Ologunagba Bright Toluwalope
18/ENG04/062
Electrical & Electronics

① Given Sp of gravity 0.8
$d_1 = 150mm = 0.15m$
$d_2 = 75mm = 0.075m$
$z_2 - z_1 = 150mm = 0.15m$
$q = 40 litres/sec = 0.04 m^3/s$
$Cd = 0.96$
Pressure difference $P_1 - P_2$

$$A_1 = \pi d_1^2/4 = \pi \times \frac{0.15^2}{4} = 0.01767 m^2$$

$$A_2 = \pi d_2^2/4 = \pi \times \frac{0.075^2}{4} = 0.00442 m^2$$

$$Q = Cd \times \frac{A_1 A_2 \times \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$$

$$0.04 = \frac{0.96 \times 0.1767 \times 0.00442 \times \sqrt{2 \times 9.8 h}}{\sqrt{0.01767^2 - 0.00442^2}}$$

$$0.04 = 0.96 \times 0.004565 \times 4.429\sqrt{h}$$

$$4.429\sqrt{h} = \frac{0.96 \times 0.004565}{0.04}$$

$$\sqrt{h} = \frac{0.04}{0.96 \times 0.004565 \times 4.429}$$

$$h = 4.247 m$$

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

$$h = \frac{P_1}{w} - \frac{P_2}{w} + z_1 - z_2$$

$$4.247 = \left(\frac{P_1 - P_2}{\rho g}\right) - 0.15$$

$$\frac{P_1 - P_2}{\rho g} = 4.247 + 0.15$$

$$P_1 - P_2 = (4.397)\rho g$$

$$P_1 - P_2 = (4.397) \times 0.8 \times 1000 \times 9.81$$

$$P_1 - P_2 = 34.51 \text{ kN/m}^2$$

$d_1 = 300\text{mm} = 0.3\text{m}$ $d_2 = 150\text{mm} = 0.15\text{m}$

(2) $S.g = 0.9$ $S.g_{\text{mercury}} = 13.6$

Reading of different manometer

$y = 250\text{mm} = 0.25\text{m}$

$$A_1 = \frac{\pi d^2}{4}$$

$$= \frac{\pi \times 0.3^2}{4}$$

$$= 0.0707$$

$$A_2 = \frac{\pi d^2}{4}$$

$$= \frac{\pi \times 0.15^2}{4}$$

$$= 0.0177$$

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

$$= y\left[\frac{S.G_m}{S.G_L} - 1\right]$$

$$= 0.25\left[\frac{13.6}{0.9} - 1\right]$$

$$= 3.53\text{m}$$

i Discharge of oil Q.

Using the relation

$$Q = \frac{A_1 A_2 \times \sqrt{2gh} \times Cd}{\sqrt{A_1^2 - A_2^2}}$$

$$Q = \frac{0.0707 \times 0.0177 \times \sqrt{2 \times 9.81 \times 3.53} \times 0.98}{\sqrt{0.0707^2 - 0.0177^2}}$$

$$Q = 1.52\ m^3/s \quad \cancel{0.1548\ m^3/s} \quad 0.1489\ m^3/s$$

ii $P_1 - P_2 = ?$

$S \cdot g = 13.6$

$Cd = 0.98 \quad z_2 - z_1 = 300mm = 0.3m$

$$\left(\frac{P_1}{w} + z_1\right) - \left(\frac{P_2}{w} + z_2\right)$$

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

$$\frac{P_1 - P_2}{w} - 0.3 = 3.53$$

$$\frac{P_1 - P_2}{w} = 3.83$$

$$P_1 - P_2 = 3.83 \times 0.9 \times 981$$

$$= 33.81\ KN/m^2$$