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* Subject :-
Hydraulic Structures

* Section :-
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Q:- No.1 : Part "a"

* **Differentiate between Culvert and causeway:-**

* Culvert is a structure that can allows water to flow under a road, railroad, trail, or similar obstruction from one side to other side. Typically embedded so as to be sorrunded by soil, a culvert may be made from a pipe, reinforced concrete or other material.

* Causeway may defined by following definition
  * A road way on a raised bed of earth, rubble or other fill, usually open water or wetland.
  * Long bridge consisting of many short spans

* The main difference is causeway is a road that is raised as to above water. While a Culvert is a tranverse channel under a road or railway for draining of water.

Q1 Part - b :-

* Cross drainage work :-

A cross drainage work is a structure carrying discharge from a natural stream across a canal intercepting the stream. Canal comes across obstructions like rivers, natural drains and other canals. The various types of structures that are built to carry canal water across the above mentioned obstruction called cross drainge works.

* Necessity of cross Drainage work :-

* Watershed canals donot cross natural drainage But in actual orientation of canal network this ideal condition may not be available and the obstricule like natural drainage may be present across canal so cross work must provided.

* At the crossing the water of the canal and the drainage get intermixed so for smooth running of the canal with its design discharge the cross drain works are required.

* Cross drainge work must be provided to maintain their natural direction.

* Types of cross drainage works:-

* Type 1 (Irrigation channel passed over drainge)

(a) **Aqueduct**

The hydraulic structure in which the irrigation canal is taken over the drainage is known as aqueduct. This structure is suitable when bed level of canal is above highest flood level of drainage.

(b) **Siphon Aqueduct:-**

In a hydraulic structure where canal is taken over drainage but drainage water cannot pass clearly below the canal it flows under siphonic actions. So it is know as siphon aquadact.

* Type II (Drainge Passes over irrigation canals)

* **Super Passage:-**

The hydraulic structurce in which drainage is taken over irrigation canal as know as super passage.

* **Siphon super-passage:-**

The hydraulic structures in which the drain is takenover the irrigation canal but canal water passes below the drainage under siphonic actions

* Type III "Drainage and canal intersect each other at Same level"

(a) Level Crossings:-

When the bed level of canal and Streams are approximately the Same and quality of water in canal and drainage not much differents the cross drainage work is constructed called level crossings.

(b) Inlet and outlet:-

When irrigation canal meets a small stream or drain at same level. A drain is allowed to enter the canal as in inlet. At Some distance from this inlet point a part of water is allowed to drain as an outlet which eventually meets the orignal Streams.

Q:2:- Part "A"

* **Difference between weir and barrage:-**

* A weir is an impervious barrier constructed across a river to raise the water level on the upstream side. The water is raised upto required height and then the water flows over the weir. in weir the water overflows the weir.

* A barrage is a weir that has adjustable gates installed overtop of it. to allow different water surface heights at different times. The water level is adjusted by operating the adjustable gates.

(QNo.2:- Part:-2:-

* Reynolds number:-

The reynold number is the ratio of inertial forces to viscous forces and is a convenient parameter for predicting if a flow condition will be laminar or turbulent

* Limits of Reynolds number:-

$$Re_D = \frac{\rho V D}{\mu}$$

i) for laminar flow: $Re < 2000$

ii) for turbulent flow:- $R > 4000$

iii) for transition flow:- $4000 > R > 2100$.

⊙ Critical velocity:-

The velocity at which flow changes from laminar to turbulent as known Critical velocity.

⊙ Lower Critical velocity:-

The velocity at which the flow enters from laminar to transition period is known as lower Critical velocity.

* **Upper critical velocity :-**

A velocity in which flow enters from transition period to turbulent flow is known as upper critical velocity

