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Section A
Hydraulic Engg
Assigment # 01
02
03

ASSIGNMENT 1

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 ~~line~~ critical depth.

Due to solid matter contained in sewage, the discharge in sewer technology is usually measured with a Venturi flume, This flume corresponds to a locally constricted channel normally without a bottom insel to force a transition between sub and supercritical flows.

Ans 2 Given data:

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

a) Discharge per unit width:

$$q = \frac{Q}{b} = \frac{12}{3} = 4m^2/sec$$

then regular channel

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

$$h_c = 1.177m$$

Critical depth = 1.177m

b) For rectangular channel:

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

$$= \frac{3}{2} \times 1.17$$

mini specific energy = 1.77

(c) As $E > \bar{E}$, there are two possible depth for a given specific energy

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

$$\because \quad v = \frac{Q}{A} = \frac{q}{h}$$

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

Substituting values in m-s 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 $h = 3.98$ m

for the super critical flow

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

$$\boxed{h = 0.481 m}$$

Hence alternate depth are 3.95 m & 0.481

ASSIGNMENT 2

ANS1 Given data:

$d = 10\ cm$, $V = 6 m/s$

$y_{all} = ?$

Solution:

By checking fraud ~~solution~~ number

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

$= 6.06$

$fr = 6.06 > 1$

Here flow is super-critical

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

$E = 1.935 m$

For alternate depth

$E = 1.935\ m$

$y_{al} = 1.93$

Ans 2 **Given data:**

$V_1 = 2\ m/s$

$y_1 = 3m$

$\Delta z = 60cm = 0.6m$

down step $= 15cm = 0.15m$

Solution:

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

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

$E_1 = 3.20m$

Now

$E_2 = E_1 - \Delta z$

$3.2 - 0.6$

$$E_2 = 2.60m$$

Also

$$E_2 = y_2 + \frac{q^2}{2gy_2^2}$$

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

$$y_2 = 2.24m$$

$$\Delta y = y_2 - y_1$$

$$= 2.24 - 3$$

$$\Delta y = -0.76m$$

So water surface drop

= 0.76m

=> For a 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

$y_2 = 3.17m$

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

$\Delta y = 0.17m$

So water surface rats = 0.02m

=> The maximum upstream possible beforee effecting upstream water surface level is for

$y_2 = y_c$

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

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

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

Scanned with CamScanner

ASSIGNMENT 3

Ans 1 **Given data:**

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

$b = 3.9m$

Required:

a) Discharge $Q = ?$

b) Froud no upstream & downstream.

Solution:

$$E_1 = E_2$$

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

Now

$$Q = A_1 V_1 = A_2 V_2$$

$$b y_1 V_1 = b y_2 V_2$$

$$y_1 V_1 = y_2 V_2$$

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

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

$$\boxed{V_2 = 4 V_1} \rightarrow (2)$$

put eq (2) in (1)

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

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

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

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

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

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

$V_1 = 1.879\ m/s \longrightarrow$ (3)

put (3) in (1)

$V_2 = 4V_1$

$V_2 = 4(1.874)$

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

a) $A_1 V_1 = b y_2 V_2$

$= 3.9 \times 3.6 \times 1.879$

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

$Q_2 = A_2 V_2 = b y_2 V_2$

$= 3.9 \times 0.9 \times 7.516$

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

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

b) Froud number at upstream

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

$\boxed{Fr_1 = 0.31}$ subcritical flow

b) Froud number → at downstream side

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

$$\boxed{Fr_2 = 2.52}$$ supercritical flow