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Civil Engineering

DRD = 0.8 D1 = 0.15m W = ρg
Q = 40 l/s D2 = 0.075m ρ = 1000 × 0.8
⇒ 4.0×10^{-2} m^3/s W = 1000 × 0.8 × 9.81 = 7,848

Cd = 0.96

$A_1 = \frac{\pi (0.15)^2}{4} = 1.767 \times 10^{-2}\ m^2$

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

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

$4.0 \times 10^{-2} = \frac{0.96 \times 1.767 \times 10^{-2} \times 4.418 \times 10^{-3} \sqrt{2gH}}{\sqrt{1.767 \times 10^{-2} - 4.418 \times 10^{-3}}}$

$4.0 \times 10^{-2} = 0.96 \times 0.004565 \times 4.429\sqrt{H}$

$C_d = 0.96$

$A_1 = \frac{\pi (0.15)^2}{4} = 1.767 \times 10^{-2} m^2$

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

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

$4.0 \times 10^{-2} = \frac{0.96 \times 1.767 \times 10^{-2} \times 4.418 \times 10^{-3} \sqrt{2gH}}{\sqrt{1.767 \times 10^{-2} - 4.418 \times 10^{-3}}}$

$4.0 \times 10^{-2} = 0.96 \times 0.004565 \times 4.429 \sqrt{H}$

$h = \left[\frac{4.0 \times 10^{-2}}{0.96 \times 4.565 \times 10^{-3} \times 4.429} \right]^2$

$H = 4.249 m$

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

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

$h = \left(\frac{P_1 - P_2}{\omega}\right) + (0 - 0.15)$

$h = \left(\frac{P_1 - P_2}{\omega}\right) - 0.15$

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

$4.397 = \frac{P_1 - P_2}{\omega} \times$

$4.391 \times 1000 \times 0.8 \times 9.81 = P_1 - P_2$

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

(2) $d_1 = 0.3m$

$d_2 = 0.15m$

guage reading $= 0.25m$

$z_2 = 300mm$

$W = \rho g$

$\rho = 1000 \times 0.9$

$W = 1000 \times 0.9 \times 9.81$

$W = 8,829$

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

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

Diff - guage reading $= \frac{S.G \text{ Manometric fluid} - S.G\,0.2}{S.G\,0.2} \times$ guage reading

$= \frac{13.6 - 0.9}{0.9} \times 0.25 = 3.53$

$h = 3.53$

Finding Q,

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

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

$Q = 0.1489 m^3/s$

$h = 3.53$

Finding Q,

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

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

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

(b) Finding the Pressure difference

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

$$H = \left(\frac{P_1 - P_2}{\omega}\right) - 0.3$$

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

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

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

$$P_1 - P_2 = 33.8\ KN/m^2$$