IQRA NATIONAL UNIVERSITY

Hydraulic structures

Final Assignment

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Section = (A)

Semester = 8th

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Dated = 24 June 2020

Q.No 1:

(a) Differentiate between culvert and causeway.

Difference between culvert and causeway is that **causeway** is a road that is raised, as to be above water, marshland etc while **Culvert** is a transverse channel under a road or railway for the draining of water. It is transverse and totally enclosed drain under a road or railway.

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

Ans:- **Cross drainage Work:**

In an Irrigation project. When the network of main canals. branch canals, distributaries, etc. are provided then these canals may have to cross the natural drainages like rivers. streams, nallaws etc. at different points within the

command area of the project. The crossing of the canals with such obstacle cannot be avoided so suitable structures must be constructed at the crossing point for the easy flow of water of the canal and drainage in the respective directions. These structures are known as cross - drainage works.

Necessity of Cross drainage works:

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

- 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.

Types of cross drainage work.

- **Type-1:**

Irrigation Canal passes over the drainage.

This condition involves the construction of following:

- **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.

- **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.

- Type - II

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.

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 is suitable when the bed level of drainage is below the full supply level of the canal.

Type - III

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 crossing drainage work constructed is called level crossing where water of canal and stream is allowed to mix.

- **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.

Q No2:

(a) Differentiate between weir and barrage.

Weir:

An impervious barrier which is constructed across a river to raise the water level on the upstream side is known as a weir. Here the water level is raised up to the required height and the surplus water is allowed.

Barrage:

When adjustable gates are installed over a weir to maintain the water surface a different levels at different time is known as a barrage.

In weir the water overflows the weir, but in dam the water overflows through a special place called spillway. And a barrage is a adjustable gates installed over top of it to allow different water surface height at different times

	WEIRS	BARRAGE
1)	Having low cost	Having high cost
2)	Low control on flow	Relatively high control on flow and water level by operation of gate.
3)	Weirs are constructed to raise the water level in dry seasons	Barrage are generally constructed to control the water flow in flood seasons.

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

Reynold's Number:

The reynolds number is the product of density times length divided by viscosity coefficient.

This is proportional to the ratio of, internal forces and viscous forces in a fluid flow.

Laminar:-

The flow in a pipe is laminar if the reynolds number is less than 2100 is called Laminar.

Turbulant:-

If the reynolds number is greater than 4000 than it is called turbulant.

Neither Laminar nor turbulant flow:

when the Reynolds number is between 2000 and 2800, the flow is neither laminar nor turbulant.

Lower Critical velocity:

