final term.

Fluid Mechanics

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Sec-A BE(C)

Semester 4th

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Submission date:- 25/06/2020

Question No. 01 (A)

Ans **Total Energy Head:-**

According to Bernoulli's equation,
The total energy ~~head~~ energy at a given point in a fluid is the energy associated with movement of fluid. And energy from static pressure in the fluid energy from height of fluid relative to an arbitrary datum height.

OR

The ~~Pr~~ Sum of Pressure head, Velocity head, and elevation head is Constant along a Stream line. The Constant is called total head.

→

Forms of Energy Head:-

There are Three forms of energy head.

① **Potential Head:-**
It is the Potential energy per unit weight.
It is due to position above same datum.

As Total head = pressure head + velocity head + potential head.

⟹ potential Head = ~~pres~~ total head − pressure head + velocity head.

② ~~velocity Head:-~~

~~It is~~

② **pressure Head:-**
It is the height of liquid columns that corresponds to a particular pressure exerted by liquid column on the base of container.

Kinetic Head:-

It represents kinetic energy per unit weight of fluid.

It is the height in feet that flowing fluid will Rise in column.

Question No. (1) (b)

Ans **Hydroulic Grade Line:-**

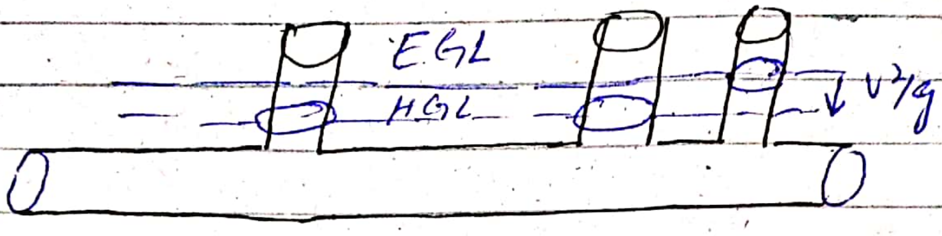
~~It is that~~
The level of water that would rise to in a Small vertical tube to Connected to the pipe and the pipe is under pressure is called hydroulic grade line.

It is denoted by "HGL".

This represents the total head available to the fluid minus the velocity head.

Hydroulic grade line lies one velocity head below the energy line.

$$HGL = \frac{P}{y+h}$$



Energy Grade Line (EGL)

It represents the elevation of energy head of water flowing in a pipe.

It is above the hydraulic grade line.

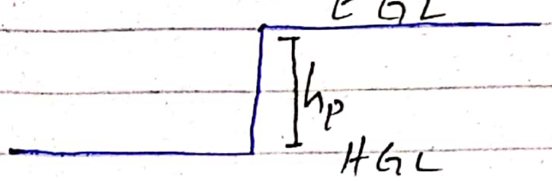
The Separation between HGL and EGL is known a velocity Head ($V^2/2g$).

Mathematically;

$$EL = H = \frac{P}{\gamma} + \frac{V^2}{2g} + h = \text{Constant}$$

along a Stream line.

rise in EGL is equal to hp



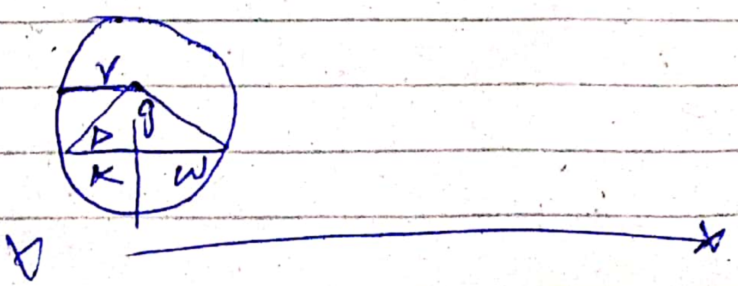
Hydroulic Radius:-

It is defined as the Cross-sectional area of flow divided by wetted perimeter,

So Calculation of rectangle trapozoidal, and triangular area will be include along perimeter of each.

It measures the effeciency of pipe.

It shows the function of shape in which the liquid is flowing.



