HYDRAULIC STRUCTURES

Submitted by

IFTIKHAR YAQUB

Reg.No. 7683

SECTION A

Submitted to

ENGR. ADEED

IQRA NATIONAL UNIVERSITY
PESHAWAR

Q: 1 (a)

Culvert:-

Culvert is a permanent drainage structure, constructed to carry roadway or railway track over small streamed or cannals. The purpose of culvert is mostly to provide cross-drainage or to take other neccesities (cables, wires etc.) from one side to other.

While;

Causeway:-

It is hydraulic structure having its floor flush or little above the bed of stream which allows flood water to pass always over it's floor. It is a road paved dip which may have open passage to stop or allow lower water flow. It is mostly constructed from concrete or earth fill embankement.

Q:1 (b)

Cross-Drainage works:-

Cross-drainage works is a structure which is constructed at the crossing point (point where the network of main canals, branch canals, distributaries etc.. cross the natural drainages like rivers, streams etc... at different points within the command area of the irrigation project) for the easy flow of water of the canal and drainage in the given directions of flow are called cross-Drainage works.

Why Cross-Drainage Works are Necessary?

Due to the following factors cross-Drainage works are necessary.

(a) **For running of Irrigation System:-**

The network of water-canals may not cross natural drainages ideally but in actual conditions the orientation of the canal network the ideal condition may not exists and the natural drainages (obstacles) may be present across the canal. So cross drainage works are constructed for running of irrigation system.

(b) **For smooth running of canal:-**

The water in the canal and the drainage gets intermixed at the crossing point so the cross drainage works are constructed inorder to maintain the smooth running of flow in canal with its required design discharge value.

(c) **For Diversion of water in Natural Directions:-**

without the construction of cross - Drainage works it may not be possible to divert the water of the canal and drainage into their natural directions because of the variations in site conditions.

Types OF Cross Drainage Works:-

Following are different types of cross Drainage works.

⇒ **Type I (Irrigation canal passes over the drainage):-**

This condition have the following two structures.

(i) **Aqueduct:-**

It is a type of hydraulic structure in which the irrigation canal is taken over the drainage (such as river, stream, nullahs etc.) is known as aqueduct. When the bed level of the canal is above the highest flood level of drainage then only this structure is suitable to construct. In this condition the water in the drainage clearly passes below the canal.

(ii) **Siphon Aqueduct:-**

whenever in hydraulic structure the canal is taken over the drainage, but the drainage water cannot passes clearly below the canal and it flows under siphonic action so it is known as siphon aqueduct. when the bed level of a canal is below the highest flood level, then only this type of structure is suitable.

Type II (Drainage Passes Over the irrigation canal):-

It includes;

(a) Super Passage

(b) Siphon Super Passage.

(i) **Super Passage:-**

The type of hydraulic structure in which the drainage is taken over the irrigation canal is known as super-passage. It is similar to aqueduct except that in this case the drain is over the irrigation cannal.

When the bed level of drainage is above the full supply level of the canal, then only this structure is suitable. It allows clear passage of water in canal below the drainage.

(ii) **Siphon Super Passage:-**

It is a type of 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. When the bed level of drainage is below the full supply level of the canal, only then this type of structure is suitable.

Type III (Drainage and Canal Intersect each other at the same level.

It includes;

(a) Level crossings.

(b) Inlet and Outlet.

(a) Level Crossings:-

In hydraulics whenever 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. It functions with the help of regulators both in canal and stream where water is disposed through canal and stream in required quantity of design. Level crossing consists of following components.

(i) Crest wall
(ii) stream regulator
(iii) Canal regulator.

(b) Inlet and Outlet:-

This type of hydraulic structure is constructed when irrigation canal meets a small stream or drain at small level, drain is allowed to enter the canal as an inlet. It's functions as that at some distance from the inlet point of structure, a part of water is allowed to drain as outlet which finally meets the original stream. In this structure stone pitching is required at the inlet and outlet. Stone pitching is provided between inlet and outlet ~~for~~ the protection of beds and banks. And this type of cross-drainage work is called inlet and outlet.