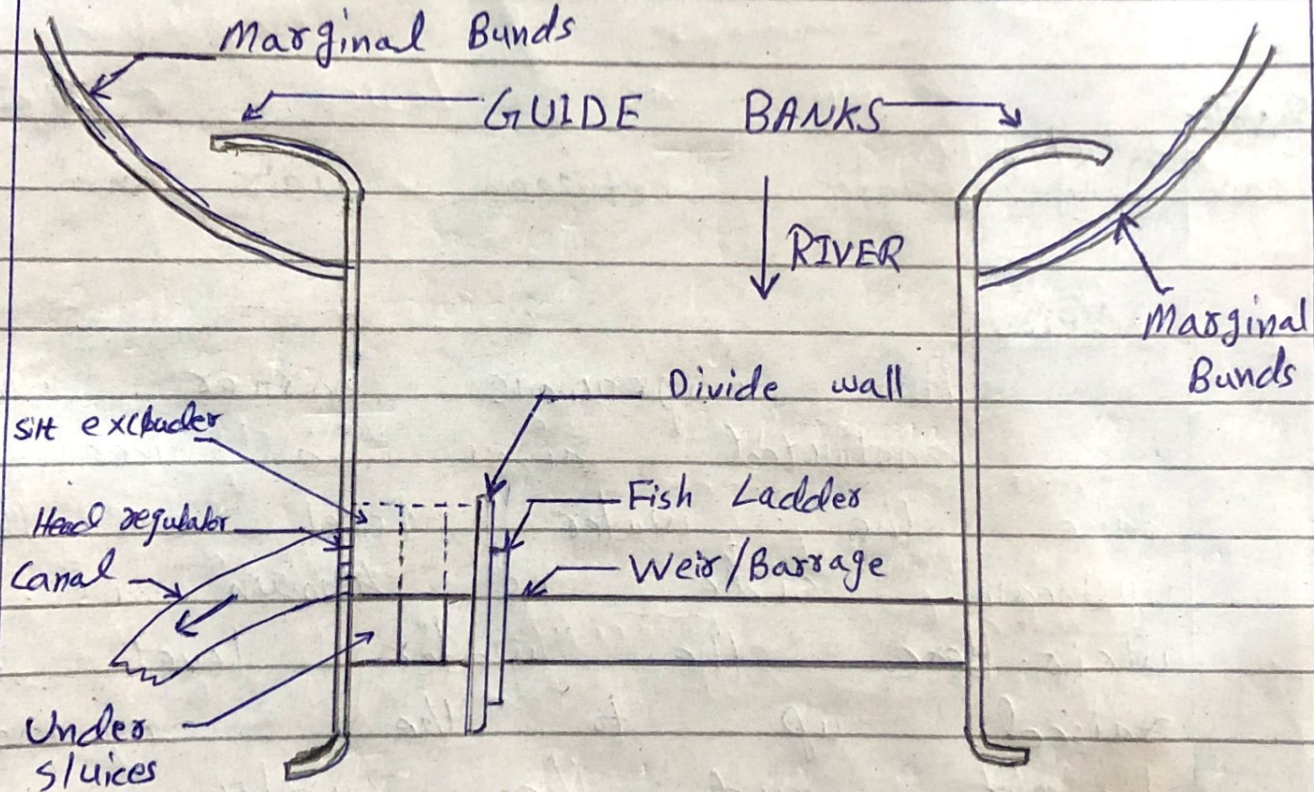
The velocity at which flow changes from laminar to transition is called lower critical velocity. The velocity at which the flow enters from laminar to transition period is known as lower critical velocity.

Higher Critical Velocity:

The velocity which flow changes from transition to turbulant as called higher critical velocity. It is also known as upper critical velocity.

Q No3:

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



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

Ans: 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

$$Y_s/b' = \phi(Y_o/b', Fr, d/b')$$

Where b' is the pier width, Y_o is the upstream flow depth, d is the sediment size, and Fr is the flow Froude number.

Laursen's (1962) experimental results underestimate the scour depths, compared to many Indian experimental.

$$Y_s/b' = 4.2\,(Y_o/b')^{0.78} Fr^{0.52}$$

The Indian field data also suggest that

$$Y_s/Y_o = (B/b')^{5/7} - 1$$

Predicts the maximum equilibrium scour depth.

$$Y_s = 2.3 K_\alpha b'$$

Where K_α = angularity coefficient which is a function of the pier alignment, i-e angle of attack of approach flow.

Q No 4:

A box culvert is to be

box culvert.

Given Data:

L.L = 1500 lb/ft²
D.L = 300 lb/ft²
Sections = 15'x15'
Thickness = 3 ft
Unit of soil = 100 lb/ft³
Φ = 30°
Unit of soil = 150 lb/ft³
fy = 60 ksi

Sol:-

Self wt of slab
Thickness * unit weight of R.C.C Concrete

3 * 156 = 468 lb/ft²

Total load
(L.L + D.L + self wt)
(1500 + 300 + 468)

Coefficient of earth pressure

$$ka = \frac{1 - \sin\Phi}{1 + \sin\Phi} = \frac{1 - \sin 30^\circ}{1 + \sin 30^\circ} = 0.33$$

Lateral pressure

(i) Vertical pressure at Top

$(L.L + D.L)\, ka$

$(1500 + 300)\, 0.33 = 494 \ lb/ft^2$

(ii) Pressure of soil

$ka \times h \times$ Unit wt of soil

$0.33 \times 100 \times 21 = 693 \ lb/ft^3$

(iii) Pressure at Top $494 \ lb/ft^2$

(iv) Pressure of bottom

(Top + lateral soil pressure)

$= 494 + 693 = 1189 \ lb/ft^2$