

3.05

. 1.22

/ 8.58 Z=1.5  
0.61

**at y = 1.22 m**

$$\therefore A = (b + Zy)y$$

$$\therefore A = (3.05 + 1.5 \times 1.22)1.22 = 5.9536 \text{ m}^2$$

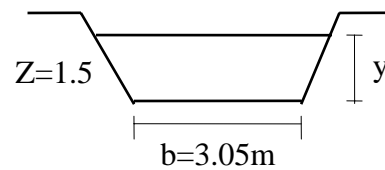
$$\therefore T = b + 2yZ$$

$$\therefore T = 3.05 + 2 \times 1.5 \times 1.22 = 6.71 \text{ m}$$

$$\therefore y_h = \frac{A}{T} \quad \therefore y_h = \frac{5.9536}{6.71} = 0.887 \text{ m}$$

$$\therefore F_e = \frac{Q}{A\sqrt{g \cdot y_h}} \quad \therefore F_e = \frac{8.58}{5.9536\sqrt{9.81 \times 0.877}} = 0.49$$

$$\therefore F_e < 1 \quad \Rightarrow$$



**at y = 0.61 m**

$$\therefore A = (3.05 + 1.5 \times 0.61)0.61 = 2.419 \text{ m}^2$$

$$\therefore T = 3.05 + 2 \times 1.5 \times 0.61 = 4.88 \text{ m}$$

$$\therefore y_h = \frac{A}{T} = \frac{2.419}{4.88} = 0.496 \text{ m}$$

$$\therefore F_e = \frac{8.58}{2.419\sqrt{9.81 \times 0.496}} = 1.6$$

$$\therefore F_e > 1 \quad \Rightarrow$$

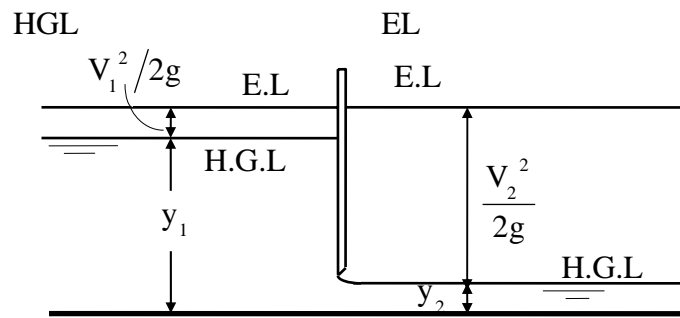
**at  $F_e = 1$ :**

$$\therefore 1 = \frac{Q}{A\sqrt{9.81 \times y_h}} \quad \therefore A \cdot y_h^{0.5} = \frac{Q}{\sqrt{9.81}} = \frac{8.58}{\sqrt{9.81}} = 2.74$$

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Assume y (m)	1	0.7	0.8	0.81
$A = (3.05 + 1.5y)y$	4.55	2.87	3.4	3.455
$T = 3.05 + 2 \times 1.5y$	6.05	5.15	5.45	5.48
$y_h = A/T$	0.752	0.557	0.624	0.63
$A \cdot y_h^{0.5}$	3.946	2.14	2.685	2.743
Test = 2.74	no	no	no	ok

$$\therefore y_c = 0.81 \text{ m}$$



$$\therefore Q_1 = Q_2$$

$$\therefore V_1 \times (y_1 \times b) = V_2 \times (y_2 \times b)$$

$$\therefore V_2 = V_1 \times \frac{y_1}{y_2} \qquad \therefore V_2 = V_1 \times \frac{1.8}{0.6} = 3V_1 \quad \dots\dots (1)$$

$$\therefore E_1 = E_2$$

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

$$\therefore y_2 = y_1 \quad ( )$$

$$\therefore 1.8 + \frac{V_1^2}{2g} = 0.6 + \frac{9V_1^2}{2g}$$

$$\therefore \frac{V_1^2}{2g} = \frac{1.2}{8} = 0.15 \text{ m}$$

$$\therefore V_2 = 3 \times 1.715 = 5.147 \text{ m/s}$$

$$\therefore \frac{V_2^2}{2g} = \frac{(5.147)^2}{2 \times 9.81} = 1.35 \text{ m}$$

