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SUBJECT	HYDRAULIC ENGINEERING
SEMESTER	6th
ASSIGNMENT	01

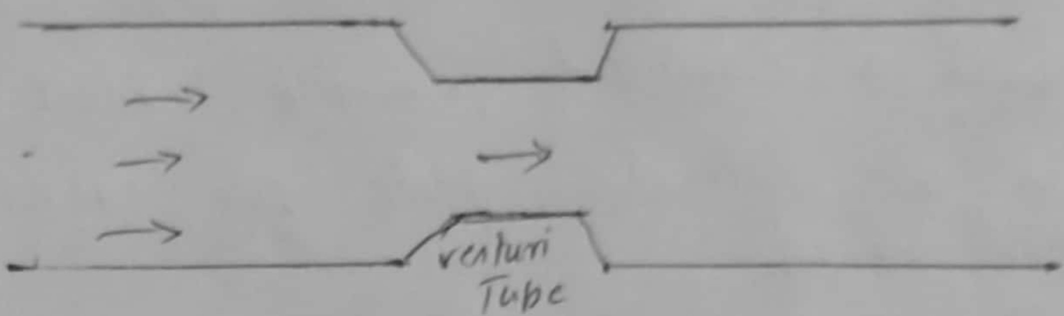
1 What is venture flume? Explain with detail?

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

It is used in flow meocurement of very large flow rate usually given in million of cubic units. A venturi meter would normolly measure in mm. where as a venture ~~flow~~ flume measure in meter.

Measurement of dischorge with venture flume rewuires two measurement one upstream and one at the threat, if the flow posses 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 of the throat, the flumes are usually designed in such away as to form a hydraulic jump on the downstream side of the structure.

The flume is called standing wave flume



A 3-m wide channel carries a total discharge of 12 m³/sec calculate.

a) The critical depth

b) The minimum specific energy

c) The alternate depths when E = 4m

(2i): Given data

$Q = 12\ m^3/sec$

$b = 3m$

As we know

Discharge per unit width

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

For rectangular channel

$h_c = (q^2/g)^{\frac{1}{3}} = (4/9.81)^{\frac{1}{3}} = 1.177m$

$\boxed{h_c = 1.177m}$

For a rectangular channel

$E_c = \frac{3}{2} h_c = \frac{2}{3}(1.177) = 1.766\ m$

min specific energy $= E_c = 1.766m$

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

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

$$E = h' + \frac{q^2}{2gh'^2}$$ Substituting the value in meter sec unit

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

For a subcritical (slow, deep) so the first term associated with potential energy dominates so rearrange as

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

iteration gives $h' = 3.948m$ for the super critical (fast, shallow) so the second term associated with K.E dominates so arrange as

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

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

alternate depth are 3.95 and 0.481m

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ASSIGNMENT	02

1) Water flows 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: First of all check froud number

$$F_r = \frac{v}{\sqrt{gy}} = \frac{6 m/s}{\sqrt{9.81 \times 0.1 m}} = 6.06$$

$$\therefore 6.06 > 1$$

So the flow is super critical

$$E = y + \frac{v^2}{2g} = 0.1 + \frac{(6)^2}{2 \times 9.81}$$

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

Solving the alternate depth for
$E = 1.935 m$ yield $y_{alt} = 1.93 m$

2) Water flows with a velocity of 2m/s and at a depth of 3m in a rectangular channel ...?

Sol: $E_1 = y + \frac{v_1^2}{2g} = 3 + \frac{2^2}{2 \times 9.81} = 3.20 m$

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

Also $E_2 = y_2 + \frac{v^2}{2gy} = y_2 + \frac{6^2}{2 \times 9.81 \cdot y} = 2.60 m.$

So $y_2 = 2.24m$. $\Delta y = y_2 - y_1 = 0.76m$ so water surface depth 0.16 m. For a downward step of 15cm we have

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

giving $y_2 = 3.17m$ and $\Delta y = y_2 - y_1 = 0.17m$. So water surface rises 0.02m. The maximum width possible before affecting upstream water surface level is for $y_2 = y_c$

$$y_c = \left(\frac{q^2}{g}\right)^{\frac{1}{3}} = \left(\frac{6^2}{9.81}\right)^{\frac{1}{3}} = 1.54m$$

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SEMESTER — 6th

ASSIGNMENT — 03

1) A water passing from the slice gate in Dam having a depth of water at u/s stream side is 3.6m, after passing through slice gate the back water curve shows the depth of water at down stream side is 0.9m. The width of slice gate is 3.9m Determine

a Discharge

b ~~Frownd~~ Freud number u/s stream and down stream.

Sol: Given data

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

As we know that

$$E_1 = E_2$$

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

Also

$$Q = A_1 V_1 = A_2 V_2$$

$$b_1 y_1 V_1 = b_2 y_2 V_2$$

$$y_1 V_1 = y_2 V_2$$

$$V_2 = y_1/y_2 \times V_1$$

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

$$\boxed{V_2 = 4V_1} \quad — ②$$

Putting in eqn (1)

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

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

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

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

$$\frac{v_1^2 - 16v_1^2}{2g} = -2.7$$

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

$$v_1^2 = \sqrt{\frac{2.7 \times 2(9.81)}{15}}$$

$$\boxed{v_1 = 1.879\ m/sec}$$

Putting the value of "v_1" in eq (2) we get

$$v_2 = 4v_1$$

$$v_2 = 4(1.879)$$

$$v_2 = 7.516\ m/sec$$

As $Q_1 = A_1 v_1 = b_1 y_1 v_1 = 3.9 \times 3.6 \times 1.879 = 26.38\ m^3/s$

$Q_2 = A_2 V_2 = b y_2 V_2 = 3.9 \times 0.9 \times 7.56 = 26.38 \, m^3/sec$

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

Froud Number -> At Wstream side

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

$Fr_1 = 0.31 < 1$ so it is subcritical flow

Froud number

$$Fr_2 = \frac{V_2}{\sqrt{g y_2}} = \frac{7.56}{\sqrt{9.81 \times 0.9}} = 2.52$$

$Fr_2 = 2.52 > 1$ so super critical flow