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18/ENG061018 Mechanical

Given SP of gravity of,

$D_1 = 150mm = 0.15m$, $D_2 = 75mm = 0.75m$

$Z_2 - Z_1 = 150mm = 0.15m$, $Q = 402lt/sec = 0.04m^3/s$

$Cd = 0.96$

pressure difference $(P_1 - P_2)$

$$A_1 = \frac{\pi D_1^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.01767m^2$$

$$A_2 = \frac{\pi D_2^2}{4} = \frac{\pi \times 0.015}{4} = 0.00442m^2$$

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

$$0.04 = \frac{0.96 \times 0.01767 \times 0.00442 \times \sqrt{2} \times 9.81 \times h}{\sqrt{0.01767^2 - 0.00442^2}}$$

$$0.04 = 0.96 \times 0.004565 \times 4.429\sqrt{h}$$

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

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

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

$$4.247 = \left(\frac{P_1 - P_2}{P_g}\right) - 0.05$$

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

$(4.247 + 0.15)\rho g = P_1 - P_2$

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

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

2. Diameter of Inlet $D_1 = 300mm = 0.3m$

Area of diameter of Inlet $D_1 = \frac{\pi \times D_1^2}{4} = \frac{\pi \times 0.3^2}{4} = 0.07m^2$

Diameter of throat $D_2 = 150mm = 0.15m$

Area of Inlet $A_2 = \frac{\pi D_2^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.01767m^2$

Specific gravity of heavy liquid (mercury) Utube Vanometer $She = 13.6$

Specific gravity of liquid (oil) flowing through pipe $Sp = 0.9$

Reading of differential manometer, $y = 250mm = 0.25m$

The differential h is given by;

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

$$= y\left[\frac{Sh_1}{SP} - 1\right] = 0.25\left[\frac{13.6}{0.9} - 1\right] = 3.53Bm \text{ of oil} //$$

Discharge of oil

Using the relation:

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

$$Q = \frac{0.98 \times 0.07 \times 0.01767 \times \sqrt{2 \times 9.81 \times 3.53}}{\sqrt{0.07^2 - 0.1767^2}}$$

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

b) Pressure difference between entrance and throat Section Pt.

We all know that:

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

$$h = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) - (z_1 - z_2) = 3.53$$

$z_2 - z_1 = 300mm = 0.3m$

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

$$\frac{P_1 - P_2}{w} = 3.83$$

$P_1 - P_2 = 3.83w$

$P_1 - P_2 = 3.82 \times 9.81 \times 0.9$

$= 33.8 kN/m^2$ //