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SEMESTER	6th
SECTION	"A"
SUBJECT:	HYDRAULIC ENGINEERING
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	SESSIONAL ASSIGNMENT.

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ASSIGNMENT-01

QUESTION: 01

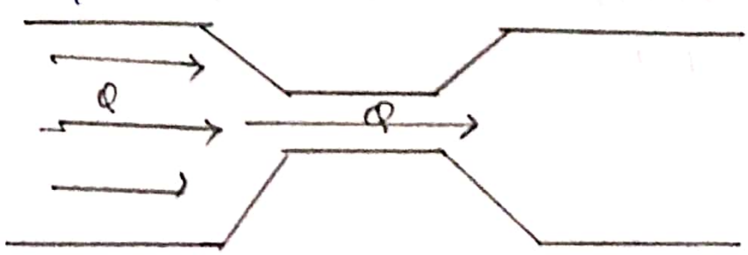
VENTURI FLUME:- it's a critical flow open flume with a constricted flow that causes drop in hydraulic flow grade line, creating a critical depth.

Used in flow measurement of very large flow rates, usually given in million of cubic units. Normally venturi measure is millimeters where as venturi flume measures in meters.

Measurement of discharge with venturi flume requires two measurement i.e one upstream and one at throat. If flow passes in sub-critical state. If flume are designed so as to pass flow from sub-critical to super critical state while passing through flume, a single measurement at throat is sufficient for computation of discharge.

To ensure occurance of critical depth flumes are designed in such a way to form hydraulic jump on downstream side of structure. These flumes are called "standing wave flumes".

It causes drop in hydraulic guide line



Flow through venturi flume

ASSIGNMENT:01

QUESTION:-02

Given Data:-

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

Required:- (1) Critical depth
(2) Minimum Specific Energy
(3) Alternative Depth when $E = 4m$

Solution:

(1) Critical Depth:-

As we Know
$q = Q/b$
$12/3 = q$
$q = 4 m^2/sec$

Now by formula
$y_c = (q^2/g)^{1/3}$
$= (4^2/9.81)^{1/3} = 1.77m$

(2) Minimum Specific Energy:

We Know $Q = AV$ — (I)
and $Q = qb$ - (II)
Equating (I) and (II)
$AV = qb$ we Know $V = qb$
$Vy = q$
$q/y_c = V$
putting values
$v = 4/1.177 = 3.398\ m/sec$

$E_{min} = 1.76\ m$

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(3) **Alternative Depth :: (E = 4m)**

As We Know $E > E_c$ there are two possible depths for given specific Energy

$E = h + V^2/2g$ where $V = Q/A = q/h$ (for rectangular channel)

$$E = h + q^2/2gh^2$$

Substituting values in meter second unit.

$$4 = h + 0.8155/h^2$$ (slow, deep)

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

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

Iteration from $h = 4$ given $h = 3.948\,m$

for sub-critical solution (fast, shallow) second term associated with Kinetic energy dominates so rearrange as

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

Iteration from $h = 0$ given $h = 0.4814\,m$

Alternate depths are 3.95 and 0.48 m.

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ASSIGNMENT: 02

Problem: 01

Given Data:

Depth = 10 cm
Velocity = 6 m/sec

Required: (1) type of flow
(2) alternate Depth

Solution:

(1) First of all, we have to check Fraud No. so

$$Fr = V/\sqrt{gy} = \frac{6 m/s}{\sqrt{9.81 m/s^2 \times 0.1}}$$

$$= 6.06 > 1$$

so flow = super-critical.

(2) Alternate Depth

We know by formula:

$$E = y + V^2/2g$$

putting values

$$E = 0.1 + 6^2/2.981 = 1.935 \ m$$

so alternate Depth for $E = 1.935m$ yields $y_{alt} = 1.93 m.$

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ASSIGNMENT: 02

Problem: 02

Given Data:

Velocity $= V_i = 2\,m/s$

Depth $= y_1 = 3\,m$

Elevation $= \Delta z = 60\,cm = 0.6\,m$

Downstep $= 15\,cm = 0.15\,m$

Required:

(1) Depth and Elevation changes

(2) Max size of upstep.

