# ASSIGNMENTS

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ID 7807

Section "A"

Subject Hydraulic Engineering

Semester 6th

Submitted To Engr. Fawad Ahmad.

## Q: 1: Venture flume:-

A type of open flume with a contracted throat that causes a drop in the hydraulic grade line used for measuring flow.

⇒ The term flume is applied to device in which the flow is locally accelerated.

⇒ Due to Solids matter contained in Sewage, the discharge in sewer technology is usually measured with a venturi flume.

⇒ The flume corresponds to a locally constricted channel normally without a bottom inset to force a transition b/w Sub & Super critical flows, which is critical flows.

⇒ On the basis of advantages & dis advantages three flumes type are recommended for design. which are charactirized by Simplicity, Economy, and hydraulic Performance.

ID = 2807 Assignment # 1:

Q No: 2

Given data:-

width $= b = 3m$

$Q = 12 m^3/sec$

Solution:-

→ Critical depth:-

$q = Q/b = 12/3$

$\boxed{q = 4 m^2/sec.}$

For rectangular channel

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

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

$\boxed{y_c = 1.177m}$

ID = 7807 Assignment #01 (3)

⇒ The Minimum Specific Energy:-

Now

$Q = A \cdot V$ — (1)

$Q = q \cdot b$ — (2)

Equate both.

$Q = Q$

$A \cdot V = q \cdot b$

$\cancel{b} y \cdot V = q \cdot \cancel{b}$

$y \cdot v = q \Rightarrow \boxed{V = q / y_c}$

$V = 4/1.177 \Rightarrow \boxed{V = 3.398 \text{ m/sec}}$

Minimum Specific Energy

$y = y_c \;,\; V = V_c$

So

$$E_{min} = y_c + \frac{(V_c)^2}{2g} = 1.177 + \frac{(3.398)^2}{2 \times 9.81}$$

$$\boxed{E_{min} = 1.76 \text{ m}}$$

→ Alternate depth when $\mathcal{E} = 4m$.

$$\mathcal{E} = y + \frac{V^2}{2g} \Rightarrow \mathcal{E} = y + \frac{Q^2/A^2}{2g}$$

$$\mathcal{E} = y + \frac{Q^2}{2g \cdot A^2} \Rightarrow y + \frac{Q^2}{2g \cdot B^2 \cdot y^2} = y + \frac{q^2}{2g \cdot y^2}$$

$$\mathcal{E} = y + \frac{4^2}{2(9.81) \times y^2} = 4 = y + \frac{(4^2)}{2(9.81)} \times \frac{1}{y^2}$$

$$y = 4 - \frac{16}{19.62} \times \frac{1}{y^2} = 4 - 0.815 \times \frac{1}{y^2}$$

For the Supercritical flow Solution, the first term associated with potential Energy.

So,

$$y = 4 - \frac{0.815}{y^2}$$

From Iteration at $y = 4m$ we get

$$y = 3.98\,m \text{ or } \boxed{3.85\,m}$$

For Super Critical, Second term is associated with K.E.

$$y^2 = \frac{0.815}{4 - y}$$

$$y = \sqrt{\frac{0.815}{4 - y}}$$

From Iteration , $y = 4m$

we have

$y = 0.481m$ or $\boxed{0.482m}$

So Alternate depth are

$$\boxed{3.95m \text{ and } 0.482m}$$

Q: No: 1:

Given data:-

Depth $= y =$ 10cm $\Rightarrow$ 0.1 m

Velocity $= V =$ 6m/sec

Solution:-

From Froude Number

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

$$\boxed{F_r = 6.06}$$

As $F_r > 1 \rightarrow$ Flow is Super Critical

Now Alternate depth

$$E = y + \frac{V^2}{2g} = 0.1 + \frac{(6)^2}{2(9.81)} = 1.934$$

or

So, $E = 1.939$ yeilds the depth

$$\boxed{y = 1.93 m}$$

Q: No: 2 :-

Given data:

Velocity $(V) = 2\ m/sec$

Depth of water $= y_1 = 3m$

Change in bottom Elevation $= 60cm = 0.6m$

Gradual downward Step $= 15cm$

Solution :-

From Specific Energy Equation.

