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Section : A

Assignments : 1, 2, 3

Subject : Hydraulic Engineering

Teacher N : Sir Fawad.

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Assignment : 01

Question # 01

What is Venturi flume? Explain with detail?

Answer:

Venturi Flume:

A Venturi 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 rates. usually given in millions of Cubic units. A Venturi meter would normally measure in millimeters whear a Venturi flume measures in meters.

Measurement of discharge with Venturi flumes requires two measurments, one upstream and one at the throat (i.e (narrowest cross-section). If the flow passes in a Subcritical state through the flume, a Single measurement at the throat (which in this Case becomes critical Section) is suffient for Computation of dischage

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Question: 02

A 3-m wide channel carries a total dischage of $12 m^3/sec$

Calculate:

a) The critical depth

b) The minimum specific energy

c) The alternate depth when $E = 4m$

Given data:

Wide of channel, $b = 3m$

dischage, $Q = 12 m^3/sec$

Solution:

(a) **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)?**

For Rectangular Channel

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

$$\boxed{E_c = 1.77m}$$

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c) The Alternate depth $E = 4cm$

As $E > E_c$, There are two possible depthe for a given Specific energy.

$$E = h + \frac{V^2}{2g}$$ where $V = \frac{Q}{A} = \frac{q}{h}$ (for rectangular channel)

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

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

For the Subcritical Solution its first terms, associated with potential engry domination

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

=> Iternation from h=4) Svies $h = 3.948m$

For the Subcritical (First, Shallow) Solution, the Second term associated with Kinetic energy dominates rearrange as:

So:

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

=> Iteration (from h=0) Swin $h = 0.4814m$

So Alternation depth are 3.95 & 0.4814m

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Assignment # 02

Question: 01

Water flows at a depth of 10cm with a Velocity of 6m/s is a rectangular Channel. Is the flow Subcritical or Supercritical? What is the alternate depth?

Solution:

First of all we find the Frounde Number to find the flow.

As We know that

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

$$Fr = 6.06 > 1$$

So the flow is Supercitical

Alternate Depth:

As We Know that

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

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

The alternate depth for $E = 1.935m$ fields $= \boxed{y_{alt-nalte} = 1.93m}$

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Question: 02

Water flows with a Velocity of 2m/s and at a dep
of 3m in a rectangular Channel. What is the chan
in depth and in water Surface elevation produced by a
gradual upward change in bottom elevation (upstep) of 6
What would be the depth and elevation changes if th
were a gradual downstep of 15cm? What is the maximu
Size of upstep that could exist upstream depth changes
result? Neglect head losses.

Given Data:

Velocity $= V_1 = 2m/s$

depth $= y_1 = 3m$

Elevation $\Delta z = 60cm = 0.6m$

down step $= 15cm = 0.15m$

Solution:

As we Know that

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

$$E_1 = 3 + \frac{2^2}{2 \times 9 \times 81}$$

$$\boxed{E_1 = 3.20m}$$

Now:

$$E_2 - E_1 = \Delta z$$

$$E_2 - 3.2 = 0.6m$$

$$\boxed{E_2 = 2.60m}$$

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Aslo

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

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

$$\boxed{y^2 = 2.24m}$$

$\Delta y = y_2 - y_1$

$\Delta y = 2.24 - 3$

$$\boxed{\Delta y = 0.76m}$$

So water Surface drop = 0.46m

*) For a demensional Step of 15cm or 0.15m we have

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

$$\boxed{E_2 = 3.35m}$$

Now $y_2 = 3.17$ &

$\Delta y = y_2 - y_1 = 3.17 - 3$

$$\boxed{\Delta y = 0.17m}$$

So water Surface rises = 0.02m

* The maximum upstep possible before effecting upstream water Surface level is for

$$y_2 = y_c$$

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

$$y_c = \sqrt[3]{\frac{6^2}{9.18}} \quad = y_c = 1.54m$$

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Assignment #03

Question #01

A water passing from the Slica gate in Dam having a depth of water at upstream side is 3.6m. after passing through Slica gate the back water curve shows that depth of water at downstream side is 0.9m The width of Slica gate is 3.9m

Determine:

a) Discharge $\tilde{Q}$

b) Froud Number UpStream and Down Stream

Given Data:

$y_1 = 3.6m$

$y_2 = 0.9m$

$b = 3.9m$

Solution:

As we know that:

$$E_1 = E_2$$

$$y_1 + \frac{V_1^2}{2g} = y_2 \frac{V_2^2}{2g} \rightarrow ①$$

⇒ Also

$$\tilde{Q} = A_1V_1 = A_2V_2$$

$$b_1y_1 \cdot V_1 = b_2y_2 \cdot V_2 \qquad (b = b_1 = b_2)$$

$$b \cdot y_1 \cdot V_1 = b \cdot y_2 \cdot V_2$$

$$y_1 \cdot V_1 = y_2 - V_2$$

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

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

$$\boxed{V_2 = 4V_1} \longrightarrow (2)$$

Putting in eq (1)

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

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

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

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

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

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

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

$\boxed{V_1 = 1.879\ m/Sec}$ ⟹ Putting in (2) we get

$$V_2 = 4V_1$$

$V_2 = 4(1.879)$ ⟹ $\boxed{V_2 = 7.516\ m/Sec}$

As.

$$Q_1 = A_1V_1 = by_1 \cdot V_1$$

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

$$\boxed{Q_1 = 26.38\ m^3/Sec}$$

$$Q_2 = A_2V_2 = b \cdot y_2 \cdot V_2$$

$$= 3.9 \times 0.9 \times 7.516$$

$$\boxed{Q_2 = 26.38\ m^3/Sec}$$

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$Q = Q_1 = Q_2 = 26.38 m^3/Sec$

① Froud Number ⟶ At upstream Side

$Fr_1 = \frac{V_1}{\sqrt{g y_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31$

Sub-Critical flow

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 Flow