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MATRIC NO.: 19/ENG07/023

ENG 214 (FLUID MECHANICS)

Assignment

1) $Z_1 = 0$

$Z_2 = 2.0m$

$V_1 = 5m/s$

$V_2 = 2m/s$

The pressure $\frac{P_1}{w} = 2.5m$

$\frac{P_2}{w} = ??$

$$h_f = \frac{0.35(V_1 - V_2)^2}{2g}$$

$$= \frac{0.35(5-2)^2}{2\times 9.81} = 0.1606m$$

Applying Bernoulli's Equation

$$\frac{P_1}{w} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{w} + \frac{V_2^2}{2g} + Z_2 + h_f$$

$$\frac{P_2}{w} = \frac{P_1}{w} + \frac{V_1^2}{2g} + Z_1 - \frac{V_2^2}{2g} - Z_2 - hf$$

$$= 2.5 + \frac{5^2}{2\times 9.81} + 0 - \frac{2^2}{2\times 9.81} - 2.0 - 0.1606$$

$$= 2.5 + 1.274 - 0.204 - 0.1606 - 20$$

$$= 1.4094m$$

$$= 1.41m$$

2)

No3.

Orifice diameter $d_o = 15cm$

$= 0.15m$

Pipe diameter $d_1 = 30cm = 0.3m$ $\quad C_d = 0.64$

$A_o = \frac{\pi d_o^2}{4} = \frac{\pi (0.15)^2}{4} = 0.01767 m^2$

$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi (0.30)^2}{4} = 0.070686 m^2$

Differential head

$y = 50cm$

$= 0.5m$

$h = \frac{P}{\omega} = y \left(\frac{S.G \text{ of mercury}}{S.G \text{ of oil}} - 1 \right)$

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

$0.5 (14.11)$

$= 7.06m$

$\therefore h = 7.06m$

$\therefore Q = \frac{C_d \times A_1 A_o}{\sqrt{A_1^2 - A_o^2}} \cdot \sqrt{2gh}$

$= \frac{0.64 \times 0.01767 \times 0.07068}{\sqrt{(0.070686)^2 - (0.01767)^2}} \cdot \sqrt{2 \times 9.81 \times 7.06}$

$= \frac{0.009407}{0.06844}$

$Q = 0.1374 m^3/s$

$Q = 0.137 m^3/s$

4) Difference of Hg (y)

$y = 170mm$

$y' = 0.17m$

S.G of mercury = 13.6

S.G of seawater = 1.026

$\therefore h = y\left(\frac{\text{S.G of Hg}}{\text{S.G of seawater}} - 1\right)$

$= y\left(\frac{13.6}{1.026} - 1\right)$

$0.17(12.255)$

$= 2.088$

Velocity $= \sqrt{2g\Delta h}$

$= \sqrt{2 \times 9.81 \times 2.08}$

$V = 6.39 m/s$

2) $d_2 = 20cm = 0.2m$

$d_1 = 10cm = 0.1m$

$A_1 = \frac{\pi d^2}{4} = \frac{\pi (0.2)^2}{4}$

$= 0.0314 m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{\pi (0.1)^2}{4}$

$= 0.00985 m^2$

$P_1 = 17.658 N/cm^2 = 176580 N/m^2$

$P_2 = 30cm$ of mercury

$0.3m$ of Hg

$0.3 mHg \times 13.6$

$h_2 = 4.08$

for $h_1 = \frac{P_1}{w} = \frac{176580}{1000 \times 9.81}$

$= 18m$

$h = 18 - (-4.08)$

$= 22.08$

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

$= \frac{0.98 \times 0.0314 \times 0.00985 \times \sqrt{2 \times 9.81 \times 22.08}}{\sqrt{(0.0514)^2 - (0.00986)^2}}$

$Q = \frac{0.00503}{0.0304}$

~~$Q = 0.1054 m^3/s$~~

$Q = 0.1654 m^3/s$