

Department of B.E Civil Engineering



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SETION: "C"

SEMESTER: 8th

FINAL TERM PAPER: HYDRAULIC STRUCTURE

• **QUESTION# 01**

a. Differentiate between culvert and causeway.

ANSWER

CULVERT	CAUSEWAY
<p>DEFINITION</p> <p>A culvert is a structure that allows water to flow under a road, railroad, trail, or similar obstruction from one side to the other</p>	<p>DEFINITION</p> <p>A causeway is a track, road or railway on the upper point of an embankment across "a low, or wet place, or piece of water</p>
<p>MATERIAL</p> <p>a culvert may be made from a <u>pipe</u>, <u>reinforced concrete</u> or other material</p>	<p>MATERIAL</p> <p>It can be constructed of earth, <u>masonry</u>, wood, or concrete</p>
<p>Culvert allow water to pass under it only while causeway allow water to pass both under and above it.</p>	<p>Culvert floor is made of asphalt or concrete while causeway floor is made of only concrete</p>

**b. Define cross drainage work. Why it is necessary?
Explain different types of cross drainage work in detail.**

CROSS DRAINAGE WORK

Definition: Cross drainage works is a structure constructed when there is a crossing of canal and natural drain, to prevent the drain water from mixing into canal water. This type of structure is costlier one and needs to be avoided as much as possible.

NECESSITY: it may be necessary for the canal to leave the watershed and flow away from it. It may be necessary for the canal to leave the watershed for a short distance where the watershed takes a sudden small loop and it is not possible to align the canal along the loop. In that case, the canal intercepts the drainages which carry the water of the pocket between the canal and the watershed and hence the cross-drainage works are required

TYPES:

(A)Irrigation canal Passes over the Drainage:

Aqueduct:

The hydraulic structure in which the irrigation canal is taken over the drainage (such as river, stream etc..) is known as aqueduct. This structure is suitable When the bed level of canal is sufficiently above the highest flood level of the drain, an aqueduct is constructed.

Siphon Aqueduct:

- In a hydraulic structure where the canal is taken over the drainage, but the drainage water cannot pass clearly below the canal. It flows under siphonic action. So, it is known as siphon aqueduct. This structure is suitable when the bed level of canal is below the highest flood level.

(B)Drainage Passes Over the irrigation canal:

Super Passage :

- The hydraulic structure in which the drainage is taken over the irrigation canal is known as super passage. The structure is suitable when the bed level of drainage is above the full supply level of the canal. The water of the canal passes clearly below the drainage.

Siphon Super Passage :

- The hydraulic structure in which the drainage is taken over the irrigation canal, but the canal water passes below the drainage under siphonic action is known as siphon super passage. This structure is suitable when the bed level of drainage is below the full supply level of the canal

(C)Drainage and Canal Intersect each other at the same level. Level Crossings :

- When the bed level of canal and the stream are approximately the same and quality of water in canal and stream is not much different, the cross drainage work constructed is called level crossing where water of canal and stream is allowed to mix. With the help of regulators both in canal and stream, water is disposed through canal and stream in required quantity.

• Level crossing consists of following components

- (i) crest wall
- (ii) Stream regulator
- (iii) Canal regulator.

Inlet and Outlet:

- When irrigation canal meets a small stream or drain at same level, drain is allowed to enter the canal as inlet. At some distance from this inlet point, a part of water is allowed to drain as outlet which eventually meets the original stream. Stone pitching is required at the inlet and outlet. The bed and banks between inlet and outlet are also protected by stone pitching. This type of CDW is called Inlet and Outlet.

- **QUESTION# 02**

a. Differentiate between weir and barrage.

ANSWER

WIER

A weir is simply a concrete or masonry structure that is built through an open channel, for instance, a river. In most cases, it is built to control water flow, measure the discharge, prevent flooding and make rivers navigable. It can be built with different materials such as wood, concrete or a mixture of rocks, gravel, and boulders.

BARRAGE

A barrage is a concrete structure that consists of a series of large gates that can be opened or closed to control the amount of water that flows through them. This allows the structure to adjust and stabilize the elevation of the upstream water for irrigation and other systems.

