Bassey Joy Anietie
18/ENG01/004
Fluid Mechanics

1) Relative Density = 0.8
Inlet Diameter; D_1 = 150mm = 150×10^{-3}m
Throat Diameter: D_2 = 75mm = 75×10^{-3}m
Q_{act} = 40l/sec = $0.04 m^3/sec$
C_d = 0.96
$z_2 - z_1$ = 160mm = 0.15m

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

$$A_2 = \frac{\pi d^2}{4} = \frac{\pi \times (75 \times 10^{-3})^2}{4} = 4.419 \times 10^{-3} m^2$$

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

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

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

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

$$\therefore h = \frac{\left(\frac{Q\sqrt{(A_1^2 - A_2^2)}}{C_d A_1 A_2}\right)^2}{2g}$$

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

$$h = \frac{\left(\frac{6.855799 \times 10^{-4}}{7.50896 \times 10^{-5}}\right)}{2 \times 9.81}$$

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

Then,

$$h = \left(\frac{P_1}{w_1} + z_1\right) - \left($$

$$h = \left(\frac{P_1}{w_1} - \frac{P_2}{w_2}\right)$$

$$4.24 = \frac{P_1 - P_2}{w}$$

$$\frac{P_1 - P_2}{w} = 4.24$$

$$\frac{P_1 - P_2}{w} = (4.$$

$$\frac{P_1 - P_2}{w} = 4.$$

$$P_1 - P_2 = 4.69$$

$$P - P_2 = 4.89$$

$$P_1 - P_2 = 4.39$$

$$P_1 - P_2 = 3.94$$

2 Inlet d; D_1 = 5
Throat d; D_2
A_1 = 0.02069
Sul of mercu
SP of oil =

$$\therefore h = \left[\frac{Sul}{SP} -\right.$$

$$h = \left[\frac{13.6}{0.9} -\right.$$

$$Q = \frac{C_d A_1 A_2}{\sqrt{(A_1^2 - A}}$$

$$Q = \frac{0.98}{\sqrt{(}}$$

$$Q = \frac{0.}{0.}$$

$$h = \left(\frac{P_1}{w_1} + z_1\right) - \left(\frac{P_2}{w_2} + z_2\right)$$

$$h = \left(\frac{P_1}{w_1} - \frac{P_2}{w_2}\right) + (z_1 - z_2)$$

$$4.24 = \frac{P_1 - P_2}{w} + (z_1 - z_2)$$

$$\frac{P_1 - P_2}{w} = 4.24 + (z_2 - z_1)$$

$$\frac{P_1 - P_2}{w} = (4.24 + 0.15)$$

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

$$P_1 - P_2 = 4.39 \times w$$

$$P_1 - P_2 = 4.39 \times (0.8 \times 9.81 \times 1000)$$

$$P_1 - P_2 = 4.39 \times 7848$$

$$P_1 - P_2 = 34452.72 \text{ N/m}^2$$

2 Inlet d; $D_1 = 300\text{mm} = 300 \times 10^{-3}\text{m}$

Throat d; $D_2 = 150\text{mm} = 150 \times 10^{-3}\text{m}$

$A_1 = 0.07069\text{m}^2$; $A_2 = 0.0177\text{m}^2$

Sp of mercury = 13.6 $C_d = 0.98$

Sp of oil = 0.9 ; Differential manometer; 250mm
; 0.25m

$$\therefore h = \left[\frac{Sm}{Sp} - 1\right]$$

$$h = \left[\frac{13.6}{0.9} - 1\right] y \qquad \therefore h = (14.11) \times 0.25$$

$$\therefore h = 3.528\text{m}$$

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

$$Q = \frac{0.98 \times 0.07069 \times 0.0177 \times \sqrt{2 \times 9.81 \times 3.528}}{\sqrt{(0.07069^2 - 0.0177^2)}}$$

$$Q = \frac{0.0102}{0.0689} \qquad \therefore Q = 0.149\text{m}^3/\text{s}$$

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

$$3.528 = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) - (Z_1 - Z_2)$$

$$3.528 + (Z_2 - Z_1) = \left(\frac{P_1}{w} - \frac{P_2}{w}\right)$$

recall, $Z_2 - Z_1 = 300\,mm = 0.3\,m$

$$(3.528 + 0.3) = \left(\frac{P_1 - P_2}{w}\right)$$

$$\left(\frac{P_1 - P_2}{w}\right) = 3.828$$

$$P_1 - P_2 = 3.828 \times w$$

recall, $w = 9.81 \times 0.9$

$$P_1 - P_2 = 3.828 \times 9.81 \times 0.9$$

$$P_1 - P_2 = 33.79\ kN/m^2$$