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Sect B

Subject Hydraulic Structure

Ans:

Stage discharge relationship for a concrete rectangular Box Culverts.

Given Data:

width = 1.4m

Height = 0.9m

Length = 26m

Slope = 1:1000

mannings; η = 0.013

spare edged entrance; ke = 0.5

Range = 0 - 3 m

Solution:

H/D ≤ 1.4m

H ≤ 0.9m

Discharge is given by;

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

Yo(m)	Q ($m^3 s^{-1}$)	yc (m)
0.3	0.299	0.166
0.6	0.785	0.317
0.9	1.330	0.451

By putting values of "yo" we will get the corresponding discharge.

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

$$= 0.299\ m^3/s$$

$$Q_2 = 2.92(0.6)\left[1.2(0.6)/1.2+2(0.6)\right]$$

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

$$= 1.330\ m^3/s$$

Critical depth

$$y_c = (V^2/g)^{1/3} \quad \text{---- "A"}$$

$$v = Q/B \quad \text{---- "B"}$$

By putting values in eq "B"

$$v_1 = Q_1/B = \frac{0.798}{1.4} = 0.213$$

$$v_2 = Q_2/B = \frac{0.785}{1.4} = 0.561$$

$$v_3 = Q_3/B = \frac{1.330}{1.4} = 0.95$$

Now by putting values in eq "A"

$$y_{c1} = (v_1^2/g)^{1/3} = \left(\frac{0.213^2}{9.81}\right)^{1/3} = 0.166 \text{ m}$$

$$y_{c2} = (v_2^2/g)^{1/3} = \left(\frac{0.561}{9.81}\right)^{1/3} = 0.317 \text{ m}$$

$$y_{c3} = (q_3^2/g)^{1/3} = \left(\frac{0.95^2}{9.81}\right)^{1/3} = 0.451$$

At the inlet over a short reach,

$$H = y_0 + \frac{v^2}{2g} + ke \cdot \frac{v^2}{2g}$$

$$v_1 = 1.142 \text{ m/s}$$

So, $$H_1 = y_{01} + \frac{v^2}{2g} + ke \cdot \frac{v^2}{2g}$$

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

$$= \boxed{0.399 \text{ m}}$$

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

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

Y_0 (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 "1.2 D"	1.08	1.477 By interpolation

2" $H/D \geq 1.4$

"Q" For orifice flows

$$Q = Cd\,(1.4 \times 0.9)\left[2g\left(H - D/2\right)\right]^{1/2}$$

$$Q = 0.62\,(1.4 \times 0.9)\left[2(9.81)\left(1.08 - \frac{0.9}{2}\right)\right]^{1/2}$$

$$\boxed{Q = 2.746\ m^3/s}$$

"The following table Summarizes the result";

H (m)	Q (m^3/s)	Type of flow
Rissing	Stage	
0.399	0.299	open channel
0.699	0.785	open channel
0.999	1.330	open channel
1.080	1.477	pipe flow
2.000	2.487	pipe flow
3.000	3.242	pipe flow
Falling stage		
2.000	2.487	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.

=urk

Ans: 02

"Loads of Bridge foundation due to scour;"

=> The erosion caused by flowing water resulting in removal of earth, sand, or silt from the foundation of the bridge in river is known as scour.

=> Scour is the most concerned issue for safe design and maintenance of hydraulic structure Scour is one of the leading cause of Bridge failure causing a huge amount of economical and social loss.

