ENG-214

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18/ENG06/007
MECHANICAL ENGINEERING

Assignment

1) $S.G = 0.8$, $D_1 = 150mm = 0.15m$, $D_2 = 75mm = 0.075m$
$Z_2 - Z_1 = 150mm = 0.15m$, $Q = 40lit/sec = 0.04m^3/s$, $Cd = 0.96$
$P_1 - P_2 = ?$

$$A_1 = \frac{\pi D_1^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.017667m^2$$

$$A_2 = \frac{\pi D_2^2}{4} = \frac{\pi \times 0.075^2}{4} = 0.004462m^2$$

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

$$h = \left(\frac{0.04}{0.96 \times 0.004565 \times 4.429}\right)^2 = 4.247m$$

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

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

$$4.247 = \left(\frac{P_1 - P_2}{P_g}\right) = 0.15$$

$$P_1 - P_2 = (4.247 + 0.15) P_g$$

$$P_1 - P_2 = (0.8 \times 1000 \times 9.81)(4.247 + 0.15)$$

$$P_1 - P_2 = 34.51 KN/m^2$$

2) Diameter of Inlet $D_1 = 300mm = 0.3m$
Area of Inlet $A_1 = \frac{\pi D^2}{4} = \frac{\pi \times 0.3^2}{4} = 0.07m^2$

Diameter of throat $D_2 = 150mm = 0.15m$
Area of throat $A_2 = \frac{\pi D^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.017667m^2$

Specific gravity of heavy liquid <mercury> in the tube
$S.g_m = 13.6$
S.G of liquid (oil) flowing through the pipe
$S.g_o = 0.9$
Reading of differential manometer, $y = 250mm = 0.25m$
The differential 'h' is given by:

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

$$= y\left[\frac{S_{gm}}{S.g_o} - 1\right] = 0.25\left[\frac{13.6}{0.9} - 1\right]$$

$$= 3.53m \text{ of oil}$$

a) Discharge of oil Q
Using the relation

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

$$Q = \frac{0.98 \times 0.07 \times 0.01761 \times \sqrt{2 \times 9.81 \times 3.53}}{\sqrt{0.07^2 - 0.01767^2}}$$

$$Q = 0.1489 m^3/s$$

b) $P_1 - P_2 = ?$ $P_1 - P_2$ = Pressure difference

$$h = \left(\frac{P_1}{w} + Z_1\right) - \left(\frac{P_2}{w} + Z_2\right) = 3.53$$

$$h = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) - (Z_1 - Z_2) = 3.53$$

$Z_2 - Z_1 = 300mm = 0.3m$

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

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

$$P_1 - P_2 = 3.83 \times w$$

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

$$\therefore P_1 - P_2 = 33.81 kN/m^2$$