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18/ENG02/002
COMPUTER ENGINEERING

Fluid mechanics assignment

1 $Z_1 = 0$

$Z_2 = 2.0m$

$L = Z_2 - Z_1 = 2.0m$

$V_1 = 5m/s$

$V_2 = 2m/s$ $\quad \frac{P_1}{w} = 2.5m$

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

$h_f = \frac{0.55(V_1 - V_2)^2}{2g} = \frac{0.55(5-2)^2}{2 \times 9.81} = \frac{0.33 \times 9}{2 \times 9.81}$

$= 0.1606m$

Applying Bernoulli Equation

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

$\frac{P_2}{w} = 2.5 + \frac{5^2}{2 \times 9.81} + 0 - \frac{2^2}{2 \times 9.81} + 2 - 0.1606$

$= 2.5 + 1.274 - 0.204 - 0.1606 + 2$

$= 5.41m$

$\frac{P_2}{w} = 5.41m$

(2) Area of inlet $A_1 = \frac{\pi}{4} \times 0.2^2 = 0.0314 m^2$

$D_2 = \frac{10}{100} = 0.1 m$

$A_2 = \frac{\pi}{4} \times 0.1^2 = 0.00785 m^2$

$P_1 = 0.17658$

$= 176.58 kN/m^2$

$\frac{P_1}{w} = \frac{176.58}{9.81} = 18 m$

$\frac{P_2}{w} = -0.3m \times 13.6 = -4.08$ of water

$Cd = 0.98$

$h = \frac{P_1}{w} - \frac{P_2}{w}$

$18 - (-4.08) = 22.08 m$

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

$= 0.98 \times \frac{0.0314 \times 0.00785}{\sqrt{(0.0314)^2 - (0.00785)^2}} \times \sqrt{2 \times 9.81 \times 22.08}$

$= \frac{0.000241}{0.0304} \times 20.81$

$Q = 0.165 m^3/s$

0.0314 m^2 ③ ~~$A_o = 15$~~

④ orifice diameter $d_o = 15cm = 0.15m$

pipe diameter $d_1 = 30cm = 0.30m$

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

$$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi(0.30)^2}{4} = 0.07065\ m^2$$

Differential head

$y = 50$

water $h = \frac{\rho}{w} = 0.5\, y\left(\frac{\text{S.G of mercury}}{\text{S.G of oil}} - 1\right)$

$= 0.5\left(\frac{13.6}{0.89} - 1\right)$

$= 7.22$ ~~of oil~~

$= 7.06\ m$

$$Q = Cd \times \frac{A_1 A_o}{\sqrt{A_1^2 - A_o^2}} \times \sqrt{2gh}$$

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

$$= \frac{0.009407}{0.06844}$$

$$= 0.137\ m^3/s$$

④ $y = 170mm = 0.17m$ of mercury

$S_{hl} = 13.6$

$S_l = 1.026$

$h = y\left(\frac{S_{hl}}{S_l} - 1\right)$

$h = 0.17\left(\frac{13.6}{1.026} - 1\right) = 2.08335$

$v = \sqrt{2gh} = \sqrt{2 \times 9.81 \times 2.08335}$

$= 6.39 m/s$

$= 6.39 m/s$

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