NJOKU VICTORY
19IENG04053
Electrical engineering
ENG 214

$d_1 = 300mm = 0.3m$, $z_2 - z_1 = 300mm = 0.3m$

$d_2 = 150mm = 0.15m$

$A_1 = \frac{\pi \times d_1^2}{4} = \frac{\pi \times 0.3^2}{4} = 0.071m^2$

$A_2 = \frac{\pi \times d_2^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.018m^2$

$C_d = 0.98$

Specific gravity of Hg $S_{Hg} = 13.6$

Specific gravity oil $S_o = 0.9$

$y = 250mm = \frac{250}{1000} = 0.25m$

$$h = \left(\frac{P_1}{W} + z_1\right) - \left(\frac{P_2}{W} + z_2\right) = y\left[\frac{S_{Hg}}{S_o} - 1\right]$$

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

$h = 3.528m$

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

$$Q = \frac{0.98 \times 0.071 \times 0.018 \times \sqrt{2 \times 9.81 \times 3.528}}{\sqrt{0.071^2 - 0.018^2}}$$

$Q = 0.152 m^3/s$

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

$$h = 3.528 = \frac{P_1}{w} + Z_1 - \frac{P_2}{w} + Z_2$$

$$3.528 = \frac{P_1}{w} - \frac{P_2}{w} + Z_1 - Z_2$$

$$3.528 = \frac{P_1}{w} - \frac{P_2}{w} - 0.3$$

$$\frac{P_1}{w} - \frac{P_2}{w} = 3.528 + 0.3$$

$$\frac{P_1}{w} - \frac{P_2}{w} = 3.828$$

$$\frac{P_1 - P_2}{w} = 3.828$$

$$\frac{P_1 - P_2}{S_g} = 3.828$$

$$P_1 - P_2 = 3.828 \times [1000 \times 0.87 \times 9.81$$

$$P_1 - P_2 = 33797.412 \text{ N/m}^2$$

$$P_1 - P_2 = 33797 \text{ N/m}^2$$

? $d_1 = 150\text{mm} = 0.15\text{m}$

$d_2 = 75\text{mm} = 0.075\text{m}$

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

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

$z_1 - z_2 = 150\ mm = 0.15m$

$Q = 40\ lit/sec = 0.04\ m^3/s$

Sp gravity $= 0.8$

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

$$0.04 = \frac{0.96 \times 0.01767 \times 0.00442 \times \sqrt{2 \times 9.81 \times h}}{\sqrt{0.01767^2 - 0.00442^2}}$$

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

$$\sqrt{h} = \frac{0.04}{0.96 \times 0.00456 \times 4.429}$$

$$\sqrt{h} = 2.0608$$

$$(\sqrt{h})^2 = (2.0608)^2$$

$$h = 4.247m$$

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

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

$$\left(\frac{P_1 - P_3}{w}\right) = 4.247 + 0.15 = 4.397$$

$$(P_1 - P_2) = 4.397 \times w$$

$$= 4.397 \times (0.8 \times 1000 \times 9.81)$$

$$(P_1 - P_2) = 34507.656 \, N/m^2$$