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SECTION: B

Assignment NO # 01:

Semester 6th

Subject # Hydraulic ENGINEERING.

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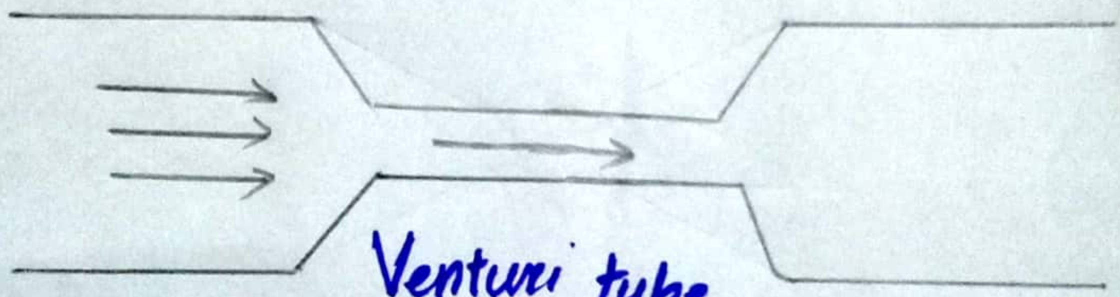
(1) **What is Venturi Flume? Explain with detail?**

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 venture flume measure in Meters. Measurement of discharge with venture flume require two measurement one upstream and one at the throat, of the flow passes in a subcritical state through if the flume is designed so as to pass the flow from subcritical to supercritical state while passing through the flume a 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.



Venturi tube.

(2) A 3-m wide channel carries a total discharge of $12\ m^3/sec$ calculate:-

(a) The critical Depth

(b) The minimum specific Energy

(c) The Alternate Depth when $E = 4m$

Sol

Given DATA:

$Q = 12\ m^3/sec$ $b = 3m$

(a) As we know that

Discharge per unit width.

→ For Rectangular channel

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

$h_c = 1.177m$

(b) For a Rectangular channel

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

Minimum Specific Energy $= E_c = 1.766m$.

(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

P.T.O

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

For a Sub-critical (Slow, Deep) So that first term associated with potential energy Dominates So rearrage as

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

Iteration Gives $h = 3.948m$ for the super-critical (fast shallow) So the 2nd term associated with K.q dominates so rearrange 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 0.48m.

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ASSIGNMENT NO # 02:

HYDRAULIC ENGINEERING.

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(1) Water flows at a depth of 10 cm with a velocity of 6 m/s in a rectangular channel. Is the flow Subcritical or supercritical? What is the alternate Depth?

Sol First of all Check Froud Number

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

$\because 6.06 > 1$

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.

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

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

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

Also

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

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

$$E_2 = E_1 - \Delta y$$

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

$$= 3.35m$$

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

So water surface raises 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 NO: 03:

HYDRAULIC ENGINEERING.

1 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 $Q = A_1V_1 = A_2V_2$

$$b_1y_1V_1 = b_2y_2V_2$$

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

$$y_1V_1 = y_2V_2$$

$$V_2 = \frac{y_1V_1}{y_2}$$

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

$$V_2 = 4V_1 \rightarrow (2)$$

putting in Equation (1)

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

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

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

$$\frac{V_1^2 - 16V_1^2}{2g} = -2.7$$

$$\Rightarrow \frac{\cancel{-}15V_1^2}{2g} = \cancel{-}2.7$$

$$V_1^2 = \frac{2.7 \times 2(9.81)}{15}$$

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

putting the value of V_1 in eq ② we get

$$V_2 = 4V_1$$

$$V_2 = 4(1.879)$$

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

As $Q_1 = A_1V_1 = by_1V_1 = 3.9 \times 3.6 \times 1.879$

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

$Q_2 = A_2V_2 = by_2V_2 = 3.9 \times 0.9 \times 7.516$

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

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

1 Froud Number ⇒ 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 Sub-critical Flow.

② Froud Number.

$$Fr_2 = \frac{V_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}}$$

$$= 2.52 > 1$$

So Super-Critical Flow.