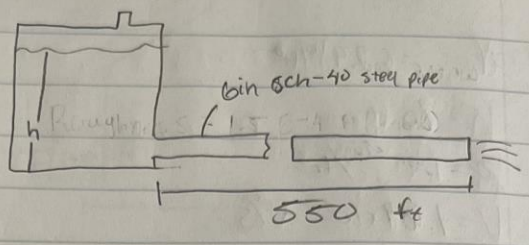
Module 5 HW Nicholas Albano (Ch8: ~~33~~, 38, ~~41~~, 46, 49, 62) (Ch10: ~~26~~, 37, 39, 43, 46, 48)

8.33:



$L = 550$ ft

$Q = 2.5\ ft^3/s$

$\gamma = 62.2$, $\rho = 1.93\ slug/ft^3$, $\nu = 9.15E\text{-}6\ ft^2/s$

$D = .505$ ft (Book)

$Q = V \cdot A \rightarrow V = \frac{Q}{A} = \frac{2.5\ ft^3/s}{\frac{\pi}{4} \cdot .505^2} = 12.46\ ft/s$

Roughness $= 1.5E\text{-}4$ (Book)

major loss $h_L = f \frac{L}{D} \cdot \frac{V^2}{2g}$, $Re = \frac{VD}{\nu}$, $rough = \frac{D}{\varepsilon}$

$$\frac{P_1}{\gamma}^{0} + \frac{V_1^2}{2g}^{0} + z_1 = \frac{P_2}{\gamma}^{0} + \frac{V_2^2}{2g} + z_2^{0} + H_{L12}$$

$$\rightarrow z_1 = \frac{V_2^2}{2g} + h_{L12} \rightarrow z_1 = \frac{V_2^2}{2g} + f \frac{L}{D} \cdot \frac{V^2}{2g} \rightarrow \frac{V_2^2}{2g}\left(1 + f \frac{L}{D}\right)$$

$$\frac{12.46^2}{2 \cdot 32.2}\left(1 + .016 \frac{550}{.5054}\right) = \boxed{45.7\ ft}$$

$f = .016$

$$Re = \frac{VD}{\nu} = \frac{12.46(.505)}{9.15E\text{-}6} = 6.8E5$$

$$\frac{D}{\varepsilon} = \frac{.505}{1.5E\text{-}4} = 3369$$

8.46:

water 60°F

$Q = 4\ ft^3/s$

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

$\rho = 1.94\ slug/ft^3$

$\nu = 1.21\ E\text{-}5\ ft^2/s$

$D = .6651\ ft$

$rough = 1.5\ E\text{-}4\ ft$

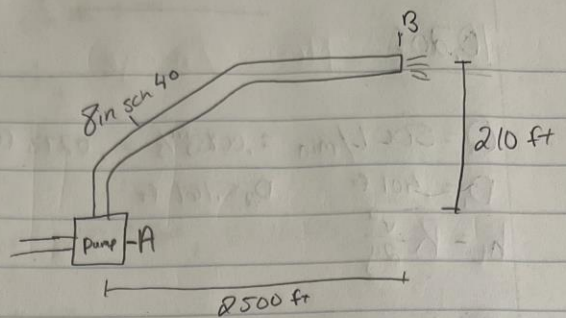
$L = 2500 ft$

$h = 210\ ft$

major → $h_L = f\frac{L}{D}\cdot\frac{V^2}{2g}$

or → $h_L = K\frac{V^2}{2g}$

$K = 16 ft$



$Re = \frac{VD}{\nu}$, $rough = \frac{D}{\varepsilon}$

$\frac{P_1}{\gamma}^{0} + \frac{V_1^2}{2g}^{0} + z_1^{0} = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2 + h_{L\,1B}$

$\frac{P_B}{\gamma} = -\frac{V_2^2}{2g} - z_2 - h_{L\,1B}$

$h_{L\,1B} = f\frac{L}{D}\cdot\frac{V^2}{2g} + 2\cdot K_{elbow}$

$V_2 = \frac{Q}{A} = \frac{4\ ft^3/s}{\frac{\pi}{4}\cdot .6651^2\ ft} = 11.51\ ft^2/s$

