OBOTTOR OGHENETEFEGOR WISDOM

[illegible]/322

ELECTRICAL ENGINEERING

FLUID MECHANICS ASSIGNMENT

1. Diameter of inlet of P_1 = 300mm = 0.3m

Area of inlet $A_1 = \pi/4 \times 0.3^2 = 0.07m^2$

Diameter of throat D_2 = 150mm = 0.15m

∴ Area of throat $A_2 = \pi/4 \times 0.15^2 = 0.01767 m^2$

Specific gravity of heavy liquid (mercury) in tube manometer $S_h = 13.6$

Specific gravity of liquid (oil) flowing through pipe $S_p = 0.9$

Reading of differential manometer, y = 250mm = 0.25

⇒ The differential (h) is given by:

$$h = \left[\frac{P_1}{\rho g} + Z_1\right] - \left[\frac{P_2}{\rho g} + Z_2\right] = y\left[\frac{S_h}{S_p} - 1\right] = 0.25\left[\frac{13.6}{0.9} - 1\right]$$

= 3.53m of oil.

∴ Discharge of oil, Q:

Using the relation,

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

$$Q = 0.98 \times \frac{0.07 \times 0.01767 \times \sqrt{2 \times 9.81 \times 3.53}}{\sqrt{0.07^2 \times 0.01767^2}}$$

$$Q = \frac{0.00121 \times 3.62}{0.0677}$$

∴ $Q = 0.189 m^3/s$

a. Pressure difference between entrance and throat section $P_1 - P_2$

$$h = \left(\frac{P_1}{\rho g} - Z_1\right)\left(\frac{P_2}{\rho g} - Z_2\right) = 3.53$$

But $Z_2 - Z_1$ = 300mm = 0.3m

$$\therefore \left(\frac{P_1}{\rho g} - \frac{P_2}{\rho g}\right) - 0.3 = 3.53$$

$\therefore P_1 - P_2 = (9.81) \times 0.1 \times 3.83$

$= 35.8 \text{ KN/m}^2$

2. Pressure difference $(P_1 P_2)$:

$A_1 = \frac{\pi}{4} D_1^2 = \frac{\pi}{4} \times 0.15^2 = 0.01767 m^2$

$A_2 = \frac{\pi}{4} D_2^2 = \frac{\pi}{4} \times (0.075)^2 = 0.00442 m^2$

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

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

$\therefore h = \left(\frac{0.04}{0.96 \times 0.00465 \times 4.429} \right) = 4.247 m$

$\therefore \text{Also } h = \left(\frac{P_1}{\omega} + f_1 \right) \left(\frac{P_2}{\omega} + f_2 \right)$

$4.247 = \left(\frac{P_1}{\omega} - \frac{P_2}{\omega} \right) (z_1 - z_2)$

$(P_1 - P_2) = P_g (4.247 + 0.15)$

$= (0.8 \times 1000 \times 9.81)(4.247 + 0.15)$

$= 34.51 \text{ KN/m}^2$