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Section A

Subject fluid mechanics one

Date 25.6-2020

Question no 1

part (a)

ANSWER:-

Total energy head:-

from Bernulli principle, the total energy at a given point in a fluid in the energy associated with movement of fluid, plus energy from static pressure in the fluid, energy from height of fluid relative to an arbitary datum height.

OR

The sum of pressure head (p/ρ) velocity head ($v^2/2g$) and elevation head is constant along a stream line. This constant is called total height head.

Forms of energy Head:- There are three types of energy head which are given below.

potential Head:- (potential Head = z)

It is the potential

energy per unit weight
It is due to position above some datum line pressure head + velocity head + potential head.

total head

potential head = Total head - velocity head - pressure head

Kinetic head:- $K.H = V^2/2g$

It represent Kinetic energy of fluid. It is height in feet the flowing fluid will rise in colum.

pressure head:-

It is height of liquid colum that corresponds to a particular pressure exerted by liquid colum that Correspond a particular pressure exerted by liquid column on the base of Contains

pressure head = total head - Kinetic head - potential head.

$$\text{pressure head} = P/\gamma$$

⇒ Total energy head equation

$$T.H = v^2/2g + Z + P/\gamma$$

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Question No 1/2 part

part "b"

Hydraulic And Energy Grade line:-

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

Write the equation of hydraulic grade line.

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

Where, z is the height above the datum level and

P/γ

distance is

Energy grade line refer to a line that represents to the height of energy head of water streaming in a pipe, course

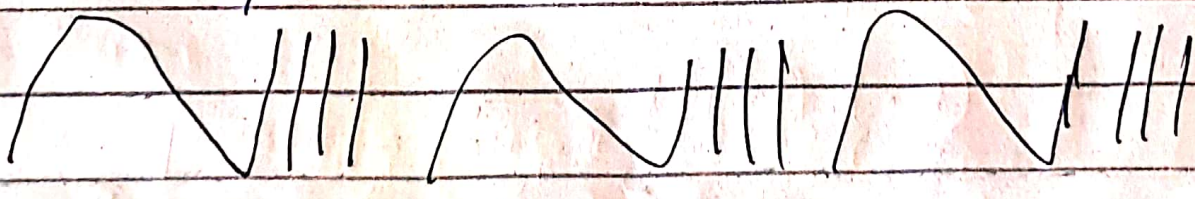
or Channel. The Line is drawn over the pressure hydraulic grade line a separation equivalent to the speed head ($v^2/2g$) of water streaming at every area or point along the pipe or Channel.

Write the equation of energy grade Line

$$EGL = h_0 = \frac{P}{\gamma} + \frac{V^2}{2g} + z$$

Hydraulic Radius:-

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



Question no 2 part "a"

ANSWER:-

Given data:-

Velocity = V = 2 m/s

pressure = P = 300 Kpa

datum = z = 5 m

Sol:-

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

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

$$H = \frac{300 \times 10^3}{9810} + \frac{2^2}{2 \times 981} + 5$$

$$\boxed{H = 35.7849 \text{ m}}$$

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Question no 2 part "b"

Given data:-

Diameter = d_1 = 300mm

Diameter = d_2 = 200 mm

pressure = p_1 = 300 Kpa = 300×10^3 N/m²

⇒ p_2 = 120 Kpa = 120×10^3 N/m²

Datum = z_2 = ?

$$Q = \frac{40 \text{ m}^3/\text{sec}}{1000}$$

d_1 = 300 mm = 0.3 m

d_2 = 200mm = 0.2 m

Required:-

z_1 = ?

Sol:-

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

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

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

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

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

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

We Know that

$$Q_1 = V_1 A_1$$

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

$$\boxed{V_1 = 0.566}$$

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

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

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

Now

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + z_1 = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + z_2$$

$$z_2 = 0$$

$$\gamma = 9810$$

$$\frac{300 \times 10^3}{9810} + \frac{0.566}{2(981)} + z_1 = \frac{120 \times 10^3}{9810} + \frac{1.27}{2(981)}$$

$$30.60 + z_1 = 12.314$$

$$\boxed{z_1 = -18.286}$$

Question No. 3

Given data:

Length of pipe = l = 500 m

diameter = d = 0.2 m

Specific gravity of oil = 0.9

flow rate = Q = 0.06 m^3/s

viscosity = μ = 6×10^{-5} $N \cdot s/m^2$

Required:-

pressure loss = Δp = ?

As we know

$$f = \frac{0.0032 (0.221}{R^{0.237}}$$

where R = Reynold's No and is given as

$$R = \frac{v \times d}{\nu} \longrightarrow (1)$$

and

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

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

and $V = \frac{Q}{A}$ ∴ for circular page

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

$\Rightarrow V = \frac{0.06}{0.031}$ $\quad A = \frac{\pi}{4}(0.2)^2$

$\Rightarrow V = 1.95 \text{ m/s}$ $\quad A = 0.031 \text{ m}^2$

Now equ (1) $\Rightarrow$

$$R = \frac{1.95 \times 0.2}{6.67 \times 10^{-5}} \Rightarrow 5.73 \times 10^6$$

Now

$$f = 0.0032 + \frac{0.221}{(5.23 \times 10^6)^{.237}}$$

$\Rightarrow f = 8.29 \times 10^{-3}$

or $\Rightarrow f = 0.00879$

Now from Bernolis equation

Head loss $= h_2 = \frac{f L v^2}{2gD} \Rightarrow$ (ii)

putting values in equ (ii)

$$h_2 = \frac{(0.00879)(500)(1.95)^2}{2(9.81)(.2)}$$

$h_2 = 4.25 \text{ m}$

Now to find pressure loss due to friction

pressure head formula is used

$h_2 = \frac{\Delta P}{S_g}$

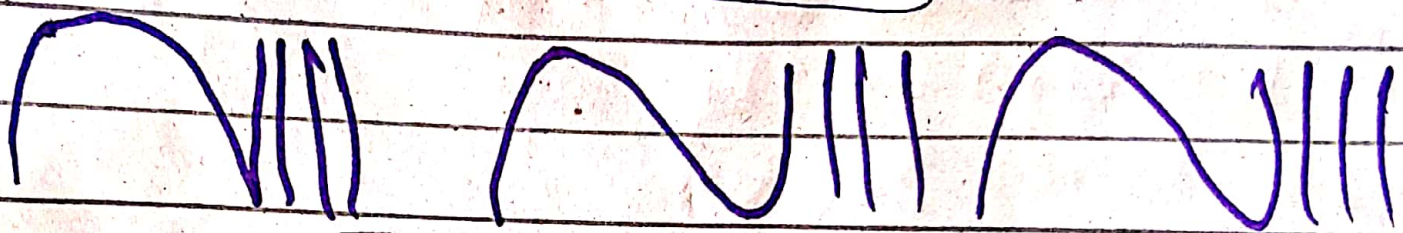
$\Rightarrow \Delta P = h_2 \times S_g$

Put Valves

$\Rightarrow \Delta P = 4.25 \times 900 \times 9.81$

$\Rightarrow \Delta P = 37602.7$ pa

$\Rightarrow \Delta P = 37.602$ KPa



The END

Thank you

Sir Sg.