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Section : A

Subj : Fluid Mechanics

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Q NO (a)

Total Energy Head :-

From Bernoulli principle, ~~in a fluid~~ The total Energy at a given point in a fluid is the Energy associated with moment of fluid, plus Energy from static pressure in the fluid Energy from height of fluid relative to an orbitrary datum hight.

OR

The Sum of pressure head (P/γ), velocity head ($\frac{V^2}{2g}$) and elevation head h is Constt along a Stream Line.

This Constt is called total head H.

Forms of Energy Head :-

There are Three Types of Energy head which are given below.

Potential Head :- It is potential Energy per unit weight. It is due to position above same detum line.

Pressure Head + velocity Head + potential Head = Total Head.

Potential Head = Total Head − velocity Head − pressure Head.

Kinetic Head :- It represented kinetic Energy of fluid. It is height in fect that a flowing fluid will rise in column.

Kinetic Head = Total Head - Potential Head - pressure Head.

Pressure Head :- It is height of Liquid Column that Corresponds to a particular pressure exerted by liquid Column that Corresponds a particular pressure exerted by liquid Column on the base of Container.

Pressure Head = Total Head - Kinetic Head - Potential Head.

Q NO1 (Part-b)

Ans -: Hydraulic Grade line HGL:

Hydraulic grade line refers to the profile of water streaming in an open channel or a pipe streaming in a part full. When a pipe is under pressure, The pressure driven review line is the level to which the water would ascend to in a little, vertical tube associated with a pipe.

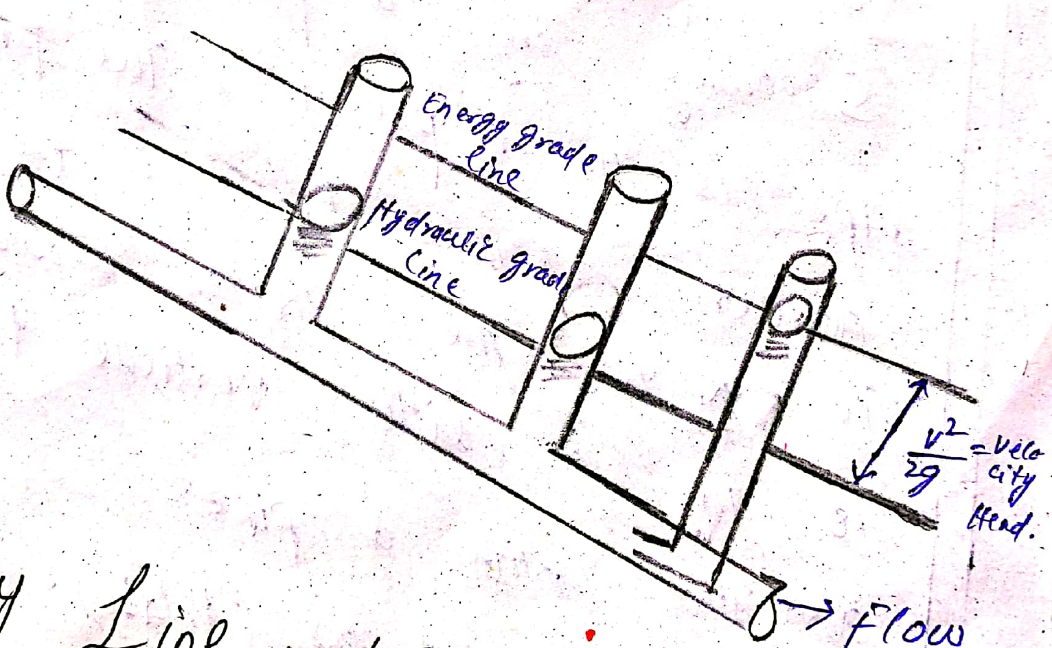
It is denoted as (HGL).

