EGBUNU HIKMAT IGANYA
18/ENG03/025
CIVIL ENGINEERING
FLUID MECHANICS ASSIGNMENT

(1) $V_1 = 5ms^{-1}$ $V_2 = 2ms^{-1}$ $L = 2.0m$

pressure head at smaller end $= 2.5m$

$$h_f = \frac{(0.35(v^1 - v^2)^2}{2g}$$

Pressure head at lower end:

$L = Z_1 - Z_2$

$$\frac{P_1}{\omega} + \frac{V_1^2}{2g} + Z_1 = \frac{P_2}{\omega} + \frac{V_2^2}{2g} + Z_2 = h_f$$

$$\frac{P_2}{\omega} = \frac{P_1}{\omega} + \frac{1}{2g}(V_1^2 + V_2^2) + (Z_1 - Z_2)h_f$$

$$= 2.5 + \frac{5^2 - 2^2}{2 \times 9.81} + 2 - \frac{(0.35(5-2)^2}{2 \times 9.81}$$

$$= 2.5 + 1.07 + 2 - 0.16055$$

$P_2 = 5.4096 bar$

∴ Pressure at lower end $= 5.4096 bar$

(2) Inlet diameter $= 20cm$

Throat diameter $= 10cm$ $C_d = 0.98$

Pressure @ Inlet $= 17.658 N/cm^2$ $J = 30cm$ of mercury

$$A_1 = \pi d^2/4 = \frac{(\frac{20}{100})^2 \times 3.14}{4}$$

$$= 0.0314m$$

$$A_2 = \pi d^2/4 = \frac{(\frac{10}{100})^2 \times 3.14}{4}$$

$$= 7.85 \times 10^{-5} m$$

$J = 30cm$ $(0.3m$ of mercury$)$

$$P_1 = \frac{17.658}{1000} = 1.7658 \times 10^{-3} N/m$$

$$= 17$$

$$\frac{P_1}{\omega} = \frac{1.7658 \times 10^{-3}}{9.81} = 1.8 \times 10^{-4} m$$

$$\frac{P_2}{\omega} = 0.3 \times 13.6 = 4.08 \text{ of } H_2O$$

$h = \frac{P_1}{w} - \frac{P_2}{w} = 1.8 \times 10^4 - (-4.08)$

$h = 4.08018m$

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

$Q = 0.98 \times \frac{0.0314 \times 7.853 \times 10^{-3}}{\sqrt{(0.0314)^2 - (7.853 \times 10^{-3})^2}} \times \sqrt{2 \times 9.81 \times 4.08018}$

$Q = \frac{0.000241}{0.0304} \times 8.947$

$Q = 0.0709 m^3/s.$

(3) $D_1 = 15cm \quad D_2 = 30cm$

500m of mercury $= 0.5m$ a: ?

$S.G = 0.9 \quad Cd = 0.64$

$A_1 = \frac{\pi d^2}{4} = \frac{(15/100)^2 \times 3.14}{4} = 0.0176m$

$A_2 = \frac{\pi d^2}{4} = \frac{(30/100)^2 \times 3.14}{4} = 0.0706m$

$h = J\left[\frac{13.6}{0.9} - 1\right]$

$h = 0.5\left[\frac{13.6}{0.9} - 1\right]$

$h = 7.05m$ ~~of oil~~

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

$Q = \frac{0.64 \times 0.0176 \times 0.0706}{\sqrt{(0.0176)^2 - (0.0706)^2}} \times \sqrt{2 \times 9.81 \times 7.05}$

$Q = \frac{9.35 \times 10^{-3}}{40.12}$

$Q = 2.33 \times 10^{-3} m^2/s.$

(4) Area $= 15m$

170mm of Mercury $= 0.17m$

SG of Mercury $= 63.6$

S.G of Sea water $= 1.026 \quad V = ?$

$h = J\left(\frac{S_1}{S_2} - 1\right)$

$h = 0.17\left[\frac{13.6}{1.026} - 1\right]$

$h = 2.083m$

$V = \sqrt{2gh}$

$V = \sqrt{2 \times 9.81 \times 2.083}$

$V = 6.39 ms^{-1}$