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Section : A

Subject : Hydraulic Engineering

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Assignment#01

Question:

venture flume:

A venture flume is a critical open flame with a constricted flow which causes a drop in the by hydraulic grade line, creating a critical depth.

- It is used in flow measurment of very large flow rates, usually given in million of cubin units.
- A venture flume would normally measure in millimeter, where as a venture flume measure in meter.
- measurment of discharge with venturi flumes at the Required two measurement one upstream and one at the throat, If the flow passes in a subcritical state through the flume.
- If the flume are designed, so as to pass the flow from subcritical

is Supercritical state while passing through at the flume, a single measurement at the throat is sufficient for computation of discharge. To ensure to occurence of Critical depth at the throat, the flume are usually designed in such way as to form the structure.

Question#02

A 3m ------ . . . E=4m

Given:

Width of Channel = $b = 3m$

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

Solution:

(a) Critical depth

→ discharge per unit width

$$\Rightarrow q = Q/b = 12/3 = 4\ m^3/sec$$

→ for Rectangular Channel

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

(4)

(b) minimum Specific Energy (E_c) = ?
↳ for Rectangular Channel

$\Rightarrow$ $E_c = 3/_2 h_c = 3/_2 \times 1.18 = 1.77m$

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

As $E > E_c$, There are Two possible depth for a given Sp-Energy.

$\Rightarrow E = h - V^2/_{2g}$ where $V = \frac{Q}{A} = q/_h$

$E = h + q^2/_{2gh^2} = 4 - \frac{0.8155}{h}$

(for the subcritical solution the first term, associated with P.E dominates

$\Rightarrow$ iteration (from $h=4$) gives $h = 3.948m$

For the sub-critical solution, the second term associated with K.E. dominate Rearrange as

(5)

So,

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

→ Elevation (from $h=0$) given $h = 0.4814\,m$

So,

Alternative depth are $3.95\,m$ & $0.4814\,m$

Assignment#02

Q#01

water flow ----- depth?

Solution:

first of all we find the froude number.

$\Rightarrow F_r = V/\sqrt{gy} = \dfrac{6m/s}{\sqrt{9.81 \times 0.1}} = 6.06 > 1$

So the flow in Super-critical

⇒ Alternate depth:

As we know that

$E = y + V^2/2g = 0.1 + \dfrac{6^2}{2 \times 9.81} = 1.935m$

↳ Alternate depth, $E = 1.935m$

field ($Y_{alternate}$) $= 1.93m$

Q#02

water flow ------ head losses.

Given:

velocity, $V_1 = 2m/s$

depth, $y_1 = 3m$

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

down step $= 1.5cm = 0.15m$

Solution:

As we know that

$E_1 = y_1 + v_1^2/2g$

$E_1 = 3 + 2^2/2\times9.81 = 3.20m$

Now

$E_2 = E_1 - \Delta z = 3.2 - 0.6 = 2.60m$

Also

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

$\Rightarrow 2.60 = y_2 + \frac{6^2}{2\times9.81\times y_2^2}$

or

$y_2 = 2.24m$

$$\Delta y = y_2 - y_1 = 2.24 - 3 = -0.76\,m$$

So water surface drop = 0.76m

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

$$E_2 = E_1 - \Delta z = 3.20 - (-0.15) = 3.35\,m$$

Now,

$$y_2 = 3.17\,m$$

&

$$\Delta y = y_2 - y_1 = 3.17 - 3 = 0.17\,m$$

So water surface Rise 0.02m

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

$$y_2 = y_c$$

$$\Rightarrow y_c = \sqrt[3]{q^2/g} = \sqrt[3]{\frac{6^2}{9.81}} = 1.54\,m$$

Assignment#03

A water passing.....3.9m

Solution:-

→ upstream Side $y = 3.6m$
→ dowstream Side $y_2 = 0.9m$
→ width of gate $b = 3.9m$

As we know that
Specific Energy on both side.
$E_1 = E_2$

$$\Rightarrow y_1 + \frac{v_1^2}{2g} = y_2 + \frac{v_2^2}{2g} \rightarrow (A)$$

Also by discharge formula.

$$\Rightarrow Q = A_1V_1 = A_2V_2$$

$$\Rightarrow b_1y_1v_1 = b_1y_2v_2$$

$$\Rightarrow V_2 = y_1/y_2 \times V_1$$

$$\Rightarrow V_2 = \frac{3.6}{3.9} \times V_1 \rightarrow (i)$$

put (i) in Eq(A), we get

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

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

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

Or,

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

$$\Rightarrow -15v_1^2 = -2.7 \times 2g$$

Or,

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

$$\Rightarrow v_1 = 1.879 \, m/se$$

putting the value of v_1 in Eq(2)

(11)

$V_2 = 4V_1$

$\Rightarrow V_2 = 4(1.879) = 7.516 m/sec.$

Also,

$Q_1 = A_1V_1$

$\Rightarrow Q_1 = b_1 y_1 V_1 = 3.9 \times 3.6 \times 1.879$

$\Rightarrow Q_1 = 26.38 m^3/sec$

$Q_2 = A_2 V_2$

$\Rightarrow Q_2 = b y_2 V_2 = 3.9 \times 0.9 \times 7.516 = 26.38 m^3/sec$

$Q = Q_1 = Q_2 = 26.38 m^3/sec.$

→ froud number at upstream side:

By formula.

$$Fr_1 = \frac{V_1}{\sqrt{gy_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31 < 1$$

(sub-critical flow)

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Froud Number at downstream side:

$$Fr_2 = \frac{V_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52 > 1$$

(Super-Critical flow)