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

$$E_1 = 3 + \frac{2^2}{2(9.81)} = 3.20m$$

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

For downward Step,

$$E_2 = E_1 - \Delta Z$$

$$= 3.20 - 0.60 \Rightarrow \boxed{E_2 = 2.60m}$$

Now

$$E_2 = y_2 + \frac{(V_2)^2}{2g} \Rightarrow y_2 + \frac{(Q/A)^2}{2g}$$

$$E_2 = y_2 + \frac{Q^2}{2g \cdot B^2 \cdot y^2} = y_2 + \frac{q^2}{2g \cdot y^2}$$

Now put the values

$$E_2 = y_2 + \frac{q^2}{2g \cdot y^2} = y_2 + \frac{(6)^2}{2 \times 9.81 (y_2)^2}$$

$\therefore q = Vy$
$= 2 \times 3$
$= 6 \, m^2/sec$

$$\Rightarrow 2.60 = y_2 + \frac{(6)^2}{2(9.81)(y_2)^2}$$

$$\boxed{y_2 = 2.34}$$

Change in depth

$$\Delta y = y_2 - y_1 = 2.34 - 3$$

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

Change in upset $= 0.76 - 0.6$
$= 0.16$

$\boxed{\text{water surface drop} = 0.16 \, m}$

For downward Step,

$$E_2 = E_1 - \Delta Z$$
$$= 3.20 - (-0.15)$$
$$\boxed{E_2 = 3.35}$$

$\therefore$ ( $-0.15$, $-ve$ because of downward direction).

From above formula

$$E_2 = y_2 + \frac{q^2}{2g \cdot (y_2)^2} \Rightarrow 3.35 = y_2 + \frac{6^2}{2 \times 9.81 \times y_2^2}$$

$$\boxed{y_2 = 3.17 \, m}$$

So Change in depth

$$\Delta y = 3.17 - 3 \Rightarrow 0.17m$$

Also the water in down step =

$$0.15 - 0.17 = 0.02$$

$$\boxed{\text{Water rises} = 0.02m}$$

Now the maximum upstep possible befor affecting upstream water lesser is for

$$y_2 = y_c$$

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

$$= \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{(6)^2}{9.81}\right)^{1/3}$$

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

ID = 7807 Assignment # 03

Q:11

Given data:

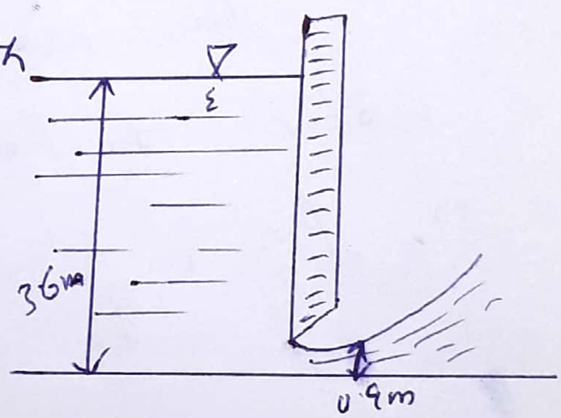
Depth of water at upstream = $y_1 = 3.6\,m$

" " " " down stream = $y_2 = 0.9\,m$

width of Sluice gate = b = 3.9 m

Solution:

Specific Energy on both stream are Same.




$$E_1 = E_2$$

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

From

$$Q = A_1 V_1 = A_2 V_2$$

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

$$\cancel{b} \cdot y_1 \cdot V_1 = \cancel{b} \cdot y_2 \cdot V_2 \qquad \therefore b = b_1 = b_2$$

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

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

$$\boxed{V_2 = 4V_1} \quad \text{—— } 1$$

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② ③

ID = 7807 Assignment # 03

By putting values of $V_2$

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

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

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

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

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

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

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

$$\boxed{V_1 = 1.879} \text{ — put in } ①.$$

$$V_2 = 4V_1 = 4(1.879)$$

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

Also,

$\Rightarrow Q_1 = A_1 V_1 = b \cdot y_1 \cdot V_1 = 3.9 \times 3.6 \times 1.879$

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

$Q = Q_1 = Q_2 \Rightarrow 26.388\ m^3/sec$

Now Froud No: at upstream Side:-

$$F_{r_1} = \frac{V_1}{\sqrt{g y_1}} = \frac{1.879}{\sqrt{9.81 \times 3.6}} = 0.31$$

$\boxed{Fr = 0.31} < 1 \Rightarrow$ Sub Critical flow.

Froud No: at Down Stream Side:-

$$F_{r_2} = \frac{V_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}}$$

$\boxed{F_{r_2} = 2.52} > 1 \Rightarrow$ Super Critical Flow.

End