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Section: "A"

Semester 6th

Assignment ① Hydraulic Engineering

Submited To

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Assignment - 1

Q No: 1

What is venture flume? Explain with detail.

Venturi Flume:

A venturi flum is a critical flow open flume with a constricted flow which causes a drop in hydraulic grad line creating a critical depth.

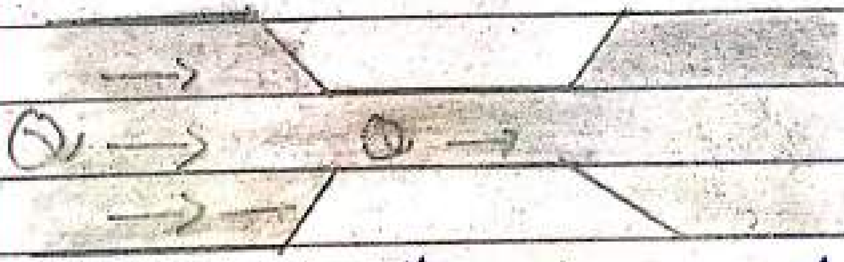
It is used in flow measurement of very large flow rate usually gives in million of cubic unit. A venturi meter would normally measures in meters.

Measurement of discharge with venturi flume required two measurement one upstream and one at a throat. If the flume passes in a sub-critical static through flume

If the flow are designed so as pass flow from sub-critical to single measirment at throat is sufficient from computation of discharge

To ensure occurence of critical depth at throat flames are usually discherge in sucha a way from a hydralic pamp on down strem side of stucture

These flumes are called standing wave flumes.
it cases drop in hydralic gradiline



Flow through a venturi Flume

Assignment # 1

Q No: 2

A 3m wide channel carries total discharge of $12\ m^3/sec$

Calculate
1. critical Depth
2. Minimum specific energy
3. Alternateve depth when E = 4m

Given data

Width of channel (b) = 3m
Discharge Q = $12\ m^3/sec$

Required

a) critical depth
b) minimum specific Energy
c) Alternative depth wen E = 4m

Solu

① Critical Depth

As $\Rightarrow q = Q/b$

$\frac{12}{3} = q$

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$q = 4 m^2/sec$

Using formula

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

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

$$y_c = 1.177 m$$

2) The minimum Specific Energy

$$Q = AV \text{ — (1)}$$

and

$$Q = qb \longrightarrow (2)$$

Equating eq (1) and (2)

$$Q = Q$$

$$AV = qb$$

by $Vy = q$

$$V = q/y_c$$

$$V = \frac{4}{1.177}$$

$$V = 3.398 \text{ m/sec}$$

$$E_{min} = y + \frac{V^2}{2g}$$

$$1.177 + \frac{(3.3981)^2}{2(9.81)}$$

$$\boxed{E(min) = 1.76}$$

③ The Alternate depth When E = 4m

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

$$E = h + \frac{V^2}{2g} \quad \text{where}$$

$$V = \frac{Q}{A} = \frac{q}{h} \quad \text{(for rectangular channel)}$$

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

[redacted]

Substituting value in meter-second

$4 = h + 0.8155/h^2$

For the sub-critical solution the first term associated with potential energy dominates so rearrange as

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

Iteration from h=4 give
h=3.948m

From the sub critical solution the second term associated with K.E. dominates so arrange as

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

Iteration from h=0 given
h= 0.4814 m

Answer: Alternate depth are 3.95 and 0.481m

 Assignment # 2

Problem # 1

Water flow at the depth of 10 cm with velocity of 6 m/s in rectangular channel. is flow critical or subcritical ?
What is its alternative depth?

Given Data

Depth = 10 cm
Velocity = 6 m/s

Required

⇒ Type of flow
⇒ Alternate depth.

Solve

First we have check Froud Number

$$Fr = \frac{V}{\sqrt{gy}} = \frac{6\ m/s}{\sqrt{9.81 \times 0.1}}$$

$$= 6.06 > 1$$

So flow is super critical.

Alternate Depth

as we know

$$E = y + \frac{V^2}{2g}$$

$$= 0.1 + \frac{6^2}{2 \times 9.81}$$

$$= 1.935 \, m.$$

The alternate depth for $E = 1.935 m$ yields

$$y_{alt} = 1.93 \, m$$

Problem – 2

Water flow with velocity of 2 m/s and depth of 3m..... 100 sec?