$$q = V_2 \times y_2 = 5.147 \times 0.6 = 3.09 \text{ m}^3/\text{s/m}$$

$$q = V_1 \times y_1 = 1.715 \times 1.8 = 3.09 \text{ m}^3/\text{s/m}$$

$$. / 2.83 \quad 0.0004 \quad 3$$

$$: 57 = C$$

$$\cdot (y_n)$$

$$\cdot (y_c)$$

$$b = 3 \text{ m} \quad , \quad S = 0.0004 \quad , \quad Q = 2.83 \text{ m}^3/\text{s} \quad , \quad C = 57$$

$$\therefore Q = C \cdot S^{\frac{1}{2}} \cdot R_h^{\frac{1}{2}} \cdot A$$

$$\therefore R_h^{\frac{1}{2}} \cdot A = \frac{Q}{S^{0.5} \cdot C} = \frac{2.83}{(0.0004)^{0.5} \times 57} = \frac{2.83}{0.02 \times 57} = 2.4825$$

$$: \quad y$$

assume y (m)	1	1.1	1.05
A = by = 3y	3.0	3.3	3.15
P = 3 + 2y	5.0	5.2	5.1
R <sub>h</sub> = A/P	0.6	0.635	0.618
A · R <sub>h</sub> <sup>0.5</sup>	2.32	2.63	2.48
Test = 2.4825	no	no	ok

$$\therefore y_n = 1.05 \text{ m}$$

$$\therefore y_h = \frac{A}{T} = \frac{y \cdot b}{b} = y$$

$$\therefore y_h = 1.05 \text{ m}$$

$$\therefore F_e = \frac{Q}{A \sqrt{g \cdot y_h}}$$

$$\therefore F_e = \frac{2.83}{3.15 \sqrt{9.81 \times 1.05}} = 0.28$$

$$\therefore F_e < 1 \quad \Rightarrow$$

**at  $F_e = 1$  :**

$y_c$

$$\therefore 1 = \frac{Q}{A \cdot \sqrt{g \times y_h}}$$

$$\therefore Q^2 = A^2 \times 9.81 \times \frac{A}{T}$$

$$\therefore Q^2 = \frac{A^3 \times 9.81}{T}$$

$$\therefore Q^2 = \frac{b^3 \times y_c^3 \times 9.81}{b}$$

$$\therefore y_c^3 = \frac{Q^2}{b^2 \times 9.81}$$

$$\therefore y_c = \left( \frac{Q^2}{b^2 \times 9.81} \right)^{\frac{1}{3}}$$

$$\therefore y_c = \left( \frac{(2.83)^2}{(3)^2 \times 9.81} \right)^{\frac{1}{3}} = 0.45 \text{ m}$$

$$1.52 = b$$

$$Z = 1.0$$

$$y_c \quad (y_n)$$

$$b = 1.52 \text{ m} , \quad Z = 1 , \quad S = 0.0004 , \quad Q = 2.83 \text{ m}^3/\text{s} , \quad C = 57$$

$$\therefore Q = C \cdot S^{\frac{1}{2}} \cdot R_h^{\frac{1}{2}} \cdot A$$

$$\therefore R_h^{\frac{1}{2}} \cdot A = \frac{Q}{S^{0.5} \cdot C} = \frac{2.83}{(0.0004)^{0.5} \times 57} = \frac{2.83}{0.02 \times 57} = 2.4825$$

