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Section	A
Assignment No	1, 2, 3
Subject	Hydraulic Engineering.

 ID 6977

Qno1)

Ans 1) Venturi flume:-

A venturi 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 give a millions of cubic units. A venturi meter would normally measure in millimeter where as a venturi flume measure in meters.

Measurement of discharge with venturi ~~mete~~ flumes require two measurement, one upstream & one at the throat (narrowest cross section). It the flow passes in a subcritical state through the flume if the flume are designed so as to pass the flow from sub to super critical state while passing through the flume, a single measurement at the throat is sufficent for computation of discharge. To ensure the occurrence of critical depth at the throat The flumes are usually designed in such a way that as to form hydraulic Jump on the downstream side of the structure.

Qno2)

Ans 2) Given data:-

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

Required:- a) The critical depth

b) The minimum specific energy

c) The alternate depth where $E = 4m$

Solution:-

a) Discharge per unit width:-

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

then rectangular channel

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

b) For rectangular channel:-

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

$$E_c = 1.766 m$$

mini specific energy $= 1.77$

c) As $E > E_c$, there are two possible depth for a given specific energy:-

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

For rectangular channel

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

Substituting values in meter-second units

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

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 $h = 3.948m$

For the supercritical solution

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

$h = 0.4814m$

alternate depth are 3.95 m & 0.481m.

Assignment NO 2:-

Qno1)

Ans:- Solution:-

By checking Froud number

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

$$\boxed{Fr \quad 6.06 > 1}$$

Flow is supercritical

$$E = y + \frac{V2}{2g} = 0.1 + \frac{6}{2 \times 9.81}$$

$E = 1.935$

For alternate depth $E = 1.935\,m$

For alternate depth $E = 1.935\,m$

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

Qno2)

Ans 2) Given data:-

$V_1 = 2 m/s$

$y_1 = 3 m$

$\Delta z = 60 cm = 0.6 m$

down step $= 15 cm = 0.15 m$

Solution:-

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

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

$$E_1 = 3.20 m$$

Now

$$E_2 = E_1 - \Delta z$$

$$= 3.2 - 0.6$$

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

Also

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

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

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

$$\boxed{\Delta y = 2.24 m}$$

$$\Delta y = y_2 - y_1$$

$$= 2.24 - 3$$

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

so water surface drop = 0.16m

⇒ For a downward step of 15 cm or 0.15m

we have

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

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

Now $y_2 = 3.17m$

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

$$\Delta y = 0.17m$$

So water surface rises 0.02m

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

$$y_2 = y_c$$

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

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

$$y_c = 1.54m$$

Assignment NO 3:-

Qno1)

Given data:-

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

$b = 3.9m$

Sol:-

$E_1 = E_2$

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

Now

$$Q = A_1V_1 = A_2V_2$$

$$by_1V_1 = by_2 \cdot V_2$$

$$y_1V_1 = y_2V_2$$

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

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

$$\boxed{V_2 = 4V_1} \quad -②$$

put in eq ①

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

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

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

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

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

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

$V_1 = 1.879$ m/sec

Put in eq (2) . we will get

$\Rightarrow V_2 = 4V_1$

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

As $Q_1 = A_1V_1 = by_1v_1$

$= 3.9 \times 3.6 \times 1.879$

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

$Q_2 = A_2V_2 = by_2V_2$

$= 3.9 \times 0.9 \times 7.516$

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

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

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

Froud number at downstream side

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

$$\boxed{Fr_2 = 2.52}$$

super critical flow