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7966

SECTION - B

CIVIL (4th SEM)

FLUID MECHANICS

SIR WAHEED

Question: 01

Part (a)

Answer:

ENERGY HEAD: Energy head is the sum of all energy heads at a point in a fluid, known as energy head.

FORMS:- Energy heads are of three types, which are as follow.

⇒ Kinetic head

⇒ Potential head

⇒ Pressure head

KINETIC HEAD: Kinetic head is the kinetic energy per unit weight of the fluid.

Mathematically:

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

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

UNIT:

Meter (m)

POTENTIAL HEAD: Potential head is the potential energy per unit weight of fluid

Mathematically:

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

UNIT:-

Meter (m)

PRESSURE HEAD:

Level of fluid due to pressure exerted by fluid.

OR

The vertical height of the free surface above any point in at liquid at rest is known as pressure head.

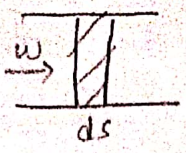
Mathematically:- Pressure head $= \frac{P.E}{weight}$

$= P/\gamma$

OR

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

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



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

Question 01 Part (b)

HYDRAULIC GRADE LINE: It is the line showing pressure head and the potential head at a point in fluid.

OR:-

The 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.

ENERGY GRADE LINE: A line represents the elevation of energy head i.e (ft, m) of water flowing in a pipe or channel. The line is drawn above the hydraulic grade line a distance

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equal to the velocity ~~equal~~ head ~~($v^2/2g$)~~ $(v^2/2g)$ of the water flowing at each section or channal.

:OR:-

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

REPRESENTED BY:-

It is represented by E.G.L.

HYDRAULIC RADIUS:-

Hydraulic radius is defined as the cross sectional area of flow divided by the wetted perimeter, so the calculation of rectangle & trapezoid area & triangle are will be included along with perimeter for each.

$$Rh = \frac{A}{P}$$

A = cross-sectional area of the following fluid; P = wetted perimeter.

QUESTION = 02

PART :- (A)

Given data:

Velocity = 2 m/sec

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

$Z = 5m$

H = pressure head + K.E + P.E

As we know that

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

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

$$H = 30.58 + 0.101 + 5$$

$$H = 35.785 \ Nm/N.$$

QUESTION: 02

PART (B)

A tapering pipe is having........

.... head loss is negligible?

To Find:-

Datum = z = ?

GIVEN THAT:

Dimeter = d_1 = 300mm = 0.3m.

Diameter = d_2 = 200mm = 0.2m

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

⇒ P_2 = 120 kpa = 120×10^3 N/m²

$Q = \frac{40}{1000}$ m²/sec ⇒ 0.04 m²/sec.

SOLUTION:~

As we know that

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

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

$A_1 = 0.07065$ m²

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

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

$$A_2 = 0.0314 \ m^2$$

Now, As we know that

$$Q = V_1 A_1$$

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

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

$$V_1 = 0.5661$$

And

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

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

$$V_2 = 1.2738$$

Now

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2$$

where $z_1 = 0$

$$\gamma = 9810$$

$$\frac{300\times10^3}{9810} + \frac{0.566^2}{2(9.81)} + 0 = \frac{120\times10}{9810} + \frac{1.27}{2(9.81)} + Z_2 \quad (8)$$

