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Matric: 19/ENR06/069

Department: Mechanical Engineering

Course: ENR 214

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Online Assignment:

1. Inlet:

$$D_1 = 0.3 \text{ m}$$

$$A_1 = \frac{\pi}{4} \times 0.3^2 \\ = 0.07 \text{ m}^2$$

Throat:

$$D_2 = 150 \text{ mm} = 0.15 \text{ m}$$

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

S_g of mercury (S_{gh}) = 13.6

S_g of oil = 0.9

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

$$h = \left(\frac{P_1}{\rho} + z_1 \right) - \left(\frac{P_2}{\rho} + z_2 \right) = y \left[\frac{S_{gh}}{S_g} - 1 \right] \\ = 0.25 \left(\frac{13.6}{0.9} - 1 \right) \\ = 3.53 \text{ m of oil}$$

i.) Discharge (Q): $C_d \frac{A_1 A_2}{\sqrt{A_1^2 - A_2^2}} \cdot \sqrt{2gh}$

$$= 0.98 \times \frac{0.07 \times 0.018}{\sqrt{0.07^2 - 0.018^2}} \times \sqrt{2 \times 9.81 \times 3.53} \\ = 0.152 \text{ m}^3/\text{s}$$

ii) Pressure difference: $P_1 - P_2$

$$h = \left(\frac{P_1}{\rho} - \frac{P_2}{\rho} \right) + (z_1 - z_2) = 3.53 \text{ m}$$

also, $z_1 - z_2 = 0.3 \text{ m}$

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

$$\frac{P_1 - P_2}{W} = 3.53 + 0.3 = 3.83$$

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

2. $S_g = 0.8$

$$D_1 \text{ (inlet)} = 0.15 \text{ m}$$

$$D_2 \text{ (throat)} = 0.075 \text{ m}$$

$$Z_1 - Z_2 = 0.15 \text{ m}$$

$$Q_{\text{act}} = 40 \text{ l/sec} = 0.04 \text{ m}^3/\text{s}$$

$$C_d = 0.96$$

$$A_1 = \frac{\pi \times 0.15^2}{4} = 0.018 \text{ m}^2$$

$$A_2 = \frac{\pi \times 0.075^2}{4} = 0.0044 \text{ m}^2$$

$$Q_{\text{act}} = \frac{C_d A_1 A_2 \sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}} = \frac{C_d \cdot A_1 A_2 \sqrt{2g} \times \sqrt{h}}{\sqrt{A_1^2 - A_2^2}}$$

$$\sqrt{h} =$$

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

$$= \frac{0.04 \times \sqrt{0.018^2 - 0.0044^2}}{0.96 \times 0.018 \times 0.0044 \times \sqrt{2 \times 9.81}}$$

$$= \frac{0.04 \times \sqrt{0.018^2 - 0.0044^2}}{0.96 \times 0.018 \times 0.0044 \times \sqrt{2 \times 9.81}}$$

$$\sqrt{h} = 2.073$$

$$h = (2.073)^2$$

$$= 4.3 \text{ m}$$

$$\text{also, } h = \left(\frac{P_1 - P_2}{W}\right) + (Z_1 - Z_2)$$

$$4.3 = \left(\frac{P_1 - P_2}{\rho g} \right) - 0.15$$

$$P_1 - P_2 = 4.45 (0.8 \times 1000 \times 9.81)$$
$$= \underline{\underline{34.92 \text{ KN/m}^2}}$$