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Section	A
Assignment	Hydraullic Engr

Assignmen # 01

QNo. 1):

Answer: 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 given in millions of cubic units.

→ A venturi meter would normally measure in millimetres, whereas a venturi flume measures in metres.

→ Measurement of discharge with venturi flumes requires two measurements, one upstream and one at the throat (narrowest cross section), if the flow passes in a subcritical state through the flume. If the flumes are designed so as to pass the flow from sub critical to supercritical state while passing through the flume, a single measurement at the throat is sufficient for computation of discharge.

→ To ensure the occurrence of critical depth at the throat, the flumes are usually designed in such away as to form a hydraulic jump on the downstream side of the structure. These flumes are called "Standing wave flumes".

QNO. 2): A 3m wide Channel carries a total discharge of $12 m^3/sec$ calculate.

*) Critical depth.

*) Minimum Specific. Energy.

*) Alternate depth $E = 4m$.

Given Data:

Wide of Channel $= b = 3m$

Discharge $= Q = 12\ m^3/sec$

Solution:

ⓐ Critical Depth:

Discharge per unit width

$$q = Q/b = \frac{12}{3}$$

$$\boxed{q = 4\ m^3/sec}$$

For Rectangular Channel

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

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

ⓑ Minimum Specific Energy $(E_c) = ?$

For Rectangular Channel

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

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

c) 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 $V = \frac{Q}{A} = \frac{q}{h}$

(For Rectangular Channel)

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

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

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

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

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

For subcritical (First, Shallow) Solution. The second term associated with kinetic energy. dominates rearrange as:

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

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

So Alternate depth are 3.95m and 0.4814m

Assignment #02

Question #01: Water flows at a depth of Layers with a velocity of 6m/s in a rectangular channel. Is the flow subcritical or super critical? What is the alternate depth?

Solution:

First of all we fined the Froude Number to forced 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 supercritical.

Alternate Depth:

As we know that

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

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

The alternate depth for $E = 1.935m$

yields $\boxed{y_{altnate} = 1.93m}$

Q#02: Water flow with a velocity of 2 m/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 change in bottom elevations (upstep) to 60cm? What whould be the depth and elevation changes of there were a gradual down slop of 15cm? What is maximum size of upslop that would exist before upstream depth changes would result? Neglect head looses.

Given Data:

velocity $= v_1 = 2\ m/s$

depth $= y_1 = 3m$

Elevation $\Delta x = 60cm = 0.6m$

down step $= 15cm = 0.15m$

Solution: As we know that

$$E_1 = y_1 + \frac{v_1^2}{2g}$$

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

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

Now $E_2 = E_1 - \Delta x$

$$= 3.2 - 0.6$$

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

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Also

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

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

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

$$\Delta y = y_2 - y_1$$

$$\Delta y = 2.24 - 3$$

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

So water surface drop = 0.16 m

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

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

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

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 upstep possible before effecting upstream water surface ~~Road~~ level is for.

$y_2 = y_c$

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

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

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

Assignment #03

Q NO.1):

Given Data: $y_1 = 3.6m$, $y_2 = 0.9\,m$

$b = 3.9m$

Solution:

As we know that

$$E_1 = E_2$$

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

Also

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

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

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

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

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

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

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

putting in eq — (1)

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

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

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

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

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

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

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

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

Putting in eq②

$$V_2 = 4V_1$$

$$V_2 = 4(1.879)$$

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

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

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

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

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

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

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

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

ⓐ Froud Number → at Upstream side

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

Sub-critical flow

ⓑ Froud Number → at downward Stream

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

Super-critical flow.