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Q1 (a) Differentiate between culvert and causeway.

Ans Culverts:-

Culvert is a tunnel carrying a stream under a road or railway. A culvert may act as a bridge ~~for~~ for traffic to pass on it. They are typically found in a natural flow of water and serves the purpose of a bridge or a current flow controller.

Causeway:-

A causeway is a tract, road or railway on the upper point of an ~~em~~ embankment across a low, or wet place or piece of water. It can be constructed of earth, masonary, wood or concrete.

The difference between causeway and culvert is that causeway is a road that is raised as to be above water, ~~or~~ marshland etc while culvert is transverse channel under a road or railway for the draining of water.

Q1 (b) Define cross drainage work. Why it is necassary? Explain types of cross drainage work in detail

Ans Cross Drainage Works:-

A cross drainage work is a structure carrying the 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 the canal water across the above mentioned obstructions or vice versa are called cross drainage works.

Necessity of Cross Drainage works:-

=> The water-shed canals do not cross natural drainages. 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 for running the irrigation system.

=> 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.

Type of Cross Drainage works:-

=> Type I (Irrigation canal passes over the drainage)

a) ~~Aqueduct~~ Aqueduct.

b) Siphon Aqueduct.

a) 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 bed level of canal is above the highest flood level of drainage. In this case, the drainage water passes clearly below the canal.

b) Siphon Aqueduct:-

In a hydraulic structure where the canal is taken over the drainage, but the drainage water cannot pass quickly or 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.

=> Type II (Drainage passes over the irrigation Canal)

a) Super passage.

b) Siphon Super passage.

a) 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.

a) 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 siphonic super passage. This structure is suitable when the bed level of drainage is below the full supply level of the canal.

⇒ Type III (Drainage and canal intersection each other of the same level)

a) Level crossing
b) Inlet and outlet

a) Level crossing:-
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 drainge 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

1) Crest wall
2) Stream regulators.
3) Canal regulators.

b) Inlet and Outlet:-
When irrigation canal meets a small stream or drain at same level, drain is allowed to enter the canal an 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 Cross drainage Works is called Inlet and Outlet.

Q2 (a)

Differentiate between weir and barrage.

Ans

Weir:-	Barrage.
1) Low Cost	High Cost
2) Low control on flow	Relatively high control on flow and water levels by operation of gate
3) No provision for transport communication accross the river	usually, a road or a rail bridge can be conveniently and economically combined with a barrage wherever necessary.
4) Chances of silting on the upstream is more.	silting may be controlled by Judicial operation of gates.

Q 2(b)

Reynolds Number

The reynolds number is the ratio of a fluid's inertial force to its viscous force. Inertial force involves force due to the momentum of the mass of flowing fluid

The Reynolds Number is unitless.

We can determine whether fluid flow is laminar or turbulent based on the Reynolds Number.

=> If the Reynolds Number is less than 2300 the flow is said to be laminar.

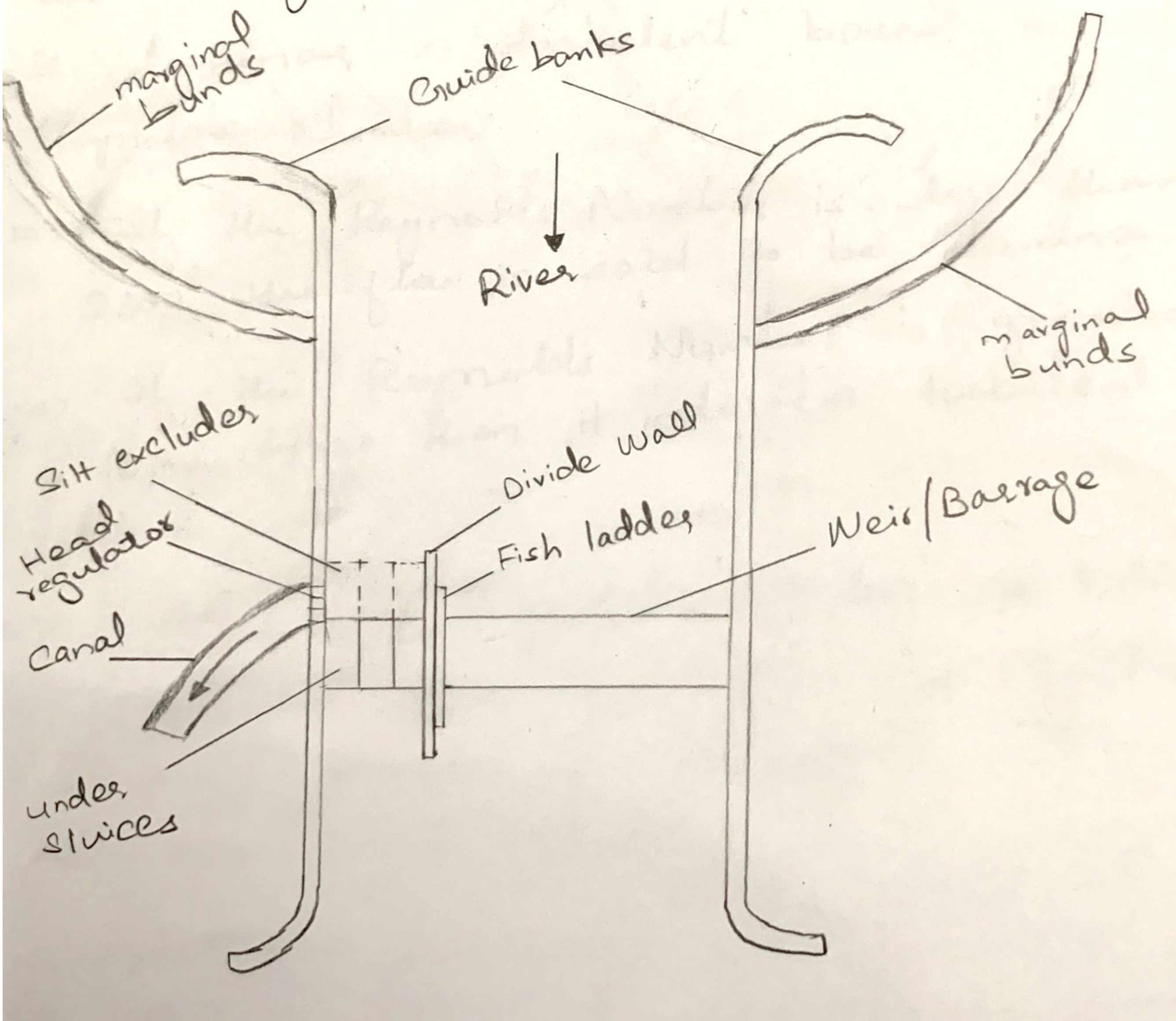
=> If the Reynolds Number is greater than 4000 then it indicates turbulent flow.

