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Civil Engineering.

Fluid Mechanics.

1) Relative Density = 0.8.

Inlet diameter d_1 = 160mm = 160×10^{-3}m.

Throat diameter d_2 = 75mm = 75×10^{-3}m.

Q_{act} = 40x / 8secs = $0.04 m^3$/8secs.

C_d = 0.96.

$Z_2 - Z_1$ = 180mm = 0.18m.

$A_1 = \frac{\pi d^2}{4} = \frac{\pi \times (160 \times 10^{-3})^2}{4} = 0.0177 m^2$.

$A_2 = \frac{\pi d^2}{4} = \frac{\pi \times (75 \times 10^{-3})^2}{4} = 4.419 \times 10^{-3} m^2$.

$Q = \frac{C_d A_1 A_2 \sqrt{2gh}}{\sqrt{(A_1^2 - A_2^2)}}$ $\therefore Q\sqrt{(A_1^2 - A_2^2)} = C_d A_1 A_2 \sqrt{2gh}$.

$\therefore \sqrt{2gh} = \frac{Q\sqrt{(A_1^2 - A_2^2)}}{C_d A_1 A_2}$

$2gh = \left(\frac{Q\sqrt{A_1^2 - A_2^2}}{C_d A_1 A_2}\right)^2$ $h = \frac{\left(\frac{Q\sqrt{(A_1^2 - A_2^2}}{C_d A_1 A_2}\right)^2}{2g}$.

$$h = \frac{\left(\frac{0.04\sqrt{(0.0177)^2 - (4.419 \times 10^{-3})^2}}{0.96 \times 0.177 \times 4.419 \times 10^{-3}}\right)^2}{2 \times 9.81}$$

$$h = \left(\frac{6.855799 \times 10^{-4}}{7.50876 \times 10^{5}}\right)$$

$$2 \times 9.81$$

$$\frac{(9.130)^2}{2 \times 9.81} = \frac{83.3569}{19.62} = 4.24m$$

Then $= h = \left(\frac{P_1}{W_1} + Z_1\right) = \left(\frac{P_2}{W_2} + Z_2\right)$

$$h = \left(\frac{P_1}{W_1} - \frac{P_2}{W_2}\right) + (Z_1 - Z_2)$$

$$4.24 = \frac{P_1 - P_2}{W} + (Z_1 - Z_2)$$

$$\frac{P_1 - P_2}{W} = 4.24 + (Z_2 - Z_1)$$

$$\therefore \frac{P_1 - P_2}{W} = (4.24 + 0.15)$$

$$\frac{P_1 - P_2}{W} = 4.39$$

$$P_1 - P_2 = 4.39 \times W \quad \therefore P_1 - P_2 = 4.39 \times (0.8 \times 9.81 \times 1000)$$

$$P_1 - P_2 = 4.39 \times 7848$$

$$P_1 - P_2 = 34462.72 \, N/m^2$$

2. Inlet d $D_1 = 300m = 300 \times 10^{-3}m$ $A_1 = 0.07009m$

Throat d_1 $D_2 = 150mm = 150 \times 10^{-3}m$ $A_2 = 0.177m$

Sh. of mercury $= 13.6$ $C_d = 0.98$.

S.P of Oil $= 0.9$

Differential Manometer = 250mm = 0.25mm.

$$h = \left[\frac{S.L}{SP} - 1\right] y$$

$$h = \left[\frac{13.6}{0.8} - 1\right] y$$

$h = (14.11) \times (0.25)$

$h = 3.528m.$

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

$$Q = \frac{0.98 \times 0.07069 \times 0.0177 \times \sqrt{2 \times 9.81 \times 3.528}}{\sqrt{(0.07069^2 - 0.0177^2)}}$$

$Q = 0.0102$ $\quad Q = 0.149 m^3/s.$

0.0689

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

$$3.528 = \left(\frac{P_1}{w} - \frac{P_2}{w}\right) - (Z_1 - Z_2)$$

$$3.528 + (Z_2 - Z_1) = \left(\frac{P_1}{w} - \frac{P_2}{w}\right)$$

Recall, $Z_2 - Z_1 = 800mm = 0.8m.$

$$(3.528 + 0.8) = \left(\frac{P_1 - P_2}{w}\right)$$

$$\frac{P_1 - P_2}{w} = 3.828$$

$P_1 - P_2 = 3.828 \times w$

Recall, $w = 9.81 \times 0.9$

$P_1 - P_2 = 3.828 \times 9.81 \times 0.9$

$P_1 - P_2 = 33.79 KN/m^2.$