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Mechanical Eng

Fluid mech assignment

1) $V_1 = 5 \text{ms}^{-1}$, $V_2 = 2 \text{ms}^{-1}$

1% at smaller end = 2.5m

$$h_i = 0.35 (V_1 - V_2)^2$$

Pressure at $2g$, $L = 2.0 \text{m}$

lower end

$$L = z_1 - z_2$$

$$\frac{P_1}{\omega} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\omega} + \frac{V_2^2}{2g} + z_2 + h_i$$

$$\frac{P_2}{\omega} = \frac{P_1}{\omega} + \frac{1}{2g} (V_1^2 - V_2^2) + (z_1 - z_2) h_i$$

$$= 2.5 + \frac{5^2 - 2^2}{2 \times 9.81} + \frac{L - (0.35(5-2)^2)}{2 \times 9.81}$$

$$= 2.5 + 1.09 + 2(0.16055)$$

$$P_2 = \underline{5.409 \text{ bar}}$$

Pressure at lower ends = 5.409 bar

2) Inlet diameter = 200mm

Throat diameter = 100mm

$$P_1 = 17.658$$

$$J = 300 \text{ mmHg}$$

$$C_d = 0.98$$

$$A_1 = \frac{\pi d^2}{4} = \frac{(200/1000)^2 \times 3.14}{4}$$

$$= 0.0314 \text{ m}^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{(100/1000)^2 \times 3.14}{4}$$

$$= 7.853 \times 10^{-2}$$

$$J = 300 \text{ mm (0.3m of mercury)}$$

$$P_1 = 17.658$$

$$= \frac{17.658}{10000} = 1.7658 \times 10^{-3} \text{ N/m}^2$$

$$P_1/\omega = \frac{1.7658}{9.81} = 1.8 \times 10^{-4}$$

$$P_2/\omega = 0.3 \times 13.6 = 4.08 \text{ of H}_2\text{O}$$

$$h = \frac{P_1}{\omega} - \frac{P_2}{\omega} = 1.8 \times 10^{-4} - (-4.08)$$

$$= h = 4.08018$$

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

$$Q = \frac{0.98 \times 0.0314 \times 7.853 \times 10^3}{\sqrt{(0.0314)^2 - (7.853 \times 10^{-3})^2}}$$

$$Q = \frac{0.000241 \times 8.947}{0.0304}$$

$$Q = 0.0709 \text{ m}^3/\text{s}$$

5) $D_1 = 15 \text{ cm}$ $D_2 = 30 \text{ cm}$

$500 \text{ mm Hg} = 0.5 \text{ m}$

$q = ?$

S.G. = 0.9, $C_d = 0.64$

$$A_1 = \frac{\pi d^2}{4} = \frac{3.142 \times (15/100)^2}{4} = 0.0176 \text{ m}^2$$

$$A_2 = \frac{\pi d^2}{4} = \frac{3.142 \times (30/100)^2}{4} = 0.0706 \text{ m}^2$$

$$h = \pi \left(\frac{13.6}{0.9} - 1 \right)$$

$$h = 0.5 \left(\frac{13.6}{0.9} - 1 \right)$$

$$= 7.05$$

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

$$Q = \frac{0.64 \times 0.0176 (0.0706)}{\sqrt{(0.0176)^2 - (0.0706)^2}} \times \sqrt{2 \times 9.81 \times 7.05}$$

$$Q = \frac{9.35 \times 10^{-3}}{40.112}$$

$$Q = 2.33 \times 10^{-3} \text{ m}^3/\text{s}$$

$$4) A = 15m$$

170mm of mercury (0.17m)

$$SG \text{ of mercury} = 13.6$$

$$SG \text{ of sea water} = 1.026 \quad v = j$$

$$h = j \left(\frac{SG}{j} - 1 \right)$$

$$h = 0.17 \left[\frac{13.6}{1.026} - 1 \right]$$

$$h = 2.083m$$

$$v = \sqrt{2gh}$$

$$v = \sqrt{2 \times 9.81 \times 2.083}$$

$$v = \underline{\underline{6.39 \text{ ms}^{-1}}}$$