Name # Ikram ullah

ID # 7976

Section # B

Subject # Fluid mechanics

Date # 25/06/2020

Deptt # BE Civil Engg

Q#1 (a)

Ans of Q no 1

⇒ ENERGY HEAD

⇒ It is the sum of all energy heat at a point in a fluid.

⇒ Form of Energy Head

⇒ There are various forms of Energy Head which are as follow

1. Kinetic Head
2. potential Head
3. pressure Head

① Kinetic Head → It is the kinetic energy per unit weight of the fluid.

Mathematical Form ⇒ $\frac{K.E}{w} = \frac{\frac{1}{2}mv^2}{mg}$

$$\Rightarrow \frac{K.E}{w} = \frac{1}{2}\frac{v^2}{g}$$

Unit ⇒ Its Unit is meter (m).

Potiential HEAD ⇒ It is the potiential energy per unit weight of the fluid.

Mathematical form

$$\frac{P.E}{W} = \frac{mgh}{mg} = h$$

Pressure Head ⇒ The vertical height of the free surface above any point in a liquid at rest is pressure head.

OR

⇒ Level of fluid due to pressure exerted by fluid.

Mathematical Form

$$\text{Pressure Head} = \frac{P_r E}{\text{weight}} = \frac{P}{\gamma}$$

OR

$$= \frac{F \cdot ds}{W}$$

$$= \frac{P \cdot A \cdot ds}{W}$$

$$= \frac{P \cdot V}{W} = \frac{P}{\gamma} \text{ is pressure}$$

Q#01(b)

Ans ⇒ **Hydraulic Grade Line**

⇒ It is the line showing the pressure Head and the potential Head at a point in fluid.

OR

⇒ The surface or profile of water flowing in an open channel or pipe ~~is~~ ~~under~~ flowing partially full. If a pipe is under pressure, the hydraulic grade line is that level water would rise in a small vertical tube connected to the pipe.

Energy Line

⇒ A line which represents the elevation of energy Head (in feet or meter) of water flowing in a pipe or channel.

⇒ The line is drawn above the hydraulic Grade line a distance equal to the velocity head ($\frac{v^2}{2g}$) of the water flowing at each section or channel.

OR

⇒ It is the line joining the total heads along a pipe line.

Represented by :- It is represented by E.G.L

Hydraulic Radius

⇒ The ratio of cross-sectional area of a channel or pipe in which a is flowing to the wetted permeter of the conduct-

Q #02(a)

Given Data

$V = 2 m/sec$

$P = 300 KPa = 300 \times 10^3 N/m^2$

$Z = 5m$

$H = \text{pressure Head} + K.E + P.E$

$$H = \frac{P}{\gamma} + \frac{V^2}{2g} + Z$$

$$H = \frac{300 \times 10^3}{9810} + \frac{4}{2 \times 9.81} + 5$$

$$H = 30.58 + 0.101 + 5$$

$$\boxed{H = 35.785 \; Nm/N}$$

Q # 2(B)

Given Data

Diameter $d_1 = 300mm = 0.3m$

Diameter $d_2 = 200mm = 0.2m$

Pressure, $P_1 = 300Kpa = 300 \times 10^3 \, N/m^2$

Pressure $= P_2 = 120 \, Kpa = 120 \times 10^3 \, N/m^2$

Flow Rate, $Q = \frac{400}{1000} \, m^2/sec = 0.04 \, m^2/sec$

Required:-

Datum $= z = ?$

Solution :- As we know that

$$A_1 = \frac{\pi d_1^2}{4}$$

$$A_1 = \frac{3.14}{4} \times (0.3)^2$$

$$A_1 = 0.07065 \, m^2$$

$$A_2 = \frac{\pi d_2^2}{4}$$

$$A_2 = \frac{3.14 \times (0.2)^2}{4}$$

$$A_2 = 0.0314\ m^2$$

Now, As we know That

$$Q = V_1 A_1$$

$$V_1 = \frac{Q}{A_1}$$

$$V_1 = \frac{0.04}{0.0706}$$

$$V_1 = 0.5661\ m/s$$

And

$$V_2 = \frac{Q}{A_2}$$

$$V_2 = \frac{0.04}{0.0314}$$

$$V_2 = 1.2738\ m/s$$

Now

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

Where $Z_1 = 0$

$\gamma = 9810$

· putting values

$$\Rightarrow \frac{300 \times 10^3}{9810} + \frac{(0.566)^2}{2(9.81)} + 0 = \frac{120 \times 10^3}{9810} + \frac{(1.27)^2}{2(9.81)} + Z_2$$

$$\Rightarrow 30.597 = 12.314 + Z_2$$

$$\Rightarrow Z_2 = 30.597 - 12.314$$

$$\Rightarrow Z_2 = 18.282\,m$$

$$\Rightarrow Z_2 = 18.282\,m$$

Result

Hence $Z_2 = 18.282\,m$

Q#03

Given Data

Length of The pipe, $L = 500m$

Diameter, $d = 0.2\,m$

Specific Gravity of oil $= 0.9$

flow rate, $Q = 0.06\ m^3/sec$

Viscosity, $\mu = 6\times10^{-5}\ NS/m^2$

Density, $\rho = 0.9\times1000 = 900\ Kg/m^3$

Required :- pressure loss

Solution

As we know That

$$\nu = \frac{\mu}{\rho} = \frac{6\times10^{-5}}{900}$$

$$\nu = 6.67\times10^{-8}\ m^2/s$$

Now we have To find "V"

$$V = \frac{Q}{A} \rightarrow (1)$$

Now circular pipe

$$A = \frac{\pi d^2}{4}$$

$$A = \frac{3.14}{4}(0.2)^2$$

$$\boxed{A = 0.0314\, m^2}$$

Putting values in eq(i)

$$V = \frac{0.06}{0.0314}$$

$$\boxed{\Rightarrow V = 1.91\, m/s}$$

Now we know that

$$R = \frac{V \times d}{\nu}$$

$$R = \frac{1.91 \times 0.2}{6.67 \times 10^{-8}}$$

$$\boxed{R = 5.72 \times 10^{6}}$$

Now

$$f = 0.0032 + \frac{0.221}{(5.72\times10^{6})^{0.237}}$$

$$f = 0.0032 + (5.5320\times10^{-3})$$

$$\boxed{f = 8.73209\times10^{-3}}$$

Now from Bernoli's Equation,

Head loss, $H_F = \frac{fLV^2}{2gD}$

Putting values

$$H_F = \frac{fLV^2}{2gD}$$

$$= \frac{(8.73209\times10^{-3})(500)(1.91)^2}{2(9.81)(0.2)}$$

$$\boxed{H_F = 4.0590}$$

Now we know by pressure loss and Head loss relation,

$$h_L = \frac{\Delta p}{\rho g}$$

$$\Delta p = h_L \times \rho g$$

$$\Delta p = 4.0590 \times 900 \times 9.81$$

$$\Delta p = 35837.47 \text{ Pa}$$

$$\Delta p = 35.837 \text{ kPa}$$

Result

Hence pressure loss

$$\boxed{\Delta p = 35.837 \text{ kPa}}$$