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Course | Fluid Mechanics (ENG 214)

1 $D_1 = 300mm = 0.3m$

$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi \times (0.3)^2}{4} = 0.07m^2$, $Cd = 0.98$

$D_2 = 150mm = 0.15m$

$A_2 = \frac{\pi d_2}{4} = \frac{\pi \times (0.15)^2}{4} = 0.017667$

$s.g(Hg) = 13.6$

$s.g(liquid) = 0.9$

Reading of manometer = 250mm = 0.25m

$\therefore h = \left(\frac{P}{w_1} + z_1\right) - \left(\frac{P_2}{w_2} + z_2\right)$

$= y\left[\frac{sgHg}{sp} - 1\right] = 0.25\left[\frac{13.6}{0.9} - 1\right] = 3.53$ of 0.1

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a) Discharge of oil

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

$= \frac{0.98 \times 0.07 \times 0.017667 \times \sqrt{2 \times 9.81 \times 3.53}}{\sqrt{(0.07)^2 - (0.017667)^2}}$

$Q = 0.1487 m^3/s$

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b) Pressure difference between entrance section and throat section

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

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

$z_2 - z_1 = 300mm = 0.3m$

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

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

$P_1 - P_2 = 3.83w \qquad w = hg \text{ or } \rho g$

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

$= 33.8 KN/m^2$

2 $D_1 = 150mm = 0.15m \qquad z_2 - z_1 = 150mm = 0.15m$

$D_2 = 75mm = 0.075m \qquad Q = 40 Lit/sec = 0.04 m^3/s$

$Cd = 0.96$

$A_1 = \frac{\pi \times d_1}{4} = \frac{\pi \times (0.15)^2}{4} \qquad A_2 = \frac{\pi \times d_2}{4} = \frac{\pi \times (0.075)}{4}$

$= 0.01767 m^2 \qquad = 0.00442 m^2$

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

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

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

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

$h = 4.247$

Recall

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

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

$4.247 = \left(\frac{P_1 - P_2}{w}\right) - 0.15$ from $w = \rho g$

$\frac{P_1 - P_2}{\rho g} = 4.247 + 0.15$

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

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