DIFFERENCE BETWEEN WEIR AND BARRAG

WEIR	BARRAGE
Low set crest	High set crest
Ponding is done by means of gates	Ponding is done against the raised crest or partly against crest and partly by shutters
Gated over entire length	Shutters in part length
Gates are of greater height	Shutters are of smaller height, 2 m
Gates are raised clear off the high floods to pass floods	Shutters are dropped to pass floods
Perfect control on river flow	No control of river in low floods Operation of shutters is slow, involve labor and time
Gates convenient to operate	Operation of shutters is slow
High floods can be passed with minimum afflux	Excessive afflux in high floods

b. Define Reynod's number. What will be the limit of reynold's number for laminar, turbulent and neither laminar nor turbulent flow? Also define lower and higher critical velocity.

ANSWER

REYNOLDS NUMBER:

The Reynolds number is the ratio of inertial forces to viscous forces within a fluid which is subjected to relative internal movement due to different fluid velocities.

LAMINAR FLOW

The flow is said to be laminar if the Reynolds no is less 2000

TURBULANT FLOW

Flow is said to be turbulent if Reynolds no is greater than 4000

TRANSITION FLOW

When the Reynolds no is in between 2000 and 2800 the flow will be consider is transition flow

LOWER CRITICAL VELOCITY

The velocity it which the flow changes from laminar to transition is called lower critical velocity.

