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Section "A"

Subject Hydraulic Structures

Submitted to Engr Adeel Sir.

Q#01

a) Differentiate b/w Culvert & Causeway.

Ans:

Culvert	Causeway
Culvert is defined as a tunnel Structure Constructed under roadways or railways to Provide Cross drainage or allow water or to to take electrical or other Cables from one Side to other. - totally enclosed by Soil or ground. - Common types are 1) pipe Culvert 2) box Culvert 3) Arch Culvert.	A Causeway is a track, road or railway on the upper Point of embankment across "a low, or wet place, or Piece of water". Can be Constructed of earth, masonry, wood or Concrete, a Causeway is a road Surfaced with Setts. one of the known earlier Causeways is the Sweet track in the Somerset levels, England.

b) DEFINE CROSS Drainage work? Why it is necessary? Explain different types of Cross drainage work in detail.

Ans:: CROSS DRAINAGE WORK:

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

Cross drainage works Can be avoided in two ways:

1) By Changing the allignment of Canal water way.
2) By mixing two or three streams into one and only one Cross drainage work to be Constructed the to make the Structure economical.

Why CROSS DRAINAGE WORK NECESSARY:

Cross Drainage work is necessary because the water Comes to an Irrigation field from rivers or tubewells So on that path if there is a drainage or Something that Can Change the path of water and Splits its way so we Construct a Cross drainage work there, that's why Cross drainage work is necessary that water Comes to an Irrigation field Can't be Split.

TYPES OF CROSS DRAINAGE WORKS:

Type - 1,

CROSS DRAINAGE WORK CARRYING CANAL OVER the DRAIN:

The Structures falling under this type are;

i) Adeeduct

ii) Syphon Adueduct.

i) Adueduct:

In this type, the Canal bed level is above the drainage bed level So Canal is to be Constructed above drainage.

It is to be Constructed in Such way that the Canal water flows from upstream to downstream.

ii) Syphon Aqueduct:

In this type the Canal water is Carrier above the drainage but the high flood Level (HFL) of drainage is above the Canal trough.

Type - 2

CROSS DRAINAGE WORK Carrying Drainage over the Canal:

The Structures falling under this type are;

i) Super Passage:

This Structure Carries drainage above Canal as the Canal bed level is below drainage bed level. This drainage Could be Constructed at road level & water flow is from upstream to downstream.

ii) Canal Syphon:

In a Canal Syphon, drainage is Carried over Canal Similar to a Super Passage & the ~~flow~~ Canal water flows under Syphonic action.

Type-3 CROSS DRAINAGE WORKS admitting Canal water into the Canal.

The Structures falling under this type are;

i) LEVEL CROSSING:

When the bed level of Canal is equal to the drainage bed level, then level Crossing is to be Constructed.

Canal Inlets:

In a Canal inlet Structure, the drainage water to be admitted into Canal is very less. The drainage is taken through the banks of a Canal at Inlet. And then this drainage mixed with Canal travels certain length of the Canal, after which an outlet is Provided to Create Suction Pressure and Suck all the drainage Solids.

Q#2 Differentiate b/w weir & barrage.

Ans:

WEIR	BARRAGE
~~IN a weir the water overflows the 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.	A barrage is a weir that has adjustable gates installed over top of it, to allow different water Surface heights at different times.
IN A WEIR the water overflows the WEIR	

b)

Ans:- Reynolds number:-

The Reynolds number is the ratio of inertial forces to viscous forces.

Mathematically:

