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Venturi Flame :-

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 measurement of very large flow. rates usually given in millions of cubic units. A venturi meter would normally measure in mm whereas a venturi flume measure in meters.

Measurement of discharge with Venturi flumes requires two measurement. One upstream and one at the throat. cross section if the flow passes in a subcritical state through the flume. If the flums are designed so as to pass the flow from sub critical to supercritical state while passing through the flume, a single measurement a the throat is sufficient for computation of discharge.

→ To ensure the occurence of critical depth at the throat, the flumes are usually designed in such away as to form a hydraulic jump on the downstream side of the structure. these flumes are called "standing wave flumes"

2- A 3m wide channel carries a total discharge of $12 m^3/sec$ calculate.

* Critical depth.
* Minimum specific energy.
* Alternate depth, E = 4m

a

Given data

Wide of channel = 3m

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

Solution

(a) Critical depth :-

Discharge per unit width

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

$$q = 4 m^2/sec$$

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For Rectangular channel

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

$$h_c = 1.18 m$$

(b) Minimum Specific Energy $E_c = ?$

For Rectangular channel

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

$$E_c = 1.77 m$$

(c) The Alternate depth $E = 4m$

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

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

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

(5)

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

For the subcritical solution the first term, associated with potential energy

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

⇒ Iteration (form $h = y$) gives $h = 3.948m$ for subcritical (first shallows) solution.

The second term associated with kinetic energy.

dominates rearrage as:

So, $$h = \sqrt{\frac{0.8155}{y-h}}$$

Iteration (from $h = 0$) gives $h = 0.4814m$

So Alternate depth are $3.95m$ and $0.4814m$.

$$E = y_1 + \frac{V^2}{2g}$$

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

$$= 1.935m$$

The alternate depth for $E = \boxed{1.935m}$

Yields $y_{alternate} = \boxed{1.93m}$

Q No 2

Given data

Velocity $= V_1 = 2m/s$

depth $= y_1 = 3m$

Elevation $\Delta x = 60cm = 0.6m$

down step $= 15cm = 0.15m$

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Solution As we know that

$$E_1 = y_1 + \frac{u_1^2}{2g}$$

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

$$E_1 = 3.20m$$

Now $E_2 = E_1 - \Delta x$

$$= 3.2 - 0.6$$

$$E_2 = 2.60m$$

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

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

$$\boxed{y_2 = 2.24m}$$

$\Delta y = y_2 - y_1$

$\Delta y = 2.24 - 3$

$\Delta y = 0.76m$

So water surface drop $= 0.16m$

* for downward step of 15cm or 0.15m

we have

$E_2 = E_1 - \Delta x = 3.20 - (-0.15)$

$\boxed{E_2 = 3.55m}$

Now $y_2 = 3.17m$

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

$\Delta y = 0.17m$

So water surface rises $0.02m$

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* The maximum step possible before affecting upstream water surface level is for

$$y = y_c$$

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

$$y_c = \sqrt[3]{\frac{6^2}{9.81}}$$

$$y_c = 1.54 m$$

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Asigment #03

Q No 1

Given data

$y_1 = 3.6m$, $y_2 = 0.9m$, $b = 3.9m$

Solution. As we know that

$E_1 = E_2$

$y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g} \rightarrow ①$

Also,

$Q = A_1V_1 = A_2V_2$

$b_1 y_1 = b_2 y_2 \cdot V_2$

$b \cdot y_1 \cdot V_1 = b \cdot y_2 \cdot V_2$

$y_1 \cdot V_1 = y_2 \cdot V_2$

$V_2 = \frac{y_1}{y_2} \times V_2$

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$$V_2 = \frac{3.6}{0.9} \times V_1$$

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

putting in eq (1)

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

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

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

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

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

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

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

Scanned with CamScanner

$V_1 = 1.879 m/sec$

put in eq

$V_2 = 4V_1$

$V_2 = 4(1.879)$

$V_2 = 7.516 m/sec$

As $Q_1 = A_1V_1 = by_1 \cdot V_1$

$3.9 \times 3.6 \times 1.879$

$Q_1 = 26.38 m^3/sec$

$Q_2 = A_2V_2 = b \cdot y_2 \cdot V_2$

$= 3.9 \times 0.9 \times 7.516$

$Q_2 = 26.38 m^3/sec$

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

(ii) Fraud number → At upsteam side

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$$Fr_1 = \frac{V_1}{\sqrt{g y_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31$$

Subcritical flow

b) Fraud Number → at downstward stream

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

(Super critical flow)