ID :- 7817

Sec :- A

Subject :- Hydraulic Engineering

Assignment :- 1,2,3

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Q1:- What is venturi flume?

Ans:-

A venturi flume is a critical-flow open Flume with a constricted ~~flow~~ flow which causes a drop in the hydraulic grade line, creating a critical depth.

It is used in flow measurement of very large flow rates, usually given in millions of cubic units. A venturi meter would normally measure in millimeters, whereas a venturi flume measures in meteres.

Measurment of discharge with venturi flumes requires two measurments, one upstream and one at the throat (narrowest cross-Section), If the flow passes ina subcritical State through the flume. If the flumes are designed so as to pass the flow from sub critical to supercritical state while passing through the flume.

Q2:-

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Given Data:-

Wide of channel = b = 3m

Discharge = Q = 12 m^3/sec

Solution:-

Critical depth

Discharge per unit width

$q = Q/b = \frac{12}{3}$

$q = 4 m^2/sec$

For Rectangular channel

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

$h_c = 1.18m$

(b) Minimum specific Energy

$E_c = \frac{3}{2} h_c = \frac{3}{2} \times 1.18$

$E_c = 1.77m.$

(c) The Alternate depth E = 4m

As $E > E_c$, There are two possible depth for a given specific energy

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$E = h + \frac{V^2}{2g}$ where $V = \frac{Q}{A} = \frac{q}{h}$ 7817

$E = h + \frac{q^2}{2g h^2}$

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

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

Iterator (from $h=4$) gives $h = 3.948m$

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

=> iteration (from $h=0$) gives $h = 0.4814m$

So Alternate depth are 3.95 m & 0.4814m

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Assignment no 2

Q1:-

Solution:-

As we know that

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

$$Fr = 6.06 > 1$$

The Flow is supercritical

Alternate Depth:-

As we know that

$$E = y + \frac{V^2}{2g}$$

$$= 0.1 + \frac{6^2}{2 \times 9.81} = 1.935m$$

The alternate depth For $E = 1.935m$

Fields $Y_{alternate} = 1.93m$

Q2.

Given Data:-

velocity $= V_1 = 2m/s$

depth $= y_1 = 3m$

Elevation $\Delta z = 600m = 0.6m$

down step $= 15cm = 0.15$

Solution:-

As we know that

$$E_1 = y_1 = \frac{V_1^2}{2g}$$

$$E_1 = 3 + \frac{2^2}{2 \times 9.81}$$

$$E_1 = 3.20m$$

Now

$$E_2 = E_1 - \Delta Z$$

$$E_2 = 3.2 - 0.6$$

$$E_2 = 2.60m$$

also

$$E_2 = y_2 + \frac{q^2}{2gy_1^2}$$

$$2.60 = y_2 + \frac{6^2}{2 \times 9.81 \cdot y^2}$$

$$y_2 = 2.24m$$

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$\Delta y = y_2 - y_1$

$\Delta y = 2.24 - 3$

$\Delta y = -0.76m$

So water surface drop $= 0.16m$

For a downward step of 15cm or 0.15m we have

$E_2 = E_1 - \Delta z = 3.20 - (-0.15)$

$E_2 = 3.35$

Now $y_g = 3.17m$

$\Delta y = y_g - y_1 = 3.17 - 3$, $\Delta y = 0.17m$

water surface rises 0.02m

The maximum upstep possible before effecting upstream water surface level is for

$y_g = y_c$

$y_c = \sqrt[3]{\frac{q^2}{g}}$

$y_c = \sqrt[3]{\frac{6^2}{9.18}}$

$y_c = 1.54m$

Assignment #3 7817

Q1:-

Given Data:-

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

$b = 3.9m$

Solution:-

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

$Q = A_1 V_1 = A_2 V_2$

$b_1 y_1 \cdot V_1 = b_2 y_2 \cdot V_2$

$y_1 \cdot V_1 = y_2 \cdot V_2$

$$V_2 = \frac{y_1}{y_2} \times V_1$$

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

$V_2 = 4V_1$ —(2)

Putting in eq (1)

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

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

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

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

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

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

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

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

$$v_2 = 4v_1 \Rightarrow v_2 = 4(1.879)$$

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

As

$$Q_1 = A_1 v_1 = b y_1 \cdot v_1$$

$$= 3.9 \times 3.6 \times 1.879$$

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

① Fraud Number At upstream side

$$Fr_1 = \frac{v_1}{\sqrt{g y_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31 \text{ sub critical}$$

② Froud Number At downstream side

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

Super-critical