PAPER:

FLUID MECHANICS I

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SECTION:

B

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SUBMITTED TO:

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QNo1 PART A

Ans of QNo 1

ENERGY HEAD:

It is the sum of all energy heads at a Point in a fluid.

FORMS OF ENERGY HEAD:

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

1) Kinetic Head.

2) Potential Head.

3) Pressure Head.

KINETIC HEAD:

It is the Kinetic energy Per

unit weight of the fluid.

MATHEMATICAL FORM:

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

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

- This is also known as velocity Head.

UNIT:

Its unit is meter (m).

POTENTIAL HEAD:

It is the Potential 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

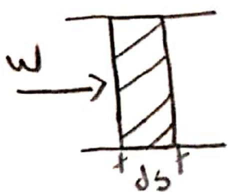
Level of fluid due to Pressure exerted by fluid.

MATHEMATICAL FORM:

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

OR

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



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

$$= \frac{P \cdot V}{w} = \frac{P}{\gamma} \text{ is Pressure.}$$

QNo1 PART B

Ans Of QNo1 PART B:

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 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.

- It is represented by H. G. L.

ENERGY GRADE LINE:

A line the represents the elevation of energy Head (in feet or meters) of water flowing in a Pipe or channel.

The line is drawn above the Hydraulic Grade line a distance equal to the velocity head ($v^2/2g$) of the water flowing at each section or channel.

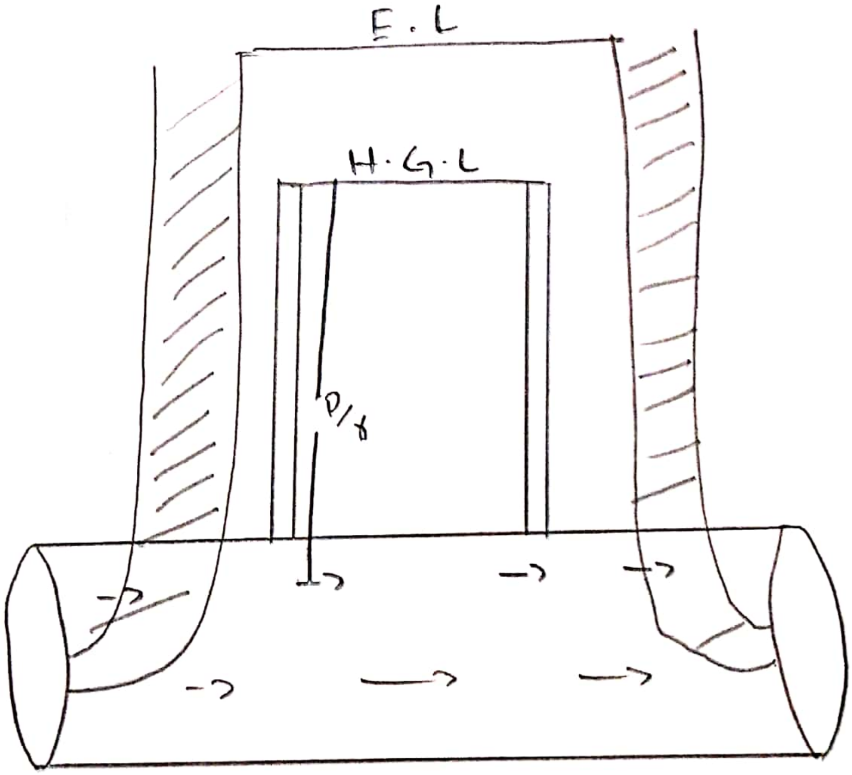
OR

It is the line joining the total heads along a Pipe line.

REPRESENTED BY:

It is represented by E.G.L

DIAGRAM:



HYDRAULIC RADIUS:

The ratio of the crossectional area of a channel or pipe in which a fluid is flowing to the wetted perimeter of the conduit.

EQUATION:

The equation used to derive the hydraulic radius for a circular sewer flowing full is:

$$R = A / P_W$$

OR

$$R = (\pi D^2/4) / \pi D = D/4$$

Qno2 Part (a)

Ans of Qno2 Part (a)

GIVEN:

$V_m = 2 m/s$

$P = 300 \, kPa$

$P = 300 \times 10^3 \, Pa$

P.E Head $= Z = 5$

$\gamma = 9.81 \, kN/m^3$

TO FIND:

Total energy per unit weight of water = Total Head = ?

SOLUTION:

