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Section : "A"

Subject : Hydraulics Structure

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(Part A) Question no (1)

Differentiate between culvert and causeway?

Answer:-

Culvert	Causeway
• A tunnel carrying a stream or open drain under a road or railway.	• A Causeway is a track, road or railway on the upper part of an embankment across a low or wet place.
• Basically a culvert is a tunnel structure constructed below roadways or railway to provide cross drainage or to take electrical or others cables from one side to other.	• A causeway is a raised path or road that crosses water or wet land

(Part B)

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

Answer:- Cross drainage Work

Cross drainage work is define as "A structure constructed when there is a crossing

of canal and natural drain, to prevent the drain water from mixing into canal water.

"Why it is necessary"

It is very necessary for irrigation purpose we construct cross drainage work which helps to divert or separate the drainage sewage waste from natural water.

• Tyes of cross drainage work

• Type 1 (Irrigation canal passes over the drainage)

a) Aqueduct
b) Siphon Aqueduct.

• Aqueduct :-

Aqueduct is define as " The hydraulic structure in which the irrigation canal is taken over the drainge. (such as river, stream e.t.c). is know as aqueduct.

• 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 know as siphon aqueduct.

- **Type - II Drainage Passes Over the irrigation Canal.**

- **Super Passage :-**

The hydraulic structure in which the drainage is taken over the irrigation canal is know as super passage. The structure is suitable when the bed level of drainage is above the full supply level of the canal.

- **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 know as siphon super passage.

- **Types 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 cross 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 let. At some distance ~~to~~ ~~drain~~ from the inlet. Point a part of water is allowed to drain as outlet which eventually meets the original stream.

Question (2)

Part A

Differentiate between weirs and barrage?

Answer:-

Weir	barrage
• A weir is low head dam is a barrier across the width of a river that alters the flow characteristics	A concentrated artillery bombardment over a wide area. • An artificial barrier across

of water and usually results in a change in the height of the river level.	a river or estuary to prevent flooding, aid irrigation or navigation or to generate electricity by tidal power.
- They are used to controll the flow of water.	

Part B

Define Reynold's ..... critical velocity!

Answer:- Reynold's number

The Reynolds number is a ratio of inertial forces to viscous forces. The Reynold's number is a dimensionless number used to categorize the fluid system in which the effect of viscosity is important in controlling the velocities.

Limit of Reynold's number for laminar

Limit of Reynolds number for laminar is less than 2100 and it based on dia of pipe. "Laminar flow is orderly"

Laminar 2100<

- Limit of Reynold's number for turbulent

Limit of Reynolds numbers for turbulent is greater than 4000. and it flow in pipe in unorderly.

Turbulent 4000 greater.

And 2100 to 4000 in between them the flow is know as Transitional Flow.

