Name = M. IKRAM

ID = 7874

Sec = B

Sub = Hydraulic

Sir = Fawad

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Q: 1"

Ans:

Sol:-

$$b = 8m$$

$$Q = 7874 \, ltr/sec = 7.874 \, m^3/sec$$

$$V = R - 200 = 7874 - 200 = 7674 \, ft/sec$$

$$= 2339.6 \, m/sec$$

As we know that

$$Q = qb$$

$$q = Q/b = \frac{7.874}{8} = 0.9843 \, m^3/sec$$

$$y_c = \left(\frac{q^2}{g}\right)^{1/3} \Rightarrow \left(\frac{0.984}{9.81}\right)^{1/3} = 0.462m$$

$$\boxed{y_c = 0.462m}$$

As this is rectangular Section

$$Q = qb \quad (1)$$

$$Q = AV \quad (2)$$

eq (1) & (2)

$$qb = AV$$

$$qb = yb v$$

$$q = yv$$

$$V_c = \frac{q}{y_c} = \frac{0.9843}{0.42} = 2.344 m/sec$$

$\therefore V > V_c$ (Super Critical flow)

Height of hydraulic Jump on upstream side.

As $Q = AV$, $Q = byv$

$$y_1 = \frac{Q}{bV_1} = \frac{7.874}{8 \times 2339.6} = 0.0004 m$$

$$y_2 = -\frac{y_1}{2} + \sqrt{\frac{y_1^2}{4} + \frac{2 y_1 V_1}{g}}$$

$$= -\frac{0.0004}{2} + \sqrt{\frac{(0.0004)^2}{4} + \frac{2(0.0004)(2339.6)}{9.81}}$$

$$\boxed{y_2 = 1.3698 m}$$

$$\Delta y = y_2 - y_1 = 1.3698 - 0.0004 = 1.3694 m$$

$\therefore \Delta E = E_1 - E_2$

As we know that

$$Q_1 = Q_2$$

$$A_1V_1 = A_2V_2 = by_1V_1 = by_2V_2$$

$$V_2 = \frac{y_1V_1}{y_2} = \frac{(0.0004)(2339.6)}{1.3698} = 0.683 \text{ m/sec}$$

$$\Delta E = E_1 - E_2 = \left(y_1 + \frac{V^2}{2g}\right) - \left(y_2 + \frac{V_2^2}{2g}\right)$$

$$= \left(0.0004 + \frac{(2339.6)^2}{2(9.81)}\right) - \left(1.369 + \frac{(0.683)^2}{2(9.81)}\right)$$

$$= 278987.2 - 1.393 \Rightarrow 278985.81 \text{ m}$$

→ Power obsorbed:

$$\Delta P = \rho g Q(E_1 - E_2)$$

$$= 1000 \times 9.81 \times 7.874 \times (278985.81)$$

$$\boxed{\Delta P = 2.15 \times 10^{10} \text{ W}}$$

$$\Delta P = 2.15 \times 10^{7} \text{ KW}$$

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Q:1" (B) (4)

(B)

Sol:-

$b = 4m$

$Q = 7874\ ft^3/sec = \frac{7874}{(3.28)^3}$

$= 223.816\ m^3/sec$

$y_1 = 2.9m,\ y_2 = 1.1m$

Specific energy at upstream & down-stream side.