Q:2 (a)

Weir	Barrage
A barrier that is built across a stream or river to raise the water level on the upstream side or to divert the water flow for different purposes is called weir.	A type of weir with adjustable gates to control the water flow according to need (irrigation, prevent flood etc..) is called Barrage.
Weir has low control on water flow.	Barrage has high control on water flow and levels by operation of gates.
It's construction cost is low.	It's construction cost is high.
The structure of barrage are heavily built structures.	The structure of barrage are slightly built structures.

Weir	Barrage
In weir the shutters are provided of required length and smaller height (almost 2m).	In Barrage, Grated over the entire length and it's gates are of greater height as compare to weir.
In weir there is more chance of silting on upstream side of weir.	In this with the help of under sluices the silt is removed.
In this there is no path for communication across stream or river.	In this a road or rail bridge can be economically combined with barrage where needed.

Q:2 (b)

Reynolds Number:-

Reynolds Number in fluid mechanics is a dimensionless value which is applied to represent whether the fluid flow in duct or stream is laminar or turbulent.

Mathematically Reynolds Number may be defined as, "the ratio of interial forces to viscous forces.

Equation:- Reynolds Number is given by,

$$Re = \frac{\rho v d}{\mu}$$

Re = Reynolds Number

v = velocity

d = diameter

μ = viscosity

Limits of Reynolds Number:-

(a) For Laminar Flow:-

When the particles moves in straigth path, uniform velocity and having Reynold's Number less than 2000, so it is Laminar flow.

Limit:-

$$Re < 2000.$$

(b) For Turbulent Flow:-

when particles moves in irregular path, with ~~un~~ non-uniform velocity and having Reynolds Number greater than 4000 is called Turbulent Flow.

Limit:- $Re > 4000$

(c) Neither Laminar Nor Turbulent:-

Also called transition flow, having Reynolds Number greater than 2000 and less than 4000.

