Assignments :

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Subject : Hydraulic Engineering

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Assignment # 1

Q NO: 01

Venture flume :

Venture Flume It is a Critical flow open flume with a Constructed flow which Causes a drop in the hydraulic grade line, producing a Critical Depth.

→ It is used in flow measurment of very Large flow rates, usually given in millions of Cubic units

→ A flume is a human made channel for wate in The Shape of an declined gravity Chute whose wall are raised above The Surrounding terrain, in Contrast to a trench or ditch.

→ Flumes are Specially Shaped that are used to measure the flow of water in open Channels. They are Static in nature having no moving parts and Improve a Relationship b/w The water Level in the flume and the flow rate by restricting the flow of water in different of ways

→ It's advantages are, hydraulic head loose is smaller as compeared to weirs.

→ It has lower pressure drop

→ It is suitable for uncleaned waste water

→ It is very easy to maintaine.

Part 2

Given data:

Width of Channel $= B = 3m$

Discharge $= Q = 12\,m^3s^{-1}$

$E = 4m$

Required:

① Critical Depth = ?

② Minimum Specific energy = ?

③ Alternate Depth = ?

Solution:

①

We know that discharge per unit width

$$q = \frac{Q}{b}$$

by putting the values

$q = \frac{12}{3}$

$= 4\ m^2/s$

For a Rectangular Channel:

Critical Depth $= h_c = \left(\frac{q^2}{g}\right)^{1/3}$ where, $g = 9.81$

putting the values

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

$\boxed{h_c = 1.117\,m}$

(2) Specific energy

we know that for a Rectangular Channel Specific energy

$E_c = \frac{3}{2} h_c$

by putting the values

$E_c = \frac{3}{2} \times 1.117$

$\boxed{E_c = 1.76\,m}$

3 Alternate depth:

we know that

$$E > E_c$$

There are two possible depths for a given Specific energy

$$E = h + \frac{V^2}{2g} \quad \text{(A)}, \text{ where}$$

$$V = \frac{Q}{A} = \frac{q}{h} \text{ (rectangular channel)}$$

Therefore

$$E = h + \frac{q^2}{2gh^2}, \left(V = \frac{q}{h} \right)$$

$$E = h + \frac{4^2}{2 \times 9.81 h^2}$$

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

$$h = 4 - \frac{0.8155}{h^2} \text{ (As arranged)}$$

Iteration (from e.g, $h = 4$) gives $h = 3.948$m

$$4 - h = \frac{0.8155}{h^2} \text{ — (arranged)}$$

by cross xing

$$h^2 (4 - h) = 0.8155$$

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

Taking under root on b/s

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

Iteration from e.g, $h = 0$

$$h = \sqrt{\frac{0.8155}{4-0}}$$

$h = 0.451\,m$

$\rightarrow$ alternate depth are 3.948 m and 0.451m

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Assignment # 02

~~Q~~:

Problem # 1 :

Given data

Depth of water flow $= y = 10cm$

$= 0.1m$

velocity ~~of~~ $= v = 6m/s$

Solution:

$$Fr = \frac{V}{\sqrt{gy}}$$ (check fraud Number)

by putting the values

$$Fr = \frac{6m/s}{\sqrt{9.81m/s^2 \times 0.1m}}$$

$Fr = 6.05$

As, ~~6.05 > 1~~

$6.05 > 1$ so the flow is Super critical.

we know That

$E = y + \frac{v^2}{2g}$ by putting The values

$E = 0.1m + \frac{(6m/s)^2}{2 \times 9.81m/s^2}$

$E = 1.934m$

Problem: 02 :

Solution:

$E_1 = y_1 + \frac{V_1^2}{2g} = 3m + \frac{(2m/s)^2}{2.981m/s^2}$

$= 3.20m$

$E_2 = E_1 - \Delta z = 3.20m - 0.060m = 2.60m$

Also $E_2 = y_2 + \frac{q^2}{2gy_2^2} = y_2 + \frac{(6m^3/s/m)^2}{2.981m/s^2 . y_2^2}$

$= 2.60m$

So $y_2 = 2.24m$ $\Delta y = y_2 - y_1 = 0.76m$ So water Surface drops 0.16m For a downward Step of 15cm we have

$$E_2 = E_1 - \Delta z = 3.20m - (-0.15m)$$
$$= 3.35m$$

So giving,

$y_2 = 3.17$ and $\Delta y = y_2 - y_1 = 0.17m$

So water surface 0.02m.

The maximum upstep possible before affecting upstream water surface is for

$$y_2 = y_c$$

$$y_c = \sqrt[3]{\frac{q^2}{g}} = \sqrt[3]{\frac{(6m^3/s/m)^2}{9.81m/s^2}}$$

$$= \boxed{1.54m}$$

Assignment # 03

Problem :

Given data

$y_1 = 3.6 m$

$y_2 = 0.9 m$

$b = 3.9 m$

Solution :

As we know that

$$E_1 = E_2$$

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

=) Also

$$Q = A_1 V_1 = A_2 V_2$$

$$b_1 y_1 \cdot V_1 = b_2 y_2 \cdot V_2 \quad \because (b = b_1 = b_2)$$

$$\cancel{b} \cdot y_1 \cdot V_1 = \cancel{b} \cdot y_2 \cdot V_2$$

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

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

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

$$\boxed{V_2 = 4 V_1} \quad \text{—} (2)$$

putting in eq 1

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

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

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

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

by taking L.C.M

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

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

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

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

putting in eq 2

eq (2)

$V_2 = 4V_1$ by putting values

$= 4(1.879)$

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

As

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

$= 3.9 \times 3.6 \times 1.879$

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

And

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

$= 3.9 \times 0.9 \times 7.516$

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

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

(1) Froud Numbe (At upstream Side)

$Fr_1 = \frac{V_1}{\sqrt{g y_1}}$

$= \frac{1.879}{\sqrt{9.81 \times 3.6}} \Rightarrow 0.31$ (sub critical flow)

(2) Froud Number (At Downstream Side)

$$F_{r_2} = \frac{V_2}{\sqrt{g y_2}} = \cancel{7.516}$$

$$= \frac{7.516}{\sqrt{9.81 \times 0.9}}$$

$$\boxed{F_{r_2} = 2.52} \rightarrow$$

Super - Critical Flow