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Section	:	B
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Subject	:	Hydraulic Eng

Assignment # 1 Part # a

Venture flume :-

A Venture 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 million of cubic units. A venture meter would normally measure in millimetres, whereas a venture flume measures in metres.

Measurement of discharge with venturi flumes requires two measurements, one upstream and one at the throat (narrowest cross-section). if the flow passes in a subcritical state through the flume. If the flumes are designed so as to pass the flow from subcritical to supercritical state while passing through the flume a single measurement at the throat (which in this case becomes a critical section).

is Sufficient for computation of discharge. To ensure the occurrence of critical depth at the throat, the flumes are usually designed in such way as to from **hydraulic jump** on the downstream side of the structure. These flumes are called "Standing wave flumes".

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Assignment # 2
Part # B

Example:-

A 3-m wide channel carries a total discharg of $12 m^3 s^{-1}$ calculate.

(a) the critical depth
(b) the minimum specific energy
(c) the alternate depths when $E = 4m$

$b = 3m$

$Q = 12 m^3 s^{-1}$

(a)

Discharge per unit width

$$q = \frac{Q}{b} = \frac{12}{3} = 4 m^2 s^{-1}$$

Then for a rectangular channel.

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

Answer:- Critical depth = 1.18m.

(b) For a rectangular channel.

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

Answer:- minimum specific energy = 1.77 m.

Answer:- minimum Specific energy $= 1.77 m$

(C) As $E > E_c$ there are two possible death for a given specific energy.

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

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

Substituting values in metre - second units

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

For the subcritical (slow deep) solution, the first term, associated with potential energy dominates: so rearrange as:

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

Assignment # 2 Part # 1

When flows at a depth of 10cm with a velocity of 6m/s in a rectangular channel. the flow subcritical? what is the altermate depth?

Solution:-

Check Froude number.

$$F_r = \frac{V}{\sqrt{VU}} = \frac{6m/s}{\sqrt{9.81/s^3 \cdot 0.1m}} = 6.06 \geq 1$$

So the flow is Supercritical.

$$E = y + \frac{V^2}{2g} = 0.1m + \frac{(6m/s)^2}{2 \cdot 9.81\ m/s^2} = 1.935m$$

Solving for the altermate depth for an $E = 1.935m$ Yields $y_{al} = 1.93m$.

Assignment # 2 Part # B

Problem

Water flows with a velocity of 2m/s and at a depth of 3m in a rectangular channel. What is the change in the ~~depth~~ depth and in water surface elevation produced by a gradual upward change in bottom elevation (upstep) of 60cm? what would be the depth and elevation changes if there were a gradual downstep of 15cm? what is the maximum size of upstep that could exist before upstream depth changes would? Neglect head losses.

Solution:-

$$E_1 = y_1 + \frac{V_1^2}{2g} = 3m + \frac{(2m/s)^2}{2 \cdot 9.81 m/s^2} = 3.20m.$$

$$E_2 = E_1 - \Delta z = 3.20m - 0.60m = 2.60m.$$

Also

$$E_2 = y_2 + \frac{q^2}{2gy_2^2} = y_2 + \frac{(6m^3/s/m)^2}{2 \cdot 9.81 m/s^2 \cdot y_2^2} = 2.60m$$

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So $y_2 = 2.24m$. $\Delta y = y_2 - y_1 = -0.76m$ so water surface drops $0.16m$.

For a downward step of 15cm we have

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

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

so water surface rises $0.02m$.

The maximum upstep possible before affecting upstream water surface is for

$y_2 = y_c$

$$y_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{(6m^3/s/m)^2}{9.81m/s^2}} = 1.54m.$$

Assignment # 3

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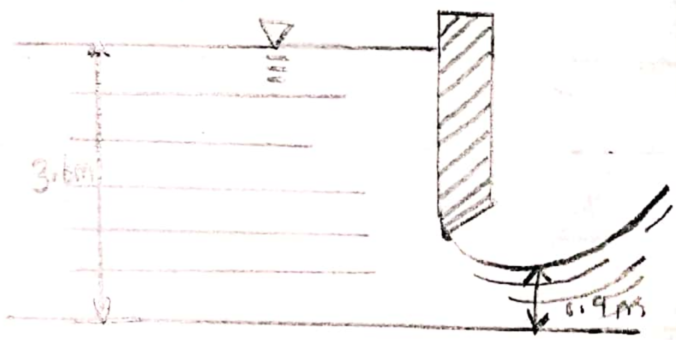
Problem

Given Data :-

Depth of water at upstream side (y_1) = 3.6m
Depth of water at downstream side (y_2) = 0.9m
width of Sluice gate (b) = 3.9m

Solution :-

As we know that
Specific energy on both Streams are same
So,



$$E_1 = E_2$$

$$y_1 + \frac{v_1^2}{2g} = y_2 + \frac{v_2^2}{2g} \rightarrow (1)$$

Also By discharge formula,

$$Q = A_1 v_1 = A_2 V_2$$

$$b_1 y_1 \cdot v_1 = b_2 y_2 \cdot v_2$$

$$\cancel{b} \cdot y_1 \cdot v_1 = \cancel{b} \cdot y_2 \cdot v_2 \qquad (\because b = b_1 = b_2)$$

$$y_1 \cdot v_1 = y_2 \cdot v_2$$

$$\Rightarrow V_2 = \frac{y_1}{y_2} \times v_1$$

$$= \frac{3.6 \times v_1}{0.9} \Rightarrow \boxed{v_2 = 4 v_1} \rightarrow (2)$$

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Assignment # 3

(2)

putting the value of v_2 in eq (1),

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

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

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

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

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

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

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

Also,

$\Rightarrow Q_1 = A_1 v_1$

$= by_1 \cdot v_1 \quad = 3.9 \times 3.6 \times 1.879$

~~$Q = A_2 v_2$~~ $\boxed{Q = 26.38 \ m^3/sec}$

$\Rightarrow Q_2 = A_2 v_2$

$= by_2 \cdot v_2 \quad = 3.9 \times 0.9 \times 7.516$

$\boxed{Q_2 = 26.38 \text{ m/sec}}$

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

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Assignment # 3

Now

Froud Number At upstream side :-

By formula

$$Fr_1 = \frac{v_1}{\sqrt{gy_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}}$$

$$\boxed{Fr = 0.31}$$

As $Fr_1 < 1$

$0.31 < 1 \rightarrow$ It is Subcritical

Froud Number At Downstream Side :-

$$Fr_2 = \frac{v_2}{\sqrt{gy_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}}$$

$$\boxed{Fr_2 = 2.52}$$

As $F_2 : > 1$

$2.52 > 1 \rightarrow$ It is super critical.

END!!!