=> When the Reynolds Number is between 2000 and 2800 then the flow will be neither laminar nor turbulent.

Lower Critical Velocity:- The velocity at which the flow enters from laminar to transition period is known as lower critical velocity.

Higher Critical Velocity:-
A velocity in which flow enters from transition period to turbulent flow is known as higher critical velocity.

Q 3)
a) Draw neat sketch of barrage showing its different components.



Q3 (b) How would you predict/Analyze maximum or, equilibrium scour depth based on experimental formulas.

Ans Scour depth under the bridge:-

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

$$D_N = R_s (W/L)^{0.61}$$

wher R_s is the regime scour depth.

The maximum scour depth in a ~~...~~ single-span bridge (no piers) with a straight approach (case 1) is about 25% more than the normal scour, where in the case of a multispan structure with a curved approach reach (case 2) 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 given by

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

Scour around bridge piers:-

Several formulae based on experimental results have been proposed to predict the 'maximum' or 'equilibrium' scour depth (y_s, below general bed level) around bridge piers in general, these assume the relationship

$$y_s/b' = \phi(y_o/b', F_r, d/b')$$

where b' is the pier width, y_o is the upstream flow depth, d is the sediment size and F_r is the flow Froude number.

Q4 A box culvert is to be designed ---

Data:-

Live load L.L = 1.5 kip/ft^2

Dead Load D.L = 300 lb/ft^2

Angle of repose = 30°

Unit weight of Soil = 100 lb/ft^2

Dimensions = 15' x 15'

fy = 60 ksi Steel

Concrete = 1:2:4

D = 0.92m thickness

Solution:-

1) Load:-

Total load on top = Self weight + LL + DL

Self weight = 3 × 15 = 45 kN/m²

45 kN/m² = 0.939 Kip/ft²

W = 1.5 + 0.939 + 0.3

W = 2.739 Kip/ft²

2) Coefficient of Earth pressure:-

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

$$= \frac{1 - \sin(30)}{1 + \sin(30)}$$

$$\boxed{K_a = 0.33}$$

3) Lateral pressure due Dead Load & Live load:-

= Total verticle load × Ka

= (L.L + D.L) × Ka

= (1.5 + 0.3) × 0.33

= 0.594 Kip/ft²

or

= $\boxed{28.4 \text{ kN/m}^2}$

4) Lateral pressure due to Soil:-

$= K_\gamma \times \gamma_{soil} \times h$

$= 0.33 \times 0.1 \times 18$

$= 0.594$ kip/ft^2

or

$= 28.4$ kN/m^2

5) Lateral pressure at top due to Live Load + Dead load:-

$= 0.594$ kip/ft^2

$= 28.4$ kN/m^2

6) Lateral pressure at bottom:-

= Lateral pressure due to (LL + DL) + Lateral pressure due to soil

$= 0.594 + 0.594$

$= 1.88$ kip/ft^2

$= 56.88$ kN/m^2