EBONG PRINCE VINCENT
18/ENG04/028
ELECTRICAL ELECTRONICS ENGINEERING
ENG 214 (FLUID MECHANICS)

Given Sp of gravity 0.8, $\Delta_1 = 150mm = 0.15m$,
$\Delta_2 = 75mm = 0.075m$. $Z_2 - Z_1 = 150mm = 0.15m$
$Q = 40 Lt/sec = 0.04 m^3/s$
$Cd = 0.96$
Pressure difference $(P_1 - P_2)$

$$A_1 = \frac{\pi \Delta^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.07767 m^2$$

$$A_2 = \frac{\pi \Delta^2}{4} = \frac{\pi \times 0.075^2}{4} = 0.00442 m^2$$

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

$$0.04 = \frac{0.96 \times 0.07767 \times 0.00442 \times \sqrt{2 \times 9.81 \times h}}{\sqrt{0.07767^2 - 0.00442^2}}$$

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

$$h = \left(\frac{0.04}{0.96 \times 0.004565 \times 4.429}\right)^2 = 4.247m //$$

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

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

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

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

$$(4.247 + 0.15) P_g = P_1 - P_2$$

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

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

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

Area of Inlet $A_1 = \frac{\pi \times D_1^2}{4} = \frac{\pi \times 0.3^2}{4} = 0.07m^2$

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

Area of inlet $A_2 = \frac{\pi D_2^2}{4} = \frac{\pi \times 0.15^2}{4} = 0.07767m^2$

Specfy gravity of heavy Liquid <mercury> in U tube manometer. $Sh_g = 13.6$

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

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

$$= y\left[\frac{Sh_g}{Sp} - 1\right] = 0.25\left[\frac{13.6}{0.9} - 1\right] = 3.53m \text{ of oil}$$

a Discharge of oil Q

Using the relation,

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

$$Q = \frac{0.98 \times 0.07 \times 0.07767 \times \sqrt{2 \times 9.81 \times 3.53}}{\sqrt{0.07^2 - 0.07767^2}}$$

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

b) Pressure difference between entrance and throat section $P_1 - P_2$ we all know that

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

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

$z_2 - z_1 = 300\,mm = 0.3\,m$ //

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

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

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

$$P_1 - P_2 = 3.83\,w$$

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

$$= 33.8\,kN/m^2$$ //