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Sec (B), BE (Civil), 6th Semester

Assignment # 1, 2, & 3.

Subject : Hydraulic Engineering

Instructor: Engr: Fawad Ahmad

Signature:

Question no 1 (A) What is Venture flume?. Explain in/with details.

Ans: Venture flume:

A Venture flume is a critical flow open flume with a constricted flow which ~~come~~ cause a drop in the hydraulic grade line, creating a critical depth.

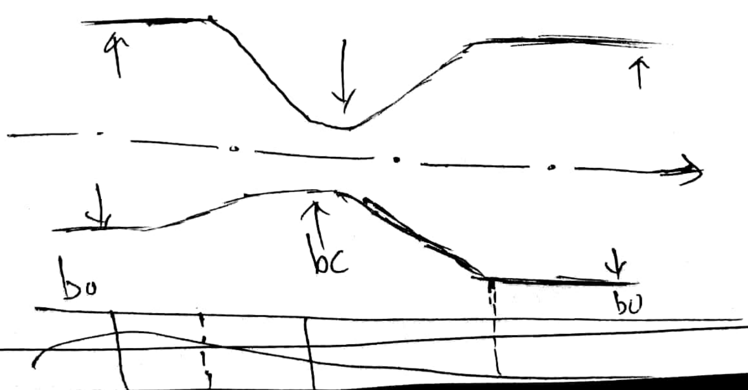
→ It is used in flow measurement of very large flow rate, usually given in millions of cubic units.

A Venture flume meter would normally measure in millimeter whereas a Venture flume measure in meter.

→ Measurement of discharge with Venture flume requires two measurement, One Upstream and one at the throat, If the flow passes in a Subcritical State through the flume.

→ If the flume are designed so, as to pass the flow from Sub-Critical to Supercritical State while passing Through the flume, a Single measurement at the throat, is Sufficient for Computation of discharge.

→ To ensure the occurrence of Critical depth at the throat, the flume are usually designed in such, to form a Hydraulic Jump on the downstream Side of Structure.



Q no 1(B) A 3-m wide Channle Carries a total ~~load~~ discharge of 12 m^3/Sec.

Calculate:

(a) Critical depth

(b) Minimum specific Energy

(c) The alternative depth when $E = 4m$.

Give data

$b = 3m$

$Q = 12\ m^3/s$

Solution:

Discharge per unit width.

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

for a channel in rectengle Shape.

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

A. $h = 1.177m$.

Critical depth = 1.18m.

(b) Minimum Specific Energy:

For Rectegular Channle

$E = \frac{3}{2} h = \frac{3}{2}(1.18)$

$E = 1.766\ m$

(C) Alternative depth:

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

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

$E = h + \frac{V^2}{2g}$ i.e. $\because V = \frac{Q}{A} = \frac{q}{h}$ (for a Rec Channle).

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

Substituting values in meter - Second units.

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

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

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

→ For the Super-Critical Solution, the Second term associated with K.E dominates.

So rectangle are;

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

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

⇒ The Alternative depth are 3.95m & 0.4814m.

Assignment no - 2

Problem # 01

Water flows at depth of 10 cm with a velocity of 6 m/s in a rectangular channel. Is the flow sub critical or super-critical, what is the alternative depth.

Solution:

Given

Velocity = 6 m/s

depth = 10 cm

Flow = ?

Alternative depth = ?

Check fraud number

$$Fr = \frac{V}{\sqrt{gy}} = \frac{6}{\sqrt{9.81 \times 0.1}}$$

$Fr = 6.06 > 1$

So flow is Super Critical.

Now

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

$$= 0.1 + \frac{(6)^2}{2(9)}.$$

$$\Rightarrow 0.1 + \frac{(6)^2}{19.62}.$$

$$E = 1.935.$$

Assignment # 2
Problem # 2

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

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

$E_1 = 3.20m$

Also

$E_2 = E_1 - \Delta Z$

$= 3.20 - 0.60$

$E_2 = 2.60m$.

Also

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

$= y_2 + \frac{(6)^2}{2 \times 9.81 \times y_1^2}$.

$E_2 = 2.60$.

So $y = 2.24 m$

$\Delta y = y_2 - y_1 = -0.76.$

So water Surface drops, 0.16m

For a ~~downstream~~ downward Step of 15cm, we have;

$E_1 = E_1 - \Delta Z.$

$= 3.20 - (-0.15) = 3.35m.$

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

So water rises 0.02 m.

$\Rightarrow$ The minimum upstep possible before affecting upstream water Surface is for;

$y_2 = y_c.$

$y_c = \sqrt{\frac{q^2}{g}} = \sqrt{\frac{(6)^2}{9.81}}$

$y_c = 1.54 \; m.$

Assignment #03. ① (1)

Problem

A water passing from the ~~surface~~ sluice gate in Dam having a depth of water at upstream side is 3.6 m, ~~aft~~ after passing through sluice gate, the back water curve shows that depth of water at downstream side is 0.9m. The width of sluice gate is 3.9m.

Given data.

$y_1 = 3.6\,m$

$y_2 = 0.9\,m$

$b = 3.9\,m.$

Required:

(a) Discharge $Q = ?$

(b) Froud number at upstream & downstream.

Q3 (2)

Solution:

Specific energy at upstream and downstream

$E_1 = E_2$

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

Also

$$Q = A_1V_1 = A_2V_2$$

$$By_1V_1 = By_2V_2$$

$$y_1v_1 = y_2v_2$$

$$(3.6)v_1 = (0.9)v_2$$

$$V = \frac{3.6}{0.9}v_1$$

$$V_2 = 4v_1 \rightarrow 2$$

Subsituting values in eq (2)

$$y_1 + \frac{v_1^2}{2g} = y_1 + \frac{V_2^2}{2g}$$

$$3.6 + \frac{v_1^2}{2g} = 0.9 + \frac{(4v_1)^2}{2g}$$

Q_3 (3)

$$3.6 + \frac{v_1^2}{2g} = 0.9 + \frac{16v_1^2}{2g}.$$

$$3.6 - 0.9 = \frac{16v_1^2}{2g} - \frac{v_1^2}{2g}.$$

$$2.7 = \frac{15v_1^2}{2g}$$

$$\frac{(2.7)(2g)}{15} = v_1^2$$

$$\sqrt{v_1^2} = \sqrt{3.53}$$

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

Putting value of v_1 in eq (2) to find v_2.

$V_2 = 4(V_1)$

$V_2 = 4(1.879)$

$V_2 = 7.516 \ m/sec$

DISCHARGE

$Q_1 = A_1 V_1$

$Q_1 = b y_1 V_1$

$Q_1 = (3.9)(3.6)(1.879)$

$Q_1 = 26.38 \ m^2/sec$

Now

$Q_2 = A_2 V_2$

$= b y_2 V_2$

$= (3.9)(0.9)(7.516)$

$Q = 26.3816 \ m^3/sec$

Fraud number

$$Fr_1 = \frac{V_1}{\sqrt{2gy_1}} = \frac{1.879}{\sqrt{2(1.81)(3.6)}}$$

$\Rightarrow$ **$Fr = 0.22$**

$$Fr_2 = \frac{V_2}{\sqrt{2gy}} = \frac{7.516}{\sqrt{2(9.81)(0.9)}}$$

$Fr_2 = 1.7806$