NAME Ataullah khan

ID 7933

SEC B

DEPT Civil

SIMESTER 4th

SUB fluid mechanics

EXAM final term

TEACHER Sir! Abdul waheed

Question No # 01

Part (a)

Energy head :-

It is the sum of all energy head at a point in a fluid

Types of energy head :-

There are various form of energy head which are as follow

⇒ Kinetic head

⇒ Potential head

⇒ Pressure head

Kinetic head :-

It is the kinetic energy per unit weight of the fluid

Mathematical Form :-

$$\frac{K.E}{W} = \frac{\frac{1}{2}mv^2}{mg}$$

$$\frac{K.E}{W} = \frac{1}{2} \cdot \frac{v^2}{g}$$

This is also known as Velocity head

unit:-

It is unit in meter (m)

Potential head:-

It is the potential energy per unit weight of the fluid

Mathematical form:-

$$\frac{P.E}{w} = \frac{mgh}{mg}$$

$$P.E = h$$

(41)

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:

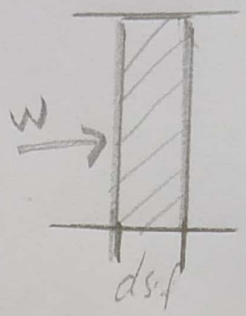
$$\text{Pressure head} = \frac{P_r E}{\text{weight}} = \frac{P}{\gamma}$$

(5)

OR

$$\Rightarrow \frac{F \cdot ds}{w}$$

$$\Rightarrow \frac{P \cdot A \cdot ds}{w}$$



$$\Rightarrow \frac{P \cdot V}{w} = \frac{P}{\gamma}$$ is pressure

Question No# 01
Part (b)

Hydraulic grade line:

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

Energy line:-

" " "

A line that repre-
-sent the elevation of energy head (in feet or meter) of water flowing in a pipe, conduit or channel. The line is drawn above the hydraulic grade line (gradient) a distance equall to the velocity head ($v^2/2g$) of the water flowing at each Section or point along the pipe or channel

(3)

Hydraulic radius:-

The ratio of the cross sectional area of a channel or pipe in which a fluid is flowing to the welted perimeter of the conduit

(1)

Question No # (2)

Part # (a)

Given data:

velocity = V = 2 m/s

Pressure = P = 300 kPa

datum = Z = 5 m

Sol:

$$H = \text{Pressure head} + K.E + P.E$$

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

(2)

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

$$\boxed{H = 35.7849 \text{ m}}$$

(3)

Question No # 2
Part (b)

Given data:

Diameter = d_1 = 300 mm

Diameter = d_2 = 200 mm

Pressure = P_1 = 300 kPa = 300×10^3 N/m²

$\Rightarrow P_2$ = 120 kPa = 120×10^3 N/m²

Datum = Z_2 = ?

$$Q = \frac{40}{1000} \text{ m}^3/\text{sec}$$

d_1 = 300 mm = 0.3 m

d_2 = 200 mm = 0.2 m

(4)

Required :-

$$Z_2 = \ ?$$

Sol :-

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

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

$$\boxed{A_1 = 0.0706} \ m^2$$

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

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

$$\boxed{A_2 = 0.0314} \ m^2$$

(5)

We know that

$$Q_1 = V_1 A_1$$

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

$$Q = \frac{40}{1000} = 0.04$$

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

$$\boxed{V_1 = 0.566 \text{ m/s}}$$

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

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

$$\boxed{V_2 = 1.27 \text{ m/s}}$$

(6)

Now

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

$$Z_1 = 0$$

$$\gamma = 9810$$

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

$$30.59 = 12.314 + Z_2$$

$$\boxed{Z_2 = 18.276 \text{ m}}$$

Question No # 03

Given data:-

$$\text{Length} = L = 500\ m$$

$$\text{dia} = d = 0.2\ m$$

$$V = 0.9$$

$$\mu = 6 \times 10^{-5}\ N.s/m^2$$

$$\phi = 0.06\ m^3/s$$

$$f_c = \left[0.0032 + \left(0.221/R^{0.237}\right)\right]$$

Req:-

Pressure loss due to friction = ?

(2)

As we know that

$$f = \left(0.0032 + \left(\frac{0.221}{R^{0.237}}\right)\right)$$

where

R = Reynold's No and is given as

$$R = \frac{V \times d}{\nu} \rightarrow (1)$$

and $\nu = \frac{\mu}{\rho}$

$$\nu = \frac{6 \times 10^{-5}}{900}$$

$$\nu = 6.67 \times 10^{-8}$$

(3)

and

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

For circular Pipe

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

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

$$A = 0.0314 \, m^2$$

Area Put in eq (II)

$$V = \frac{0.06}{0.0314} \Rightarrow 1.910 \, m/s$$

Now eq (I)

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

(4)

$$R = \frac{1.91 \times 0.2}{6.67 \times 10^{-8}} \Rightarrow 5.73 \times 10^{6}$$

$$f = 0.0032 + \frac{0.221}{R^{0.237}}$$

$$f = 8.729 \times 10^{-3}$$

$$\boxed{f = 0.008729}$$

Now from Bernoulis equation

Head loss $= h_2 = \frac{fLv^2}{2gD} \rightarrow (iii)$

Putting value in eq (iii)

$$h_2 = \frac{(0.008729)(500)(1.910)^2}{2(9.81)(0.2)}$$

(5)

$\Rightarrow h_2 = 4.05 \text{ m}$

Now to find pressure loss due to friction

Pressure head formula is used

$$h_2 = \frac{\Delta P}{S g}$$

$$\Rightarrow \Delta P = h_2 \times S g$$

$$\Rightarrow \Delta P = 4.05 \times 900 \times 9.81$$

$$\Rightarrow \Delta P = 36757.45 \text{ Pa}$$

$$\Rightarrow \boxed{\Delta P = 36.757 \text{ K.Pa}}$$