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Assignment # Final Paper

Semester: 8th

Section : “C”

Subject: Hydraulic structure

Submitted to: Engr. Aded sab

QUESTION NO 1

a. Differentiate between culvert and causeway.

ANSWER:

- ***Culvert:***

Culverts are structures used to convey runoff from one side of the road to another and are usually covered with embankment and composed of structural material around the entire perimeter, although some are supported on spread footings with the streambed serving as the bottom of the culvert. For economy and hydraulic efficiency, culvert should be designed to operate with the inlet submerged during the flood flows, if conditions permit. Cross-drain are those culverts and pipes that are used to convey runoff from one side of highway to another.

- **CAUSEWAY:**

A bridge having its floor flush or little above the stream of water which allow flood water to pass always over its floor

- ✓ **DIFFERENCES:**

I. Calvert allow water to pass under it only while causeway allow water to pass both under and above it.
II. Calvert floor is made of asphalt or concrete while causeway floor is made of only concrete

QUESTION NO 1

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

ANSWER:

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 of Cross Drainage Works :

• The water-shed canals do not cross natural drainage. But in actual orientation of the canal network, this ideal condition may not be available and the obstacles like natural drainages may be present across the canal. So, the cross drainage works must be provided.

• At the crossing point, the water of the canal and the drainage get intermixed. So, for the smooth running of the canal with its design discharge the cross drainage works are required.

• The site condition of the crossing point may be such that without any suitable structure, the water of the canal and drainage can not be diverted to their natural directions. So, the cross drainage works must be provided to maintain their natural direction of flow.

➢ 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 dis posed 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 in 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 NO 2

a. Differentiate between weir and barrage.

ANSWER

- ***WEIR:***

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.

s.no	WEIR		BARRAGE
1)	Low set crest	1)	High set crest
2)	Ponding is done by means of gates	2)	Ponding is done against the raised crest or partly against crest and partly by shutters
3)	Gated over entire length	3)	Shutters in part length
4)	Gates are of greater height	4)	Shutters are of smaller height, 2 m
5)	Gates are raised clear off the high floods to pass floods	5)	Shutters are dropped to pass floods
6)	Perfect control on river flow	6)	No control of river in low floods Operation of shutters is slow, involve labor and time
7)	Gates convenient to operate	7)	Operation of shutters is slow
8)	High floods can be passed with minimum afflux	8)	Excessive afflux in high floods

DIFFERENCE BETWEEN WEIR AND BARRAG:

QUESTION 2

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.

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.