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

ρ = density

v = velocity

d = diameter

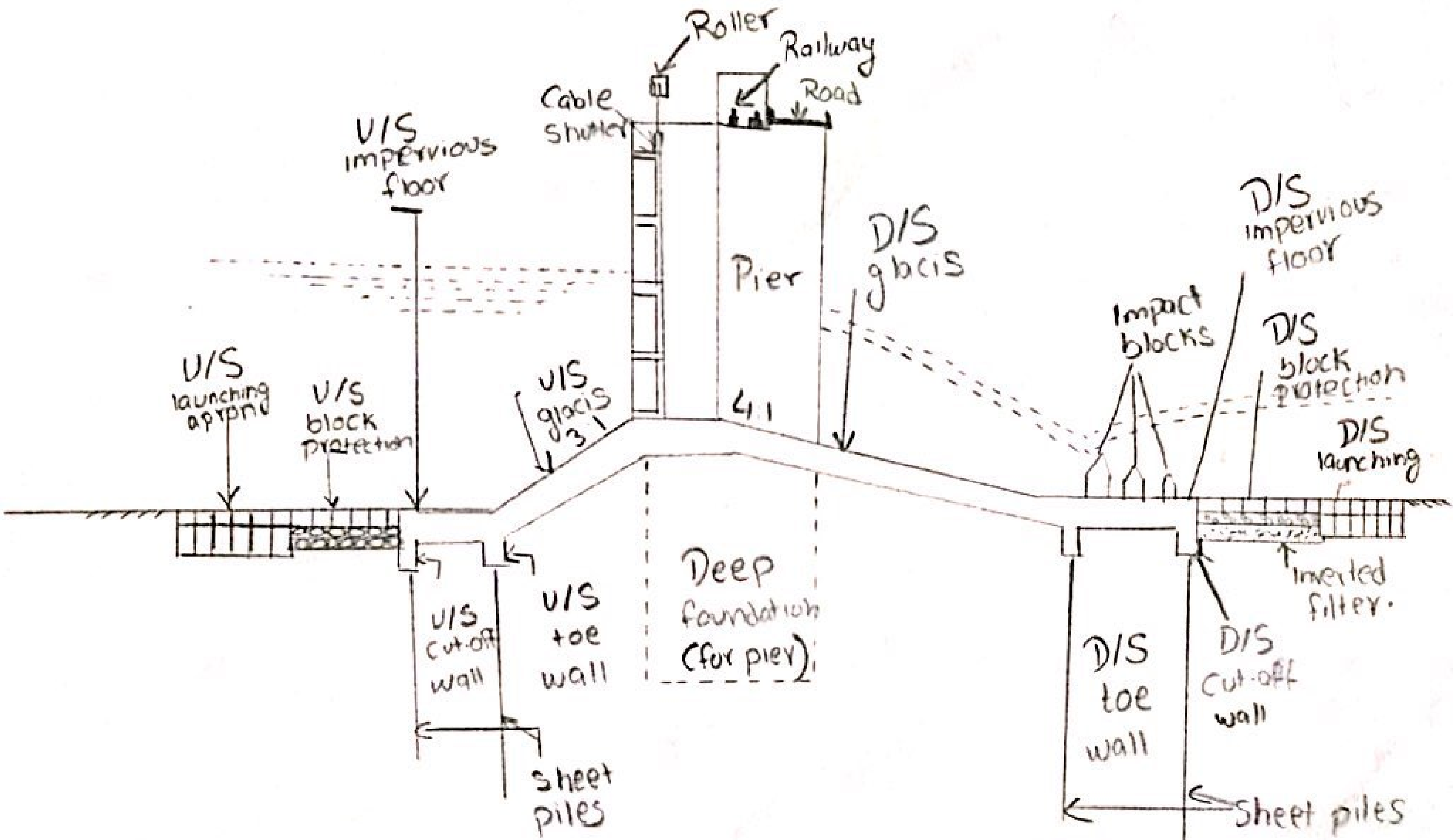
μ = viscosity

The Reynolds number is used to determine whether a fluid is in laminar or turbulant flow, ~~if the assumed that~~ Reynolds number less than 2100 indicates laminar ~~turbulant~~ flow, and a Reynolds number b/w ~~greater than~~ 2100-4000 indicates ~~turbulant~~ transition flow. while Reynolds number greater than 4000 is known as ~~transition flow~~ turbulant flow.

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 at which turbulent flow starts. A velocity in which flow enters from transition period to turbulent flow is know as upper or Higher critical velocity.



Component parts of barrage.

Q#3.

b) How would you Predict/analyze maximum or, equillibrium Scour depth based on Experimental formulas?

Ans: Several formulae based on experimental results have been Proposed to predict the 'maximum' or 'equillibrium' Scour depth (ye below general bed level) around bridge piers. In general these assume the relationship

$$y_c/b = \phi(y_b/b,\ F_r,\ d/b)$$

Where b is the Pier width, yo is the upstream flow depth, d is Sediment Size and Fr is the flow fraud number.

Laursen's (1962) experimental results underestimate the Scour depths, Compared to many Indian experiments (Inglis, 1949) Which Suggest the formula (approach flow is normal to the bridge Piers)

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

The indian field data also suggest that the scour depth should be taken as twice the regime scour depth. In case of live beds (a stream with bedload transport) the formula.

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

Predicts the maximum equillibrium scour depth.

In a relatively deep flow a first-order estimate of (clear) local scour (around pier) may be obtained by

$$y_s = 2.3 K_a b'$$

Question # 4

Problem:

Given DATA:

Length of Slab = 15 ft

width of Slab = 15 ft

L.L = 1.5 Kip/ft²

D.L = 300 lb/ft³ = 0.3 Kip/ft²

Unit wt of Soil - γ = 100 lb/ft³ = 0.1 Kip/ft²

Angle, θ = 30°

Mix design = 1:2:4 = M_{15} = 15 MPa = 21

Steel f_y = 60 Ksi

Thickness = 0.92 m ⇒ 3.02 ft

Design the box Culvert.

Solution:

Load Calculations.

Total load Carrying on top Slab:

Self wt of Slab + live load + Dead load

For Self wt of Slab:

$= \gamma \times h$

$= 150 \times 3.02$

$= 453 \ lb/ft^2$

$\Rightarrow 0.453 \ Kip/ft^2$

Total load: $W = 1.5 + 0.3 + 0.453$

$W = 2.253 \ Kip/ft^2$

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

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

$= (1.5 + 0.3) \times (0.333) = 0.599$

$= 0.6$ Kips

lateral Pressure due to Soil

$K_a \times \gamma \times h$

$= 0.333 \times 0.1 \times 18.02$

$= 0.6$ Kips / ft^2

Lateral Pressure @ top = Lateral Pressure due to (D.L + L.L)

$= 0.5994$ Kips/ft^2.

@ Bottom = Lateral Pressure due to (D.L + L.L) + Lateral Pressure due to Soil

$= 0.5994 + 0.6$

$= 1.2$ Kips / ft^2.