KATIHAR ENGINEERING COLLEGE, KATIHAR
(DEPARTMENT OF CIVIL ENGINEERING)

Subject : Hydraulics & OCF
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Class Test-02 Solution
B. Tech 4th Semester

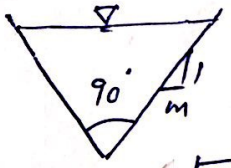
Q-1 (0.446 m)

$$\text{Energy Loss } (E_L) = \frac{(y_2 - y_1)^3}{4 y_1 y_2} = \frac{(1.4 - 0.4)^3}{4 \times 1.4 \times 0.4}$$

$$= 0.446 \text{ m}$$

Q-2 ($0.11 \text{ m}^3/\text{s}$)

$$y_c = \left(\frac{2Q^2}{g m^2}\right)^{1/5}$$



$m = 1$

$$y_c^5 = \frac{2Q^2}{g m^2}$$

$$Q^2 = \frac{y_c^5 \cdot g \cdot m^2}{2}$$

$$Q = \left(\frac{y_c^5 \cdot g m^2}{2}\right)^{1/2} = \left(\frac{0.30^5 \cdot 9.81 \times 1^2}{2}\right)^{1/2}$$

$$Q = 0.109 \text{ m}^3/\text{s}$$

Q-3 ($4.34 \text{ m}^3/\text{s}$)

$B = 4$ m

$y_1 = 0.2$ m, $y_2 = 1.0$ m

$$y_1 y_2 \left(\frac{y_1 + y_2}{2}\right) = \frac{q^2}{g}$$

$$0.2 \times 1 \left(\frac{1.2}{2}\right) \times 9.81 = q^2$$

$$q = \sqrt{0.6 \times 0.2 \times 9.81} = 1.084 \text{ m}^3/\text{s/m}$$

P.T.O

$$Q = q \times B = 4 \times 1.084 = 4.336 \ m^3/s$$

Q-4 (b) (7.63)

$$\frac{y_2}{y_1} = 10.30$$

$$\frac{y_2}{y_1} = \frac{1}{2}\left[-1 + \sqrt{1+8F_1^2}\right]$$

$$10.30 \times 2 + 1 = \sqrt{1+8F_1^2}$$

$$\sqrt{1+8F_1^2} = 21.6$$

$$1+8F_1^2 = 466.56$$

$$F_1 = \sqrt{\frac{465.56}{8}} = 7.63$$

Q-5 (d)

$$q = 8 \ m^3/s/m$$

$$S_0 = 0.004$$

$$n = 0.015$$

$$y_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{64}{9.81}\right)^{1/3} = 1.87 \ m$$

A/c to Manning's Eqn

$$Q = \frac{1}{n} A R^{2/3} S_0^{1/2}$$

For very wide rectangular channel $R \simeq y$

$$q = \frac{1}{n} y_0 \cdot y_0^{2/3} S_0^{1/2}$$

$$q = \frac{1}{n} y_0^{5/3} S_0^{1/2}$$

$$8 = \frac{1}{0.015} \cdot y_0^{5/2} \times \sqrt{0.004}$$

$$y_0 = 1.29 \ m$$

$$y = 1 \ m$$

$y_c > y_0 > y$ (S_3)

Q-6 (d)

$$\frac{dy}{dx} = \frac{S_0 - S_f}{1 - Fr^2}$$

$$= \frac{1.2 - 1.05}{1 - (0.8)^2} \times 10^{-3}$$

$$= \frac{1.2 - 1.05}{1 - 0.64} \times 10^{-3}$$

Q-7 ($3\ m^3/s$)

