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SUBJECT # FLUID MECHANICES

SECTION # "B"

DATE # 25/ JUN/ 2020.

Q1 (A) :-

TOTAL ENERY HEAD:-

It is Sum of all energy head at a point in a fluid

VARIOUS FORMS OF ENERGY HEAD :-

KINATIC HEAD:-

It is Kinatic energy per unit weight of the fluid

$$\frac{K \cdot E}{W} = \frac{1/2\, mv^2}{mg} = \frac{1}{2}\frac{v^2}{g}$$

This is also known as velocity head Unit is meter (m).

POTENTIAL HEAD:-

It is potential energy per Unit weight of fluid.

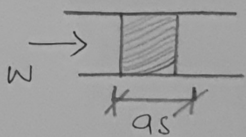
$$\frac{P \cdot E}{W} = \frac{mgh}{mg} = h$$

PRESSURE HEAD :-

The vertical height of a free ~~space~~ Surface above any point in a liquid at rest is pressure head or level of fluid due to pressure exterted by fluid

Now

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



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

$$\therefore \frac{P \cdot V}{W} \quad \because \frac{P}{r} \text{ is pressure.}$$

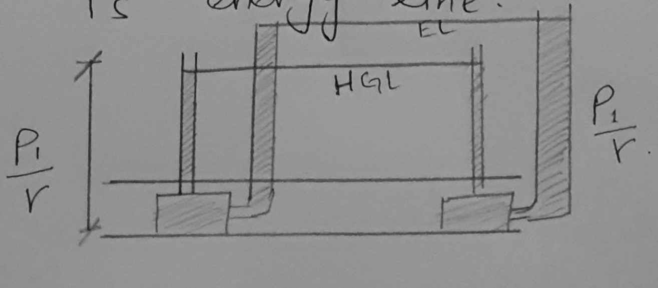
Q1(B) **HYDRAULIC GRADE LINE:-**

It is line showing the pressure head & potential head at a point in fluid.

The term $\frac{P}{r} + Z$ is static head or piezometric head because it represent the level to which liquid will raise in piezometric tube. The HGL is line drawn through top of piezometric colums.

The line showing total head of fluid at any point is Energy line

Line joining level of pilot tube is energy line.



ENERGY LINE :-

A line that represents the elevation of energy head of water flowing in a pipe Condult or channel.

The line is drawn above the hydraulic grade line a distance equal to the velocity head of the water flowing at each section or point along the pipe or channel.

HYDRAULIC RADIUS:-

Hydraulic radius is the area of the 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 is d/4. Hydraulic radius measures the flow efficiency of a pipe. In trenchless techonology, it is a function of the shape 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 hydraulic mean depth.

$$r_h = V_s / V_P = \phi V_B / S_P$$

$$S = S \, S_P / V_B$$

$$r = \phi / S$$

Q2 (A):-

Given data:-

velocity = 2 m/s

Pressure = 300 KPa

datum = 5 m.

Required data:-

H = ?

Solution:-

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

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

$$H = \frac{300 \times 10^3}{9310} + \frac{2^2}{2 \times 981} + 5$$

H = 357849 m.

Result:-

H = 357849 m.

Q_2
(B)

Given data :-

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

Diameter $= d_2 = 200\ mm = 0.2\ m.$

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

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

Datum $= Z = ?$

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

Required data:-

$Z_2 = ?$

Solution:-

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

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

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

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

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

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

we know that

$$Q_1 = V_1 A_1$$

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

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

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

$$\boxed{V_1 = 0.566}$$

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

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

$$\boxed{V_2 = 1.27}$$

Now

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

$Z_1 = 0$

$r = 9810$

$$\frac{300 \times 10^3}{9810} + \frac{(0.566)^2}{2(9.8)} + 0 = \frac{120 \times 10^3}{9810} + \frac{(1.27)^2}{2(9.8)} + Z_2$$

$$30.59 = 12.314 + Z_2$$

$$Z_2 = 18.276$$

Result:-

$Z_2 = 18.276.$

Q3:-

Given :-

Length of pipe = l = 500 m

Length of dia = d = 0.2 m

Specific gravity of oil = 0.9

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

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

Required data:

Pressure loss = ΔP = ?

Solution:-

As we know

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

where R = Reynoid's no and is given as

$$R = \frac{V \times d}{\nu} \quad — \text{①}$$

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

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

and $V = \frac{Q}{A}$ ∴ For circular pipe

$A = \pi/4 \, d^2$

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

$A = 0.031 \, m^2$

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

$\Rightarrow V = 1.935 \, m/sec.$

Now equ ①

$\Rightarrow R = \frac{1.95 \times 0.2}{6.67 \times 10^{-5}}$

$= 5.73 \times 10^{6}$

$f = 0.0032 + \frac{0.221}{(5.73 \times 10^{6})^{0.237}}$

$\Rightarrow f = 8.79 \times 10^{-3}$

or

$f = 0.00879.$

Now from Bernoul's equation

Head loss = $h_L = \frac{flv^2}{2gD}$ — (ii)

putting vale in equ (ii)

$$h_L = \frac{(0.00879)(500)(1.95)^2}{2(9.81)(0.9)}$$

$\Rightarrow$ $h_L = 4.259$ m.

Now, to find pressure loss due to friction

pressure Head formula is Used

$$h_L = \frac{\Delta P}{\delta P}$$

$\Rightarrow$ $\Delta P = h_L \times \delta P$

put values.

$\Delta P = 4.259 \times 900 \times 9.81$

$\Rightarrow$ $\Delta P = 37602.7$ Pa $\Rightarrow$ 37.602 KPa

Result :-

$\Delta P = 37.602$ kpa