Ahmed Fawwaz Abiola

18/ENG06/004

Mechanical Engineering

ENG 214

Assignment

1) a) $d_1 = 300mm = 0.3m$

$d_2 = 150mm = 0.15m$

$A_1 = \frac{\pi d^2}{4} = \frac{\pi (0.3)^2}{4} = 0.07069 m^2$

$A_2 = \frac{\pi d^2}{4} = \frac{\pi (0.15)^2}{4} = 0.01767 m^2$

$(Z_2 - Z_1) = 300mm = 0.3m$

$y = 250mm = 0.25m$

$h = y\left(\frac{\text{Specific gravity of mercury}}{\text{Specific gravity of oil}} - 1\right)$

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

$h = 0.25(15.1 - 1)$

$h = 0.25(14.1)$

$h = 3.53m$

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

$$Q = \frac{0.98 \times 0.07069 \times 0.01767}{\sqrt{(0.07069)^2 - (0.01767)^2}} \times \sqrt{2 \times 9.81 \times 3.53}$$

$$Q = \frac{1.221 \times 10^{-3}}{0.06845} \times \sout{8.322}\ 8.322$$

$$Q = 0.1488\ m^3/s$$

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

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

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

$$h = \frac{1}{w}(P_1 - P_2) + (Z_1 - Z_2)$$

$$3.53 = \frac{1}{w}(P_1 - P_2) - 0.3$$

$$\frac{1}{w}(P_1 - P_2) = 3.53 + 0.3$$

$$\frac{1}{w}(P_1 - P_2) = 3.83$$

$$P_1 - P_2 = w(3.83)$$

$$P_1 - P_2 = 0.9 \times 1000 \times 9.81 \times 3.83$$

$$(P_1 - P_2) = 33815.07\ N/m^2 \text{ or } 33.815\ kPa$$

2) Relative

$(Z_1 - Z_2)$

$d_1 = 15$

$d_2 = 7$

$A_1 =$

$A_2 =$

$Cd = 0$

Actu

$Q =$

0.04

0.0

~~6~~

6.

81x3.53

2) Relative density of $\frac{\text{Liquid}}{\text{~~water~~}} = 0.8$

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

$d_1 = 150mm = 0.15m$

$d_2 = 75mm = 0.075m$

$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi (0.15)^2}{4} = 0.01767 m^2$

$A_2 = \frac{\pi d_2^2}{4} = \frac{\pi (0.075)^2}{4} = 4.418 \times 10^{-3} m^2$

$C_d = 0.96$

Actual rate of flow (Q) = 40 litres/sec
= $0.04 m^3/sec$

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

$$0.04 = \frac{0.96 \times 0.01767 \times 4.418 \times 10^{-3}}{\sqrt{(0.01767)^2 - (4.418 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81} \times \sqrt{h}$$

$$0.04 = \frac{7.494 \times 10^{-5}}{0.01711} \times 4.429 \times \sqrt{h}$$

~~$6.944 \times 10^{-4} = 3.31909\sqrt{h}$~~

$6.944 \times 10^{-4} = 3.31909 \times 10^{-4} \sqrt{h}$

$$\sqrt{h} = \frac{6.944 \times 10^{-4}}{3.31909 \times 10^{-4}}$$

$\sqrt{h} = 2.0620$

$h = (2.0620)^2$

$h = 4.25m$

kPg

$$\frac{P_1}{w} + z_1 + \frac{v_1^2}{2g} = \frac{P_2}{w} + z_2 + \frac{v_2^2}{2g}$$

$$h = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) + (z_1 - z_2)$$

$$4.25 = \frac{1}{w}(P_1 - P_2) - 0.15$$

$$\frac{1}{w}(P_1 - P_2) = 4.25 + 0.15$$

$$\frac{1}{w}(P_1 - P_2) = 4.40$$

$$(P_1 - P_2) = w(4.40)$$

$$P_1 - P_2 = 0.8 \times 1000 \times 9.81 \times 4.40$$

$$= 34531.2 \, N/m^2$$

$$P_1 - P_2 = 34.5311 \, kPa$$