrt{2gh(\gamma_w - \gamma)/\gamma}$ $\quad V_1 = \sqrt{2(32.2)(0.02)(62.4 - 1.184)/1.184}$ $\quad V_1 = 8.16\ ft/sec$ ✓



HW. 2.3

Chapter 15:

4) D: 10 in Flow Rate (Q): 25 gal/min SG: 0.83 Dynamic Viscosity (μ): 2.5×10^{6} lb-s/ft^2
orifice diameter (d_1): 1.0 in (d_2): 7.0 in Specific Weight (γ_s): sg(62.4 lb/ft^3)

a) $A_1 = \frac{\pi(0.83)^2}{4}$ $A_1 = 0.541\ ft^2$ $A_2 = \frac{\pi(0.083)^2}{4}$ $A_2 = 5.41\times10^{-3}\ ft^2$

$\gamma_s = (0.83)(62.4\ lb/ft^3)$ $\gamma_s = 51.79\ lb/ft^3$

Conversion from gal/min to ft^3/s $\frac{25\ \cancel{gal/min}}{} \Big| \frac{1\ ft^3/sec}{449\ \cancel{gal/min}} = 0.056\ ft^3/sec$

$V_1 = \frac{Q}{A_1} = \frac{0.056}{0.541}$ $V_1 = 0.1035\ ft/sec$

$\rho_s = sg(\rho_w) = 0.83(1.94) = 1.6102\ slugs/ft^3$
Kinematic Viscosity $= \frac{2.5\times10^{-6}}{1.6102} = 1.55\times10^{-6}\ ft^2/s$

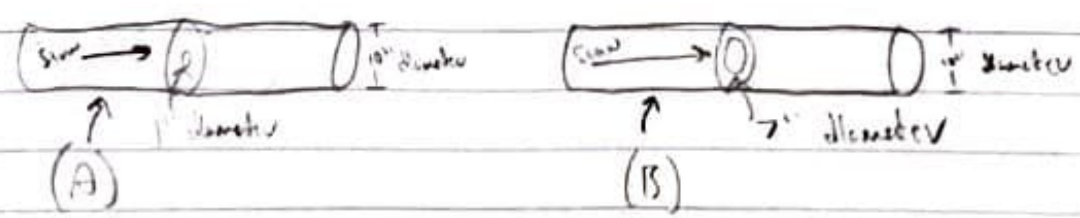
$N_R = \frac{V_1 D}{\nu} = \frac{0.1035(0.83)}{1.55\times10^{-6}} = 5.54\times10^{4}$
Diameter ratio of (a) 1.0 in pipe $\beta = \frac{d}{D} = \frac{1.0}{10}$ $\beta = 0.1$ $C_D = 0.594$

answered

a) $h = \left(\frac{0.1035}{0.594}\right)^2 \frac{[(0.541/5.41\times10^{-3})^2 - 1]}{2(32.2)[(62.4/51.79) - 1]}$ $h = 23\ ft$ ✓

b) $A = \frac{\pi(0.58)^2}{4}$ $A = 0.264\ ft^2$ $\beta = \frac{7.0}{10}$ $\beta = 0.7$ $C_D = 0.618$

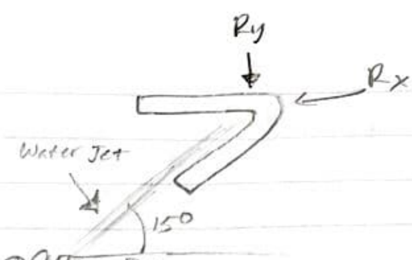
$h = \left(\frac{0.1035}{0.618}\right)^2 \frac{[(0.541/0.264)^2 - 1]}{2(32.2)[(62.4/51.79) - 1]}$ $h = 0.00678\ ft$ ✓



