

Name

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Submitted to

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Subject

Hydraulic Engineering

Semester

6th

Section

B

Date

29-06-20

Assignment

01

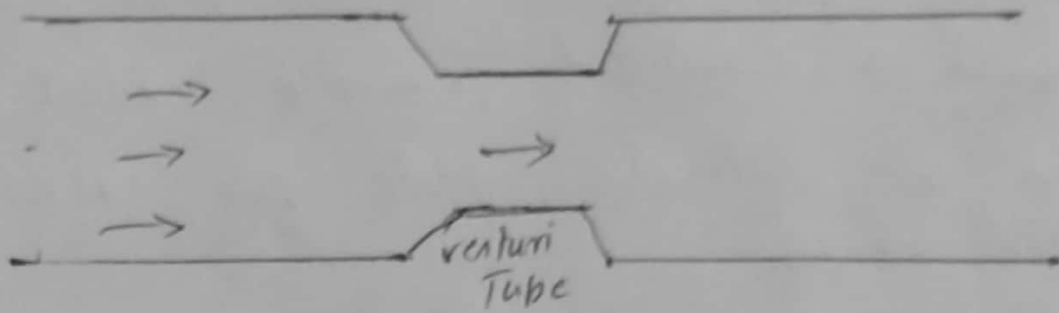
Q What is ventur flume? Explain with detail?

ANS A ventur 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 rate usually given in million of cubic units. A ventur meter would normally measure in mm. where as a ventur ~~flum~~ flume measure in meter.

Measurement of discharge with ventur 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 is designed so as to pass the flow from subcritical to super critical state while passing through the flume, a single measurement at a throat is sufficient for computation of discharge. To ensure the occurrence of critical depth of the throat, the flumes are usually designed in such a way as to form a hydraulic jump on the downstream side of the structure.

(2)
The flume is called standard wave flume



A 3-m wide channel carries a total discharge of $12 \text{ m}^3/\text{sec}$ calculate.

- The critical depth
- The minimum specific energy
- The alternate depths when $E = 4 \text{ m}$

Given data

$$Q = 12 \text{ m}^3/\text{sec}$$

$$b = 3 \text{ m}$$

As we know

Discharge per unit width

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

For rectangular channel

$$h_c = \left(\frac{q^3}{g} \right)^{\frac{1}{3}} = \left(\frac{4^3}{9.8} \right)^{\frac{1}{3}} = 1.177 \text{ m}$$

$$h_c = 1.177 \text{ m}$$

For a rectangular channel

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

$$\text{min specific energy} = E_c = 1.766 \text{ m}$$

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

$$E = h^3 + \frac{v^2}{2g} \quad \text{where } v = \frac{Q}{A} = \frac{Q}{bh} \quad (\text{Rectangular channel})$$

$$E = h^3 + \frac{Q^2}{2gh^2} \quad \text{Substituting the value in meter see unit}$$

$$4 = h^3 + \frac{0.8155}{h^2}$$

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

$$h^3 = 4 - \frac{0.8155}{h^2}$$

iteration gives $h^1 = 3.948 \text{ m}$ for the supercritical (fast, shallow) so the second term associated with K.E dominates so rearrange as

$$h^3 = \sqrt{\frac{0.8155}{4-h}}$$

iteration (from, eg, $h^0 = 0$) gives $h^1 = 0.44814 \text{ m}$
alternate depths are 3.95 and 0.4481 m.

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Assignment?

020

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 froude number

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

$$\therefore 6.06 > 1$$

So the flow is super critical

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

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

Solving the alternate depth for

$$\bar{E} = 1.935 \text{ m yield } y_{alt} = 1.93 \text{ m}$$

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

Sol:

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

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

Also

$$E_2 = y_2 + \frac{v_2^2}{2gy} = y_2 + \frac{0^2}{2 \times 9.81 \cdot y} = 2.60 \text{ m}$$

So $J_2 = 2.24 \text{ m}$. $\Delta y = J_2 - y_1 = 0.76 \text{ m}$ so water surface depth 0.16 m . For a downward step of 15 cm we have

$$E_2 = E_1 - \Delta Z_1 = 3.20 - (-0.15 \text{ m}) = 3.35 \text{ m}$$

giving $J_2 = 3.17 \text{ m}$ and $\Delta y = J_2 - y_1 = 0.17 \text{ m}$. So water surface rises 0.02 m . The maximum water possible before affecting upstream water surface level is for $J_2 = y_1$.

$$y_1 = \left(\frac{q^2}{g} \right)^{\frac{1}{3}} = \left(\frac{6^2}{9.81} \right)^{\frac{1}{3}} = 1.54 \text{ m}$$

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Assignment

03

6
1) A water passing from the slice gate in Dam having a depth of water at u stream side is 3.6 m, after passing through slice gate the back water curve shows the depth of water at down stream side is 0.9 m. The width of slice gate is 3.9 m Determine

a Discharge

b ~~From~~ Froude number u stream and down stream.

Sol: Given data

$$y_1 = 3.6 \text{ m}, y_2 = 0.9, b = 3.9 \text{ m}$$

As we know that

$$E_1 = E_2$$

$$y_1 + \frac{v_1^2}{2g} = y_2 + \frac{v_2^2}{2g} \quad \text{--- (1)}$$

Also

$$Q = A_1 v_1 = A_2 v_2$$

$$b_1 y_1 v_1 = b_2 y_2 v_2$$

$$y_1 v_1 = y_2 v_2$$

$$v_2 = \frac{y_1}{y_2} \times v_1$$

$$v_2 = \frac{3.6}{0.9} \times v_1$$

$$\boxed{v_2 = 4 v_1} \quad \text{--- (2)}$$

Putting in eqn (1)

$$J_1 + \frac{v_1^2}{2g} = J_2 + \frac{v_2^2}{2g}$$

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

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

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

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

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

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

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

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

$$v_2 = 4v_1$$

$$v_2 = 4(1.879)$$

$$v_2 = 7.516 \text{ m/sec}$$

$$\text{At } Q_1 = A_1 v_1 = 4 \times 1.879 = 7.516 \text{ m}^3/\text{s}$$

$$Q_2 = A_2 V_2 = b y_2 v_2 = 3.9 \times 0.9 \times 7.56 = 26.38 \text{ m}^3/\text{sec}$$

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

Froude Number \rightarrow At Wstream side

$$Fr_1 = \frac{v_1}{\sqrt{g y_1}} = \frac{1.879}{\sqrt{9.81 \times 5.6}} = 0.31$$

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

Froude number

$$Fr_2 = \frac{v_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52$$

$Fr_2 = 2.52 > 1$ so super critical flow