Name Usama Raheel

ID 7764

Sec A

Submitted to Sir Adeed

Subject Hydraulic structure.

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Q. 1. a) Differentiate b/w culvert and causeway.

Culvert	Causeway.
It is a tunnel carrying a stream under a road or railway. A culvert may act as a bridge 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. There are some common types of culvert such as pipe, box and arch culvert. The culvert type is based on hydraulic water surface elevation and roadway heigt and other condition.	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.

b) Define cross drange work. Why it necessary? Explain different types of cross drainge work in detail.

Ans:- Cross dranige work.

In an irrigation project when the network of main canals branch canals, distributaries etc. are provide then canals may have to cross the natural drainge like rivers, streams, nallahs etc.

Necessity of Cross Drainage work

The water-shed cannals do not cross natural drainages. But in actual orientation of the canal network, this idea condition may not be available and the obstacles like natural drainge may be present across the canal. At the crossing point, the water of the cannal and the canal and the drainage get intermixed. So, for the smoth running of the cannal with its design discharge the cross drainge work are required.

Types of Cross Drainage works.

Type-I Irrigation canal Passes over the Drainge
Aqueduct:-

The hydraulic structure in which the irrigation canal is taken over the drainage is known as aqueduct. This structure is suitable when bed level of canal is above the highest flood level of drainage.

Type II:- Drainge Passes over the irrigation canal

Super Passage:-

Thy hydrulic structure in Which the drainage is taken over the irrigation canal. The structure is suitable when the bed level of drainage is above the full supply level of the cannal. The water of the cannal Passes clerly below the drainge

Type III :- Drainge and canal intersect each other at the same level.

Inlet outlet:-

When irrigation carnal meets a small stream or drain at same level, drain is allowed to enter the carnal as inlet. At some distance from this inlet point, a part of water is alluwed to drain as outlet.

Q2:- Differentiate between weir and ~~[illegible]~~ barrage.

Weir	Barrage
• Weir is a solid obstruction put across the river to raise water level and divert the water into canal.	• The function of barrage is similer to that of weir but the heading up of water is effected by the gate alone.
• If water is store for a small period of short supplies it is called storage weir.	• No solid obstruction is put across the river. The crest level in the barrage is kept at low level.
• A dam stores the supply for comparatively longer duration.	• During the floods the gates are raised to clear off the high flood level.

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

Ans:- Reynold's number:-

It is a dimensionless value which is applied in fluid mechanics to represent whether the fluid flow in a duct or past a body is steady or turbulent. This value is obtained by comparing the inertial force with the viscouse force.

The Reynolds number is denoted by Re.

Formula of Reynold's number.

$$Re = \frac{\rho VL}{\mu}$$

Limit of laminar:

If Re < 2000, the flow is called Laminar.

Limit of Turbulent.

If Re > 4000, the Flow is called turbulent.

Limit of transition:-

If $2000 < Re < 4000$, the flow is called transition.

