NAME : QASIM ZEB

ID NO = 7823

SECTION = A

SUBMITTED TO = ENGR, FAWAD AHMAD

SUBJECT = HYDRUALIC ENGINEERING

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ASSIGNMENT NO = 1

QUESTION NO = 1

VENTURI FLUME:-

A venturi flume is a critical flow open flume with a constricted flow which causes a flow drop in a hydraulic grade line, creating a critical depth.
It is used a flow measurement of a very large flow Rates, usually given in Millions of cubic units. A venturi Meter would Normally Measure in a Millimeters, whear.as a venturi flume Measure in Meters.

Measurement of discharge with venturi flumes Requires two Measurements, one up-stream and one at the throat (Narrow cross Section) if a flow passes in a Sub-critical

State through the flume.
If the flumes are designed so as to pass the flow from Sub-critical to super critical state. While passing through the flume a single Measurement at the throat (which in this case become a critical Section, is sufficient for computation of discharge. To ensure the occurance of critical depth at the throat, the flumes are usually designed in such way as to form a hydraulic Jump at downstream side of the structure. These flumes are called "Standing wave flumes"

QUESTION NO= 2

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

1) The critical depth
2) The maximum specific Energy
3) The alternate depth where E=4m

GIVEN DATA:-

Wide channel = b = 3m
Discharge = Q = 12 m³/sec

SOLUTION:-

=> Ⓐ Critical depth

Discharge per-unit width

$q = Q/b = 12/3 = 4$

$q = 4\ m^3/sec$

For Rectangular channel

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

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

$$\boxed{h_c = 1.18m}$$

#) (b) Minimum Specific Energy

For Rectangular

$$E_c = 3/2\, h_c = 3/2 \times 1.18$$

$$\boxed{E_c = 1.77m}$$

:) (B) 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 $v = Q/A = q/h$ (For Rectangular channel)

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

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

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

For the sub-critical solution the first term associated with potential Energy

For the Sub-critical (First, Shallow) solution, the second term association with Kinatic Energy.
Dominates Rearrange as

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

=) Itration (from h=0) given h=0.4814
So Alternate depth are
3.95m and 0.4814m

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ASSIGNMENT NO # 02

QUESTION NO = 1

SOLUTION:-

First of all we find the Froud Number and secondly flow

As we know that

$$F_0 = \frac{V}{\sqrt{gy}} = \frac{6}{\sqrt{9.81 \times 0.1}}$$

$$F_0 = 6.01 > 1$$

So the flow is super-critical

Alternate depth:-

$$E = y + \frac{V^2}{2g}$$

$$= 0.1 + \frac{6^2}{2 \times 9.81} = 1.935m$$

$$\boxed{E = 1.935m}$$

The Alternate depth for E = 1.935m

$$\boxed{y_{alternate} = 1.93m}$$

QUESTION NO = 2

GIVEN DATA:-

velocity = V_1 = 2 m/sec

depth = y_1 = 3m

Elevation = ΔZ = 60 cm = 0.6m

down step = 15cm = 0.15m

SOLUTION:-

As we know that

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

$$E_1 = 3 + \frac{(2)^2}{2 \times 9.81} \Rightarrow 3.20$$

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

Now $E_2 = E_1 - \Delta Z$

$$E_2 = 3.2 - 0.6$$

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

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Also $E_2 = y_2 + \frac{q^2}{2gy_1^2}$

$$2.60 = y_2 + \frac{6^2}{2 \times 9.81 \times y_1^2}$$

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

$$\Delta y = y_2 - y_1$$

$$\Delta y = 2.24 - 3$$

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

So water surface drop is 0.16m

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

$$E_2 = E_1 - \Delta Z$$

$$\Rightarrow 3.20 - (0.15)$$

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

Now $y_2 = 3.17\,m$

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

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

So water surface Rises 0.02m

*) The Maximum up-step possible before affecting upstream water surface level is for

$$y_2 = y_c$$

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

$$y_c = \sqrt[3]{(6)^2/9.8}$$

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

ASSIGNMENT NO # 3

PROBLEM:-

GIVEN DATA:-

$y_1 = 3.6m$

$y_2 = 0.9m$

$b = 3.9m$

SOLUTION:-

As we know that

$$E_1 = E_2$$

$$y_1 + \frac{v_1^2}{2g} = y_2 + \frac{V_2^2}{2g} \rightarrow (1)$$

Also

$$Q = A_1V_2 = A_2V_2$$

$$\Rightarrow b_1y_1 \cdot V_1 = b_2y_2 \cdot V_2 \quad (b = b_1 = b_2)$$

$$\not{b} \times y_1 \times V_1 = \not{b} \times y_2 \cdot V_2$$

$$y_1 V_1 = y_2 \cdot V_2$$

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

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Putting the values

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

$$\boxed{V_2 = 4V_1} \rightarrow ②$$

putting in ①

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

$$3.6 + \frac{V_1^2}{2g} = 0.9 + \frac{16V_1^2}{2g}$$

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

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

$$\not{-}\frac{15V_1^2}{2g} = \not{-}2.7$$

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

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

Put in Eq ②

$\Rightarrow V_2 = 4V_1$

$V_2 = 4(1.879) \Rightarrow 7.516$

$$V_2 = 7.516 \text{ m/sec}$$

As

$Q_1 = A_1V_1 = by_1 \cdot V_1$

$= 3.9 \times 3.6 \times 1.879$

$$Q_1 = 26.39 \text{ m}^3/\text{sec}$$

$Q_2 = A_2V_2 = by_2 \cdot V_2$

$= 3.9 \times 0.9 \times 7.516$

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

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

Fraud Number

(Due to upstream)

$$Fr_1 = \frac{V_1}{\sqrt{g y_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31$$

$\Rightarrow$ 0.31 (Sub-critical flow)

Fraud Number

(Due to down stream side)

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

$\Rightarrow$ 2.52 (Super critical flow)