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Section B

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Subject Hydraulics Engineering

Submitted To,

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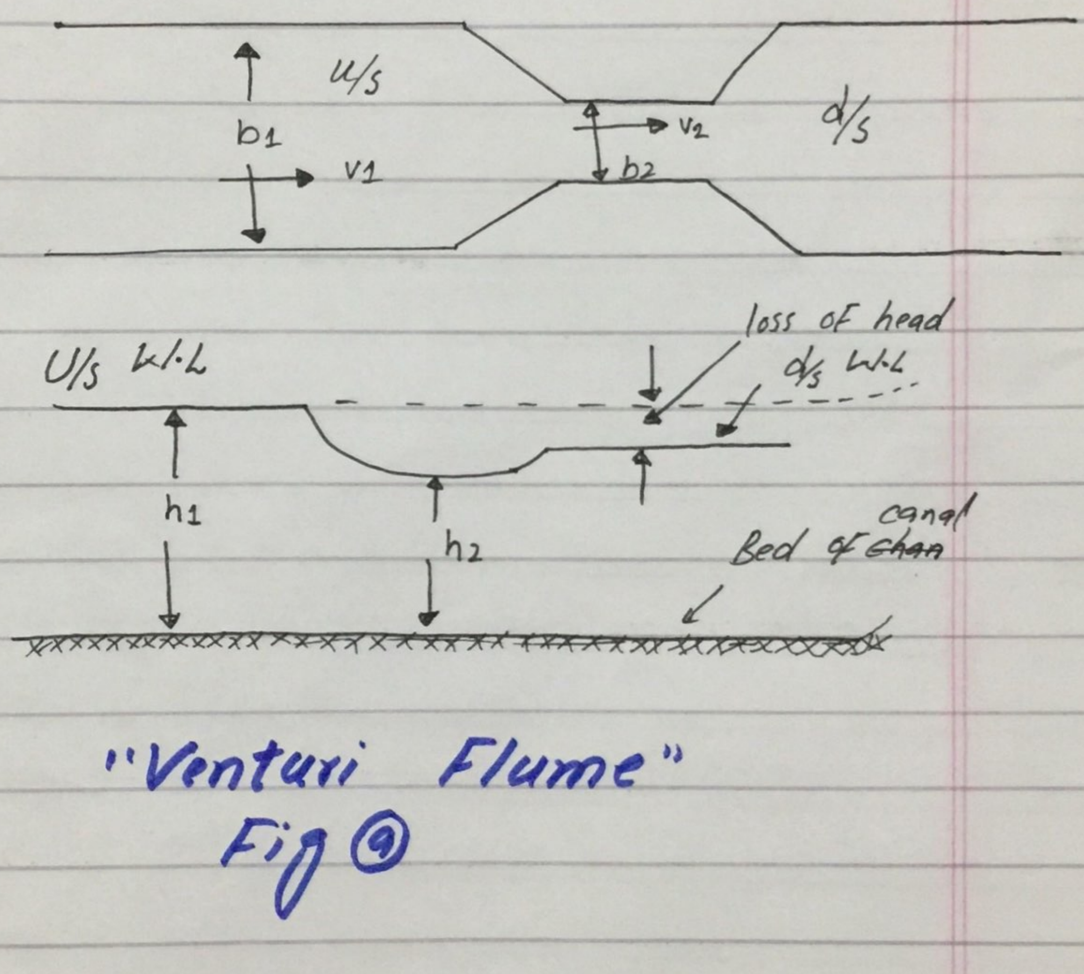
(Assignment #1)

 ID = 7831

1 - Venturi Flume :-

Venturi flume is a hydraulic structure constructed in the channel for measurement of discharge observation. Figure ⓐ Showns the Venturi flume. it mainly Consist Short channel reach for restricting water way. This channel Known Throat. The in Size for normal Section to the throat and back to the normal Section is done gradully. Due to decrease in the water way at the throat the velocity and the discharge per unit increases. due to which the reduction in depth of the flow occure at the throat. The discharge of the channel is obtained by taking observations of the reading on upstream and inside the throat.



"Venturi Flume"

Fig ⑨

The principle is the Same as of venturi meter and the discharge of the channel is determined by formula (According to Fig ⓐ)

$$Q = \frac{a_1 a_2 \sqrt{2g(h_1 - h_2)}}{\sqrt{a_1^2 - a_2^2}}$$

where

Q = discharge of channel

a_2 = water way at throat Section

a_1 = Waterway of the Channel

h_1 = depth of water in upstream Side.

h_2 = depth of water in venturi flume.

2- Given Data :-

- $b = 3m$
- $Q = 12\ m^3/sec$

Required :-

(a) Critical depth =? (h_c)
(b) minimum Specific energy =?
(c) alternate depth when ($E = 4m$)

Solution :-

(a) $h_c = ?$

As Discharge per unit width :

$$q = Q/b = 12/3 = 4\ m^2/sec$$

Then for a rectangular channel:

$$h_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{4^2}{9.81}\right)^{1/3}$$

$$h_c = 1.177\ m$$

Critical depth (h_c) = 1.18m

(b) For a rectangular channel

$$E_c = \frac{3}{2} \cdot h_c = \frac{3}{2} \times 1.177$$

$$E_c = 1.766\ m$$

minimum Specific ~~energy~~ energy $E_c = 1.77m$

(c)

As $E > E_c$ there are two possible depths for a given specific energy

$$E = h + \frac{v^2}{2g} \quad \text{where } v = \frac{Q}{A} = \frac{q}{h}$$

(For rectangular channel)

$$\Rightarrow \quad E = h + \frac{q^2}{2gh^2}$$

Subsitating valeues in metre-second units.

$$4 = h + \frac{0.8155}{h^2}$$

For the subcritical (slow, deep) solution the first term associated with potential energy

$$h = 4 - \frac{0.8155}{h^2}$$

Iteration (from e.g $h = 4$) gives $h = 3.948\,m$

For suppercritical (fast, shallow) solution the second term associated with K.E

$$h = \sqrt{\frac{0.8155}{4-h}}$$

Iteration (from e.g $h = 0$) gives $h = 0.4814\,m$

| alternate depths are 3.95 and 0.481 m |

(Assignment #2)

7831

Problem #1 :-

Given Data:-

- water flow at depth (y) = 10cm or 0.1m
- velocity (V) = 6m/s

Required:-

alternate depth (y_{alt}) = ?

