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Sec :- A

Subject :- Hydralic Engineering

Submitted to :- Engr Fawad

Module :- 6th

Date :- 30-June-20

Assignment # "1"

Q1) What is Venture flume ? Explain with detail?

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

It is used in flow measurement of very large flow rate, usually given in millions of cubic units. A venturi meter would normally measure in mm, where as a venture flume measure in meters.

Measurement of discharge with venture flume requires two measurement. one upstream & one at the throat, if the flow passes in 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 flume, a single measurement at a throat is sufficient for computation of discharge. To ensure the occurence of critical depth at the throat, the flume are usually designed in such away as to form a hydralic jump on the downstream side of the structure. The flume is called standered wave flame.

Q2) A 3m wide channel carries a total discharge of $12m^3/sec$. Calculate

1) The critical depth
2) The minimum specific energy
3) The alternate depth when $t = 4m$

Sol:-

$b = 3m$

$Q = 12m^3/sec$

a) Discharge per unit width.

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

Then for a rectangular channel

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

So critical depth $= 1.18m$

b) For a rectangular channel.

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

So minimum specific energy $= 1.77m$

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

$$E = h + \frac{V^2}{2g} \quad \text{where} \quad V = \frac{Q}{A} = \frac{q}{h} \text{ (rectangular channel)}$$

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

Substituting value in meter-sec unit

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

for a sub critical (slow, deep) SO, the first term associated with potential energy dominates so rearrange as

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

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

for the super critical (fast, shallow) SO, the second term, associated with K.E dominates so rearrange as:

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

Iteration (from, e g, $h = 0$) gives $h = 0.4814m$

alternate depth are 3.95 & 0.481m

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Assignment # "02"

Problem # 1

Q1) Water flow at a depth of 10cm with a velocity of 6m/s in a rectangular channel. Is the flow subcritical or super critical? What is the alternate depth.

Sol:-

Check Froude Number

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

So the flow is super critical

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

$$= 1.935\ m$$

Solving the alternate depth from an:

$E = 1.935m$ yields $y_{alt} = 1.93m$

"Problem #2"

Water flow with a velocity .....? Neglet head loss.

Sol:-

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

$$E_2 = E_1 - \Delta z = 3.20m - 0.60m = 2.60m$$

Also

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

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

So the water surface drop 0.16m . for a down word step of 15cm we have;

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

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

So the water surfaces rise 0.02m . The maximum upstep possible before affecting upstream water surface is for $y_2 = y$

$$y = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{(6m^3/s/m)^2}{9.81 m/s^2}} = 1.54m$$

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Assignment "#03"

Problem 01:-

A water passing from the slice gate in Dam ..... ?

Given data:-

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

$b = 3.9m$

Sol:-

as we know that

$E1 = E2$

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

Also $Q = A_1V_1 = A_2V_2$

$b y_1 \cdot V_1 = b_2 y_2 \cdot V_2$ $\quad (b = b_1 = b_2)$

$b y_1 V_1 = b y_2 V_2$

$y_1 V_1 = y_2 V_2$

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

$$V_2 = \frac{3.6}{0.9} \times V_1 = 4V_1 \quad -(2)$$

putting eq (1)

$$y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g} = 3.6 + \frac{V_1^2}{2g} = 0.9 + \frac{(4V_1)^2}{2g}$$

$V_1 = 1.879$ m/sec put in eq (2) we get

$V_2 = 4V_1$

$Q_1 = A_1 V_1 = b y_1 \cdot V_1$

$= 3.9 \times 3.6 \times 1.879$

$Q_1 = 26.38 \ m^3/sec$

$\Rightarrow Q_2 = A_2 V_2 = b \cdot y_2 \cdot V_2$

$= 3.9 \times 0.9 \times 7.516$

$Q_2 = 26.38 \ m^3/sec$

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

(1) Froud Number → At upstream side

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

↓ Sub critical flow

2) Froud Number → At down stream side

$F_{r2} = \frac{V_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52$ ↓ Super critical flow