Sessional

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Assignment # 1, 2, 3

Subject : Hydraulic engineering

Q1

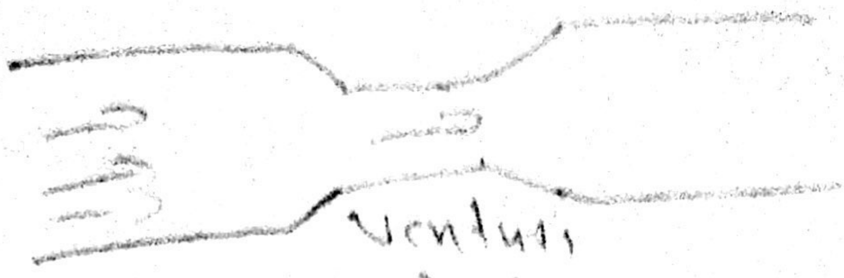
Assignment:- 1

Venturi flume:-

A Venturi flume is a Critical-flow open flume with a Constricted flow which causes a drop in the ~~dr~~ hydraulic grade line, ~~Critical~~ Creating a Critical depth. it is used in flow measurement of Very large flow rates, usually given in million of Cubic units

A Venturi meter would
normally measure in mm.
where as a Venture flume
Measure in meter.
Measurement of discharge
with Venturi flame
requires two measurement.
one upstream and
one at the throat.
if the flow losse,
on a Subcritical State
through the flume.
It the flume is deigned
So as to pass the
flow from Sub
Critical

to Super Critical
State while passing
through the flume,
a single measurement
at a throat is sufficient
for completion of
discharge to ensure
the occurance of Critical
depth of the throat.
The flumes are usually
designed in such a way
as to form a hydraulic
jump on the downstream
side of structure


venturi
tube

Q:2

Ans:-

$b = 3m$

$Q = 12 m^3 s^{-1}$

Sol:-

(a) Discharge Per unit width:

$q = \frac{Q}{b} = 12/3 = 4 m^2 s^{-1}$

Then, for a rectangular Channel

$h_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{4^2}{9.81}\right)^{1/3} = 1.177 m$

$$\boxed{\text{Critical depth} = 1.18m}$$

(b) for Rectangular Channel:

$$E = \frac{3}{2} h_c = \frac{3}{2} \times 1.177 = 1.766m$$

$$\boxed{\text{Minimum Specific Energy} = 1.77m}$$

(c)

As $E > E_c$, there are two Possible depth for a given Specific energy.

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

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

Substituting Values in Meter Second units.

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

For the Subcritical (Slow, deep) Sol
the first term, associated wi
Potential energy.

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

Iteration (from e.g. h = 4) give
$h = 3.948m$

For Supercritical (fast, shallow) Sol
the second term, associated
with Kinetic energy.

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

Iteration (from e.g. h = 0) give h = 0.4

Alternate depth are
$\boxed{3.95m \text{ and } 0.481m}$

Assignment:- 2

Problem:- 1

Sol:-

Check Froude Number

$$Fr = \frac{V}{\sqrt{gy}} = \frac{6\,m/s}{\sqrt{9.81/s^2 \times 0.1m}} = 6.06 > 1$$

So the flow is Super Critical

$$E = y + V^2/2g = 0.1m + \frac{(6\,m/s)^2}{2 \times 9.81\,m/s^2}$$

$$= 1.935\,m$$

Solving the alternate depth fomon.

$E = 1.935\,m$ yeild, $y_{alt} = 1.93\,m$

Problem: 2:-

Sol:-

$E_1 = y_1 + \frac{V_1^2}{2g} = 3m + \frac{(2m/s)^2}{2 \times 9.81\, m/s^2} = 3.20m$

$E_2 = E_1 - \Delta z = 3.20m - 0.6m = 2.60m$

Also

$E_2 = y_2 + \frac{q^2}{2gy_2^2} = y_2 + \frac{(6m^3/s/m)^2}{2 \times 9.81 m/s^2 \cdot y_2^2} = 2.60m$

So $y_2 = 2.24m$ & $\Delta y = y_2 - y_1 = -0.76m$

So water surface drop 0.16m

for downward step of 15cm we have

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

giving $y_2 = 3.17m$ and $\Delta y = y_2 - y_1 = 0.17$

So water surface rises 0.07 m

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

$$y_2 = y_c$$

$$y_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{\left(6\,m^3/s/m\right)^2}{981\,m/s^2}}$$

$$= 1.54\,m$$

Assignment: 3

Q3

Sol:-

Given data:-

$y_1 = 3.6m, \quad y_2 = 0.9$

$b = 3.9m$

As we know that

$E_1 = E_2$

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

Also

$Q = A_1V_1 = A_2V_2$

$b_1y_1V_1 = b_2y_2V_2$

$y_1V_1 = y_2V_2$

$V_2 = y_1/y_2 \times V_1$

$\boxed{V_2 = 4V_1} \quad (2)$

putting the value of V_1 in eq (2) we get

$V_2 = 4V_1$

$V_2 = 4(1.879)$

$V_2 = 7.516 \, m/sec$

→ As $Q_1 = A_1V_1 = b_1y_1V_1$

$= 3.9 \times 3.6 \times 1.879$

$= 26.38 \, m/sec$

→ $Q_2 = A_2V_2 = by_2V_2 = 3.9 \times 0.9 \times 7.516$

$= 26.38 \, m^3/sec$

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

(1) Froud number → At upstream side.

$$Fr_1 = \frac{V_1}{\sqrt{gy_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31$$

$Fr_1 = 0.31 < 1$ So it is subcritical flow

(2) Froud number

$$Fr_2 = \frac{V_2}{\sqrt{gy_2}} = \frac{7.56}{\sqrt{9.81 \times 0.9}}$$

$$= 2.52$$

$Fr_2 = 2.52 > 1$ So

Supercritical flow