Limit:- $2000 < Re < 4000.$

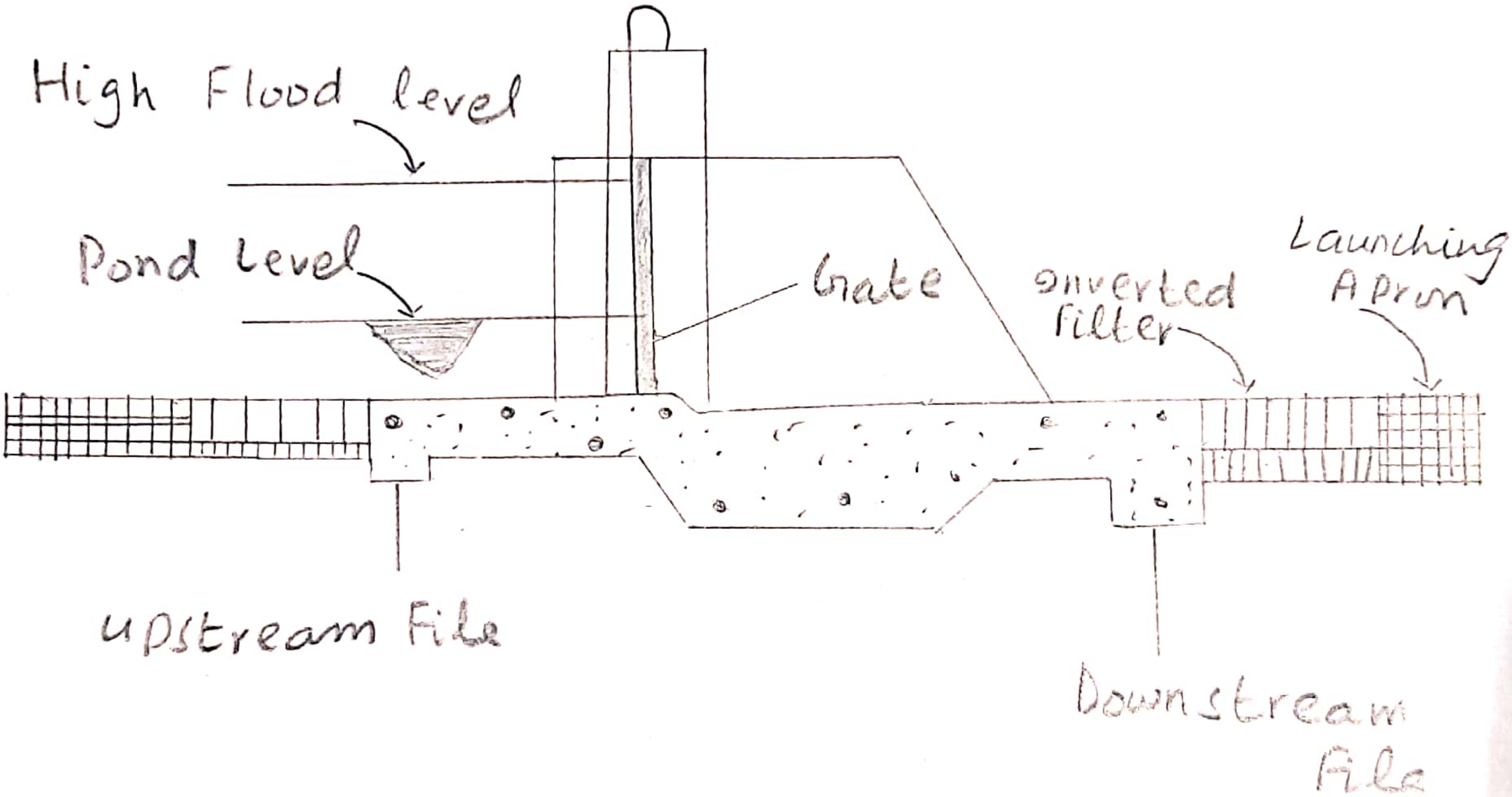
Lower Critical Velocity:-

The velocity at which the flow converts from Laminar to transition period is known as lower critical velocity.

Higher Critical Velocity:-

The velocity of flow at which the flow is converted from a transition zone to turbulent is known as higher critical velocity.

Q:3 (a)



Components of Barrage

Q:3 (b)

In order to predict the maximum or equilibrium scour depths, several formulas are used which are based on the proposed experimental results. In general form, the assume relation is,

$$y_s/b' = \phi\,(y_0/b',\ F_r,\ d/b')$$

where,

b' = the pier width

y_0 = upstream flow depth

d = sediment size

F_r = Flow Froude Number

In 1962 Lauren's, his experimental results has underestimated the scour depths, compared to many Indian experiments (Inglis 1949) which suggest the formula

formula (approach flow is normal to the bridge piers)

$$y_s/b' = 4.2\,(y_0/b')^{0.78}\,F_r^{0.52}$$

The India field data also suggests that the scour depth should be taken as twice the regime scour depth.

In the case of live beds (a stream with bedload transport) the formula,

$$y_s/y_0 = (B/b')^{5/7} - 1$$

This formula predicts the maximum equilibrium scour depth.

Q: 04

Given Data:-

Live load = 1500 lb/ft^2

Dead load = 300 lb/ft^2

Angle of repose, $\theta = 30°$

section = 15' × 15'

Thickness = 0.92 m = 3 ft

unit weight of soil = 100 lb/ft^3

f_y = 60 ksi

Unit weight of R.C.C

concrete = 156 lb/ft^3

(⇒ Plain concrete unit weight is 150 lb/ft^3 but we consider R.C.C concrete i.e 156 lb/ft^3).

Solution:-

⇒ Self wt. of slab

= thickness × unit wt. of R.C.C concrete

= 3 ft × 156 lb/ft³

= 468 lb/ft²

⇒ Total load

L.L + D.L + self wt.

1500 + 300 + 468

= 2268 lb/ft²

⇒ Co-efficient of earth pressure

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

$$= \frac{1-\sin(30°)}{1+\sin(30°)}$$

= 0.33

→ Lateral Pressure

→ Vertical Pressure at top

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

$(1500 + 300)\, 0.33$

$= 594\ lb/ft^2$

→ Pressure of soil

$k_a \times h \times$ unit wt. of soil

$0.33 \times (15' \times 3') \times 100$

$0.33 \times 18 \times 100$

$= 594\ lb/ft^2$

→ Lateral pressure at top $= 594\ lb/ft^2$

→ Pressure at bottom

$=$ top + pressure of soil

$= 594 + 594$

$= 1188\ lb/ft^2$