Mason Finn

HW 2.3

Chapter 16



16.20

$Q = Av = (3.142 \times 10^{-2})(30\,m/s) = 0.943\,m^3/s$

X: $R_x = \rho Q(v_2 - v_1) = \rho Q(v_2 - (-v_1 \cos 15))$

$R_x = \rho Q v(1 + \cos 15°) = 1.966 \rho Q v$

$R_x = (1.966)\left(\frac{1000\,kg}{m^3}\right)\left(\frac{0.943\,m^3}{s}\right)\left(\frac{30\,m}{s}\right)$

$R_x = 55.618 \times 10^3\,kg \cdot m/s^2 = 55.618\,kN$

Y: $R_y = \rho Q(v_2 - v_1) = \rho Q(0 - (-v_1 \sin 15)) = \rho Q v \sin 15°$

$R_y = (1000)(0.943)(30)(0.259) = 7.327 \times 10^3\,kg \cdot m/s^2 = 7.327\,kN$

$V_{1x} = V_1 \cos(15) = (30\,m/s)(0.966) = 28.98\,m/s$

$V_{1y} = V_1 \sin(15) = (30\,m/s)(0.259) = 7.76\,m/s$

$V_{e/x} = V_{1x} - 12\,m/s = 16.98\,m/s$

$|V_{e'y}| = \sqrt{(16.98)^2 + (7.76)^2} = 18.67\,m/s$

$\dot{m} = \rho Q = \rho A V_{e_1} = (1000\,kg/m^3)(3.142 \times 10^{-2}\,m^2)(18.67\,m/s) = 586.6\,kg/s$

Velocity at angle $\rightarrow$ $\alpha = \tan^{-1}(7.76 / 16.98) = 24.56$

$\beta = 24.56° - 15 = 9.56°$

$V_{e,F} = (V_{e1})\cos(9.56) = (14.67)(0.986) = 18.41\ m/s$

$R_x = M_e(\Delta V_x) = M_e(V_{e2x} - V_{e1x}) = (586.6)(18.41 - (-16.98))$

$\boxed{R_x = 20.86\ kN}$

$R_y = M_e(\Delta V_y) = M_e(V_{ey_2} - V_{ey_1}) = (586.6)(0 - (-7.76))$

$\boxed{R_y = 4.55\ kN}$

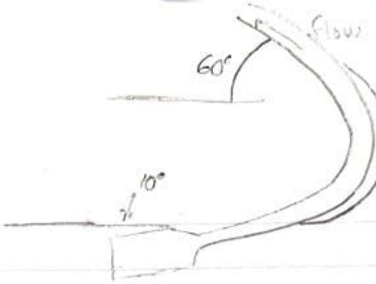
Given:

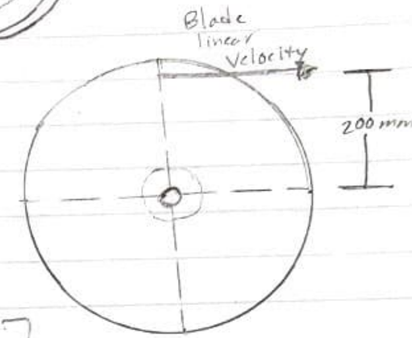
D = 7.50 mm

V = 25 m/s

H_2O Temp = 15°C

16.29





$$f_x = \rho A V[V\cos 10° - (-V\cos 60°)]$$

$$10^3 \times \frac{\pi}{4} \times (7.5\times10^{-3})^2 \times 25[25\cos 10° + 25\cos 60°]$$

$$= 40.997 \approx \boxed{41\ N}$$

$$f_y = \rho A V[V\sin 10 - V\sin 60°]$$

$$10^3 \times \frac{\pi}{4} \times (7.5\times10^{-3})^2 \times 25 \times [25\sin 10° - 25\sin 60]$$

