"HYDRAULICS ENGINEERING"

Assignment #01 — Page # 1

Name : Muhammad Yaseen — I.D : 7544

Question #01

What is Venture Flumes? Explain with detail?

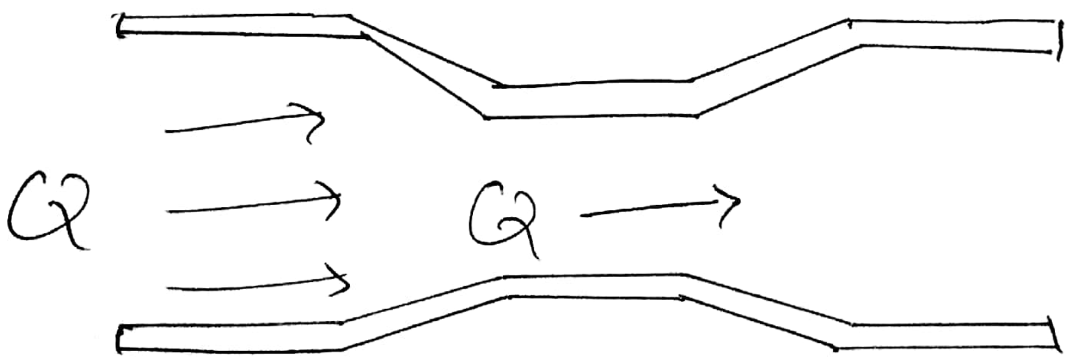
Venture Flume:

A venture flume is a critical flow open flume with a constricted flow which causes a drop in the hydraulic grade line, creating a critical depth

Explanation:

It is used in flow measurement of very large flow rates, usually given in millions of cubic units. A venturi meter would measure in millimeters, whereas a venturi flume measures in meters.

A venturi flume is placed in the channel in order to measure the volumetric flow as shown in figure.



If the depth of at Point A is $y_A = 2.5\,m$ and the throat at point B is $y_B = 2.35\,m$, The design equation of a venturi flume depends significantly on the effects of approach, constriction geometry and streamline curvature. For sufficiently large structures, effects of scale may be suppressed.

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Question #02:

A 4m wide channel carries a total discharge of $14\ m^3/sec$.

(a) Calculate depth.

(b) The minimum Specific Energy.

(c) The alternate depth when $E = 5m$.

Given:

$b = 4m$

$Q = 14\ m^3/sec$

Solution: (a) **Depth:**

As discharge per unit width is;

$$q = Q/b = 14/4$$

$$\boxed{q = 3.5\ m^2/sec}$$

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$$h = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{3.5^2}{9.8}\right)^{1/3}$$

$$\boxed{h = 1.077\ m}$$

(b) Minimum Specific Energy:

For a rectangular channel;

$$E_c = 3/2\ h_c = 3/2 \times 1.077$$

$$\boxed{E_c = 1.615\ m}$$

(c) Alternate Depth:

As,

$E > E_c$, There are two possible depths for a given specific energy,

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$E = h + \frac{v^2}{2g}$, where $v = Q/A$, q/h

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

Substituting value in meter-second unit

$5 = h + \frac{(3.5)^2}{2 \times 9.8 \times h^2}$

by solving the above equation

$h \approx 5m$

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Assignment #02 Page # 01

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Problem #01:

Water flows at - - - - - - -

- . . . . - what is the alterate depth.

Given :

Depth = 15cm = 0.15m

Velocity = 8 m/sec

Solution:

$$Fr = \frac{V}{\sqrt{gy_h}}$$

$$Fr = \frac{8}{\sqrt{9.8 \times 0.15}}$$

$$Fr = 6.6 > 1$$

So the flow is Super Critical.

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Assignment #02

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

$= 0.15 + \frac{8}{2 \times 9.8}$

$E = 2.91$

Iteration Gives

$y_{alt} = 1.96 \text{ m}$

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Name: Muhammad Yaseen I.D 7544

Problem #02:

Solution:

$$E_1 = y_1 + \frac{V_1^2}{2g} = 3m + \frac{(2)^2}{2 \times 9.8}$$

$$\boxed{E_1 = 3.2m}$$

Also, $E_2 = y_2 + \frac{V_2^2}{2g} =$

or $E_2 = E_1 - \Delta Z = 3.2 - 06$

$$\boxed{E_2 = 2.6m}$$

So $y_2 = 2.24m$,

$\Delta y = y_2 - y_1 = -0.76$

So water surface drops 0.16m.

For a downstream step of 15cm we have

$E_2 = E_1 - \Delta Z$

$= 3.2 - (-0.15) = \boxed{3.35\ m}$

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Assignment #02

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

So water rises 0.02m

→ The minimum upstep possible before affecting upstream water surface is for,

$y_2 = y_1$

$$y_c = \sqrt{\frac{q^2}{g}} = \sqrt{\frac{(6)^2}{9.8}}$$

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

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Assignment #03 Page #01

Name : Muhammad Yaseen I.D : 7544

Problem:

A water passing from the ----

------ slice gate is 3.2m.

i) Determine:

(a) Discharge Q

(b) Fraoud Number Upstream and downstream.

Solution:

Given:

$y_1 = 2.8m$

$y_2 = 0.9m$

$b = 3.2m$

$$E_1 = E_2$$

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

Also

$$Q = A_1V_1 = A_2V_2$$

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

$b V_1 y_1 = b V_2 y_2$

$y_1 V_1 = y_2 V_2$

$2.8 V_1 = 0.9 V_2$

$V_2 = \frac{2.8}{0.9} V_1$

$$\boxed{V_2 = 3.11 V_1} \quad \text{——— (1)}$$

Substituting values in equation:

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

$$2.8 + \frac{V_1^2}{2g} = 0.9 + \frac{(3.11 V_1)^2}{2g}$$

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Assignment #03 Page #03

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$$2.8 + \frac{V_1^2}{2g} = 0.9 + \frac{9.67 V_1^2}{2g}$$

by solving we get

$$V_1 = 2.07 \ m/s$$

Putting in equation (2)

we get

$$V_2 = 3.11 \times 2.07 = 6.437 \ m/s$$

Discharge:

$$Q_1 = A_1 V_1 = b y_1 V_1 = 3.2 \times 2.8 \times 2.07$$

$$Q_1 = 18.54 \ m^3/sec$$

$$Q_2 = A_2 V_2 = b y_2 V_2 = 3.2 \times 0.9 \times 6.43$$

$$Q = 18.51 \ m^3/sec$$

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Assignment #03 Page #04

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Fraud's Number:

$$Fr_1 = \frac{V_1}{\sqrt{gy_1}}$$

$$Fr_1 = \frac{2.07}{\sqrt{9.8 \times 2.8}}$$

$$\boxed{Fr_1 = 0.39}$$

$$Fr_2 = \frac{V_2}{\sqrt{gy_2}}$$

$$Fr_2 = \frac{6.437}{\sqrt{9.8 \times 0.9}}$$

$$\boxed{Fr_2 = 2.17}$$