Solution:

As we know

$$E_1 = y_1 + V_1^2/2g$$

$$= 3 + 2^2/2\times9.81$$

$$= 3.20\,m$$

Now

$$E_2 = E_1 - \Delta z = 3.20\,m - 0.60\,m = 2.60\,m$$

Also ~~[illegible]~~

$$E_2 = y_2 + q^2/2gy_2^2 = y_2 = \frac{(6\,m^3/s)^2}{2.981\,m/s^2 \cdot y_2^2} = 2.60\,m$$

So $y_2 = 224\,m$ $\quad \Delta y = y_2 - y_1 = 0.76\,m$

So water surface drops $0.16\,m$. For a downward step of $15\,cm$ we have

$$E_2 = E_1 - \Delta z = 3.20 - (-0.15) = 3.35\,m$$

Now providing $y_2 = 3.17$ and $\Delta y = y_2 - y_1 = 0.17\,m$

water surface rises $0.02\,m$.

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ASSIGNMENT: 02

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

$y_2 = y_c$

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

$y_c \sqrt[3]{6^2/9.18}$

$y_c = 1.54 m$

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ASSIGNMENT: 03

Given Data:-

Depth at upstream side $= y_1 = 3.6m$
Depth at downstream side $= y_2 = 0.9m$
Width of slice gate $= 3.9m$

Required:-

(1) Discharge
(2) Froude Number (upstream & Downstream)

Solution:-

As we know

$$E_1 = E_2$$

$$y_1 + V_1^2/2g = y_2 + V_2^2/2gh \quad \text{— (I)}$$

we also know

$$Q = A_1V_1 = A_2V_2$$

$$b_1y_1V_1 \cancel{A} b_2y_2V_2$$

$$\Rightarrow \quad y_1V_1 = y_2V_2$$

$$V_2 = y_1/y_2 \, V_1$$

putting values

$$V_2 = 3.6/0.9 \, V_1$$

$$V_2 = 4V_1 \quad \text{— (II)}$$

putting eq (II) in (I) we get

$$y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g}$$

$$3.6 + \frac{V_1^2}{2g} = 0.9 + \frac{(4V_1)^2}{2g}$$

$$3.6 + \frac{V_1^2}{2g} = 0.9 + \frac{16V_1^2}{2g}$$

$$\frac{V_1^2}{2g} - \frac{16V_1^2}{2g} = 0.9 - 3.6$$

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ASSIGNMENT: 03

$$\frac{V_1^2 - 16V_1^2}{2g} = -2.7$$

$$\frac{-15V_1^2}{2g} = -2.7$$

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

$$V_1 = 1.879 \, m/sec$$

putting value of "V_1" in eq (11)

$$V_2 = 4V_1$$

$$V_2 = 4(1.879) = 7.516 \, m/sec$$

As $\underline{Q_1} = A_1V_1 = by_1V_1$

$$\Rightarrow Q_1 = 3.9 \times 3.6 \times 1.879 = 26.38 \, m^3/sec$$

$\underline{Q_2} = A_2V_2 = by_2V_2$

$$\Rightarrow Q_2 = 3.9 \times 0.9 \times 7.516 = 26.38 \, m^3/sec$$

$$Q = Q_1 = Q_2 = 26.38 \, m^3/sec$$

$\Rightarrow$ Fraud Number at upstream side

$$Fr_1 = \frac{V_1}{\sqrt{gy_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31 \text{ (sub-critical flow)}$$

$\Rightarrow$ Fraud Number at Downstream side

$$Fr_2 = \frac{V_2}{\sqrt{gy_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52 \text{ (super-critical flow)}$$

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