Name # Yahya- Hakeem

ID # 7804

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Section # A.

Subject # Hydraulic Engineering

Assignment NO # 01, 02, 03

Instructor # Sir Fawad.

Assignment # 1 page #1

Q1) What is venture flume? Explain with Detail?

Ans:- venturi flume is a critical-flow open flume with a constricted flow which caused a drop in the hydraulic grade line creating a critical depth. It is used in flow measured of very large flow rates. usually give a millions of cubic units A venturi meter would normally measure in millimeter where as a venturi flume measure in meter.

measurement of discharge with venturi flumes require two measurment one upstream and one at the throat (narrowest cross section)? If the flow passes in a sub critical state through the flume. If the flume are designed so as to pass the flow from sub to supper crictical state while passing through the flume a single measurment at the throat is sufficient for computation of discharge. To ensure the occurance of crictical depth at the throat the way as to form a hydraulic jump on down stream side of structure.

Q2 A 3m wide channel carries a total discharge of 12 m³/sec calculates

(a) The critical depth
(b) The minimum specific energy
(c) The alternates depth wher 6 = 4m

Given data.

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

(a) Discharge per unit width.

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

the rectangular channel

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

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

critical depth = 1.18m

(b) for rectangular Channel:

$E_c = 3/2\, h_c = 2/3 \times 1.17$

$E_c = 1.766m$

mini Specific energy = 1.77

(c) As E > E there are two possible depth for a given Specific energy

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

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

Substituting values in meter-second unit

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

for the subcritical (slow-deep) solution the first term associated with potential energy

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

e.g $h = 4$ gives $h = 3.9418\,m$

for the supercritical solution

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

$h = 0.4814\,m$

alternate depth are 3.95 and 0.481m

Assignment # 2
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Q(1) water flows at a depth of 10cm with a velocity of 6m/s in a rectangular channel is the flow subcritical or supercritical what is the alternate depth.

Given data:-

$d = 10cm$

$v = 6m/s$

Required:-

$y_{alt} = ?$

Solution:-

By checking froude number.

$$fr = \frac{v}{\sqrt{gy}} \Rightarrow \frac{6}{\sqrt{9.81 \times 0.1}} = 6.06$$

$fr = 6.06 > 1$

Flow is supercritical

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

$E = 1.935m$

for alternate depth $E = 1.935m$

$y_{at} = 1.93$

Q2:- water flow with a velocity 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 changing in bottom elevation up step of 60cm. what would be the depth and elevation changes it there were a gradual down step of 15cm what is max size of upstep that could exist before upstream depth changes would result Neglect head losses.

Given data:

$V1 = 2m/s$

$y1 = 3m$

$\Delta z = 60cm = 0.6m$

down step = 15cm = 0.1m

Solution:-

$$E1 = y1 + \frac{V_1^2}{2g}$$

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

$$E1 = 3.20m$$

Now

$$E1 = E1 - \Delta z$$

$$= 3.2 - 0.6$$

$$\boxed{E2 \quad 2.60m}$$

Also

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

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

$$y_2 = 2.24m$$

$$\Delta y = y_2 - y_1$$

$$= 2.24 - 3$$

$$\Delta y = -0.76m$$

So water surface drop $= 0.16m$

→ for a downward stop of 15cm or 0.15m we have.

$$E_2 = E_1 - \Delta z$$

$$E_2 = 3.20 - (-0.15)$$

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

Now $y_c = 3.17m$

$$\Delta y = y_2 - y_1$$

$$\Delta y = 3.17 - 3$$

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

So water surface rises 0.02m

$$E_2 = 3.35\,m$$

Now $\Delta y_2 = 3.17$.

$$\Delta y = y_2 - y_1 = 3.7 - 3$$

$$\Delta y = 0.17$$

So water surface rises 0.02 m

The max upstep possible before effecting upstream water surface level is for $y_2 = y_c$.

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

$$y_c = \sqrt[3]{\frac{6^2}{9.81}}$$

$$y_c = 1.54\,m$$

Assignment # 3

Q.— A water passing from the slice gate in Dam having a depth of water of upstream side is 3.6m after passing through sluice gate the back water curve shows that depth of water ~~curve~~ at down stream is 0.9m
The width of slice gate is 3.9m

Determinde:

(a) Discharge
(b) Froud no upstrem and downstream

Given data:-

$y_1 = 3.6m$
$y_2 = 0.9m$
$b = 3.9m$

Solution:-

$E_1 = E_2$

$$y_1 + \frac{v_1^2}{2g} = y_2 + \frac{V_2^2}{2g} \quad 4$$

Now

$Q = A_1V_1 = A_2V_2$

$by_1 \cdot V_1 = by_2 \cdot V_2$

$y_1v_1 = y_2V_2$

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

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

$$V_2 = 4V_1 \rightarrow (2)$$

Put in eq (1)

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

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

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

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

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

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

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

Put in eq (2) we will get

$V_2 = 4V_1$

$V_2 = 4(1.879)$

$V_2 = 7.516 m/sec$

As $Q_1 = A_1V_1 = by_1V_1$

$= 3.9 \times 3.6 \times 1.879$

$Q_1 = 26.38 m^3/sec$

$Q_2 = A_2V_2 = by_2 \cdot V_2$

$3.9 \times 0.9 \times 7.516$

$Q_2 = 26.38 m^3/sec$

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

Froud number at up stream sid

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

$Fr_1 = 0.31$ sub critical flow

Froud Number → at downstream sid

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

$$\boxed{Fr_2 = 2.52}$$

Super critical flow.