

NAME

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SUBMITTED BY

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SUBMITTED TO

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SUBJECT

HYDRAULIC ENGG

SEMESTER

6th

ASSIGNMENT NO:-

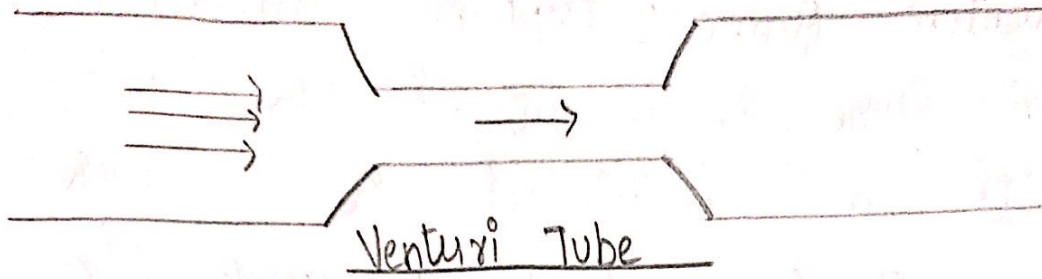
01

Q. 1. What is venturi 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 venturi flume measure in meters.

Measurements of discharge with venturi flume requires two measurement one upstream and one at the throat, if the flow passes in a subcritical state through, if the ~~flow~~ flume is designed so as to pass the flow from subcritical to supercritical 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. - the flume is called standard wave flume.



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

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

Sol:- Given data:-

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

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

a) As we know;  
Discharge per unit width

→ For rectangular channel

$$h_c = \left( \frac{Q^2}{g} \right)^{1/3} = \left( \frac{4}{9.81} \right)^{1/3} = 1.177 \text{ m}$$

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

b) For a rectangular channel

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

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

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)

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

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

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

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

Iteration gives  $h = 3.948\text{m}$  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  $h = 0.4814\text{m}$   
alternate depth are 3.95 and 0.481m.

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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?

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

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

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

Solving the alternate depth for

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

2.

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

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

AKO

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

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

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

giving  $y_2 = 3.17\text{m}$  and  $\Delta y = y_2 - y_1 = 0.17\text{m}$  so water surface rises  $0.02\text{m}$ . the maximum water step possible before affecting upstream water surface level is for  $y_2 = y_1$

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

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1.

Given data

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

As we know that

$$E_1 = E_2$$

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

Also

$$Q = A_1 v_1 = A_2 v_2$$

$$b_1 y_1 v_1 = b_2 y_2 v_2$$

$$b y_1 v_1 = b y_2 v_2$$

$$y_1 v_1 = y_2 v_2$$

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

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

$$v_2 = 4v_1 \quad - (2)$$

putting in equ (1)

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

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

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

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

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

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

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

Putting the value of "v" in equ (2) we get.

$$v_2 = 4v_1$$

$$v_2 = 4(1.879)$$

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

As  $Q_1 = A_1 v_1 = b y_1 v_1 = 3.9 \times 3.6 \times 1.879 = 26.38 \text{ m}^3/\text{sec}$ .

$\Rightarrow Q_2 = A_2 v_2 = b y_2 v_2 = 3.9 \times 0.9 \times 7.516 = 26.38 \text{ m}^3/\text{sec}$

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

1. Froude Number  $\Rightarrow$  At upstream 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

2. Froude number :-

$$Fr_2 = \frac{v_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52 > 1$$

so supercritical flow