$$\boxed{-19.11\ N}$$

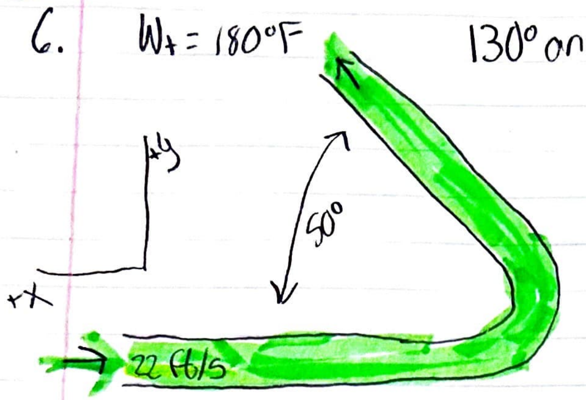
This is negative because the force ~~in~~ the Vertical direction is exceerted down.

HW 2.3

CH 16 16,11,2024

6. $W_t = 180°F$ 130° angle $V = 22$ ft/s $\gamma_w = 62.4$ lb/ft³

$a = 2.95$ in²



Complete forces in x and y

$Q = V \cdot A \therefore (264)\frac{in}{s} \cdot 2.95\,in^2 = 778.8\,\frac{in^3}{s}$

$\dot{m} = \rho \cdot Q = \cancel{62.4}\ 778.8\ \frac{in^3}{s}$

$.0361 \cdot 778.8 = 28.11\ \frac{lb}{s}$

$F_x = \dot{m}(22\cos 50 - 22)$

$28.11(22\cos 50 - 22)$

$1015.43\ \frac{lbft}{s^2} \cdot .03108 = \boxed{31.58\ lbft = F_x}$

$F_y = \dot{m}(22\sin 50 - 0) = 473.74 \cdot 12 = 5684.88\ \frac{lb\,in}{s^2}$

$\therefore 5684.88 \cdot .083$

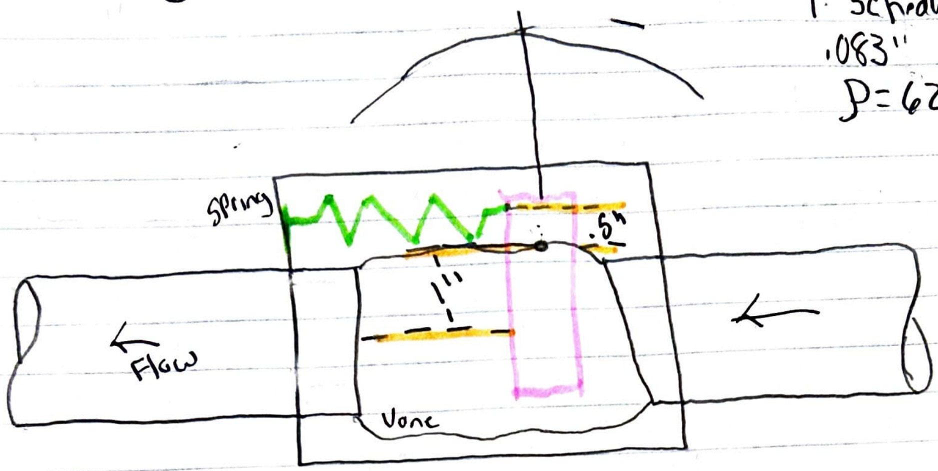
$= \frac{471.845}{32.174} = \boxed{14.67\ lb \cdot ft = F_y}$

11. Calc Spring force needed to hold the Vane @ 100 gpm or $.223\ ft^3/s$

1" Schedule 40 Pipe

.083"

$\rho = 62.4\ lb/ft^3$



$$F_W = \rho \cdot A \cdot V^2$$
$$= \rho(Q) \cdot v$$

$$F_W = (62.4)(.223)(40.89)$$
$$F_W = 568.99\ lb\ ft$$

$$V = \frac{.223}{\frac{\pi}{4}\left(\frac{1}{12}\right)^2} = 40.89\ ft/s$$

$$F_W \cdot 1 - S_F \cdot .5 = 0$$

$$S_F = 2 \cdot 568.99 = \boxed{S_F = 1137.98\ lbf}$$