Question No. 02 (b)(A)

Ans

Sol:

Given that;

$V = 2$ m/sec

$P = 300$ KPa

$\Rightarrow P = 300\times10^3$ N/m^2

$z = 5$ m

Required:

Head loss $= H = ?$

From Bernoulli's equation

$H =$ pressure Head + K.E + P.E

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

put values;

$$H = \frac{300\times10^3}{9810} + \frac{2^2}{2\times9.8} + 5$$

$$\Rightarrow \boxed{H = 35.783\,m} \text{ Ans.}$$

Question No. 02 (b)

Sol:-

Given data:-

Pressure = $P_1 = 300 kPa$

$\Rightarrow P_1 = 300 \times 10^3 Pa$

$P_2 = 120 kPa = 120 \times 10^3 Pa$

Diameter;

$d_1 = 300 mm$

$d_2 = 200 mm$

Datum = $z = ?$

As we know that;

$Q = \frac{40}{1000} m^2/sec = 0.04 m^2/sec$

$d_1 = 0.3m$

$d_2 = 0.2m$

→

$$A_1 = \frac{\pi d_1^2}{4} = \frac{\pi (0.3)^2}{4}$$

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

$$A_2 = \frac{\pi \cdot d_2^2}{4} = \frac{\pi (0.2)^2}{4}$$

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

As

$$Q = V_1 A_1$$

$$\Rightarrow V_1 = \frac{Q}{A_1} = \frac{0.04}{0.0706}$$

$$\Rightarrow \boxed{V_1 = 0.566}$$

Similarly;

$$V_2 = \frac{Q}{A_2} = \frac{0.04}{0.0314}$$

$$\Rightarrow \boxed{V_2 = 1.27}$$

Now

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

Put $Z_1 = 0$, $\gamma = 9810$

$$\Rightarrow \frac{300\times10^3}{9810} + \frac{(0.566)^2}{2(9.81)} + 0 = \frac{120\times10^3}{9810} + \frac{(1.27)^2}{2(9.81)} + Z_2$$

$\Rightarrow 30.597 = 12.314 + Z_2$

$\Rightarrow Z_2 = 30.597 - 12.314$

$\Rightarrow Z_2 = 18.2834$

Datum $= Z_2 = 18.2834$

X————X

Question No. 03

Ans **Solution**

Given data:-

Length of pipe = $L = 500m$

dia. = $D = 0.2m$

Specific gravity = $S = 0.9$

flow rate = $Q = 0.06 m^3/s$

Viscosity = $\mu = 6 \times 10^{-5} Ns/m^2$

Required:-

Pressure loss = $\Delta P = ?$

We know that;

$$f = \left(0.0032 + \frac{0.221}{R^{0.237}}\right) \rightarrow (1)$$

Here

R = Reynold's number

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

→

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

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

and $V = \frac{Q}{A}$ $\therefore A = \frac{\pi}{4}D^2$

$\Rightarrow V = \frac{0.06}{0.031}$ $= 0.031\ m^2$

$\Rightarrow V = 1.9356\ m/s$

$\Rightarrow R = \frac{1.9356\times0.2}{6.67\times10^{-5}} = 5.8\times10^{3}$

Hence

eq(i) $\Rightarrow f = 0.0032 + \frac{0.221}{(5.8\times10^3)^{0.237}}$

$\Rightarrow \boxed{f = 0.0664}$

According to Bernouli's equation

head loss $= h_L = \frac{fLV^2}{2gD} \rightarrow$ (ii)

Putting values in eq(ii)

$\rightarrow$

$$h_L = \frac{(0.0664)(500)(1.9356)^2}{2(9.81)(0.2)}$$

$h_L = 31.786$

To find pressure loss

$$h_L = \frac{\Delta P}{\delta g} \Rightarrow \Delta P = h_L \times \delta g$$

Putting values

~~h_L=~~ $\Delta P = 31.786 \times 900 \times 9.81$

$\Rightarrow \Delta P = 280638 \text{ Pa}$

$\Rightarrow \boxed{\Delta P = 280.638 \text{ kPa}}$

X ———————————————— X

THE END