=> The scour removes the bed material around the foundation of the bridge resulting in exposure of

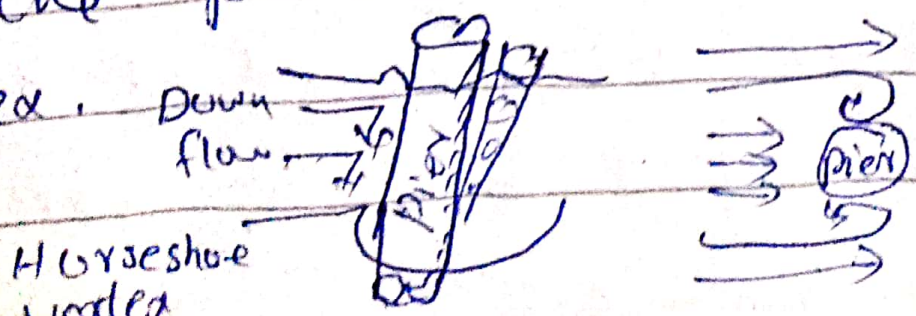
foundation and endanger the stability of the bridge. The scour is responsible for about 60% of bridge failures resulting in loss of lives and huge amount of economic loss.

⇒ Scour exposes the bridge foundations and thus greatly effect and reduces the buckling capacity (resistance) of piles as well as reduces the lateral capacity of piers. Additionally, Bridge Subjected to scour become more vulnerable during floods Period.

Working mechanism of scour:

- At the obstruction in form of abutment or pier the undirectional flow change into three dimensional and the flow accelerates around the nose as the water pileup in front face of the observation

=> This phenomenon results in formation of vortix at the base of the pier which is called horseshoe vortex while the vortix formed in the vertical direction downstream of the pier is called wake vortex.



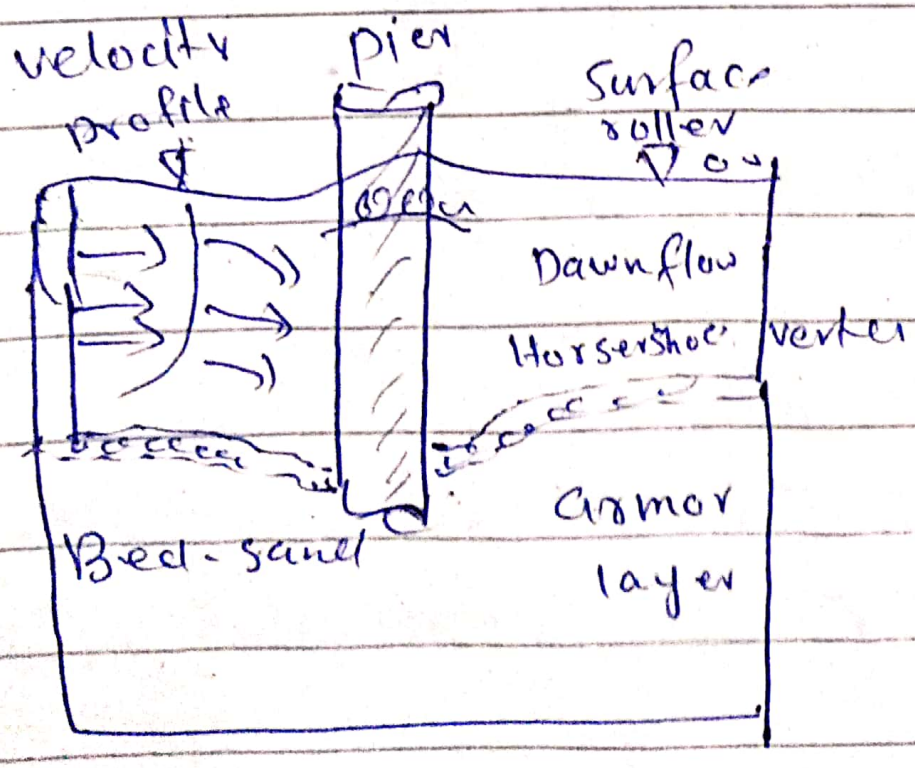
→ The pilvep of water due to observation due to deceleration of flow due to stagnation pressure of water result a downward flow which result to horseshoe vortex. Thus the vertical Component of the downward flow cause erosion around the bed of the pier

=> In the practical case the rivers bed is generally composed of mixture of various size of different materials. Due to washing out of mixture of various size of finer material an armor layer is formed of cause material which protects

from further scouring the underlying finer particle

Due to armour layer the clear water regime can be extended as the value increases of critical velocity.

Armor layer:



End.