→ The Hydraulic grade line is a line representing the total Head avaliable to the fluid-minus velocity head and can be expressed as

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

Where HGL = Hydraulic Grade Line

The Hydraulic Grade line lies on velocity head below the Energy line



★ **Energy Line :- (EGL)**

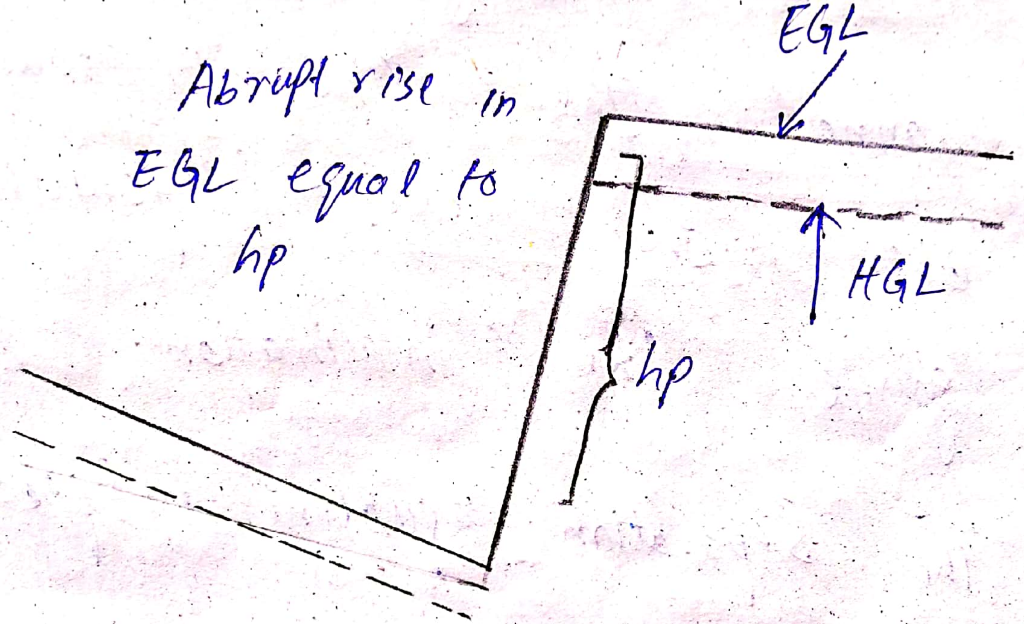
Energy Grade line refer to a line that represent to the height of Energy head of water Streaming in a pipe course, or Channel. The line is drawn over the pressure Hydraulic grade line (inclination. The Separation equalant to Speed head $\left(\frac{v^2}{2g}\right)$ of the water Streaming at every area or a point along the pipe or channel.

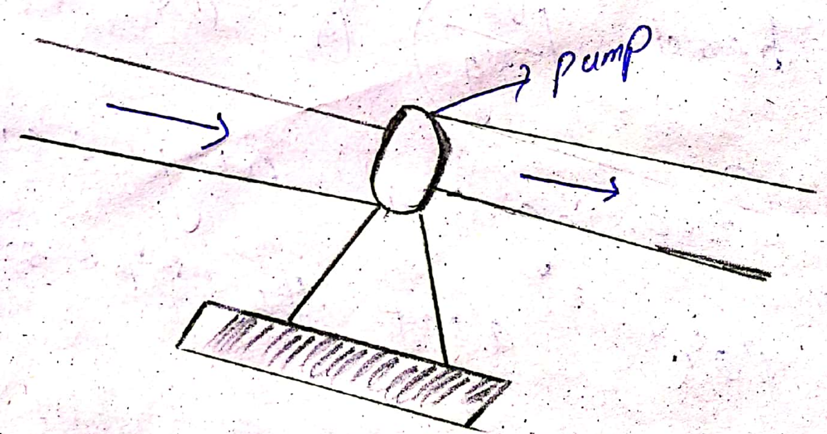
→ The Energy line is a line that represent that total head available the fluid can be represented as.

$$EL = H = \frac{P}{\gamma} + \frac{v^2}{2g} + h = \text{Constt along}$$

a Stream line.

