ASSIGNMENT

Name : Sheraz-uddin

ID NO : 7695

Subject : Hydraulic Structure

Section : B

Submitted TO : Engr. Adeed

PROBLEM :-

Ans :- A Stage discharge relationship for a Concrete rectangular Box culvert :-

* GIVEN DATA :-

Width = 1.3 m

Height = 0.9 m

length = 24 m

Slope = 1 : 1000

mannings ; n = 0.013

Square edged entrance ; k_e = 0.5

Range = 0 - 3 m

Solution:-

$$H/D \leq 1.3m$$

$$H < 0.9m$$

Discharge is given by;

$$Q = 2.92\, y_0 \left[1.2\, y_0 / 1.2 + 2y_0\right]^{2/3} \quad \text{— (A)}$$

Y_0(m)	Q ($m^3 s^{-1}$)	Y_c (m)
0.3	0.299	0.175
0.6	0.785	0.333
0.9	1.330	0.474

* By putting values of "Y_0" we will get the corresponding discharge-

$$\rightarrow \quad Q_1 = 2.92\,(0.3)\left[1.2(0.3)/1.2+2(0.3)\right]^{2/3}$$

$$\boxed{Q_1 = 0.299\ m^3/s}$$

$\Rightarrow$

→ $Q_2 = 2.92(0.6)\left[1.2(0.6)/1.2+2(0.6)\right]^{2/3}$

$$\boxed{Q_2 = 0.785 \text{ m}^3/\text{s}}$$

→ $Q_3 = 2.92(0.9)\left[1.2(0.9)/1.2+2(0.9)\right]^{2/3}$

$$\boxed{Q_3 = 1.330 \text{ m}^3/\text{s}}$$

* CRITICAL DEPTH:-

$$y_c = (q^2/g)^{1/3} \quad \text{— (A)}$$

$$q = Q/B \quad \text{— (B)}$$

By putting values in eq (B)

→ $q_1 = \frac{Q_1}{B} = \frac{0.299}{1.3} = \boxed{0.23}$

→ $q_2 = \frac{Q_2}{B} = \frac{0.785}{1.3} = \boxed{0.603}$

→ $q_3 = \frac{Q_3}{B} = \frac{1.330}{1.3} = \boxed{1.023}$

Now putting values in eq (A)

$$\rightarrow Y_{c_1} = \left(\frac{q_{V_1}^2}{g}\right)^{1/3} = \left(\frac{(0.23)^2}{9.81}\right)^{1/3} = 0.175\,m$$

$$\rightarrow Y_{c_2} = \left(\frac{q_{V_2}^2}{g}\right)^{1/3} = \left(\frac{(0.603)^2}{9.81}\right)^{1/3} = 0.333\,m$$

$$\rightarrow Y_{c_3} = \left(\frac{q_{V_3}^2}{g}\right)^{1/3} = \left(\frac{(1.023)^2}{9.81}\right)^{1/3} = 0.474\,m$$

* At the Inlet over a short reach;

$$H = y_o + \frac{V^2}{2g} + Ke.\frac{V^2}{2g}$$

$$\rightarrow V_1 = 1.142\ m/s$$

So,

$$\rightarrow H_1 = y_o + \frac{V^2}{2g} + ke.\frac{V^2}{2g}$$

$$H_1 = 0.3 + \frac{(1.142)^2}{2(9.81)} + 0.5\left(\frac{(1.142)^2}{2(9.81)}\right)$$

$$H_1 = 0.399\,m$$

$\Rightarrow$

$$\rightarrow H_2 = 0.6 + \frac{(1.142)^2}{2(9.81)} + 0.5\frac{(1.142)^2}{2(9.81)}$$

$$\boxed{H_2 = 0.699m}$$

$$\rightarrow H_3 = 0.9 + \frac{(1.142)^2}{2(9.81)} + 0.5\frac{(1.142)^2}{2(9.81)}$$

$$\boxed{H_3 = 0.999m}$$

y_o (m)	H (m)	Q ($m^3 s^{-1}$)
0.3	0.399	0.299
0.6	0.699	0.785
0.9	0.999	1.330
orifice > 0.9 "1.2D"	1.08 →	1.477

By interpolation.

"2": $H/D \geq 1.3$

"a": for orifice flow;

$$Q = C_d\,(1.3 \times 0.9)\left[2g\left(H - D/2\right)\right]^{1/2}$$

$$Q = 0.62\,(1.3 \times 0.9)\left[2(9.81)\left(1.08 - \frac{0.9}{2}\right)\right]^{1/2}$$

$Q =$ [redacted] 2.591 m^3/s

→ The following result are obtained;

H (m)	Q ($m^3 s^{-1}$)	y_o (m)
1.08	2.591	> 0.9

→ no orifice flow exists

Scanned with CamScanner

"b": For pipe flow the energy equation gives;

$$H + S_o L = D + h_L$$

Where;

$$h_L = K_e \frac{V^2}{2g} + (Vn)^2 \frac{L}{R^{4/3}} + \frac{V^2}{2g}$$

Thus;

$$Q = 2.08 (H - 0.57)^{1/2}$$

→ During rising stages the barrel flows full from H = 1.08m and during falling stages the flow becomes free-surface flow when H = 0.999m.

→ The following table summarizes the results;

H(m)	Q ($m^3 s^{-1}$)	Type of flow
* RISING STAGES;		
0.399	0.299	open channel
0.699	0.785	open channel
0.999	1.330	open channell
1.080	1.477	pipe flow
2.00	2.487	pipe flow
3.00	3.242	pipe flow
* Falling stages;		
2.00	2.487	~~open channel~~ pipe flow
1.080	1.477	pipe flow
0.999	1.330	pipe flow
0.699	0.785	open channel
0.399	0.299	open channel

Part (B)

:~ Types of loads :- ON BRIDGE

→ Dead loads.

→ Live loads.

→ Environmental loads.

* **Dead loads:-** Include the weight of the bridge itself plus other parmanent object affixed to the bridge, such as toll booths, highway signs, guardrails, gates or a concrete road surface.

* **Live loads:-** Live loads are temporary loads that act on a bridge, such as cars, trucks, trains or pedestrians.

* **Environmental loads :-** are temporary loads that act on a bridge and that are due to weather or other environmental influences, such as wind from hurricans, tornadoes or high gusts, snow and earthquakes. Rain water collecting might also be a factor if proper drainage is not provided.

* Mechanism of scour:-

At the obstruction in form of pier or abutment, The unidirectional flow changes into three dimensional as the water pileup infront face of the obstruction & the flow accelerates around the nose. This phenomenon results in formation of vortex at the base of the pier known as horse shoe vortex and the vortex form in the vertical direction downstream of the pier known as vortex.

→ The pileup of water due to obstruction because of decceleration of flow due to stagnation pressure of water causes a downward flow results in horseshoe vortex. The vertical component of the downward flow causes erosion around the base of the pier.

→ Due to rolling of unstable shear layers at the surface of the pier wake vortex are generated at the separation line and moves forward with flow downstream of the pier.

→ In pratical case the river bed is generally composed of mixture of different sizes of material. Due to washing out of finer materials an armor layer is formed of coarser materials which protect the underlying finer practicles from further scour. Due to presence of armor layer the clear water regime can be extended as the value of critical velocity increases.