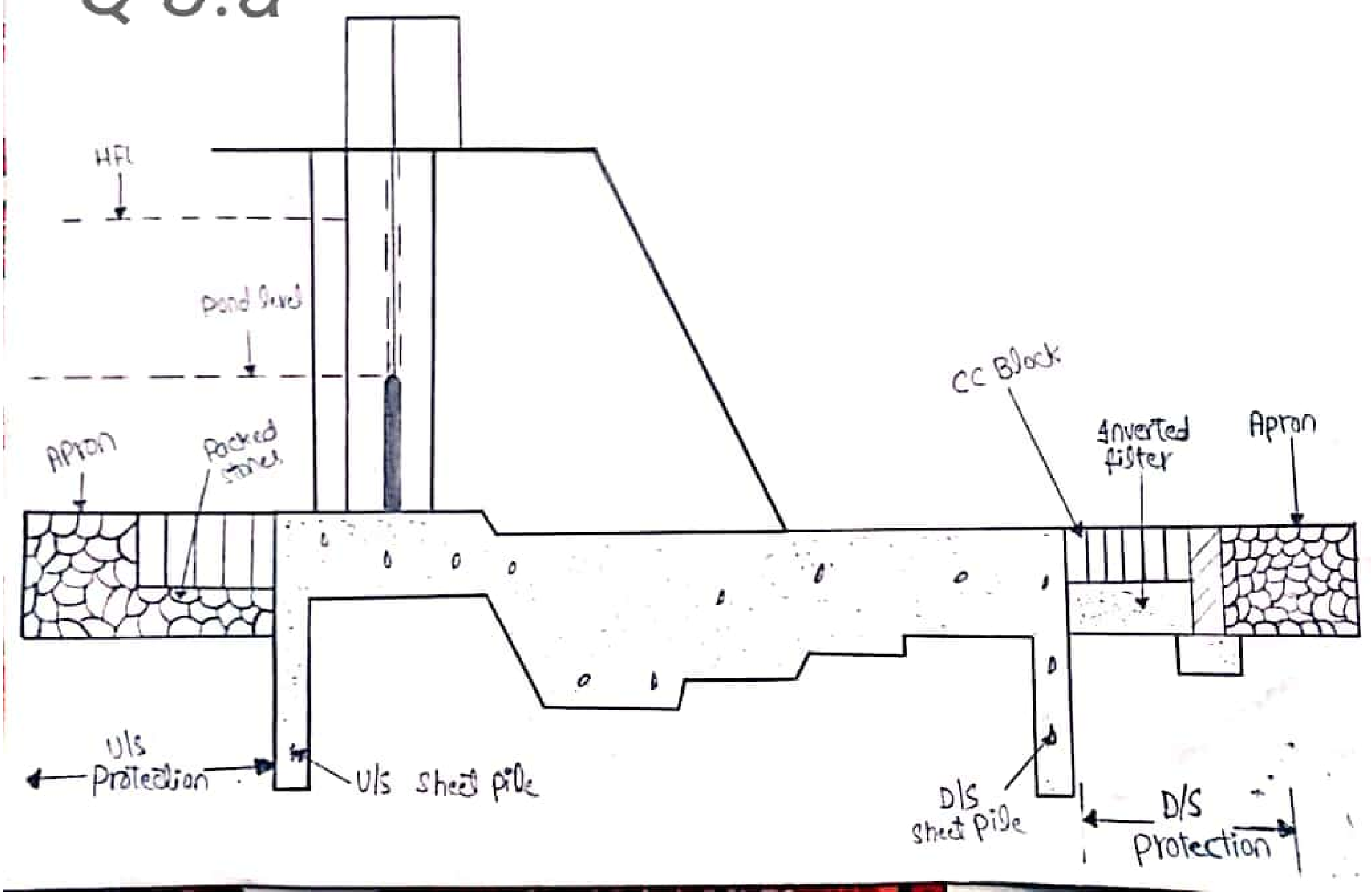
Lower critical velocity:-

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 upper or higher critical velocity.

Q 3.a



HFL
Pond level
Apron
Packed stones
CC Block
Inverted filter
Apron
U/s Protection
U/s Sheet pile
D/S Sheet Pile
D/S Protection

Q3 b). How would you predict/analyze maximum or equilibrium scour depth based on experimental formulas?

Ans: Several formula 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

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

where b' is the pier width, y_0 is the upstream flow depth, d is the sediment size, and Fr is the flow Froud number.

Laursen's (1962) experimental result underestimate the scour depths, compared to many Indian experiments which suggest the formula.

$$y_s/b' = 4.2(y_0/b')^{0.78} Fr^{0.52}$$

In a relatively deep flow a first-order estimate of local scour may be obtained by

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

Where K_α = angularity coefficient.

Q4. Problem.

Given data:-

Length = 15ft
Width => 15ft.

L.L = 1.5 kip/ft²
D.L = 300 lb/ft³ = 0.3 kip/ft³

Unit wt of soil, γ = 100 lb/ft³ = 0.1 kip/ft³
Angle, θ = 30°
Thickness = 0.92m
Mix design = 1:2:4

Steel fy = 60 ksi
Thickness = 0.92m => 3.02ft,
Fy = 60 ksi steel
Design the box culvert

Solution:-

Load calculation.

Total load earing on top slab.

Self wt of slab + live load + Dead load.

$= \gamma \times h$

$= 150 \times 3.02$

$= 453$ lb/ft

w = Total load = 1.5 + 0.3 + 0.453

w = 2.253

Co-efficient of earth pressure

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

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

$K_a = 0.333$

Lateral pressure due to (D.L + L.L)

Total vertical load

$(L.L + D.L) \times K_a$

$= (1.5 + 0.3) + (0.333)$

$= 0.599$

Lateral pressure due to soil

$K_a \times \gamma \times h$

$= 0.333 \times 0.1 \times 18.02$

$= 0.6$ kips/ft²

Lateral pressure

a) Top:-

Lateral pressure due to (D.L+L.L)

$= 0.599 \text{Kips/ft}^2$

b) Bottom:-

Lateral pressure due to (D.L+L.L) + Lateral pressure due to soil.

$= 0.599 + 0.6$

$= 1.2 \text{ kips/ft}^2$.