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DEPT: MECHATRONICS

MATRIC NO: 18/ENG05/058

FLUID MECHANICS ASSIGNMENT

1) Given $R.D = 0.8$, $D_1 = 150\text{mm} = 0.15\text{m}$, $D_2 = 75\text{mm} = 0.075\text{m}$

$$C_d = 0.96 \quad Q = 0.04\text{m}^3/\text{s}$$

$$A_1 = \frac{\pi D_1^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.007767\text{m}^2$$

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

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

$$0.04 = \frac{0.96 \times 0.007767 \times 0.00442 \times \sqrt{2 \times 9.81 \times h}}{\sqrt{(0.007767)^2 - (0.00442)^2}}$$

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

$$h = \left(\frac{0.04}{0.96 \times 0.004565 \times 4.429} \right)^2$$

$$h = 4.247\text{m}$$

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

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

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

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

$$P_1 - P_2 = (4.247 + 0.15) \rho$$

$$P_1 - P_2 = (0.8 \times 1000 \times 9.81) (4.247 + 0.15)$$

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

2) Diameter of Inlet $D_1 = 300 \text{ mm} = 0.3 \text{ m}$

$$\text{Area of Inlet } A_1 = \frac{\pi \times D_1^2}{4} = \frac{\pi \times 0.3^2}{4}$$

$$= 0.07 \text{ m}^2$$

Diameter of Inlet $D_2 = 150 \text{ mm} = 0.15 \text{ m}$

$$\text{Area of Inlet } A_2 = \frac{\pi \times D_2^2}{4} = \frac{\pi \times 0.15^2}{4}$$

$$= 0.01767 \text{ m}^2$$

$$S.G.C = 13.6, \quad sp = 0.9$$

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

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

$$y = \left[\frac{Shv}{sp} - 1 \right] = 0.25 \left[\frac{13.6 \pm 1}{0.9} \right] -$$

$$= 3.53 \text{ m of oil}$$

a) Discharge of Oil; $Q = \frac{cd \times A_1 A_2 \times \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}}$

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

$$Q = 0.1489 \text{ m}^3/\text{s}$$

b) Pressure difference between

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

$$\text{NB: } z_2 - z_1 = 300 \text{ mm} = 0.3 \text{ m}$$

$$3.53 = \left(\frac{P_1}{w} - \frac{P_2}{w} \right) - (z_1 - z_2)$$

$$\left(\frac{P_1 - P_2}{w} \right) + 0.3 = 3.53$$

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

$$P_1 - P_2 = 3.83 \times w$$

$$P_1 - P_2 = 3.83 \times 9.81 \times 0.9$$
$$= 33.8 \text{ kN/m}^2$$