NAME : ABDUL ALI .

ID : 7884

SECTION : A

SEMESTER : 6th

SUBJECT : HYDRAULIC ENGINEARING

SUBMITTED TO,

Sir Engr, FAHAD AHMAD

Assignment : 01

Question : 01 :-

⇒ VENTURE FLUME :-

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

⇒ It is used in the flow measurement of very large flow rates, usually given in millions of cubic units,

⇒ A venturi meter would normally measures in millimeter, where as a venturi flume measures in meter.

⇒ Measurement of discharge with venturi flumes requires two measurements. One upstream and one at the throat, If the flow possess in a subcritical state through the flume.

⇒ If the flume are designed so as to pass the flow from sub critical to super critical state while passing through at the flume, a single measurement at the throat is sufficient for computation of discharge. To measure the occurance of critical depth at the throat, the flume are usually designed in such way as to form the structure.

Assignmen : 01 :-

Question : 02 :-

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

- ⇒ The critical depth
- ⇒ The minimum specific energy
- ⇒ The Alternate depth where $E = 4m$.

Given Data :-

wide of channel $= b = 3m$.

Discharg $= Q = 12 m^3/sec$

Solution :-

ⓐ Critical depth :-

⇒ Discharge per unit width

$$q = Q/b = 12/3$$

$$\boxed{q = 4 m^2/sec}$$

For Rectangular Chanel

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

$$\boxed{h_c = 1.18m}$$

(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.

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

(For rectangular channel).

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

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

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

For the subcritical Solution the first term, associated with Potential energy domaintes.

⇒ Iteration (from $h=4$) gives $h = 3.948m$

For the subcritical (first, shallow) solution, the second term associated with kinetic energy. dominates rearrange as

so $h = \sqrt{\dfrac{0.8155}{4-h}}$

⇒ Iteration (from $h=0$) give $h = 0.4814m$

so Alterate depth are $\boxed{3.95m}$ & $\boxed{0.4814m}$.

Assignment : 02 :-

Question . 01 :-

Water flows at a depth of 10cm
Is the flow subcritical or supercritical?
what is the Alternate depth?

Solution :-

First of all we first the Froud number to find the flow.

As we know that,

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

$$F_r = 6.06 > 1$$

So, the flow is super critical.

Alternate depth :-

As we know that

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

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

The alternate depth for $E = 1.935\,m$

yields $\boxed{y_{altnate} = 1.93m}$

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Question : 02 :-

Water flow with a velocity of 2m/s and at a depth of 3m in a rectangular channel. what is the change in depth and in water surface elevation produced by a gradual upward change in bottom elevation (upstep) of 60cm? what would be the depth and elevation change if there were a gradual down step of 15cm, what is maximum size of upstep that could exits before upstream depth changes would result? Neglect head losses.

Given Data :-

velocity - V_1 = 2m/s

depth = y_1 = 3m

Elevation ΔZ = 60cm = 0.6m

downstep = 15 cm = 0.15m.

Solution :-

As we know that

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

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

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

Now,

$$E_2 = E_1 - \Delta Z$$

$$E_2 = 3.2 - 0.6$$

$$\boxed{E_2 = 2.60m}$$

Also

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

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

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

$$\Delta y = y_2 - y_1$$

$$\Delta y = 2.24 - 3$$

$$\boxed{\Delta y = -0.76m}$$

So water surface drop = 0.16m

⇒ For a downward step of 15 cm or 0.15m

we have,

$$E_2 = E_1 - \Delta Z$$

$$E_2 = 3.20 - (0.15)$$

$$\boxed{E_2 = 3.35m}$$

Now

$y_2 = 3.17 m$

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

$\boxed{\Delta y = 0.17m}$

So water surface rises 0.02m

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

$y_2 = y_c$

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

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

$\boxed{y_c = 1.54m}$

Assignment : 03 :-

Question :-

A water passing from the Slice gate in Dam having a depth of water at upstream side is 3.6m after passing through sluice gate, the water curve shows that depth of water at down stream side is 0.9m. The width of slice gate 3.9m.

→ Determine * Discharge * Froud number and downstream.

Givendata :-

Depth of water at upstream side $y_1 = 3.6m$

Depth of water at downstream side $y_2 = 0.9m$

width of Slice gate $b = 3.9m$

Solution :-

As we know that specific energy on both streams are same

so $E_1 = E_2$

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

Also by discharge formula

$Q = A_1V_1 = A_2V_2$

$\cancel{b}y_1V_1 = \cancel{b}y_2V_2$ $\boxed{b_1 = b_2}$

$y_1V_1 = y_2V_2$

$$V_2 = \frac{y_1}{y_2} \times V_1$$

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

$$\boxed{V_2 = 4V_1} \rightarrow 2$$

Putting the values of V_2 in eq 1

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

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

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

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

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

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

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

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

Putting the values of V_1 in eq(ii)

$V_2 = 4V_1$

$V_2 = 4(1.879)$

$\boxed{V_2 = 7.516 m/sec}$

Also

$Q_1 = A_1V_1$

$Q_1 = b_1y_1V_1 = 3.9 \times 3.6 \times 1.879$

$\boxed{Q_1 = 26.38 m^2/sec}$

$Q_2 = A_2V_2$

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

$\boxed{Q_2 = 26.38 m^2/sec}$

$Q = Q_1 = Q_2 = 26.38 m^2/sec$

⇒ Froud Number at upstream side :-

By formula

$$F_{r1} = \frac{V_1}{\sqrt{gy_1}}$$

$$= \frac{1.879}{\sqrt{9.81 \times 3.6}}$$

$$\boxed{F_{r_1} = 0.31 < 1}$$

It is sub critical flow.

⇒ Froud Number at downstream side :-

$$F_{r_2} = \frac{V_2}{\sqrt{g y_2}}$$

$$F_{r_2} = \frac{7.516}{\sqrt{9.81 \times 0.9}}$$

$$\boxed{F_{r_2} = 2.52}$$

$F_{r_2} > 1$

It is super critical flow.