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Section :- "B"

Semester :- 6<sup>th</sup>

Subject :- Hydraulics Engineering

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Assignments

Assignment No # 01

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## Assignment No "01"

### Venturi Flame :-

A venturi flame is critical flow open flame with a constricted flow which cause drop in the hydraulic grade line creating a critical depth.

It is used in flow measurement of very large flow rates usually given in million of cubic units. A venturi meter would normally measure in mm where as a venturi flame measure in meters.

Measurement of discharge with venturi flames requires two measurement one upstream and one at the throat. If the flow passes in subcritical state through the flames. If the flames are design so as to pass the flow from subcritical to super critical state while passing through the flame. a single measurement at the throat is sufficient for computation of discharge. To ensure the occurrence of optical depth at the throat.

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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 a way as to  
form.

③

Example :

- A 3 m wide channel carries a total discharge of  $12 \text{ m}^3 \text{ s}^{-1}$ . calculate
- The critical depth.
  - The minimum specific Energy.
  - The alternate depth when

$$E = 4 \text{ m}$$

$$b = 3 \text{ m}$$

$$Q = 12 \text{ m}^3 \text{ s}^{-1}$$

(A)

Discharge per unit width :

$$q = \frac{Q}{b} = \frac{12}{3} = 4 \text{ m}^2 \text{ s}^{-1}$$

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

Answer

critical depth = 1.18 m

(B)

for a rectangle channel

$$E_1 = \frac{3}{2} h_c = \frac{3}{2} \times 1.177 = 1.766 \text{ m}$$

Answer

Minimum Specific Energy = 1.77.



(4)

As  $E > E_c$  there are two possible depths for a given specific energy.

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

for rectangular channel

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

Substituting value in meter - second units.

for the subcritical (slow, deep) the first term associated with P.E

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

$$y = 3.45 \text{ ft}$$

EO : ON Computer

Assignment No: 02

①

Problem #01

Assignment No "02"

water flows a depth of 10cm with a velocity of 6m/s in a rectangular channel is the flow subcritical or supercritical what is the alternate depth.

Solution:-

check Froude number:

$$Fr = \frac{v}{\sqrt{gy}} = \frac{6 \text{ m/s}}{\sqrt{9.81/\text{s}^2} \cdot 0.1 \text{ m}} = 1.935 \text{ m}$$

So the flow is supercritical

$$F = y + \frac{v^2}{2g} = 0.1 \text{ m} + \frac{(6 \text{ m/s})^2}{2 \cdot 9.81 \text{ m/s}^2}$$

$$= 1.935 \text{ m}$$

Solving for alternate depth for  
 an  $F = 1.935 \text{ m}$  yields  $y_{alt} = 1.93 \text{ m}$



(2)

### Problem # 02

water flows with a velocity of  $2\text{ m/s}$  and at a depth of  $3\text{ m}$  in a rectangular channel. what is the change in depth and in water surface elevation produced by a gradual upward change in bottom elevation (upstep) of  $60\text{ cm}$ ? what would be the depth and elevation change if there were a gradual downstep of  $15\text{ cm}$ ? what is the maximum size of upstep that could exist before upstream depth changes would result? Neglect head losses.

Solution  $\therefore$

$$E_1 = y_1 + \frac{v_1^2}{2g} = 3\text{ m} + \frac{2\text{ m/s}^2}{2 \times 9.81\text{ m/s}^2}$$
$$= 3.20\text{ m}$$

$$E_2 = E_1 - \Delta_1 = 3.20\text{ m} - 0.60\text{ m} = 2.60\text{ m}$$

Also

$$E_2 = y_2 + \frac{q^2}{2gy^3} = y_2 + \frac{(6\text{ m}^3/\text{s m})^2}{2 \times 9.81\text{ m/s}^2} = 2.60\text{ m}$$

③

Also

$$F_2 = y_2 + \frac{q^2}{2gy_2^2} = \frac{y_2 + (6 \text{ m}^3/\text{s m})^2}{2 \times 9.81 \text{ m/s}^2} = 2.60 \text{ m}$$

So  $y_2 = 2.24 \text{ m}$  ,  $\Delta y = y_2 - y_1 = -0.76 \text{ m}$

So water surface drops 0.76 m  
for a downward step of 15 cm we  
have.

$$F_2 = F_1 - \Delta z = 3.20 - (-0.15 \text{ m}) \\ = 3.35 \text{ m}$$

giving  $y_2 = 3.17 \text{ m}$  and  $\Delta y = y_2 - y_1$   
 $= 0.17 \text{ m}$  so  
water surface raises 0.17 m.

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

$$y_2 = y_c$$

$$y_c = 3 \sqrt{\frac{q^2}{g}} = 3 \sqrt{\frac{(6 \text{ m}^3/\text{s m})^2}{9.81 \text{ m/s}^2}} \\ = 1.54 \text{ m}$$

Assignment No : 03

①

Problem 01:

A water passing from the slice gate in Dam.....?

Given data:

$$y_1 = 3.6 \text{ m} \quad , \quad y_2 = 0.9 \text{ m}$$

$$b = 3.9 \text{ m}$$

Sol:-

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

$$Q_1 = A_1 V_1 = A_2 V_2$$

$$b y_1 V_1 = b y_2 V_2 \quad (b = b_1 = b_2)$$

$$y_1 V_1 = y_2 V_2$$

$$y_1 V_1 = y_2 V_2$$

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

$$V_2 = \frac{3.6}{0.9} \times V_1 = 4V_1 \quad \text{--- (1)}$$

Putting eq, (1)

$$y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g} = 3.6 + \frac{V_1^2}{2g} = 0.9 + \frac{(4V_1)^2}{2g}$$



②  $V_1 = 1.879 \text{ m/sec}$  put in eq. ②

we get

$$V_2 = 4V_1$$

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

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

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

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

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

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

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

① Froude Number  $\rightarrow$  At upstream side

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

$\downarrow$

② Froude Number. sub critical flow.

$\rightarrow$  At down stream side

$$F_2 = \frac{V_2}{\sqrt{g y_2}} = \frac{7.516}{\sqrt{9.81 \times 0.9}} = 2.52 \text{ super critical flow.}$$