UDOFIA, IBABA EMMANUEL
181ENG04/1092
Electrical/Electronics Engineering
ENG 311: Fluid mechanics

Throat diameter $d_2 = 95mm = 95 \times 10^{-3} m$
Inlet diameter $d_1 = 150mm = 150 \times 10^{-3} m$
Relative Density = 0.8
$Q_{act} = 40L/secs = 0.04 m^3/secs$
$C_d = 0.96$
$Z_2 - Z_1 = 150mm = 0.15m$

$$A_1 = \frac{\pi d^2}{4} = \frac{\pi \times (150 \times 10^{-3})^2}{4} = 0.0177 m^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{\pi \times (95 \times 10^{-3})}{4} = 4.419 \times 10^{-3} m^2$$

$$Q = \frac{C_d A_1 A_2 \sqrt{2gh}}{\sqrt{(A_1^2 - A_2^2)}} \quad \therefore Q\sqrt{(A_1^2 - A_2^2)} = C_d A_1 A_2 \sqrt{2gh}$$

$$\therefore \sqrt{2gh} = \frac{Q\sqrt{(A_1^2 - A_2^2)}}{C_d A_1 A_2}$$

$$2gh = \left[\frac{Q\sqrt{(A_1^2 - A_2^2)}}{C_d A_1 A_2}\right]^2 \qquad h = \left[\frac{Q\sqrt{(A_1^2 - A_2^2)}}{C_d A_1 A_2}\right] \div 2g$$

$$h = \left[\frac{0.04\sqrt{(0.0177)^2 - (4.419 \times 10^{-3})^2}}{0.96 \times 0.177 \times 4.419 \times 10^{-3}}\right]^2 \div 2 \times 9.81$$

$$= \frac{(9.130)^2}{2 \times 9.81} = \frac{83.3569}{19.62} = 4.24m$$

Then $h = \left(\frac{P_1}{\omega_1} + Z_1\right) = \left(\frac{P_2}{\omega_2} + Z_2\right)$

$$h = \left(\frac{P_1}{\omega_1} - \frac{P_2}{\omega_2}\right) + (Z_1 - Z_2)$$

$$4.24 = \frac{P_1 - P_2}{\omega} + (Z_1 - Z_2)$$

$$\frac{P_1 - P_2}{\omega} = 4.24 + (Z_2 - Z_1) \Rightarrow \frac{P_1 - P_2}{\omega}$$

$$\frac{P_1 - P_2}{\omega} = 4.39$$

$P_1 - P_2 = 4.39 \times \omega \quad \therefore P_1 - P_2 = 4.39 \times (0.8 \times 9.8 \times 1000)$
$P_1 - P_2 = 4.39 \times 7840$
$P_1 - P_2 = 34452.92 N/m^2$