Total Head $= K.E_{Head} + P.E_{Head} + Pressure_{Head}$ $\rightarrow (1)$

$$\text{Pressure}_{\text{head}} : P/\gamma$$

$$\text{"} = \frac{300}{9.81}$$

$$\text{Pressure}_{\text{Head}} = 30.6\ m$$

$$\text{Kinetic Head} = \frac{v^2}{2g}$$

$$\text{"} = \frac{(2)^2}{(2)(9.81)}$$

$$\text{Kinetic Head} = 0.2\,m$$

$$\text{Potential Head} = Z = 5\,m$$

Putting values in eq ①

$$\text{Total HEAD} = 0.2 + 30.6 + 5$$

$$\text{Total Energy Per unit weight} = 35.8\,m$$

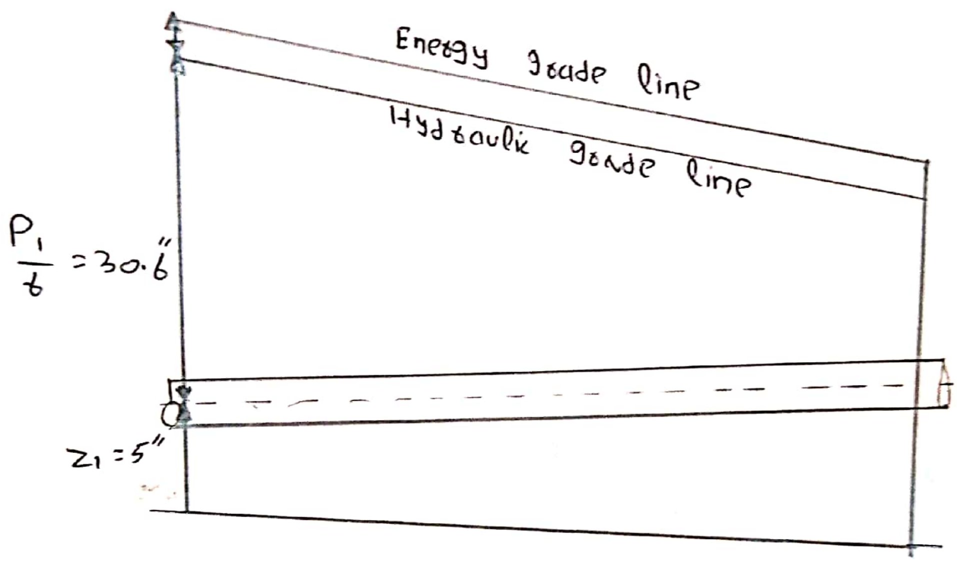
RESULT:

T.E Per unit weight = 35.8 m

Q no 2 Part B

Ans Of Q no 2 Part B

FIGURE:



GIVEN:

$D_1 = 300\ mm$

$D_1 = 0.3m$

$D_2 = 200mm$

$D_2 = 0.2m$

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

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

$Q = 40\ liter/s = 0.04\ m^3/s$

$h_L = 0$

To Find:

$$Z_2 - Z_1 = ?$$

Solution:

According to Bernoullis Theormm we have:

$$H_1 = Z_1 + \frac{V_1^2}{2g} + \frac{P_1}{\gamma}$$

$$H_2 = Z_2 + \frac{V_2^2}{2g} + \frac{P_2}{\gamma}$$

As given that head loss negligible so:

$$H_1 = H_2$$

Now:

$$Z_1 = \frac{V_1^2}{2g} + \frac{P_1}{\gamma} = Z_2 + \frac{V_2^2}{2g} + \frac{P_2}{\gamma} \rightarrow (1)$$

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

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

$$A_1 = 0.0675 \, m^2$$

$$A_1 = 0.0675 \, m^2$$

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

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

$$A_2 = 0.03 m^2$$

$$A_2 = 0.03 \, m^2$$

Now as we know

$$Q = AV$$

So

$$V_1 = \frac{Q_1}{A_1}$$

$$V_1 = \frac{0.04}{0.0675}$$

$$V_1 = 0.6 \, m/s$$

Putting values in eq (1) we get:

$$z_1 + \frac{(0.621)^2}{2\times 9.81} + \frac{300}{9.81} = z_2 + \frac{(1.341)^2}{2\times 9.81} + \frac{120}{9.81}$$

$$z_1 + 30.6 = z_2 + 12.32$$

$$z_2 - z_1 = 30.6 - 12.32$$

$$z_2 - z_1 = 18.28\,m$$

RESULT:

$$z_2 - z_1 = 18.28\,m$$

Q No 3

Ans Of Qno 3

GIVEN:

$L = 500\,m$

$D = 0.2\,m$

$(\gamma)_{oil} = 0.9$

$\rho_{water} = 1000\ kg/m^3$

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

$Q = 0.06\ \frac{m^3}{s}$

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

where R is reynold's number

To FIND:

Δp = Pressure loss due to friction.

SOLUTION:

$$\gamma = \frac{\rho_{oil}}{\rho_{water}}$$

ρ_{oil} = (Density of oil)

$$\rho_{oil} = \gamma + \rho_{water}$$

$$'' = 0.9 \times 1000$$

$$\rho_{oil} = 900\ Kg/m^3$$

As we know that

$$Q = A V$$

$$V = \frac{Q}{A}$$

$$V = \frac{0.06}{\left(\frac{\pi}{4} \times (0.2)^2\right)}$$

$$V = 1.91\ m/s$$

$$V = 1.91\ m/s$$

As we know that.

Reynold's number is given by

$$Re = \rho_{oil} V D / \mu$$

$$= \frac{900 \times 1.91 \times 0.2}{6 \times 10^{-3}}$$

$$Re = 5730000$$

$$Re = 5730000$$

Now we have

$$cf = \left[0.032 + \frac{0.221}{R^{0.237}}\right]$$

$$cf = 0.032 + \frac{0.221}{[5730000]^{0.237}}$$

$$cf = 8.72 \times 10^{-3}$$

$$f = 4cf = 4 \times 8.72 \times 10^{-3}$$

$$f = 0.03488$$

$$f = 0.03488$$

Now

$$\Delta p = \frac{f l v^2}{2D} \rho_{oil}$$

$$\Delta p = \frac{(0.03488)(500)(1.91)^2}{2 \times 0.2} (900)$$

$$\Delta p = 143151.44 \ N/m^2$$

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RESULT:

$$\Delta p = 143151.44 \ N/m^2 .$$