Solution:-

Check Froude Number

$$Fr = \frac{V}{\sqrt{gy}} = \frac{6}{\sqrt{(9.81 * 0.1)}}$$

$$Fr = 6.06 > 1$$

So the flow is Supercritical.

$$E = y + \frac{V^2}{2g} = 0.1 + \frac{6}{2*9.81}$$

$$E = 1.935m$$

Solving for the alternate depth for an E = 1.935m yield y_{alt} = 1.93m

$$* \boxed{y_{alt} = 1.93m}$$

Ans

Problem # 2 :-

Given Data :-

- velocity $V = 2m/s$
- Depth $y_1 = 3m$
- $\Delta z_1 = 60cm$ or $0.60m$ (upstep)
- $\Delta z_2 = -15cm$ or $-0.15m$ (down step)

Solution :-

$$E_1 = y_1 + \frac{v_1^2}{2g}$$

$$E_1 = 3 + \frac{(2)^2}{2 * 9.81} = \boxed{3.20m}$$

$$E_2 = E_1 - \Delta z_1 = 3.20 - 0.60$$

$$\boxed{E_2 = 2.60m}$$

Also

$$E_2 = y_2 + \frac{q^2}{2gy_2^2}$$

$$E_2 = y_2 + \frac{(6)^2}{2(9.81)(y_2)^2} = 2.60m$$

So $y_2 = 2.24m$, $\Delta y = y_2 - y_1$

$= -0.76m$ So water Surface

drops $0.16m$.

For downward step of 15cm we have;

$E_2 = E_1 - \Delta z_2$

$E_2 = 3.20 - (-0.15) = 3.35m$

giving $y_2 = 3.17m$ and $\Delta y = y_2 - y_1$

$\Delta y = 0.17m$ So water surface rise $0.02m$.

The maximum upstep possible before affecting upstream water surface level is for $y_2 = y_c$

$$y_c = \sqrt[3]{\frac{v^2}{g}}$$

$$y_c = \sqrt[3]{\frac{(6)^2}{9.81}}$$

$$y_c = \left(\frac{(6)^2}{9.81}\right)^{1/3}$$

$$\boxed{y_c = 1.54m}$$ Ans

(Assignment # 3)

7831

Problem :-

Given Data :-

- $h_1 = 3.6m$
- $h_2 = 0.9m$
- $b = 3.9m$

Required :-

ⓐ Discharge $Q = ?$

ⓑ Froud Number upstream and downstream $Fr_1, Fr_2 = ?$

Solution :-

ⓐ Discharge $Q = ?$

We have if we assuming that total head Same on either side of the gate.

$$Z_{S1} + \frac{V_1^2}{2g} = Z_{S2} + \frac{V_2^2}{2g} \quad \text{—(K)}$$

We have

$$V = Q/bh \quad \text{put in eq (K)}$$

and $Z_{S1} = h_1$ and $Z_{S2} = h_2$

Then eq (K) $\Rightarrow$

$$h_1 + \frac{Q^2}{2g(bh_1)^2} = h_2 + \frac{Q^2}{2g(bh_2)^2} \quad \text{—(N)}$$

Now put the valuse in eq (N)

$$3.6 + \frac{Q^2}{2(9.81)(3.9*3.6)} = 0.9 + \frac{Q^2}{2(9.81)(0.9*3.9)}$$

$$3.6 + \frac{Q^2}{275.46} = 0.9 + \frac{Q^2}{68.86}$$

$$3.6 + 0.0003630Q^2 = 0.9 + 0.0145Q^2$$

$$\sqrt{0.014137Q^2} = \sqrt{2.7}$$

$$Q = \frac{1.643}{0.118}$$

$$\boxed{Q = 13.923\ m^3/sec}$$

(b) $Fr_1 = ?$ $Fr_2 = ?$

As

$Q = AV$ $A = hb$

$Q = (h_1 b)V$

$V_1 = Q/h_1 b$ and $V_2 = Q/h_2 b$

$$V_1 = \frac{13.923}{(3.6*3.9)}, \quad V_2 = \frac{13.923}{(0.9*3.9)}$$

$V_1 = 0.991\ m/sec$, $V_2 = 3.96\ m/sec$

We know that:

$$Fr = \frac{V}{\sqrt{gh}}$$

$$Fr_1 = \frac{0.991}{\sqrt{9.81 * 3.6}}$$

$$Fr_1 = \frac{0.991}{5.942}$$

$$\boxed{Fr_1 = 0.166}$$

and

$$Fr_2 = \frac{3.96}{\sqrt{9.81 * 0.9}}$$

$$Fr_2 = 3.96 / 2.97$$

$$\boxed{Fr_2 = 1.33}$$

Froud Numbers upstream , downstream
= 0.166 , 1.33

Ans