$\frac{P_B}{\gamma} = -z_2 - \frac{V_2^2}{2g}\left(1 + f\frac{L}{D} + 2K_{elbow}\right)$

$Re = \frac{11.51(.6651)}{1.21E\text{-}5} = 6.326E5$

$f = .015$

$\frac{D}{\varepsilon} = \frac{.6651}{1.5E\text{-}4} = 4434$

$f_T = .0140 \rightarrow K_{elbow} = 2\cdot 16(.0140) = .448$

$P_B = -210 ft - \frac{11.51^2}{2\cdot 32.2\ ft/s^2}\left(1 + .015\frac{2500}{.6651} + .448\right)\cdot 62.4\ lb/ft^3$

$P_B = 7633.45\ lb\text{-}ft/s$

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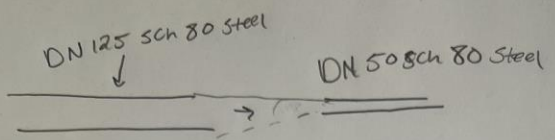


10.20:

$Q = 500 L/min = .0083 m^3/s = .0273 ft^3/s$

$D_1 = .401 ft$ $D_2 = .161 ft$

$A_1 = \frac{\pi}{4} .401^2 = .126 ft^2$

$A_2 = \frac{\pi}{4} .161^2 = .0203 ft^2$

$h_L = K \frac{v^2}{2g}$

~~$D_1 / D_2 = 2.49$~~

~~$A = \frac{\pi}{4} \cdot 2.49^2 = 4.869$~~

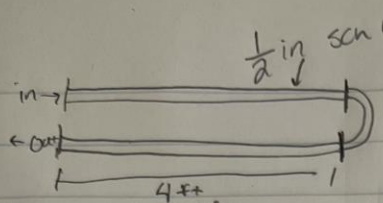
$V_1 = \frac{Q}{A} = \frac{.0273}{.126} = .216 ft/s$

$V_2 = \frac{Q}{A} = \frac{.0273}{.0203} = 1.34 ft/s$

$K = 0.4$ from table

$h_L = 0.4 \frac{1.34^2}{2 \cdot 32.2} = \boxed{.0111}$

10.37:



$Q = 12.5 \text{ gal/min} = .0278 \text{ ft}^3/\text{s}$

ethylene glycol at 77°F, $\gamma = 68.47 \text{ lb/ft}^3$, $\rho = 2.13 \text{ slugs/ft}^3$, $\nu = 1.59E-4$

$D = .0518 \text{ ft}$

$K = 50$

$A = \frac{\pi}{4}(.0518)^2 = .0021$

$Re = \frac{VD}{\nu} = 4.31E3$ $\quad$ roagh $= \frac{D}{\varepsilon} = \frac{.0518}{1.5E-4} = 3.45E2$

$f = .0429$

$f_T = .0259$

$V = \frac{Q}{A} = \frac{.0278}{.0021} = 13.23 \text{ ft}^2/\text{s}$

$$\frac{P_1}{\gamma} + \cancel{\frac{V_1^2}{2g}}^{0} + \cancel{z_1}^{0} = \frac{P_2}{\gamma} + \cancel{\frac{V_2^2}{2g}}^{0} + \cancel{z_2}^{0} + h_{L1B}$$

$$\frac{P_1}{\gamma} - \frac{P_2}{\gamma} = h_{L1B} \rightarrow h_L = f\frac{L}{D}\frac{V^2}{2g} \rightarrow .0429\,\frac{4}{.0518} \cdot \frac{13.23^2}{2 \cdot 32.2} = 9.0035$$

$$h_L = K\frac{V^2}{2g} \rightarrow 50 \cdot .0259\,\frac{13.23^2}{2 \cdot 32.2} = 3.519$$

$$P_1 - P_2 = (9.003 + 3.519)68.47 = \boxed{857.38 \text{ lb/ft}^2}$$