$S_0 = \frac{1}{800}$

$B = 2m$, $y = 1$

$C = 60$

$Q = A C \sqrt{R S_0}$

$A = 2 \times 1 = 2\ m^2$

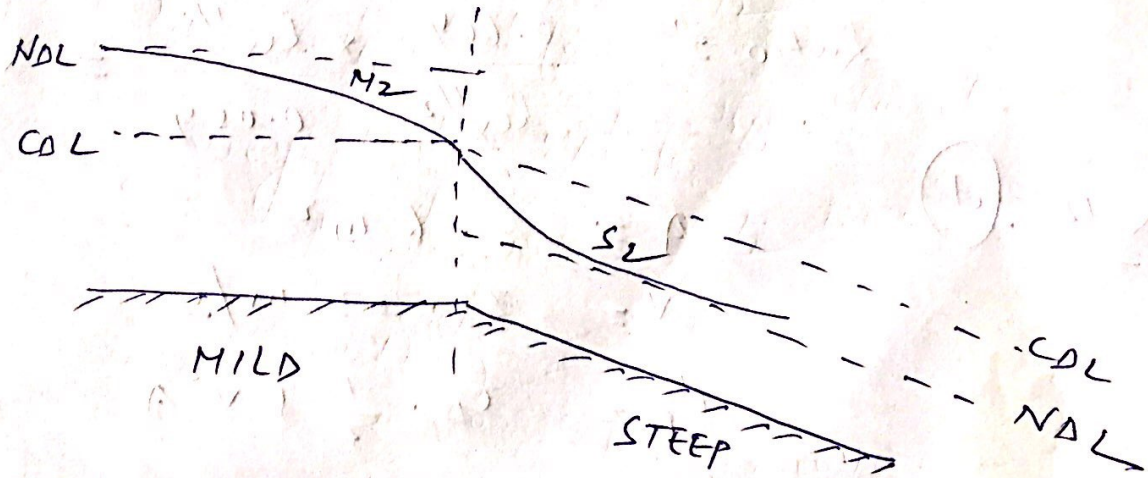
$R = A/P$

$P = B + 2y = 2 + 2 \times 1 = 4\ m$

$R = A/P = \frac{2}{4} = \frac{1}{2} = 0.50\ m$

$Q = 2 \times 60 \times \sqrt{0.50 \times \frac{1}{800}} = 3\ m^3/s$

Q-8 (d)

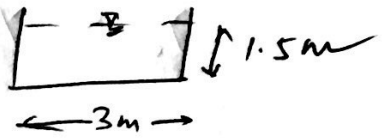


$M_2 - S_2$

Q-9 (d)

$\tau_0 = \gamma_w R S_0$

$$R = \frac{A}{P} = \frac{3 \times 1.5}{6}$$



$$R = 0.75 \text{ m}$$

$$\tau_w = \gamma_w R S_0$$

$$= 9.81 \times 10^3 \times 0.75 \times 0.0002$$

$$= 1.5 \text{ N/m}^2$$

Q-10 (2.25 m) $y_c = 1.5$ m

$$E_c = \frac{3}{2} y_c = \frac{3}{2} \times 1.5$$

$$= 2.25 \text{ m}$$

Q-11 (d)

In Laminal flow $C_f = \dfrac{0.664}{Re_x^{1/2}}$

In turbulent flow $C_f = \dfrac{0.059}{Re_x^{1/5}}$

$$\text{Ratio} = \frac{0.664}{Re_x^{1/2}} \times \frac{Re_x^{1/5}}{0.059} = K \cdot Re_x^{-0.30}$$

Q-12 (d)

$$A = 2.6 \text{ m}^2$$

$$V = 33.33 \text{ m/s}$$

$$F_D = C_D \cdot \frac{1}{2} \rho V^2 A$$

$$= 0.30 \times \frac{1}{2} \times 1.2 \times 33.33^2 \times 2.6$$

$$= 520 \text{ N}$$

Q-13 ©

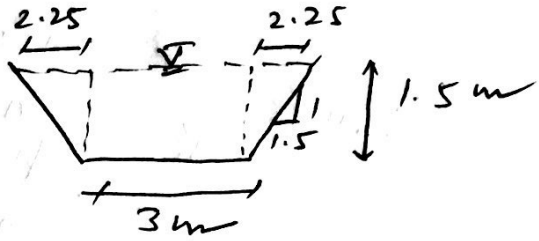
$Q = 1\ m^3/s$, $B = 1\ m$

$y_0 = 0.20\ m$

$$y_c = \left(\frac{q^2}{g}\right)^{1/3} = \left(\frac{1}{9.81}\right)^{1/3} = 0.47\ m$$

$y_c > y_0$ (steep)

Q-14 (0.32)



$Q = 8\ m^3/s$

$y_0 = 1.5\ m$

Top width (T) $= 3 + 2 \times 2.25 = 7.5\ m$

Area (A) $= \frac{1}{2} \times (3 + 7.5) \times 1.5$

$= 7.875\ m^2$

Hydraulic Depth (D) $= \frac{A}{T} = \frac{7.875}{7.5}$

$= 1.05\ m$

$$Fr = \frac{V}{\sqrt{gD}} = \frac{Q}{A\sqrt{gD}} = \frac{8}{7.875\sqrt{9.81 \times 1.05}}$$

$= 0.32$

Q-15 ©

Horizontal Slope → H_2, H_3

Adverse Slope → A_2, A_3

Critical Slope → C_1, C_3

} Exist

<END OF THE SOLUTION>