ELECT/Elec 4

A/Amg : AMADI-DUKU, C. Melvin

MAT NO: 19/ENG04/013

Soln

i) $D_1 = 300mm = 3m$, $Cd = 0.98$ $D_2 = 150mm = 15m$

$A_1 = \frac{\pi(3^2)}{4} = 0.07m^2$ $A_2 = \frac{\pi(15^2)}{4} = 0.1767m^2$

Discharge

$h = P_1 - P_2 = h_{oil}(S_n - 1) = 0.25[13.6 - 1]$

$= 3.53m$

Using $Q = \frac{Cd\sqrt{2gh} \times a_3 a_2}{\sqrt{a_1^2 - a_2^2}} = \frac{0.98 \times \sqrt{2 \times 981 \times 3.53} \times 0.07 \times 0.0177}{\sqrt{0.07^2 - 0.0177^2}}$

$Q = 0.149 m^3/s$

pressure difference

$\frac{P_1 - P_2}{w} + Z_2 - Z_1 = 3.53$

$Z_2 - Z_1 = 300$

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

Hence $P_1 - P_2 = 33.8 KN/m^2$

2) $Z_1 - Z_2 = 150mm = 0.15m$

Flow rate $= 40\ l/s = 0.04\ m^3/s$ $Cd = 0.96$

Relative density $= 0.8$, inlet diameter $= 150mm = 0.15m$

throat diameter $= 75mm = 0.075m$

$$A_1 = \frac{\pi(0.15)^2}{4} = 0.0177m^2 \qquad A_2 = \frac{\pi(0.075)^2}{4} = 4.4179\times10^{-3}\ m^2$$

$$Q = \frac{Cd\ A_1 A_2\sqrt{2gh}}{\sqrt{A_1^2 - A_2^2}} \quad = \quad 0.04 = \frac{0.96\times0.0177\times4.4179\times10^{-3}\times\sqrt{2gh}}{\sqrt{0.0177^2 - (4.4179\times10^{-3})^2}}$$

$$0.04 = \frac{7.51\times10^{-5}\times\sqrt{2gh}}{0.017}$$

$$6.8\times10^{-4} = 7.51\times10^{-5}\times\sqrt{2gh}$$

$$9.058 = \sqrt{2gh}$$

$$82.05 = 2gh$$

$$82.05 = 2\times9.81h$$

$$h = 4.182m$$

applying

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

$$h = \frac{P_1 - P_2}{w} - 0.15$$

$$4.18 = \frac{P_1 - P_2}{7848} - 0.15$$

$$4.332 = \frac{P_1 - P_2}{7848} \qquad P_1 - P_2 = 33997.2 \simeq 34\ kN/m^2$$