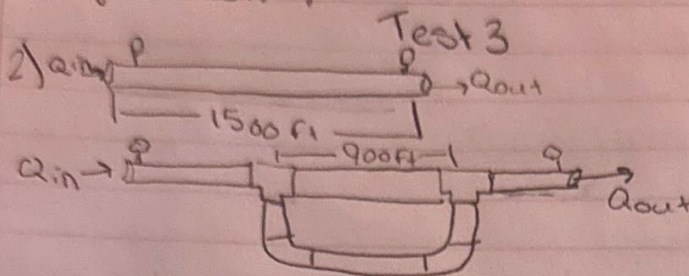


Adilgich Ashley

4/10/24



$$Q = 65 \text{ gpm} = 0.00409 \text{ m}^3/\text{s}$$

$$D = 47.50 \text{ mm}$$

$$E = 1.5 \times 10^{-6}$$

$$V = 2.30805 \text{ m/s}$$

$$1500 \text{ ft} = 457.2 \text{ m}$$

$$900 \text{ ft} = 274.32 \text{ m}$$

$$\frac{P_A}{\gamma} + \frac{V_A^2}{2g} + z_A = \frac{P_B}{\gamma} + \frac{V_B^2}{2g} + z_B + h_{L_{A-B}}$$

$$\frac{P_A - P_B}{\gamma} = h_{L_{A-B}}$$

$$\frac{D}{E} = \frac{47.50 \times 10^{-3}}{1.5 \times 10^{-6}} = 31,666.67 \quad Re = \frac{VD}{\nu} = \frac{2.30805(47.50 \times 10^{-3})}{8.94 \times 10^{-7}} = 122,631.56$$

$$f = \left[\frac{0.25}{10 \log \left(\frac{1}{31,666.67} \right) + \frac{5.74}{122,631.56^{0.9}}} \right]^2 = 0.01709$$

$$\frac{P_A - P_B}{\gamma} = f \frac{L}{D} \frac{8}{\pi^2} Q^2 = 0.01709 \frac{457.2}{(47.50 \times 10^{-3})^5} \frac{8}{\pi^2} (0.00409 \text{ m}^3/\text{s})^2 = 44.66 \text{ m}$$

$$P_A - P_B = 9.78 \times 44.66 = 437 \text{ kPa}$$

$$h_{L_c} = f_c \frac{[457.2 - 274.32]}{(47.50 \times 10^{-3})^5} \cdot \frac{8}{\pi^2} Q^2$$

$$h_{L_c} = 62,491,216.94 f_c Q^2$$

$$h_{L_b} = f_b \frac{274.32}{(47.50 \times 10^{-3})^5} \cdot \frac{8}{\pi^2} Q^2 = 93,736,915.42 f_b Q^2$$

$$h_{L_s} = 20 f_s \frac{8}{\pi^2} \frac{1}{(47.50 \times 10^{-3})^5} Q^2 = 20(0.0097) \frac{8}{\pi^2} \frac{1}{(47.50 \times 10^{-3})^5} Q^2 \quad f_s = \frac{0.25}{(10 \log \left(\frac{1}{31,666.67} \right))^2} = 0.0097$$

$$= 3,148.82 Q^2$$

$$44.66 \text{ m} = 62,491,216.94 f_c Q^2 + 93,736,915.42 f_b Q^2 + 3,148.82 Q^2$$

$$h_{L2} = f_c \frac{L_c}{D_c} \frac{8}{\pi^2 g} Q_c^2 = f_c \frac{274.32}{(34.80 \times 10^{-3})^5} \cdot \frac{8}{9.81 \pi^2} Q_c^2 = 444,101,752.113 f_c Q_c^2$$

$$h_{L2} = 60 f \frac{8}{\pi^2 g} \frac{1}{D_c^5} Q_c^2 = 60(0.0097) \frac{8}{9.81 \pi^2 (47.50 \times 10^{-3})^5} Q_c^2$$

$$= 9,446.48 Q_c^2$$

$$h_{L2} = 30(0.0097) \frac{8}{9.81 \pi^2 (34.8 \times 10^{-3})^5} Q_c^2 + 6.11 \frac{8}{9.81 \pi^2 (34.8 \times 10^{-3})^5} Q_c^2$$

$$+ 0.006 \frac{8}{9.81 \pi^2 (34.8 \times 10^{-3})^5} Q_c^2 = 48507.33 Q_c^2$$

$$44.66 = 62491,276 f_a Q_c^2 + 444,101,752.113 f_c Q_c^2 + 9,446.48 Q_c^2$$

$$+ 48507.33 Q_c^2$$

Da= 47.5 mm 0.0475 m
Db= 47.5 mm 0.0475 m
Dc= 34.8 mm 0.0348 m
e= 4.60E-05 m

D/e_a 1.03E+03 hl_a= 62491276.9 hl_c= 444101752
D/e_b 1.03E+03 Hl_b= 93736915.4 Hl_c 9446.48 Pa-Pb/y= 44.66
D/e_c 7.57E+02 hl_a= 3148.82 hl_c 50000

Qa(m3/s)	Va(m/s)	RE_a	fa	fb	Qb(m3/s)	Vb	RE_b	fb	%error
0.00409	2.31	1.23E+05	2.18E-02	0.01	2.14E-01	1.21E+02	6.42E+06	1.96E-02	-95.60%
				0.03	2.14E-01	1.21E+02	6.42E+06	1.96E-02	34.80%
				0.04	2.14E-01	1.21E+02	6.42E+06	1.96E-02	51.10%
				0.05	2.14E-01	1.21E+02	6.42E+06	1.96E-02	60.88%
				0.02	2.14E-01	1.21E+02	6.42E+06	1.96E-02	2.20%
				0.024	2.14E-01	1.21E+02	6.42E+06	1.96E-02	18.50%
				0.0194	2.14E-01	1.21E+02	6.42E+06	1.96E-02	-0.82%
				0.01956	2.14E-01	1.21E+02	6.42E+06	1.96E-02	0.00%

fc	Qc(m3/s)	Vc	RE_c	fc	%error	
	0.01	4.47E-03	4.70E+00	1.83E+05	2.25E-02	-124.81%
	0.03	4.47E-03	4.70E+00	1.83E+05	2.25E-02	25.06%
	0.02	4.47E-03	4.70E+00	1.83E+05	2.25E-02	-12.40%
	0.021	4.47E-03	4.70E+00	1.83E+05	2.25E-02	-7.05%
	0.0213	4.47E-03	4.70E+00	1.83E+05	2.25E-02	-5.54%
	0.024	4.47E-03	4.70E+00	1.83E+05	2.25E-02	6.33%
	0.02248	4.47E-03	4.70E+00	1.83E+05	2.25E-02	0.00%

New
Qa(m3/s) %error

Qa=Qb+Qc 0.21843407 0.00%