$E_1 = E_2$

$$Y_1 + \frac{V_1^2}{2g} = y_2 + \frac{V_2^2}{2g} \quad \text{--- (1)}$$

We know that

$Q = A_1V_1 = A_2V_2$

$by_1v_1 = by_2V_2 \qquad \because b_2 = b_1 = b$

$V_2 = \frac{y_1v_1}{y_2} = \frac{2.9}{1.1}v_1$

$$\boxed{V_2 = 2.634V_1} \quad \text{--- (2)}$$

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Put Value of eq 2 in 1

$$2.9 + \frac{V_1^2}{2\times9.81} = 1.1 + \frac{(2.63V_1)^2}{2\times9.81}$$

$$2.9-1.1 = \frac{6.938}{19.62} - \frac{V_1^2}{19.62}$$

$$1.8 = \frac{6.938V_1^2}{19.62} - \frac{V_1^2}{19.62}$$

$$\sqrt{V_1^2} = \sqrt{\frac{1.8\times19.62}{5.938}}$$

$$\boxed{V_1 = 2.44 m/sec}$$

Put Value of V_1 in eq 1

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

$$2.9 + \frac{(2.44)^2}{2g} = 1.1 + \frac{V_2^2}{2g}$$

$$\cancel{2.9 + \frac{(2.44)^2}{2g}}$$

$$2.9 - 1.1 = \frac{V_2^2}{2g} - \frac{5.95}{2g}$$

$$1.8 \times 2 \times 9.81 = V_2^2 - 5.95$$

$$\sqrt{V_2^2} = \sqrt{41.266}$$

$$\boxed{V_2 = 6.42 \, m/sec}$$

Now to determine type of flow using froud no.

UPSTREAM SIDE:

$$Fr_1 = \frac{V_1}{\sqrt{g y_1}} = \frac{2.44}{\sqrt{9.81 \times 2.9}} = 0.457 < 1$$

Sub Critical flow

DOWSTREAM SIDE:

$$Fr_2 = \frac{V_2}{\sqrt{9.81 \times 1.1}} = 1.95 > 1$$

Super Critical flow

Q:2 (a)

$y_1 = 1.8m$, $b = 66' = \frac{66}{3.28} = 20.12m$

$Q = \frac{7874}{(3.28)^3} = 223.186 \ m^3/sec$

Minimum height (P) of weir

$Q = AV \Rightarrow V = \frac{Q}{A} = \frac{Q}{by}$

$V_1 = \frac{223.186}{(20.12)(1.8)} \Rightarrow 6.163 m/sec$

Ase we know that

$y_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{11.091}{9.81}\right)^{1/3}$ $\because q = Q/b$ $q = 11.09$

$y_c = 2.323m$

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Also $V = \sqrt{gy} \Rightarrow V_c = \sqrt{g y_c}$

$$V_c = \sqrt{9.81 \times 2.32} = 4.75 \text{ m/sec}$$

Now according to specific energy $E_1 = E_2$

$$y_1 + \frac{V_1^2}{2g} = \frac{V_c^2}{2g} + y_c + P$$

$$1.8 + \frac{(6.163)^2}{2 \times 9.81} = \frac{4.75}{2(9.81)} + 2.323 + P$$

$$P = 3.7 - 2.323 - 0.24$$

$$\boxed{P = 1.137 \text{ m}}$$

Q::2" (b)

B

Ans:

$b = 2.8m$, $d = 1.5m$

$H_1 = 5m$; $H_2 = 5+1.5 = 6.5m$

$H = 5+0.6 = 5.6m$

$Cd = 0.7874$

$Q = ?$

Discharged through submerged portion

$$Q_1 = Cd \times b \times (H_2 - H_1) \times \sqrt{2gh}$$

$$= 0.7874 \times 2.8 \times (6.5 - 5.6) \times \sqrt{2(9.81)(5.6)}$$

$$Q = 20.794 \, m^3/sec$$

=> Discharge of free portion

$$Q_2 = 2/3 \times cd \times b \times \sqrt{2g}\,[H^{3/2} - H_1^{3/2}]$$

$$= \frac{2}{3} \times 0.7874 \times 2.8 \times \sqrt{2 \times 9.81}\left[5.6^{3/2} - 5^{3/2}\right].$$

$$Q_2 = 13.48\, m^3/sec$$

Total discharge

$$Q = Q_1 + Q_2 = 20.794 + 13.48$$

$$\boxed{Q = 34.27\, m^3/sec}$$

Q:: 3" (a)

A

$P_1 = R + 800 = 7874 + 800$

$P_1 = 8674 \, N/m^2$

$d_1 = R - 200 = 7874 - 200$

$= 7674 \, mm$

$A_1 = \frac{\pi}{4} d_1^2 = \frac{\pi}{4} (7.674)^2$

$= 46.23 \, m^2 \Rightarrow V_1 = 0.02 \, m/s$

$d_2 = R + 300 = 7874 + 300$

$= 10874 \, mm$

~~$d_2 = R + 300$~~ $d_2 = 10.874 \, m$

$$A_2 = \frac{\pi}{4}(10.874)^2 = 92.82\,m^2$$

$$V_2 = \frac{Q}{A} = \frac{0.95}{92.82} = 0.01\,m/sec$$

(1) Head loss due to Sudden enlargement

$$h_e = \left(1 - \frac{A_1}{A_2}\right)^2 \left(\frac{V_1 - V_2}{2g}\right)^2$$

$$h_e = \left(\frac{1 - 46.23}{92.75}\right)^2 \left(\frac{0.02 - 0.01}{2 \times 9.81}\right)^2$$