Given Data

$V_1 = 2 m/s$

Depth $y_1 = 3 m$

Elevation = Δz = 60 cm = 0.6 m

Down step = 15 cm = 0.15 m

Required

Depth and elevation change
Max size of upset

Sol

$E_1 = y_1 + \frac{V_1^2}{2g}$

$E_1 \quad 3 + \frac{2^2}{2 \times 9.81}$

$E_1 = 3.2\ 0m$

Now

$$E_2 = E_1 - \Delta z = 3.20\,m - 0.60\,m$$

$$= 2.60\,m$$

Also

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

$$= y_2 + \frac{(6\ m^3/s)^2}{2\ 9.81\,m/s^2 \cdot y_2^2}$$

$$E_2 = 2.60\ m$$

So

$$y_2 = 2.24\,m$$

$$\Delta y = y_1 - y_1 = 0.76\,m$$

So Water surface drops 0.16 m

For a downward step of 15 cm we have

$$E_2 = E_1 - \Delta z$$

$$= 3.20\,m - (-0.15)\,m$$

$E_2 = 3.35 m$

Giving $y_2 = 3.17$ and $\Delta y = y_2 - y_1$
$\Delta y = 0.17 m$ water surface rises $= 0.02 m$

The maximum upstep possible before affecting upstream water surface level is for

$$y_2 = y_c$$

$$y_c = \sqrt[3]{q^2/g}$$

$$y_c = \sqrt[3]{6^2/9.8}$$

$$y_c = 1.54 m$$

Assignment # 3

Q: Problum:- A water passing from slice gate ------ 3.9m

Given Data

~~Discharge~~:

Depth at upstream = y_1 = 3.6m
Depth at dwonstrem = y_2 = 0.9m
width of slice gate b = 3.9m

Required

① Discharge
② Froud number upstream & Down stream.

Sol

As we know

$E_1 = E_2$

$$y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g} \quad \text{--- ①}$$

Also

$Q = A_1V_1 = A_2V_2$

$b_1 y_1 V_1 = b_2 y_2 V_2$

$$y_1 U_1 = y_2 U_2$$

$$U_2 = \frac{y_1}{y_2} \times U_1$$

$$U_2 = 4U_1 \quad \text{—— (2)}$$

Put in eq — (1)

$$y_1 + \frac{U_1^2}{2g} = y_2 + \frac{U_2^2}{2g}$$

$$3.6 + \frac{U_1^2}{2g} = 0.9 + \frac{(4U_1)^2}{2g}$$

$$3.6 + \frac{U_1^2}{2g} = 0.9 + \frac{16U_1^2}{2g}$$

$$\frac{U_1^2}{2g} - \frac{16U_1^2}{2g} = 0.9 - 3.6$$

$$\frac{U_1^2 - 16U_1^2}{2g} = -2.7$$

$$\frac{-15U_1^2}{2g} = -2.7$$

$$\sqrt{V_1^2} = \sqrt{\frac{2.7 \times 2(9.81)}{15}}$$

$$V_1 = 1.879 \text{ m/sec}$$

Put value of V_1 in eq-②

$V_2 = 4V_1$

$V_2 = 4(1.879)$

$V_2 = 7.516 \text{ m/sec}$

As

$Q = A_1 V_1 = b y_1 V_1$

$= 3.9 \times 3.6 \times 1.879$

$= 26.38 \text{ m}^3/\text{sec}$

$Q_2 = A_2 V_2 = b y_2 V_2$

$= 3.9 \times 0.9 \times 7.516$

$Q_2 = 26.38 \text{ m}^3/\text{se}$

$Q = Q_1 = Q_2 = 26.38 \text{ m}^3/\text{sec}$

1) Froud Number at upstream side

$$Fr_1 = \frac{V_1}{\sqrt{gy_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}}$$

$= 0.31$ (sub critical flow)

2) Froud Number at dwon strem side

$$Fr_2 = \frac{V_2}{\sqrt{gy_2}}$$

$$= \frac{7.516}{\sqrt{9.81 \times 0.8}}$$

$$Fr_2 = 2.52$$

(super critical flow)