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Section C

Assignment #01

QNO 1:-
ANS:-
Venture flumes

A venture flume is a critical-flow open flume with a constricted flow 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 millimeters, whereas a venturi flume measure in meter.

Measurement of discharge with venturi flumes require two measurements, one upstream and one at the throat. If the flow passes in a subcritical state through the flume. If the flume are designed so as to pass the flow from sub critical to super critical state while passing throug the flume, a single measurement at the throat is sufficient for computation of discharge.

Question #2
Numerical
Given:-
⇒ Wide of channel = 3m
⇒ Discharge = Q = 12 m^3/sec

Req:-
⇒ critical depth
⇒ minimum specific energy
⇒ alternate depth

Sol:- As

critical depth:-
Discharge per unit width
$q = Q/h = 12/3$
$\boxed{q = 4\ m^3/sec}$

For rectangular channel
$h_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{4^2}{9.81}\right)^{1/3}$
$\boxed{h_c = 1.18\,m}$

Minimum specific Energy
For rectangular channel
$E_c = \frac{3}{2} h_c = \frac{3}{2} \times 1.18$
$\boxed{E_c = 1.77\,m}$

The alternate depth $E = 4m$
$E > E_c$, 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)

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

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

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

for the section subcritical solution the first term, associated with potential energy dominates.

Iteration (from e.g. $h=4$)

gives $h = 3.98$ m.

For the supercritical solution, the second term associated with kinetic energy dominates

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

Iteration (from e.g. $h=0$)

gives $h = 0.4814$ m

So alternate depth are 3.85 m and 0.4814 m.

Assignment #02

QNO1:- Numerical

ANS :-

Sol:- As

first we find the froud number.

$$Fr = \frac{v}{\sqrt{gy}} = \frac{6\,m/s}{\sqrt{9.81 \times 0.4}}$$

$Fr = 6.067 > 1$

so the flow is supercritical

Alternate depth:-

As we know that

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

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

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

The alternate depth for $E = 1.935\,m$

yields. $\boxed{y_{alternate} = 1.93\,m}$

QNO 2:-

Numerical

ANS #2:-

Given:-

velocity = v_1 = 2m/s.

depth = y_1 = 3m

Elevation Δz = 60cm = 0.6m

down step = 15cm = 0.15 m

Solution:-

As we know that

$$E1 = y1 + \frac{u1^2}{2g}$$

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

$$\boxed{E1 = 3.20\,m}$$

Now $E2 = E1 - \Delta Z$

$$= 3.20 - 0.6$$

$$\boxed{E2 = 2.60\,m}$$

Also

$$E2 = y2 + \frac{q^2}{2g\,y_2^2}$$

$$2.60 = y2 + \frac{(6)^2}{2 \times 9.81 \cdot y_2^2}$$

$$\boxed{y2 = 2.24\,m}$$

$$\Delta y = y2 - y1$$

$$= 2.24 - 3$$

$$\boxed{\Delta y \;\; -0.76\,m}$$

so water surface drops 0.10m

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

$$E2 = E1 - \Delta Z$$

$$= 3.20 - (-0.15)$$

$$\boxed{E2 = 3.35\,m}$$

Now $y_2 = 3.17\,m$

$\Delta y = y_2 - y_1$

$= 3.17 - 3$

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

so water surface rises $= 0.02\,m$

The maximum upset possible before affecting upstream water surface level is for

$y_2 = y_c$

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

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

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

Assignment #03

Q NO 1:-
Given:-

$y_1 = 3.6m$
$b = 3.9m$
$y_2 = 0.9m$

Sol:-
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

$Q = A_1V_1 = A_2V_2$ $\quad \because b = b_1 = b_2$

$b_1 y_1 \cdot v_1 = b_2 y_2 \cdot v_2$

$\cancel{b} y_1 \cdot v_1 = \cancel{b} y_2 \cdot v_2$

$y_1 v_1 = y_2 v_2$

$v_2 = \frac{y_1}{y_2} \times v_1$

$v_2 = \frac{3.6}{0.9} \times v_1$

$\boxed{v_2 = 4v_1} \rightarrow (2)$ put in eq (1)

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

$3.6 + \frac{v_1^2}{2(9.81)} = 0.9 + \frac{(4v_1)^2}{(2)9.81}$

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

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

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

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

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

$\boxed{V_1 = 1.879\ m/sec}$ put in eq (ii)

$V_2 = 4V_1$

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

As

$Q_1 = A_1V_1 = by_1 \cdot V_1$

$= 3.9 \times 3.6 \times 1.879$

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

$Q_2 = AV_2 = b \cdot y_2 \times V_2$

$= 3.9 \times 0.9 \times 7.516$

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

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

1) Froud number → At upstream side

$F_{r1} = \dfrac{V_1}{\sqrt{gy_1}} = \dfrac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31$

↓

sub-critical flow

2) Froud number:- ⇒ At downstream side

$F_{r2} = \dfrac{V_2}{\sqrt{gy_2}} = \dfrac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52$

super critical flow