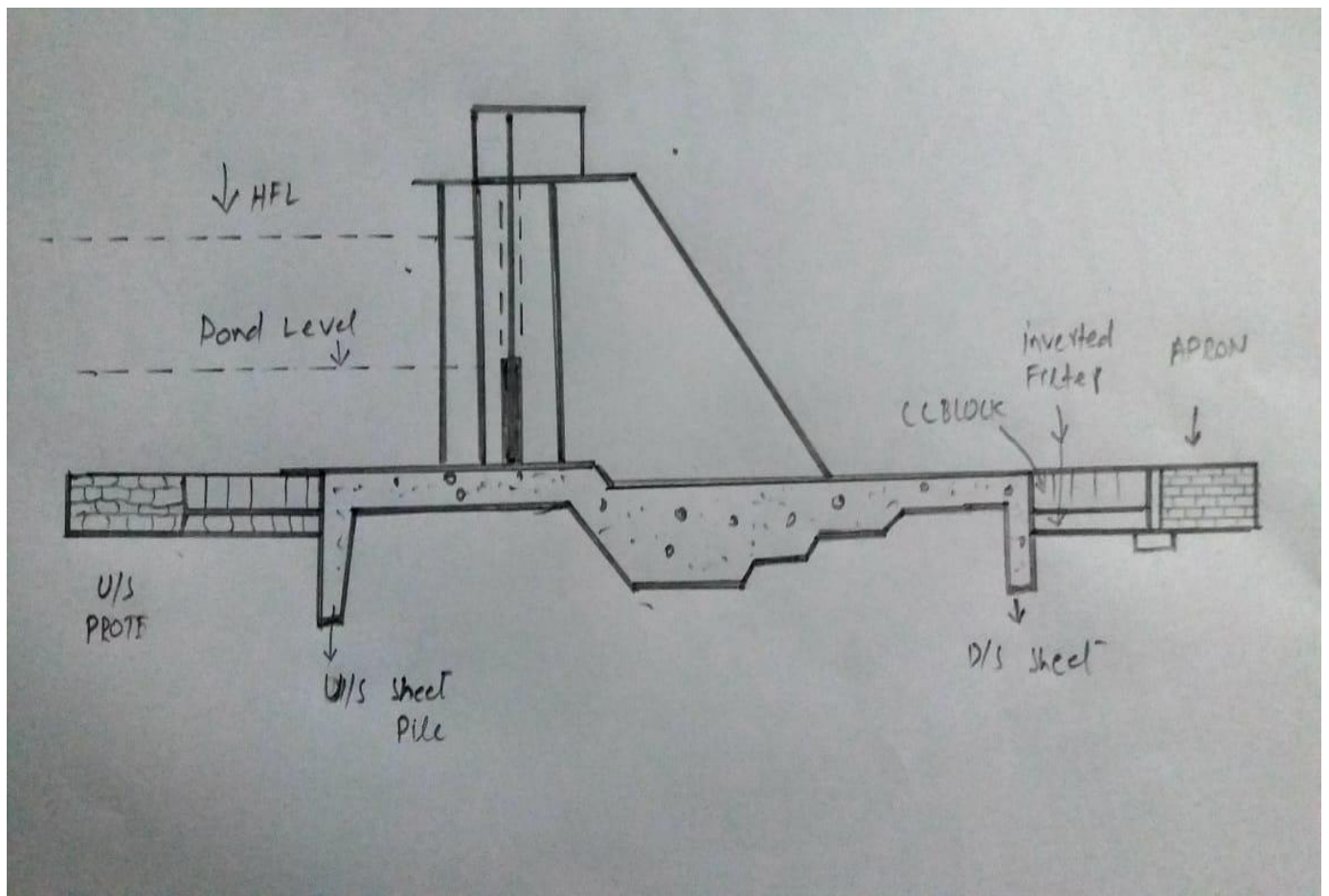
HIGHER CRITICAL VELOCITY

The velocity it which the flow changes from transition to turbulent flow is called higher critical velocity

QUESTION# 03

a. Draw neat sketch of barrage showing its different components.

ANSWER



b. How would you predict/analyze maximum or, equilibrium scour depth based on experimental formulas?

ANSWER

If the contracted width (i.e. the bridge length, L) is less than the regime width, W . The normal scour depth, D_N , under the bridge is given by

$$D_y = R^2(W/L)^{0.61}$$

Where R , is the regime scour depth.

The maximum scour depth in a single-span bridge (no piers) with a straight approach is about 25% more than the normal scour given by equation whereas in the case of a multi plane structure with a curved approach reach it is 100% more than the normal scour. If the constriction is predominant, the maximum scour depth is the maximum of case 1 or case 2, or the value given by

$$D_{max} = R_s(W/L)^{1.56}.$$

QUESTION# 04

A box culvert is to be designed having inside dimensions 15ft.*15ft. The culvert is subjected to L.L of 1.5 kip/ft² and superimposed D.L of 300 lb/ft². Unit weight of soil is 100 lb/ft³. Angle of repose is 30°. Use 1:2:4 concrete and $f_y=60$ ksi steel. Design the box culvert

QUESTION # 04

Given Data :-

$$L.L = 1.5 \text{ kip/ft}^2 \Rightarrow 1500 \text{ lb/ft}^2$$

$$D.L = 300 \text{ lb/ft}^2$$

$$\text{Unit weight of soil} = 100 \text{ lb/ft}^3$$

$$\phi = 30^\circ$$

$$f_y = 60 \text{ ksi steel}$$

$$\text{Inside dimensions} = 15 \text{ ft} \times 15 \text{ ft}$$

Required :-

$$\text{Box culvert} = ?$$

Solution :-

LOAD CALCULATION :-

Total load acting on top slab = self wt of slab + L.L + D.L

$$A \Rightarrow \text{Self wt of slab} = 0.92 \times 15 = 13.8 \text{ KN/m}^2$$

$$13.8 \text{ KN/m}^2 = 0.2882 \text{ kip/ft}^2$$

or 288.2 lb/ft^2

$$\text{Total Load} = 288.2 + 1500 + 300$$
$$= 2088.2 \text{ lb/ft}^2$$

Date: _____

COEFFICIENT OF EARTH PRESSURE :-

$$K_a = \frac{1 - \sin \theta}{1 + \sin \theta} = \frac{1 - \sin 30^\circ}{1 + \sin 30^\circ}$$

$$K_a = 0.333$$

i- Lateral pressure due to (L.L + D.L)

$$\begin{aligned} &= \text{Total vertical load (L.L + D.L)} \times K_a \\ &= (1500 + 300) \times 0.33 \\ &= 599.4 \text{ lb/ft}^2 \end{aligned}$$

ii- Lateral pressure due to soil = $K_a \times h$

$$\begin{aligned} &= 0.333 \times 100 \times 18 \\ &= 599.94 \text{ lb/ft}^2 \end{aligned}$$

iii- Lateral Pressure top = lat press due to (D.L + L.L)

$$= 599.4 \text{ lb/ft}^2$$

Bottom = lat pr due to (D.L + L.L) + lat pre due to soil

$$= 599.4 + 599.94$$

$$= 1199.34 \text{ lb/ft}^2$$

or

$$= 1.199 \text{ kip/ft}^2$$