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assume y (m)	1	1.3	1.2	1.15
$A = (1.52 + ly)y$	2.52	3.666	3.264	3.0705
$P = 1.52 + 2y\sqrt{1^2 + 1}$ $P = 1.52 + 2.828y$	4.348	5.196	4.9136	4.772
$R_h = A/P$	0.58	0.705	0.66	0.64
$A \cdot R_h^{0.5}$	1.918	3.08	2.66	2.46
Test = 2.4825	No	no	no	ok

$$\therefore y_n = 1.15 \text{ m}$$

$$\therefore T = b + 2yZ$$

$$\therefore T = 1.52 + 2 \times 1.0 \times 1.15 = 3.82 \text{ m}$$

$$\therefore y_h = \frac{A}{T} \quad \therefore y_h = \frac{3.0705}{3.82} = 0.804 \text{ m}$$

$$\therefore F_e = \frac{Q}{A\sqrt{g \cdot y_h}} \quad \therefore F_e = \frac{2.83}{3.0705\sqrt{9.81 \times 0.804}} = 0.328$$

$$\therefore F_e < 1 \quad \Rightarrow$$

**at  $F_e = 1$ :**

$y_c$

$$\therefore 1 = \frac{Q}{A\sqrt{9.81 \times y_h}}$$

$$\therefore Q^2 = A^2 \times 9.81 \times \frac{A}{T}$$

$$\therefore Q^2 = \frac{A^3 \times 9.81}{T}$$

$$\therefore \frac{A^3}{T} = \frac{Q^2}{9.81} = \frac{(2.83)^2}{9.81} = 0.816$$

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assume y (m)	0.7	0.5	0.6	0.61
$A = (1.52 + ly)y$	1.554	1.01	1.272	1.299
$T = 1.52 + 2y$	2.92	2.52	2.72	2.74
$A^3 / T$	1.29	0.409	0.76	0.80
Test = 0.816	no	no	no	ok

$$\therefore y_c = 0.61 \text{ m}$$

/ 30

/ 17.0

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$n = 0.02$

$b = 5 y$

$Q = 2.83 \text{ m}^3/\text{s}$  ,  $S = 30 \text{ cm/km}$  ,  $n = 0.02$

**A:  $b = 4 y$**

$$\therefore Q = \frac{1}{n} \cdot S^{\frac{1}{2}} \cdot R_h^{\frac{2}{3}} \cdot A$$

$$\therefore Z_n = R_h^{\frac{2}{3}} \cdot A = \frac{Q \cdot n}{S^{0.5}} = \frac{17 \times 0.02}{(30 \times 10^{-5})^{0.5}} = 19.63$$

$$\therefore A = b \cdot y = 4y \times y = 4y^2$$

$$\therefore P = b + 2y = 4y + 2y = 6y$$

$$\therefore R_h = \frac{A}{P} = \frac{4y^2}{6y} = 0.666y$$

$$\therefore R_h^{\frac{2}{3}} \cdot A = 19.63$$

$$\therefore (0.666y)^{\frac{2}{3}} \times 4y^2 = 19.63$$

$$\therefore y^{\frac{8}{3}} = 6.43$$

$$\therefore y = (6.43)^{\frac{3}{8}} = 2 \text{ m}$$

$$\therefore b = 4y = 4 \times 2 = 8 \text{ m}$$

**B:**

$$\rightarrow R_h = 0.5 y$$

$$\therefore R_h = \frac{A}{P} = \frac{by}{b+2y}$$

$$\therefore \frac{by}{b+2y} = 0.5 y$$

$$\therefore \frac{b}{b+2y} = 0.5$$

$$\therefore y = 0.5 b$$

$$\therefore b = 2 y$$

$$\therefore A = by = 2y \times y = 2y^2$$

$$\therefore R_h^{\frac{2}{3}} \cdot A = 19.63$$

$$\therefore (0.5y)^{\frac{2}{3}} \times 2y^2 = 19.63$$

$$\therefore y^{\frac{8}{3}} = 15.58$$

$$\therefore y = (15.58)^{\frac{3}{8}} = 2.8 \text{ m}$$

$$\therefore b = 2y = 2 \times 2.8 = 5.6 \text{ m}$$