EL = Energy line





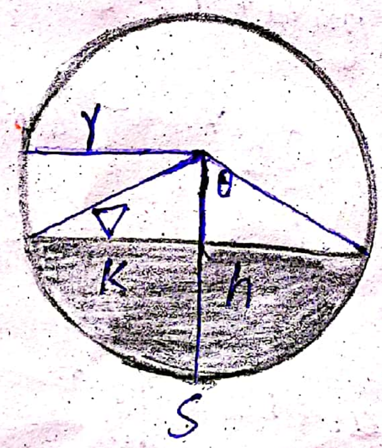
Hydraulic Radius :-

Hydraulic Radius is the area of water prism in a pipe or channel divided by the wetted perimeter. Thus, for a round Conduit flowing full or half full; the Hydraulic radius measures the flow efficiency of a pipe.

→ In trenchless technology, it is a function of the shap of the pipe in which the liquid is flowing.

→ It does not indicate half of the diameter as the name suggests.

→ Another term Sometimes used for this Quantity is the hydraulic mean depth.



Q NO 2 (a)

Given Data:

$V = 2 m/sec$

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

$Z = 5m$

$\gamma = 9810$

Required:

H = Total Energy per unit weight = ?

Solution:

As we know that

H = Pressure Head + Kinetic Energy (Head) + Potential Energy (Head)

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

Putting the values in the above equations.

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

$$H = 30.581 + 0.20 + 5$$

$$\boxed{H = 35.784m}$$

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Q No2 (part-b)

Ans ⇒ **Given data**

Diammeter = $d_1 = 300\,mm$

" = $d_2 = 200\,mm$

pressure = $P_1 = 300\,kpa = 300 \times 10^3\,N/m^2$

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

Required data:-

Datum = Z = ?

Solution:

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

$d_1 = 300\,mm = 0.3\,m$

$d_2 = 200\,mm = 0.2\,m$

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

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

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

$$A_2 = \frac{\pi d^2}{4} \Rightarrow \frac{(3.14)(0.2)^2}{0.0706}$$

~~$V_1 = 0.566$~~ $\boxed{A_2 = 0.0314}$

We know that

$$Q = V_1 A_1$$

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

$$\boxed{V_1 = 0.566}$$

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

$$\boxed{V_2 = 1.27}$$

Now

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

put

$$Z_1 = 0$$

$$\gamma = 9810$$

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

$$30.597 = 12.314 + Z_2$$

$$\boxed{Z_2 = 18.283}$$

Now Datum = $\boxed{Z = 18.283}$

Ans

---x---

Q NO-3

Ans: 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 = $\mu = 6 \times 10^{-5} \, N/m^2$

Required, Pressure loss = $\Delta P = ?$

We know

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

Here

R = Reynoids namber

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

and

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

$$\rightarrow \quad \nu = 6.67 \times 10^{-8} \, m^2/s$$

and $V = \dfrac{Q}{A}$; $A = \dfrac{\pi D^2}{4}$

$$\Rightarrow \quad V = \frac{0.06}{0.031}$$

$$\Rightarrow \quad \boxed{V = 1.9356 \, m/s}$$

$$\Rightarrow \quad R = \frac{1.9356 \times 0.2}{6.67 \times 10^{-5}} = 5.8 \times 10^{3}$$

Hence eq. (1) $\Rightarrow$ $f = 0.0032 + \dfrac{0.221}{(5.8 \times 10^{3})^{0.237}}$

$$\Rightarrow \quad \boxed{f = 0.0664}$$

According to Bernoulli's equation

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

putt value in eq → (ii)

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

$$\boxed{h_L = 31.786}$$

to find pressure loss

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

putting values

$$\Delta p = 31.786 \times 900 \times 9.81$$

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

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

Ans