HYDRAULIC STRUCTURE

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Section : A

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Question No 1:

a. Differentiation of Culvert and Causeway:

Culvert:

Culvert is described as a tunnel system installed from one side to the other under roads or railways to provide cross drainage in order to carry water, electric or other cables.

Its design depends on the hydraulic, water surface elevation, road height and other factors. This is completely surrounded by earth or dirt. The forms used under the roadways and railways are the pipe culvert, box culvert and arch culvert.

Causeway:

Causeway is a road built up on an embankment. In common use, a causeway is a bridge or railway on top of an embankment usually over a large body of water or wetland.

Originally causeways are more like dykes, generally pierced to allow pan water, while other modern causeway look much the same as bridges or viaducts.

b. Cross Drainage Work:

Cross drainage work is basically a structrure which is built in a condition when a canal and a natural drain comes to cross each other without interrupting the continuous supplies of both.

Necessity:

On the basis of water Quality:

The necessity of cross drainage work is that if there is no cross-drainage work then the water of canal mixed with water of natural drainge which is very bed in condition when both qualities are different.

On the basis of water Quantity:

Similarly canal is design for fixed quantities ie having a fixed peak flow, so as the water of both canal and natural drain mixed at crossing point then the quantities get disturbed which cause floods as well as hydralic structure failure etc.

Types of Cross Drainage Work:

There are various types of cross Drainage work depending on crossing condition of ~~dr~~ natural drain and canal, which are;

- By passing the canal over the drainage.
- By passing the canal below the drainage.
- By passing the drain through the canal.

• By passing the canal over the drainage:

This may be accomplished either through

- Aqueduct
- Syphon-aqueduct

• Aqueduct:

When the highest flow level of the drain is sufficiently below the bottom of the canal, so the drainage water flows freely under gravity, the structure is known as aqueduct.

• **Syphon-aqueduct:**

When the highest flow level of the drain is above the canal bed and water passes through the aqueduct barrels under syphonic action such is called syphon-aqueduct.

• **By passing the canal below the drain:**

This may be accomplished either through

- Super passage
- Syphon Super passage

• **Super passage:**

When the flow surface level of the canal is sufficiently below the bottom of drain trough, so that the canal water flows freely under gravity, such is called super passage.

• **Syphon Super passage:**

When the flow surface level of the canal is sufficiently above the bed level of the drain trough so that the flow of canal is under syphonic action, such structure is called syphon Super passage.

- **By passing drain through canal:**

By passing the drain through canal, so that the canal water and drainage water are allowed to intermingle with each other.

This may accomplished through;

- A level crossing
- Inlets and outlets.

Question No 2:

a. Differentiation between weir and barrage:

Weir	Barrage
• A low dam built across a river to raise the level of water stream or regulate its flow	• An artifical barrier across a river to prevent flooding, irrigation, navigiation and to generate Electric power.
• Weir has high crest	• Barrage has low crest
• In weir shutters are dropped to pass flood	• In Barrage gates are raised clear off the high flood to pass flood.
• In weir shutter inpart length has heigh of 2 m	• In barrage gates over entire length and have greater height.

Weir	Barrage
Raised creast causes silting upstream	Less silting upstream due to low crest.
In weir no contral of river in low floods	Barrage have perfect contral on river flow.
In ~~weir~~ excess afflux in high flood	In barrage has very minimum aflux Problem
No mean for silt disposal	Silt removal is done through under sluices.
No possible to provide Rail-rood bridge in weir.	Rail-road bridge can be constructed over barrage.
Shorter construction period	longer construction period.

b. Reynolds Number:

The reynold's number is defined as;

The product of density time velocity times length divided by the viscosity co-efficent.

This is proportional to the ratio of interial force and viscous foarce in a fluid flow.

Limit of Reynold's Number:

- **For laminar flow:**

In case of laminar flow the reynold's number limit is;

$$R_e < 2000$$

- **For turbulent flow:**

In case of turbulent flow the reynold's number limit is;

$$R_e > 4000$$

- **For transition flow:**

In case of transition flow the reynold's number limit is; between 2000 to 4000.