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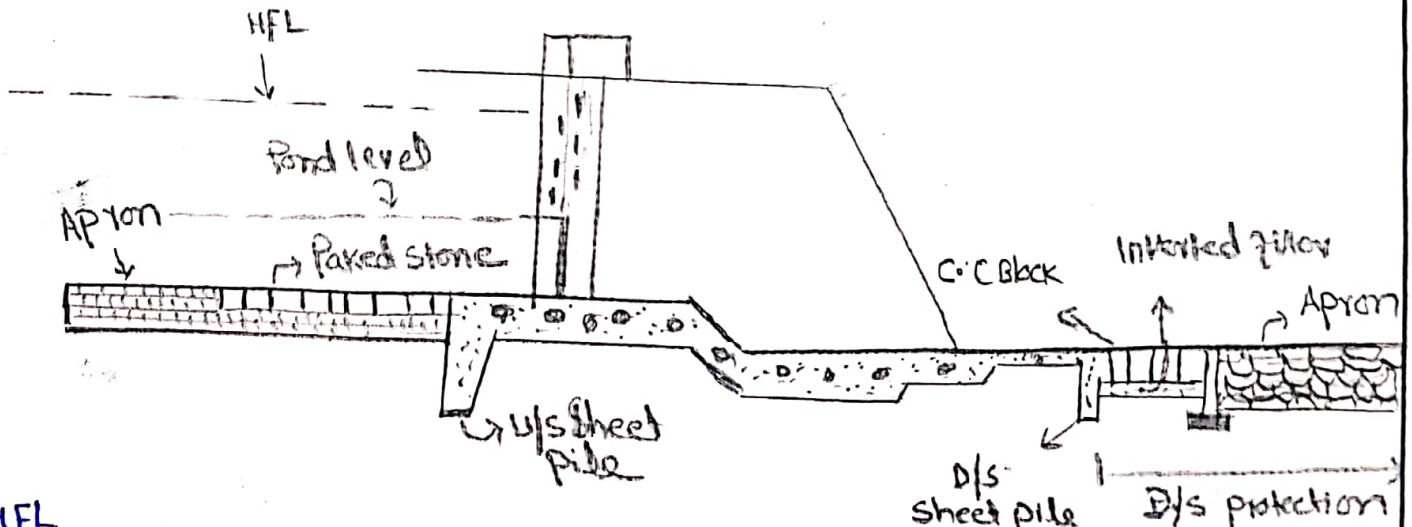
Q 03 - Part "a"

"Barrage and its Components"



- HFL
- Pond level
- Apron
- U/s sheet pile
- C.C block
- Inverted filter
- D/s sheet pile
- Packed stone
- D/s protection

Q3 :- Part "B"

* Maximum or equilibrium Scour depth analyzation:-

* Several formula link or based on experimental results have been proposed to pridict "maximum" or "equilibrium" Scour depth (y_s, below generals level) around bridge piers. The relationships are

$$y_s/b' = \phi\left(y_0/b', Fr, d/b'\right)$$

* where 'b' is the pier width, y_0 is upstream flow depth, d is the sediment size and Fr is the flow froude number

* Laursen's (1962) Experimental results uder estimate the scour depth, Compare to many indian experiments. which Suggest the formula

$$y_s/b' = 4.2\left(y_0/b'\right)^{0.78} Fr^{0.52}$$

* The indian field data also suggest that scour depth should be taken as twice the regime scour depth. In Case of live loads beds. (A stream bed load transfer) formula

$$y_s/y_0 = (B/b')^{5/7} - 1$$

Predict the maximum equilibrium scour depth.

In a relatively deep flow a first order estimate of (clear) local scour around may be obtained by

$$y_s = 2.3 K_a b'$$

where K_a = angularity coefficient which is a function of the pier alignment

Q NO.4 :-

Given Data:-

Box Culvert = 15 ft x 15 ft

L.L = 1.5 K/ft²

D.L = 300 lb/ft² = 0.3 K/ft²

γ_{soil} = 100 lb/ft³ = 0.1 K/ft³

Angle of response = 30°

fy = 60 ksi

Ratio = 1:2:4 = 156 lb/ft³

Req: DATA :-

Design culvert = ?

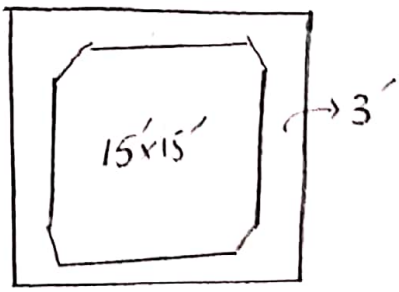
Solution:-

Thickness of slab = 0.92 m = 3 ft

Self wt of slab = thickness x Rcc wt

Self wt = 3' * 156 lb/ft³

= 468 lb/ft²



total load = L.L + D.L + Self wt of slab

= 1500 lb/ft² + 300 + 468

T.L = 2268 lb/ft²

* Coefficient Earth pressure:-

$$\frac{1-\sin\theta}{1+\sin\theta} = \frac{1-\sin 30}{1+\sin 30} = 0.33$$

* Lateral pressure:-

Vertical pressure at top

$(L.L + D.L) \times 0.33$

$= (1500 + 300) + 0.33$

$= 594 \text{ lb/ft}^2$

* Pressure of soil:-

$K_a \times \gamma_{soil} \times h$

$0.33 \times 100 \times (15' + 3')$

$= 594 \text{ lb/ft}^2$

* Pressure at top $= 594 \text{ lb/ft}^2$

at bottom

top + Lateral

$= 594 + 594$

$= 1188 \text{ lb/ft}^2$