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SECTION	"C"
ASSIGNMENT	Sessional Assignment. 1
SEMESTER	8th
SUBJECT	HYDRAULIC STRUCTURE
SUBMITTED TO	ENGR. ADDED KHAN

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QUESTION :-

Establish the stage (head water level) - discharge relationship for a concrete rectangular box culvert using the following data:

width = 1·2 m

Height = 0·6 m

Length = 30 m

slope = 1 in 1000

Manning's n = 0·013

Square-edged entrance condition

Free jet outlet flow

Range of head water level for investigation = 0-3m

Neglect the velocity of approach.

SOLUTION :

(1) $H/D \leq 1.2$. For $H < 0.6m$, free flow open-channel conditions prevail.

Reffering to fig 10.6 and assuming that the steep slope entry gives entrance control i.e. the depth at the intel is critical, ~~For H = 0.2 m~~

For H = 0·2m

ignoring entry loss $y_c = (2/3) \times 0.2$

$= 0.133m$

and $V_c = 1.142 ms^{-1}$.

This gives the critical slope $(V/n) = 0.00424$.

There fore the slope of culvert is mild and hence subcritical flow analysis gives

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the following results:

$$Q = 1.2 y_0 \left[1.2 y_0 / (1.2 + 2 y_0)\right]^{2/3} (0.001^{1/2} / 0.013)$$

$$= 2.92 y_0 \left[1.2 y_0 / (1.2 + 2 y_0)\right]^{2/3}$$

y_0 (m)	Q ($m^3 s^{-1}$) (equation (i))	y_c (m)
0.2	0.165	0.124
0.4	0.451	0.243
0.6 (=D)	0.785	0.352

At the inlet over a short reach

$$H = y_0 + V^2/2g + KV^2/2g$$

Cross-Drainage And Drop Structure

The entrance loss coefficient, K_e is a follows

for a square-edged entry 0.5

for a flared entry 0.25

for a rounded 0.05

y_0 (m)	H (m) (equation ii)	Q ($m^3 s^{-1}$)
0.2	0.236	0.165
0.4	0.467	0.451
0.6	0.691	0.785
orifice ← >0.6 (1.2D)	0.72 →	0.817 (by interpolation)

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(2) $H/D \geq 1.2$

(a) For orifice flow

$$Q = C_d (1.2 \times 0.6) [2g (H - D/2)]^{1/2}$$

with $C_d = 0.62$ the following results are obtained.

H (m)	Q ($m^3 s^{-1}$)	y_o (m) equation i
0.72	1.29	> 0.6 → no orifice flow exists

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

Where,

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

Thus,

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

	H (m)	Q ($m^3 s^{-1}$) equation iv
$y_o = 0.6$ (equation i) ←	0.691	0.723
	0.72	0.805
	1.00	1.364
	2.00	2.487
	3.00	3.242

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During rising stages the barrel flows full from H = 0.72 and During falling stages the flow becomes free - surface flow when H = 0.691 m.

The following table summarizes results.

H (m)	Q ($m^3 s^{-1}$)	Type of flow
Rising stages		
0.236	0.163	Open channel
0.467	0.451	open channel
0.691	0.785	open channel
0.720	0.803	pipe flow
1.00	1.364	pipe flow
2.00	2.487	pipe flow
3.00	3.242	pipe flow
Faling stages		
2.00	2.487	pipe flow
1.00	1.364	pipe flow
0.72	0.803	pipe flow
0.691	0.723	pipe flow
0.691	0.[illegible]5	open channel
0.467	0.451	open channel
0.236	0.165	open channel

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BRIDGE SCOUR :-

BRIDGE SCOUR is the removal of sediment such as sand and rocks from around bridge abutments or piers. Scour by swiftly moving water can scoop out scour holes, compromising the integrity of a structure

Effect Of Scour :

→ Lowering the river bed level around pier.
→ Destablize the foundation (pier)

Mechanisms :- of Scour.

⇒ DEVELOPMENT OF SCOUR :-

Vortex system formed in front of the obstruction, and has the form of horseshoe. River flow and the energy of the vortex increased shear stress commence local sediment transport

⇒ LOCAL SCOUR AT PIERS :-

Occurs due to the acceleration of flow around the pier the formation of flow vortices.

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PROCTECTION :-

GRAVEL BAGS :-

Put around pier use for filter function to reduce flow but disadvantages handling cost and potiential damage to bags during installation and after a time loose rock due to flow.