Name - Shah Zeb - Khan

ID # 6938

Section - "A"

Semester - 6th

Assignment : Hydraulic Engineering

Submitted to : Engr. Fawad

Assignment # 01

Question # 01 : What is venture flume? with detail?

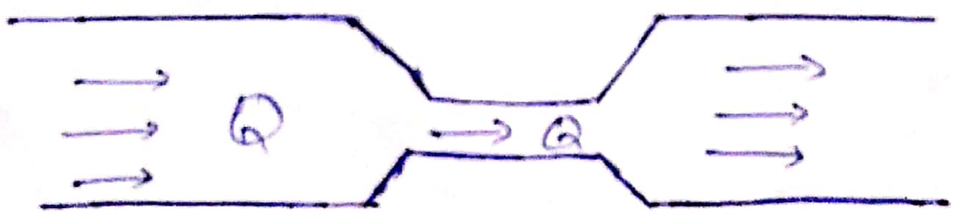
Answer :

venture flume :-

A venturi flume is a critical-flow open flume with a constricted flow which causes a drop in the hydraulic grade line, creating a critical depth.

it is used in flow measurment of very large flow rates, usually given in millions of cubic unit. A venturi meter would normally measure in millimetres, whereas a venturi meter flume measures in meters.

measurement of discharge with venturi flumes required two measurents, one upstream and one at the throat (narrowest cross-section). if the flow passed in a subcritical state through the flume. if the flumes are designed so as to pass the flow sub critical to supercritical state while passing through the flume. a single measurement at the throat (which in the case become a critical section). is sufficient for computation of discharge. To ensure the occurrence of the critical depth at the throat. the flumes are usually designed in such way as to from a hydraulic jump on the down stream side of the structure. These flumes are called Standing waves flume:



Flow Through venturi flume:

Question #02

A 3m wide channel carried a total discharge of $12\ m^3/sec$.

Calculate: a) The critical depth

b) The minimum specific energy

c) The alternate depth when $E = 4m$.

Solution:-

Given data:

wide of channal $= b = 3\ m$

Discharge $= Q = 12\ m^3/sec$

a) critical depth:

Discharge per unit width

$q = Q/b = \frac{12}{3}$

$q = 4\ m^2/sec$

For Rectangular channel

$h_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{4^2}{3.81}\right)^{1/3} = 1.18m$

$h_c = 1.18m$

b) Minimum Specific Energy :- (E_c) ?

for Rectangular channel

$$E_c = \frac{3}{2} h_c = \frac{3}{2} \times 1.18$$

$$\boxed{E_c = 1.77\ m}$$

c) The Alternate depth $E = 4m$

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

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

for (rectangular channel)

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

$$4 = h + \frac{0.815}{h^2}$$

for the Subcritical solution the first term, associated with the potenical energy domenates

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

iteration (from $h = 4$) given $h = 3.948\ m$

For the Subcritial (first - Shallow) solution

The Second term associted with kinetic energy.

dominates rearrange as

So

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

⇒ iteration (from h = 0) gives h = 0.4814 m

So Alternate depth are 3.95 & 0.4814 m.

Assignment # 02

Question #01 : water flows at a depth of 10cm with a velocity of 6 m/s in a rectangular channel. Is the flow Subcritical or Supercritical? what is the alternate depth?

Solution :- First of all we find Froude Number to find the flow.

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

$$F_r = 6.06 > 1$$

So The flow is Supercritical

Alternate depth :- As we know that

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

$$= 0.1 + \frac{6^2}{2 \times 9.81} = 1.935m$$

$$\boxed{E = 1.935m}$$

Question # 02 : water flow with velocity of 2 m/s and at a depth of 3m in a rectangular ... — — —
. . . — — — — — . . . that Could exist before the up Stream depth changes would result, neglect head losses.

Given data:

Velocity $= V_1 = 2\,m/s$

depth $= y_1 = 3\,m$

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

down step $= 15\,cm = 0.15\,m$

Solution:- As we know that

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

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

$$\boxed{E_1 = 3.20\,m}$$

Now $E_2 = E_1 - \Delta z$

$E_2 = 3.2 - 0.6$

$E_2 = 2.60m$

Also

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

$$2.60 = y_2 + \frac{6^2}{2 \times 9.81 \cdot y_2^2}$$

$y_2 = 2.24m$

$\Delta y = y_2 - y_1$

$\Delta y = 2.24 - 3$

$\Delta y = -0.76m$

So water Surface drop $= 0.76m$

*) for a downward step of 15cm or 0.15m we

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

$E_2 = 3.25m$

Now $y_2 = 3.17m$

$\Delta y = y_2 - y_1 = 3.17 - 3$

$\Delta y = 0.17m$

So water surface rises 0.02m

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

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

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

$y_c = 1.54m$

———— o ———— o ———— o ————

Assignment #03

Question # A water passing from the slice gate in dam having depth of water in . . . ‒ ‒ ‒ ‒ ‒ ‒

. . ‒ ‒ ‒ ‒ ‒ ‒ ‒ . . The width of slice gate is 3.9m

Determine a) Discharge

b) froued upstream & downstream!

Given data,

$y_1 = 36\,m$, $y_2 = 0.9\,m$

$b = 3.9\,m$

Solution:

$$E_1 = E_2$$

$$y_1 + \frac{v_1^2}{2g} = y_2 + \frac{v_2^2}{2g} \longrightarrow ①$$

Also:

$$Q = A_1 v_1 = A_2 V_2$$

$$b_1 y_1 \cdot v_1 = b_2 y_2 \cdot V_2$$

$$b \cdot y_1 \cdot v_1 = b_2 \cdot y_2 \cdot V_2 \qquad (b = b_1 = b_2)$$

$$y_1 \cdot v = y_2 \cdot V_2$$

$$V_2 = \frac{y_1}{y_2} \times v_1 \Rightarrow \frac{3.6}{0.9} \times v_1$$

Scanned with CamScanner

$$V_2 = 4V_1 \longrightarrow (2)$$

Putting in eq (1)

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

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

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

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

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

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

Puting in eq (2) we get

$$V_2 = 4V_1$$

$$V_2 = 4(1.879)$$

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

As $Q_1 = A_1V_1 = by_1 \cdot V_1$

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

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

$Q_2 = A_2 V_2 = b . y_2 . V_2$

$= 3.9 \times 0.9 \times 7.516$

$Q_2 = 26.38 \ m^3/sec$

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

① Froud Number ⇒ At upstream side

$Fr_1 = \frac{V_1}{\sqrt{g y_1}} = \frac{1.878}{\sqrt{9.81 \times 3.6}} = 0.31$

So its subcritical flow.

② Froud Number ⇒ At downstream side

$Fr_2 = \frac{V_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52$

So its super crictical flow.