Submitted by 7870

Submitted To Engr. Fawad Khan

Subject Hydraulic Engineering

Assignment #01

Module 6th

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1- 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 hydraulic grade line. critical depth.

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

Measurements of dishage with venture flume requires two measurement one upstream and one at the throat, of the flow passes in a subcrtical state through, of the [redacted] 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 occurance 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. The flume is called standard wave flume.

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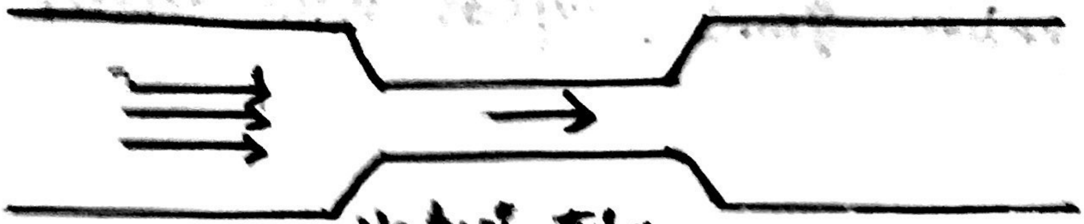

Venturi Tube

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

a) The critical depth

b) The minimum specific energy

c) The alternate depths when E = 4m

Sol:- Given Data :-

$Q = 12 m^3/sec$

$b = 3m$

a) As we know;

Discharge per unit width

→ For rectangular channel

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

$$hc = 1.177m$$

b) For a rectangular channel

$$Ec = \frac{3}{2} hc = 3/2(1.177) = 1.766m$$

Min specific energy = Ec = 1.766m

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

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

(Rectangular channel)

$\Rightarrow E = h + \dfrac{q^2}{2gh^2}$ substituting the value in meter-sec unit.

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

For a subcritical (slow, deep) so that 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 rearrange as

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

Iteration (from, e.g, $h=0$) gives $h = 0.4814m$
alternate depth are 3.95 and 0.481m.

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Assignment # 02

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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?

First of all check froud Number

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

$\therefore$ $6.06 > 1$

so the flow is super critical

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

$$E = 1.935m$$

Solving the alternate depth for

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

2.

Sol:- $E_1 = y_1 + \frac{V_1^2}{2g} = 3 + \frac{2^2}{2 \times 9.81} = 3.20m$

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

Also

$$E_2 = y_2 + \frac{q^2}{2gy} = y_2 + \frac{6^2}{2 \times 9.81 y} = 2.60m$$

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So $y_2 = 2.24m$. $\Delta y = y_2 - y_1 = 0.76m$ so water surface depth 0.16m. 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 upstep possible before affecting upstream water surface level is for $y_2 = y_1$

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

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Assignment # 3

Module 6th

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Given data:-

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

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

$$Q = A_1V_1 = A_2V_2$$

$$b_1y_1V_1 = b_2y_2 \cdot V_2$$

$$\cancel{b}y_1V_1 = \cancel{b}y_2V_2$$

$$y_1V_1 = y_2V_2$$

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

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

$$V_2 = 4V_1 \quad - (2)$$

putting in equ (1)

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

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

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

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

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

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

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

putting the value of "v_1" in equ ② we get.

$V_2 = 4v_1$

$V_2 = 4(1.879)$

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

As $Q_1 = A_1V_1 = by_1V_1 = 3.9 \times 3.6 \times 1.879 = 26.38 \text{ m}^3/\text{sec}.$

$\Rightarrow Q_2 = A_2 \cdot V_2 = by_2V_2 = 3.9 \times 0.9 \times 7.516 = 26.38 \text{ m}^3/\text{sec}$

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

1. Froud Number $\Rightarrow$ At upstream side

$$Fr_1 = \frac{V_1}{\sqrt{gy_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31$$

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

2. Froud number :-

$$Fr_2 = \frac{V_2}{\sqrt{gy_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52 > 1$$

so supercritical flow

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