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Section A

Semester 6th

Program B-SC Civil Engineering

Assignment Hydraulic Engineering

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Assignment # 01

Q1: What is venture flume? Explain with detail?

Ans:
A Venture flume is a critical flow open flume with a constricted flow which cause a drop in hydraulic ~~gauge~~ -grade line creating a critical depth. It is used in flow measurment of very large flow rates, usually give a millions of cubic units. A venturi meter would normally measure a millimeter, where as a ventri flame measure in meters. Measurments of discharge with ventri flames required two measurement one upstream & one at the throat. If the flow passes in a sub critical stage through the flume. If the flume are designed so as to pass the flow from sub to super critical stage while passing through the flume. a single measurment at the throat is sufficient for computation of discharge. To ensure the occurrance of critical depth at the throat, the

flumes are usually designed in such way as to form a hydraulic jump on the down stream side of structure.

Question # 02

A 3-m wide channel carries a total discharge of $12 m^3/sec$. Calculate.

(A) Critical depth

(B) The minimum specific energy.

(C) Alternate depth where E = 4m.

Givendata:

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

1) Discharge per unit width:-

$$q = \frac{Q}{b} = \frac{12}{3} = 4 m^2/sec$$

then rectangular channel

$$h_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{4^2}{9.81}\right) = 1.77m$$

~~Ctrd~~ Critical depth = 1.18m

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2) For rectangular channel:

$$E_c = \frac{3}{2} h_c \Rightarrow \frac{3}{2} \times 1.17$$

$$E_c = 1.766 m$$

mini specific energy = 1.77

3) As E > E; there are two possible depth for a given specif energy:

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

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

subsitituting value in meter-second unit

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

Now for the subcritical (slow, deep) solution, the first term assosiated with potential energy

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

e.g. = h = 4 gives h = 3.948m

⇒ for the super critical solution

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

$$h = 0.4814 m$$

alternate depth are 3.95m & 0.481m

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Assignment # 02

Q1: water flow at a depth of 10cm with a velocity of 6m/s in a rectangular channel is the flow of subcritical or super critical? What is the alternate depth?

Given data

$d = 10 cm$, $V = 6 m/s$

$y_{alt} = ?$

Solution:

By checking fround number

$$Fr = \frac{V}{\sqrt{gy}} \Rightarrow \frac{6}{\sqrt{9.81 \times 0.1}} = 6.06$$

$\boxed{Fr = 6.06 > 1}$ Flow is super critical

$$E = y + \frac{V^2}{2g} = 0.1 + \frac{6}{2 \times 9.81}$$

$$E = 1.935 m$$

For alternate depth = E = 1.935 m

$\boxed{y_{alt} = 1.93}$

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QNo2: water flow with a velocity of 2m/s & at a depth of 3m in a rectangular channel. water is the change in depth & in water surface elevation produced by a gradual upward change in bottom elevation (upstep) of 60 cm? what would be the depth & Elevation change it there were a gradual down step of 15cm? what is max size of up step that could exist before upstream depth changes would result? Neglected head loss?

Given data:

$V_1 = 2m/s$ ⇒ $y_1 = 3m$

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

down step = $15cm = 0.15m$

Sol=

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

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

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

Now

$$E_2 = E_1 - \Delta z$$

$$= 3.2 - 0.6$$

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

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So

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

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

$$\boxed{y_2 = 2.24 \, m}$$

$$\Delta y = y_2 - y_1$$

$$= 2.24 - 3$$

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

So water surface drop = 0.16m

⇒ For a downsword step of 15cm or 0.15m

we have

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

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

Now $y_2 = 3.17m$

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

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

The water surface rises = 0.02m

⇒ The max upstep possible before effecting upstream water surface level is for

$$y_2 = y_c$$

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

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

$$\boxed{y_c = 1.54m}$$

Assignment # 03

Q1) A water passing from the slice gate in dam having a depth of water at upstream side is 3.6m after passing through sluice gate the back water curve shows that depth of water at downstream side is 0.98m. The width of sluice gate is 3.9m.

Determine

a) Discharge = Q

b) froud no upstream & downstream.

Given data)

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

$b = 3.9m$

Solution.

$$E_1 = E_2$$

$$y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g} \longrightarrow (i)$$

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Now $Q = A_1 V_1 = A_2 V_2$

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

$y_1 V_1 = y_2 V_2$

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

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

$\boxed{V_2 = 4V_1}$ —— (2)

put in eq 4 → (1)

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

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

$\left(\frac{V_1^2}{2g}\right)^2 - \frac{16V_1^2}{2g} = 0.9 - 3.6$

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

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

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

$\boxed{V_1 = 1.879 m/sec}$

put in eq 4 (2) we will get

$V_2 = 4V_1$

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

As

$Q_1 = A_1V_1 = by_1V_1$

$= 3.9 \times 3.6 \times 1.879$

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

$Q_2 = A_2V_2 = by_2 \times V_2$

$= 3.9 \times 0.9 \times 7.516$

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

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

1) Froud number at upstream side :-

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

$\boxed{Fr_1 = 0.31}$ subcritical flow

2) Froud number at down stream side :-

$Fr_2 = \frac{V_2}{\sqrt{gy_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52$

$\boxed{Fr_2 = 2.52}$

super critical flow.

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