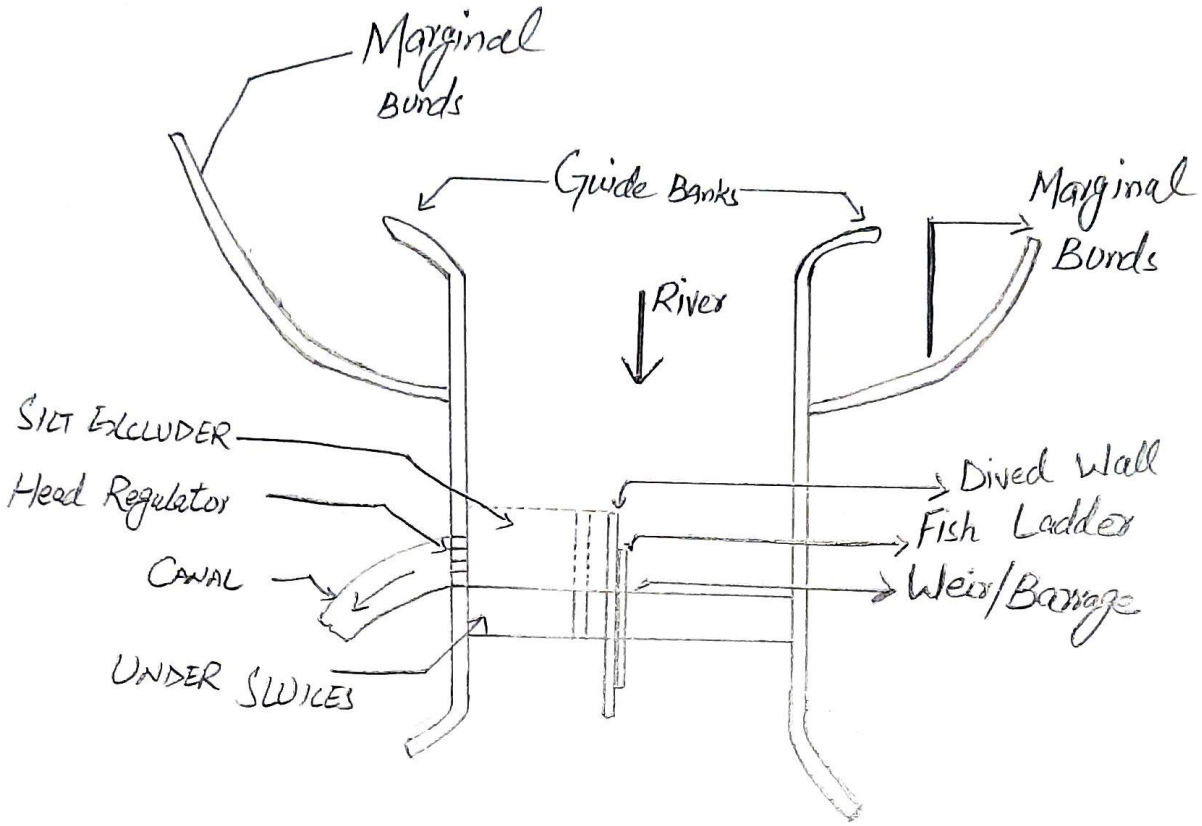
HIGHER CRITICAL VELOCITY:

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

QUESTION NO 3

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

ANSWER



Sketch of Barrage

QUESTION NO 3

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, DN, under the bridge is given by

Dy = R2(W/L)^061

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

Dmax = Rs(W/L)^1.56.

Q No 4:

A box culvert is to be designed having inside dimensions 15ft.*15ft. The culvert is subjected to L.L of 1.5 kip/ft^2 and superimposed D.L of 300 lb/ft^2. Unit weight of soil is 100 lb/ft^3. Angle of repose is 30^0. Use 1:2:4 concrete and fy=60 ksi steel. Design the box culvert.

Question No 4.

Answer.

Given Data:

Live load = 1.5 kip/ft² = 1500 lb/ft²
Dead load = 800 lbf/ft²
ϕ = 30°
Unit wt of soil = 100 lb/ft³
Dimensions = 15 ft x 15 ft
fy = 60 ksi

Required Data:

Design the box culvert.

Solution:-

Load calculation.

T.L = Sf wt of culvert + L.L + D.L

Sf wt of culvert = 0.92 x 15 = 13.8 kN/m²

13.8 kN/m² = 0.28822 kip/ft²

Now

Total load = 288.2 + 1500 + 300

Total load = 2088.2 lb/ft²

Coefficient of earth pressure :-

$$K_a = \frac{1-\sin\delta}{1+\sin\delta} = \frac{1-\sin 30}{1+\sin 30}$$

$K_a = 0.333$

① lateral pressure due to (L.L + D.L)
= Total vertical load (L.L + D.L) × K_a
= (1500 + 300) × 0.333
= 599.4 lb/ft²

② lateral Pressure due to Soil = $K_a \times l_1$
= 0.333 × 102 × 18
= 599.94 lb/ft²

③ lateral pressure @ bp = lat pressure due to (D.L + L.L)
= 599.4 lb/ft²

Bottom = lat P. due to (D.L + L.L) + lat Pre due to soil
= 599.4 + 599.94 = 1199.34 lb/ft² = **1.199 kip/ft²**