Name	Sarmad Mahmood
ID	7828
Section	A
Instructor	Engr. Fawad khan
subject	Hydraulic Engineering

Assignment # 1

Q # 1

→ Venturi flume :-

It 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 measurment of very large flow rates, usually given in millions of cubic units. A venturi meter would normally measure in milimetres, whereas a venturi flume measures in metres.

Measurment of discharge with venturi flumes requires two measurments, one upstream and one at the throat (narrowest cross section) if the 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 measurment at the throat is sufficent for computation of discharge. To ensure the occurance of critical depth at the throat, these are designed in such a way as to form a hydraulic jump on the downstream side of the structure. These flumes are called "standing wave flume

Date:

Q # 2

→ Given data :-

width of channel = b = 3m
Discharge = Q = 12 m^3/sec.

→ Solution :-

ⓐ Critical depth

→ discharge per unit width

$q = Q/b = 12/3$

$= 4 m^3/sec$.

→ For rectangular channel.

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

$h_c = 1.18$ m

ⓑ Minimum Specific Energy (E_c):

→ For rectangular channel.

$$E_c = 3/2 \, h_c = \frac{3}{2} \times 1.18$$

$= 1.77$ m.

ⓒ The Alternate depth $E = 4m$.

→ As $E > E_c$, There are two possible depth's for a given E_c

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

(For rectangular channel.)

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

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

→ For the subcritical solution the first term, associated with potential energy dominates

→ Iteration (from $h = 4$) gives $h = 3.948m$

For the subcritical (First, shallow) solution. The term associated with kinetic energy dominates, rearrange as

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

→ Iteration (from $h = 0$) gives $h = 0.4814$ m

So Alternate depth are 3.95 m and 0.4814 m.

Assignment # 2

Q # 1

→ First of all we find the Froude number to find the flow.

As we know that

$$F_r = \frac{V}{\sqrt{gy}} = \frac{6\,m/s}{\sqrt{9.81 \times 0.1}}$$

$$F_r = 6.06 > 1$$

So the flow is super-critical.

→ **Alternate depth :-**

As we know that

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

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

The alternate for $E = 1.935\,m$

yields $\boxed{y\ alternate = 1.93\,m}$

Scanned with CamScanner

Q # 2

→ Given data :-

- velocity = V_1 = 2 m/s
- depth = y_1 = 3 m
- Elevation = 600 mm = 0.6 m
- down step = 15 cm = 0.15 cm

→ Solution :- As we know that

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

$$E_1 = 3 + \frac{2^2}{2 \times 9.81}$$

$$\rightarrow E_1 = 3.20 \text{ m}$$

Now $E_2 = E_1 - \Delta Z$

$= 3.2 - 0.6$

$= 2.60$ m

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

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

$y_2 = 2.24$ m

$$\Delta y = y_2 - y_1$$
$$= 2.24 - 3$$
$$= -0.76 \text{ m}$$

So water surface drop = 0.16 m

- For a downward step of 15 cm or 0.15 m we have

$$E_2 = E_1 - \Delta z = 3.20 - (-0.15)$$
$$\rightarrow E_2 = 3.35 \text{ m}$$

Now $y_2 = 3.17$ m , $\Delta y = y_2 - y_1$
$$= 3.17 - 3$$
$$\Delta y = 0.17 \text{ m}$$

→ So water surface rises 0.02 m.

- The maximum upstep possible before effecting upstream water surface level is for

$$y_2 = y_c \rightarrow y_c \sqrt[3]{\frac{q^2}{g}}$$

$$y_c = \sqrt[3]{\frac{6^2}{9.18}} \qquad y_c = 1.54 \text{ m}$$

Assignment # 3

Q#1

→ Given data :-

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

$b = 3.9 m$

→ Solution :- As we know that

$E_1 = E_2$

$$y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g} \quad — (1)$$

→ Also

$$Q = A_1 V_1 = A_2 V_2 \qquad (b = b_1 = b_2)$$

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

$$y_1 \cdot V_1 = y_2 \cdot V_2$$

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

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

→ $V_2 = 4V_1$ —— (2)

putting in eq ①

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

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

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

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

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

$$\frac{-15v_1^2}{2g} = -2.7$$

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

$v_1 = 1.879$ m/sec → putting in eq 2 we get.

$$V_2 = 4v_1$$
$$= 4(1.879)$$

$V_2 = 7.516$ m/sec.

→ As

$$Q_1 = A_1 V_1 = b y_1 \cdot V_1$$

$$= 3.9 \times 3.6 \times 1.879$$

• $Q_1 = 26.38\ m^3/sec$

$$Q_2 = A_2 V_2 = b \cdot y_2 \cdot V_2$$

$$= 3.9 \times 0.9 \times 7.516$$

• $Q_2 = 26.38\ m^3/sec$

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

① Froude number → At upstream side

$$F_{r1} = \frac{V_1}{\sqrt{g y_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31 \rightarrow$$ sub-critical flow.

② Froude number → At downstream side

$$F_{r2} = \frac{V_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.53$$

↓

super-critical flow.