- Lower critical velocity :-

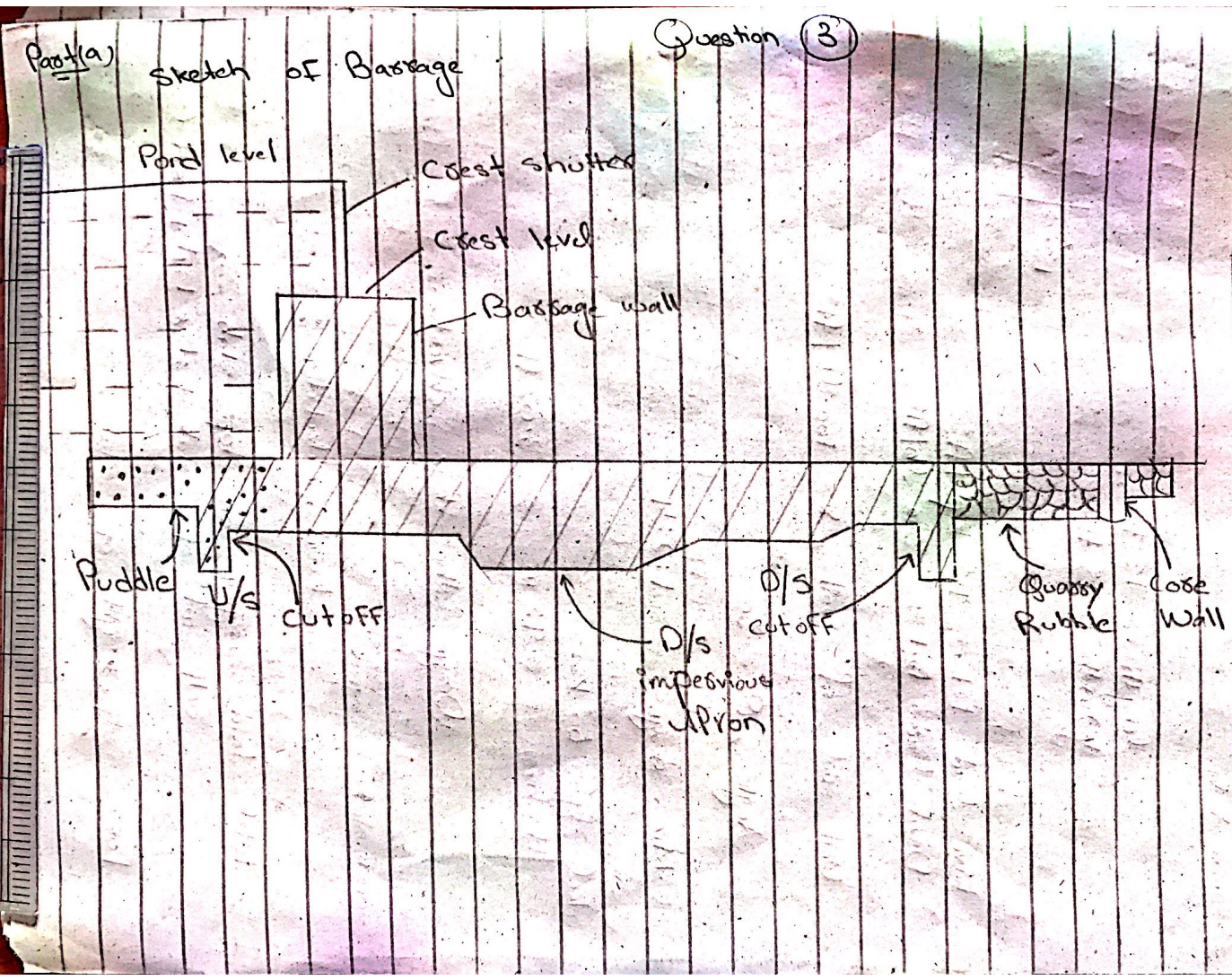
The velocity at which the flow enters from laminar to transition period is know as low critical velocity.

- 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 transition highes velocity.

Question (3)

Part (a) Sketch of Barrage



Question (3)

Part B

How would you Predict / analyze maximum or, equilibrium scour depth based on experimental Formulas ?

Answer:- Several formula 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

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

where b' is the pier width, y_0 is the upstream flow depth, d is the sediment size and F_s is the flow froude numbers.

⇒ In experimental results underestimate the scour depths compared to many indian experiments which suggest the formula (approach flow is normal to the bridge pier).

$$Y_s/b' = 4.2 (y_c/b')^{0.78} F_s^{0.78}$$

The Indian field data also suggest that should be that as twice the regime scour depth

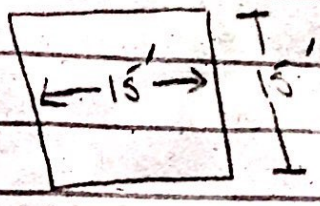
$$y_s / y_0 = (B/b')^{5/7} - 1$$

Predicts the maximum ~~velocity~~ equilibrium scour depth.

Problem Question (1)

Given data:

length = 15 ft
Width = 15 ft



Live load L.L = 1.5 kip/ft²
Dead load D.L = 300 lb/ft³

Unit wt of soil, γ = 100 lb/ft³.

Angle, θ = 30°

Mix design, = 1:2:4

Steel fy = 60 ksi
Thickness = 0.92 m ⇒ 3.02 ft

Design the box culvert

Solution + Design:-

Load calculations:

Total load carrying on top slab:-
Self wt of slab + Live load + Dead load

For self weight of slab:

$= \gamma \times h$

$= 150 \times 3.02$

$= 453 \text{ lb/ft}^2$

$= 0.453 \text{ kips/ft}^2$

Total load $w = 1.5 + 0.3 + 0.453$

$w = 2.253$

- Co-efficient of earth Pressure:

$$ka = \frac{1 - \sin\phi}{1 + \sin\phi}$$

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

$$\boxed{ka = 0.333}$$

- lateral Pressure due to (D.L + L.L).

Total vertical load.

$= (L.L + D.L) \times ka.$

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

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

- lateral Pressure due to soil:

$= ka \times \gamma \times h$

$= 0.333 \times 0.1 \times 18.02$

$= 0.6 \text{ kips/ft}^2$

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

$= 0.5994 \text{ kips/ft}^2$

@ Bottom = lateral Pressure due to (D.L + L.L) + lateral Pressure due to soil

= 0.5994 + 0.6

= 1.2 kips/ft².