$$h_e = 6.5 \times 10^{-7}\,m$$

(2) power lost due to sudden enlargement

$$P = \rho g Q h_e = 1000 \times 9.81 \times 0.95 \times 6.5 \times 10^{-7}$$

$$\boxed{P = 0.0006052\,W}$$

(3) pressure in the Smallest pipe

apply Bernoulli's equation

$$\frac{P_1}{\rho g} + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + \frac{V_2^2}{2g} + h_L$$

$$\frac{8674}{1000 \times 9.81} + \frac{(0.02)^2}{2 \times 9.81} = \frac{P_2}{1000 \times 9.81} x \frac{(0.01)^2}{2 \times 9.81} + 6$$

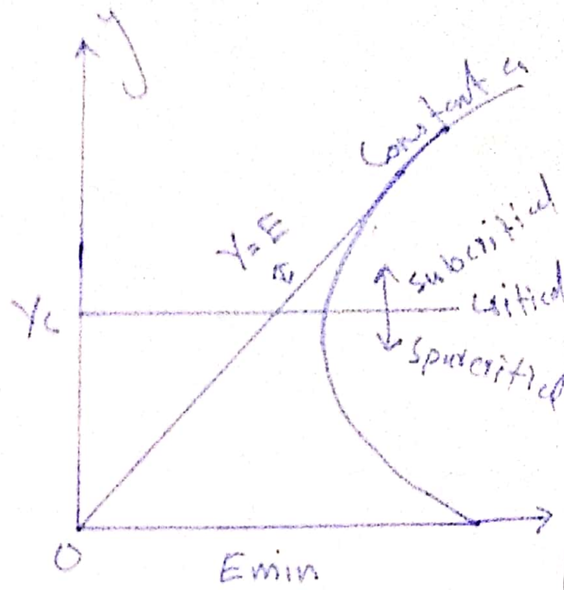
$$P_2 = 8673.995\,N/m^2$$

Q3: (b)

(14)

(3)

Ans:



The above graph is plot between depth flow(y) and Specific Energy(E) It is made From three degree plynomial equation which Shows us the different Specific energy for the depth flow which may be either

1. Sub critical
2. Critical
3. Supercritical

Specific energy is used to clarify the meaning of the above terms in an open channel.

How is this acheived:

Total energy = potential energy + Kinetic energy

$TE = mgh + \frac{1}{2}mv^2$ $\quad \because w = mg$

$= wh + \frac{1}{2}\frac{w}{g}v^2$ $\quad m = w/g$

Ignoring "W" weight of water

$T.E = h + \frac{v^2}{2g} \Rightarrow \boxed{T.E = y + \frac{V^2}{2g}} \rightarrow (1)$

As we know that

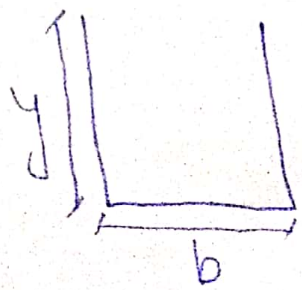
$Q = VA$, $V = Q/A$ Squaring b.s

$V^2 = \frac{Q^2}{A^2}$ put V_2 in eq (1)

Suppose channel is rectangular

$A = y \times b$ — (x)

$Q = qb$ — (y)



putting value of (x) & (y) in (2)

$E = y + \frac{Q^2}{y^2 b^2 2g}$ (putting)

$$E = y + \frac{q^2}{y^2 2g} \Rightarrow \text{putting}(y)$$

$$E - y = \frac{q^2}{y^2 2g} \Rightarrow y^2 (E - y) = \frac{q^2}{2g}$$

$$(E - y) y^2 = \text{Constant}$$

As 'q' and "g" are Constant

* Critical depth is the flow depth corresponding to minimum specific energy

$y > y_c \Rightarrow$ Subcritical flow

$y = y_c \Rightarrow$ Critical flow

$y < y_c \Rightarrow$ Supercritical flow