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section :: "A"

subject :: Hydraulic-Engineering

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Assigment # 07 (1)

QNo1 What is venture Flume? Explain with detail

Venturi Flume:-

A venturi flume is a critical flow open flume with a construction flow which causes a drop in hydraulic grade line, creating a critical depth.

It is used in flow measure of very large flow rate, usally goes in millions of cubic units.

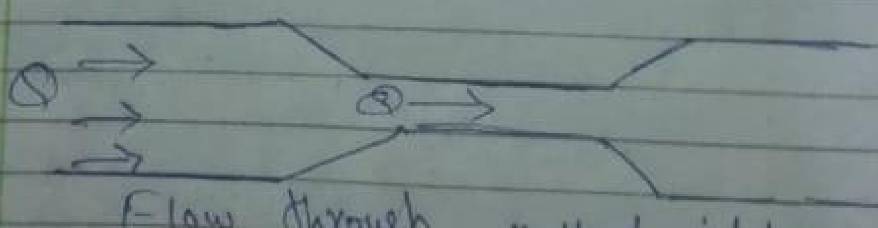
A venturi meter would normally measure in millimeters. whereas a venturi flume measure in meters.

Measurment of dischary with venturi flume requires two measurment one upstream and one at a throat.

if flow passes in a sub-critical stat through flume.

if flow are designed so as to pass flow from sub-critical to super-critical stat while.

To ensure occurrence of depth throat flumes are usually designed in such away from a hydraulic flow



Flow through a venturi flume

(4)

⇒ Iteration (from h = 4) gives

$h = 3.948 m$

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) gives $h = 0.4814 m$

So Alternate depth are

3.95m & 0.4814m.

Assigment #02 (5)

Question #1

Water flows at a depth of 10m with the velocity of 6 m/s in a rectangular channel. Is the flow subcritical or supercritical?
what is the alternate depth?

Solution:-

First of all we find the froude number to final the flow.
As we Know that

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

$F_r = 6.06 > 1$

So the is superexitical.

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 is $E = 1.935\,m$
Yields $\boxed{y_{alternate} = 1.93\,m}$

Question - 02:-

Water flow with a velosity of 2m/s and at a depth of 3m in a rectangular channel what is the change in depth and in water surface elevation produced by a gradual upward change in bottom elevation (upstep) of 600m? what would be the depth and elevation change of these were a gradual down step of 15cm? what is maximum size of upstep that could exist before upstream depth change would result? Neglect head losses.

Given data:-

$$\text{Velocity} = V_1 = 2\,m/s$$

$$\text{depth} = y_1 = 3m$$

$$\text{Elevation } \Delta z = 600cm = 0.6m$$

$$\text{down step} = 15cm = 0.15m$$

(2)

b) Minimum Specific Energy (E_c) = ?

For Rectangular channel.

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

$$E_c = 1.77\ m$$

c) The Alternate depth $E = 4m$

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

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

(For rectangular channel)

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

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

$h = 4 - \frac{0.8155}{h^2}$ For the subcritical Solution the First term associated with potentialenergy domentas.

Solution:

As we Know that

$$E_1 = y_1 - \frac{v_1^2}{2g}$$

$$E_1 = 3 + \frac{2^2}{2 \times 9.81} \qquad E_1 = 3.20\,m$$

Now $E_2 = E_1 - \Delta z$

$$E_2 = 3.2 - 0.6$$

$$E_2 = 2.60\,m$$

Also

$$E_2 = y_2 + \frac{q^2}{2gy_2^2}$$

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

$y_2 = 2.24\,m$

$\Delta y = y_2 - y_1$

$\Delta y = 2.24 - 3$

$\Delta = -0.76\,m$

So water surface drop = 0.76m

Assignment # 03

Given data:-

$y_1 = 3.6\ m \qquad y_2 = 0.9\ m$

$b = 3.9\ m$

Sol:-

As we Know that

$E_1 = E_2$

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

Also:-

$$Q = A_1 V_1 = A_2 V_2$$

$$b_1 y_1 \cdot V_1 = b_2 y_2 \cdot V_2 \quad (b = b_1 = b_2)$$

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

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

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

$$V_2 = \frac{3.6}{0.9} \times V_1 \qquad V_2 = 4 V_1 \rightarrow (2)$$

Putting in eq (1):

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

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

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

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

$E_2 = 3.35m.$

Now $y_2 = 3.17m$

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

$\Delta y = 0.17\ m$

So water surface rises 0.02m

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

$y_2 = y_c \qquad y_c = \sqrt[3]{\frac{q^2}{g}}$

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

$y_c = 1.54m$

(10)

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

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

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

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

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

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

putting in eq (2)

we get -

$$V_2 = 4v_1$$

$$V_2 = 4(1.879) \Rightarrow V_2 = 7.516 \text{ m/sec}$$

As

$$Q_1 = A_1 v_1 = b y_1 \cdot V_1$$

$$= 3.9 \times 1.879$$

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

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

1) Froud number → At upstream side

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

Sub-critical flow

2) Froud number → At Downstream side

$$Fr_2 = \frac{V_2}{\sqrt{gy_2}} = \frac{7.576}{\sqrt{9.81 \times 0.9}} = 2.52$$

Super critical flow

Assisgment #01

②

Question #2

A 3m wide channel carries a total discharge of 12 m³/sec calculalate.

*) The critical depth.

*) The minemum specific energy

*) The Alternate depth water E = 4m

Given data:-

wide of channel = $b = 3m$

Discharges = $Q = 12 m^3/sec$

Solution:-

a) Critical depth:-

=> Discharge per unit width

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

$q = 4 m^2/Sec$

For Rectangular channel.

$h_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{4^2}{9.81}\right)^{1/3} = h_c = 1.18m$