$$30.59 = 12.314 + Z_2$$

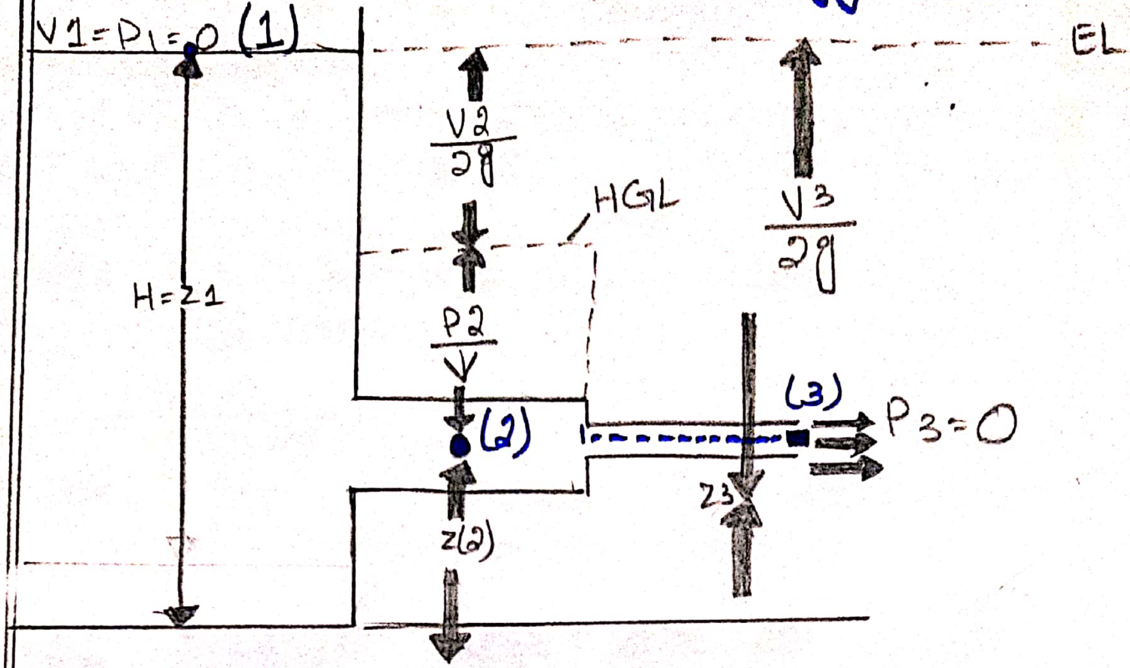
$$30.59 - 12.314 = Z_2$$

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

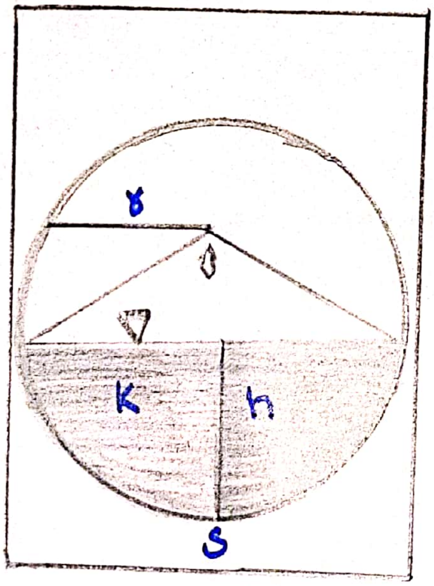
HNCE:

Datum = $Z = 18.276$

The Hydrulic Grade Line & Energg Line:



Hydrolic Radius:



QUESTION:(03)

A 500m long 0.2m diameter pipe transport an oil of specific Gravity .... reynold's number?

Given data:

Length of the pipe $L = 500m$

Diameter, $d = 0.2m$.

Specific Gravity of oil $= 0.9$

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

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

Density, $\rho = 0.9 \times 100 = 900 \, kg/m^3$.

Solution.

Requried pressure loss.

As we know that,

$$v = \frac{u}{\rho}$$

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

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

Now we have to find "v"

$$V = \frac{Q}{A} \quad -(1)$$

Now For Orcular pipe.

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

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

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

putting values in eq (1)

$$V = \frac{0.06}{0.0314}$$

$$\Rightarrow \boxed{V = 1.91 m/s}$$

Now we know that

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

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

$$\boxed{R = 5.72 \times 10^{6}}$$

Now,

$$f = 0.0032 + \frac{0.221}{(5.72\times10^{5})^{0.237}}$$

$$f = 0.0032 + (5.5320\times10^{-3})$$

$$f = 8.73209\times10^{-3}$$

Now From Bernadi's Equation.

Head loss, $HF = \frac{fLV^2}{2gD}$

putting values.

$$HF = \frac{fLV^2}{2gD}$$

$$= \frac{(8.73209\times10^{-3})(500)(1.91)^2}{2\times(9.81)(0.2)}$$

$$HF = 4.0590.$$

Now we know by pressure loss & Head loss relation,

$$\Rightarrow h_f = \frac{\Delta P}{\gamma}$$

$$\Rightarrow h_f = \frac{\Delta P}{\rho g}$$

$$\Rightarrow \Delta P = h_f \rho g$$

$$\Rightarrow \Delta P = 4.0590 \times 900 \times 9.81$$

$$\Rightarrow \Delta P = 35837.47 \text{ pa}$$

$$\Rightarrow \boxed{\Delta P\ 35.837 \text{ kpa}}$$

Resolt:-

Hence pressure loss,

$\Delta P = 35.837$ kpa.