

Name# M-IKRAM

ID# 7874

Sec# B

Assignment

1, 2, 3

Assignment: 1

Q1

Venturi flume:-

A Venturi flume is a critical-flow open flume with a constricted flow which causes a loop in the 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, whereas a Venturi flume measure in meter.

Measurement of discharge with Venturi flume requires two measurement.

one upstream and

one at the throat.

if the flow losses

on a subcritical state

through the flume.

if the flume is designed

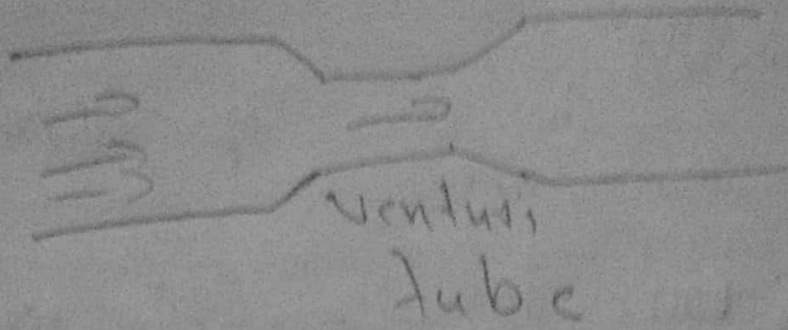
so as to pass the

flow from sub

critical

to super critical
state while passing
through the flame,
a single measurement
at a throat is sufficient
for completion of
discharge to ensure
the occurrence 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.



$$\underline{\underline{Q: 2}}$$

Ans:

$$b = 3 \text{ m}$$

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

Sol:-

(a) Discharge Per unit width:

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

Then, for a rectangular Channel

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

Critical depth = 1.18 m

(b) for Rectangular Channel:-

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

Minimum Specific Energy = 1.77 m

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

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

$$\Rightarrow E = h + \frac{Q^2}{2g b^2 h^2}$$

Substituting values in Meter Second units.

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

For the Subcritical (Slow, deep) flow
the first term, associated with
potential energy.

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

Iteration (from eq. $h=4$) gives

$$h = 3.948 \text{ m}$$

For Supercritical (fast, shallow) flow
the second term, associated
with kinetic energy,

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

Iteration (from eq. $h=0$) gives $h=0.4814$

Alternate depths are

$$3.95 \text{ m and } 0.4814$$

Assignment:- 2

Problem:- 1

Sol:-

check Froude Number

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

So the flow is Super Critical

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

$$= 1.935 \text{ m}$$

Solving the alternate depth
form on.

$$E = 1.935 \text{ m} \quad \text{yield } y_{alt} = 1.935 \text{ m}$$

Problem: 2:-

Sol:-

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

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

Also

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

$$\text{So } y_2 = 2.24\text{m} \times \Delta y = y_2 - y_1 = -0.76\text{m}$$

So water surface drop 0.16m
for downward step of 15cm we have

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

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

So water surface rises 0.17m.

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

$$y_2 = y_c$$

$$y_c = \sqrt[3]{\frac{Q^2}{g}} = \sqrt[3]{\frac{(6 \text{ m}^3/\text{s}/\text{m})^2}{9.81 \text{ m/s}^2}}$$

$$= 1.54 \text{ m}$$

Assignment:

Q3

Sol:-

Given data:-

$$y_1 = 3.6 \text{ m}, \quad y_2 = 0.9$$

$$b = 3.9 \text{ m}$$

As we know that

$$E_1 = E_2$$

$$y_1 + \frac{v_1^2}{2g} = y_2 + \frac{v_2^2}{2g} \quad \text{--- (1)}$$

Also

$$Q = A_1 v_1 = A_2 v_2$$

$$b_1 y_1 v_1 = b_2 y_2 v_2$$

$$y_1 v_1 = y_2 v_2$$

$$v_2 = \frac{y_1}{y_2} \times v_1$$

$$v_2 = \frac{y_1 v_1}{y_2} \quad \text{--- (2)}$$

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

$$V_2 = 4V_1$$

$$V_2 = 4(1.879)$$

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

→ As

$$Q_1 = A_1 V_1 = b_1 y_1 V_1$$

$$= 3.9 \times 3.6 \times 1.879$$

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

$$\begin{aligned} \rightarrow Q_2 &= A_2 V_2 = b_2 y_2 V_2 = 3.9 \times 0.9 \times 7.56 \\ &= 26.38 \text{ m}^3/\text{s} \end{aligned}$$

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

① Froude number \rightarrow At upstream side

$$F_{r1} = \frac{V_1}{\sqrt{g y_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31$$

$F_{r1} = 0.31 < 1$ So it is
Subcritical flow

② Froude number

$$F_{r2} = \frac{V_2}{\sqrt{g y_2}} = \frac{7.56}{\sqrt{9.81 \times 0.9}} = 2.52$$

$$F_{r2} = 2.52 > 1 \text{ So}$$

Supercritical flow