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Question no 1

Part A

Q : Differentiate between culvert and causeway.

ANSWER:

CALVERT:

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

A small bridge having total length of 6m or less than it between the faces of abutment. These are permanent drainage structure constructed to carry roadway or railway track over small streamed or canal

CAUSEWAY:

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" It can be constructed of earth, masonry, wood, or concrete. One of the earliest known wooden causeways is the Sweet Track in the Somerset Levels, England , that dates from the Neolithic age. Timber causeways may also be described as both boardwalks and bridges.

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

DIFFERENCES:

1: Calvert allow water to pass under it only while causeway allow water to pass both under and above it.

2: Calvert floor is made of asphalt or concrete while causeway floor is made of only concrete

Question no 1

Part B

Q : 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

Part A

Q : Differentiate between weir and barrage.

Answer :

WEIR

A **weir** or **low head dam** is a barrier across the width of a river that alters the flow characteristics of water and usually results in a change in the height of the river level. They are also used to control of the flow of water for outlets of lakes, ponds, and reservoirs. There are many weir designs, but commonly water flows freely over the top of the weir crest before cascading down to a lower level.

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

Question no 2

Part B

Q : 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 no 3

Part A

Q : Draw neat sketch of barrage showing its different components.

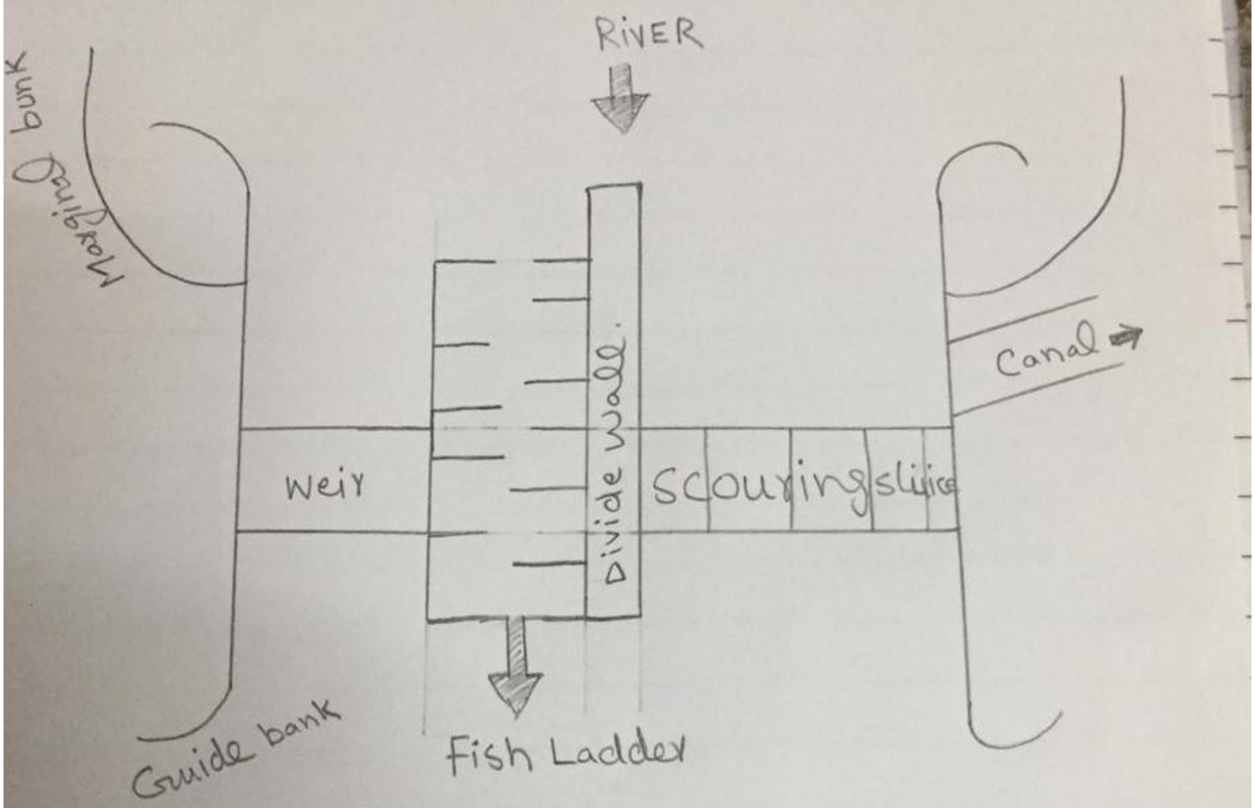

Fig. (Component parts of weir and barrage)

Question no 3

Part B

Q : 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.

Question 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/ft2 and superimposed D.L of 300 lb/ft2. Unit weight of soil is 100 lb/ft3. Angle of repose is 300. Use 1:2:4 concrete and fy=60 ksi steel. Design the box culvert.

Given Data:

Live Load, L.L = 1.5 kip/ft^2 = 1500 lb/ft^2.

D.L = 300 lb/ft^2.

φ = 30°

Unit wt of Soil is = 100 lb/ft^3

Diamensions = 15 ft x 15 ft

f_y = 60 ksi

REQUIRED DATA:

Design the box Culvert.

Solution:

Load Calculation:-

Total Load carry on top slab = Self wt of slab + L.L + D.L.

@ => Self wt of slab = 0.92 x 15 = 13.8 KN/m^2

13.8 KN/m^2 = 0.2882 kip/ft^2 or 288.2 lb/ft^2

Now

Total Load = 288.2 + 1500 + 300

Total Load = 2088.2 lb/ft^2

Co-efficient of Earth Pressure:-

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

$$\boxed{K_a = 0.333}$$

(1) Lateral pressure due to (L·L + D·L)

= Total vertical Load (L·L + D·L) × Ka

= (1500 + 300) × 0.333

= 599.4 lb/ft²

(2) Lateral pressure due to Soil = Ka × h

= 0.333 × 100 × 18

= 599.94 lb/ft²

(3) Lateral pressure @ top = Lat press due to (D·L + L·L)

= 599.4 lb/ft².

Bottom = Lat pressure due to (D·L + L·L) + Lat press due to Soil.

= 599.4 + 599.94

= 1199.34 lb/ft² or $\boxed{1.199 \text{ kip/ft}^2}$