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Lover Critical Velocity:

It may be defined as;

→ "A velocity at which laminor flow stopes"

or

→ "The velocity at which the flow enter's from laminor to transition period is known as lowe critical velocity."

Higher Critical Velocity:

It may be defined as;

→ "A velocity at which turbulent flow starts."

or

→ "A velocity in which flow enters from transition period to turbulent flow is known as upper or higher critical velocity."

Question No 3:

a. Diagram of Barrage:

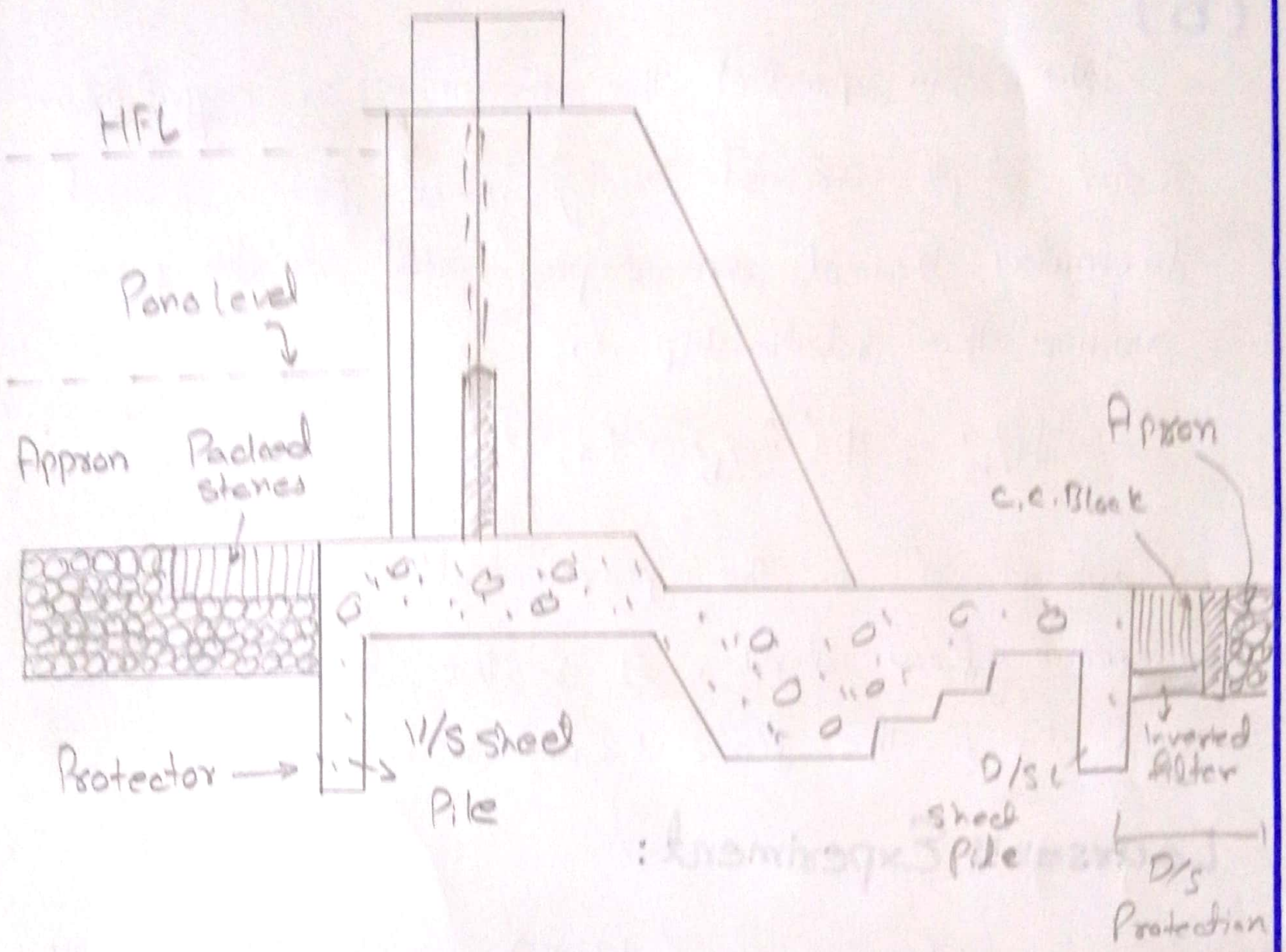


Diagram of Barrage

Question No 3:

(b)

We can predict the maximum or equilibrium scour depth around bridge piers from several formulas based on experimental results which assume the relationship as;

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

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

Laursen's Experiment:

Laursen's (1962) experimental results underestimate the scour depths, compared to many Indian experiments which suggest the formula (approach flow is normal to the bridge piers)

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

Indian field data:

The indian field data also suggest that the scour depth should be taken as twice the regime scoure depth.

In case of live beds (a stream with bed load transport) the formula $y_s/y_0 = (B/b')^{5/7} - 1$ predicts the maximum equilibrium scour depth.

Question No 4:

Given data:

Inside dimension = 15 ft × 15 ft

Live load = 1.5 K/ft^2 = 1500 lb/ft^2

Dead load = 300 lb/ft^2

Unit weight of Soil = 100 lb/ft^3

Angle of repose = 30°

Use concrete of 1:2:4 ratio

f_y = 60 ksi

Thickness = 0.92 m = 3 ft

Required data:

Design a box Calvert = ?

Solution :

1. Load Calculation :

Total load carry on top Slab =

= Self weight of Slab + L.L + D.L

Self weight of Slab = 3 × 150

= 450 lb/ft^2

$\omega = 450 + 1500 + 300 = 2250 \ lb/ft^2$

2. Co-efficient of Earth Pressure :

$$Ka = \frac{1 - \sin \alpha}{1 + \sin \alpha}$$

$$Ka = \frac{1 - \sin(30)}{1 + \sin(30)}$$

$$Ka = 0.33$$

3. Lateral Pressure due to (D.L + L.L)

= Total vertical load (L.L + D.L) × ka

= (1500 + 300) × 0.33

= 594 lb/ft^2

4. Lateral Pressure due to Soil :

= $ka \times \gamma h$

= 0.33 × 100 × 18

= 594 lb/ft^2

5. Lateral Pressure :

@ Top ;

= lateral pressure due to (D.L + L.L)

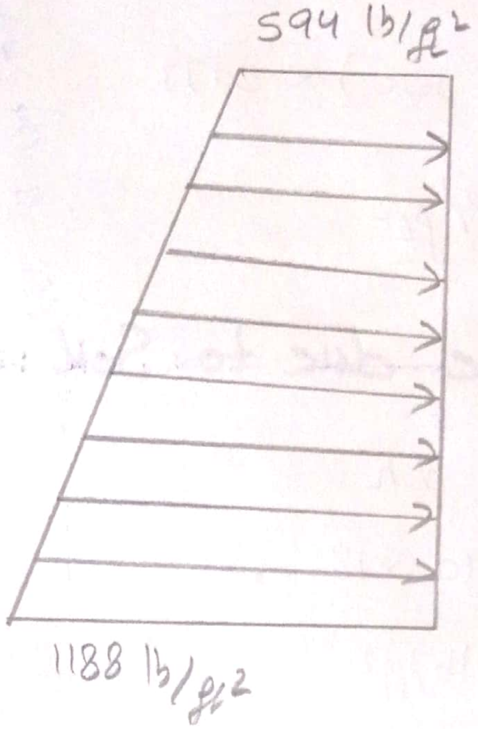
= 594 lb/ft^2

@ Bottom ;

= lateral Pressure due to (D.L + L.L) + lateral pressure due to Soil

= 594 + 594

= 1188 lb/ft^2



594 lb/ft²
1188 lb/ft²