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Department	BE (civil)
Subject	hydraulic Structure
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Q:No:01 §13

Ans: **Culverts:** It is a transerse and totally enclosed drain under a road or railway.

OR

Culvert 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.

⇒ **Causeway:**

A road that is raised, as to be above water, marshland etc.

Q) = No = 01(b) (2)

Cross Drainage works?

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. By mixing two or three streams into one and only one cross drainage work to be constructed.

→ The cross-drainage work is required to dispose of the drainage water so that the canal supply remains uninterrupted.

→

⇒ Types of Cross Drainage Works

* Type I (Irrigation Canal passes over the drainage)
  - (a) Aquecluct
  - (b) Siphon Aquecluct
* Type II (Drainage passes over the Irrigation Canal)
  - (a) Super passage
  - (b) Siphon Super passage
* Type III (Drainage and Canal Intersection each other of the Same level)
  - (a) Level crossing
  - (b) Inlet and outlet

⇒ Type-I: Irrigation Canal passes over the Drainage:

This Condition Involves the Construction of following:

(a) * **Aqueduct:**

→ The hydraulic structure in which the irrigation Canal is taken over the drainage (such as river, stream etc) is known as aqueduct. This structure is suitable when bed level of Canal is above the highest flood level of drainage. In this case, the drainage water passes clearly below the Canal

(b) **Sipton Aqueduct:**

(a) (a) 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 known as Siphon aqueduct. This Structure is Suitable when the bed level of Canal is below the highest flood level.

⇒ **Type-II Drainage passes over the Irrigation Canal.**

(a) **Super passage:** The hydraulic Structure in which the drainage is taken over the irrigation Canal is known as Super passage. The Structure is Suitable when the bed level of drainage is above the full Super level of the Canal. The water of the Canal passes clearly below the drainage.

(b) **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 known as Siphon Super passage. This structure is Suitable when the bed level of drainage is below the full Supply level of the Canal.

⇒ **Type-III Drainage and Canal Intersect each other at the Same level.**

(a) ★ **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, water is disposed through Canal and Stream is required quantity. Level Crossing Consist

of following Components.

(i) Crest wall (ii) Stream regulator (iii) Canal regulator

(b) **Inlet and outlet:** When Irrigation Canal meets a Small Stream or drain at Same level, drain is allowed to enter the Canal as inlet. At Some distance from this Inlet point, a part of water is allowed to drain as outlet which eventually meets the original Stream. Stone pitching is required at the Inlet and outlet. The bed and banks blw Inlet and outlet are also protected by Stone pitching. This type of CDW is called Inlet and outlet.

Q=No-02-(a) {7}

Ans **Weir:** A weir is an Impervious barrier Constructed across a river to raised the water level on the upstream Side the water is raised upto required height and then flow over the weir have traditionally been used to Create mill pond

Weir are also used to prevent flooding, measure discharge and help render a river navigable.

The ~~are~~ Crest of an overflow ~~navigable~~ Spillways on large dam is often called weir. weir can be build of wood, Concrete or moraine material (rock, gravel)

⇒**Barrage:** A river barrage is low be headed diversion dam that is build to allow diversion of part of the water flow. A brrage determines a little increase of upstream water profile and a little upstream Reservior. The purpose of barrage is essentially to stabilized the upstream water Level and river profile

In order to ensure a long technical life to the diversion facilities. we can often see mountain s

Q = No: 02 (b) 593

⇒ **Reynolds number:** It is the ration of Inertial force to viscous forces within a fluid flow.

⇒ **Laminor:** If Reynolds number is less than 2000. Than it is Laminor flow

→ **Turbulant** If the Reynol number is greater than 4000 than it is turbulent flow

→ **Neither Laminor nor turbulant flow:** When the Reynold number in between 2000 and 2800, the flow is neither Laminor nor turbulent.

⇒ **Lower Critical velocity:** The velocity at which flow Change from Laminar to transition is called lower Critical velocity.

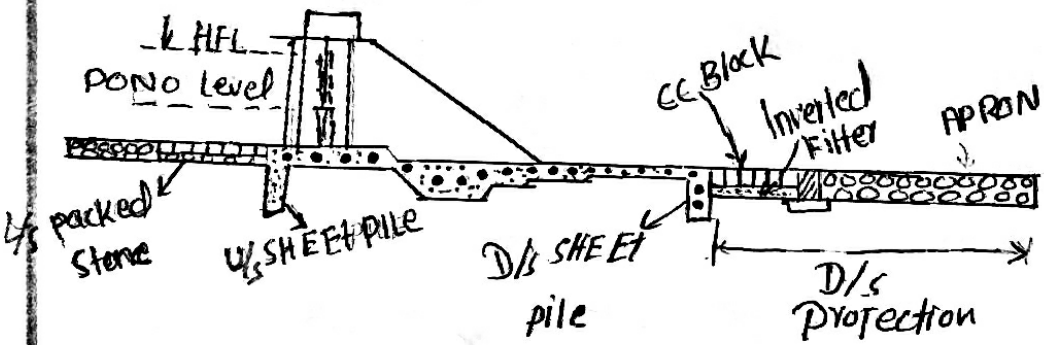
→ **Higher Critical velocity:** A velocity in which flow change from transition to turbulent flow is known as higher Critical velocity.

Q = No = 03 (a) {10}

Net Sketch of barrage:

→ The function of barrage is similar to that of weir, but the heading up of water is effected by the gates alone

→ ① During the flood, the gates are raised to clear of the high flood level. When the flood recides, the gates are lowered and the flow is obstructed, thus raising the water level at the U/s of the barrage.



Q = No: 3 (b)

Ans We can predict the maximum or equilibrium Scours depth around bridge piers from Several formula based on experimental results which as Shown the relationship as

$$y_s/b' = \alpha\left(y_o/b', F_r, d/b'\right)$$

Where b' as the pier width, y_o is the upstream flow depth. d is the Sediment Size and F_r is the flow froude number.

Laursen's experiment: Laursen's experimental result underestimate the Scour depth. Compared to many Indian experiments which Suggested the formula (approch flow is normal to the bridge pier.

$$y_s/b' = 4.2\left(y_o/b'\right)^{0.78} F_r^{0.52}$$

Indian field data: The Indian field data also Suggested that the Scour depth Should be taken as twice the regime Scours depth In Case of liver load beds (a Stream with bed load transport) the formula

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

predicts the maximum equilibrium Scour depth.

Q=No=04

Given data:

* Live Load = L.L = 1.5 kip/ft² = 1500 lb/ft²
* Dead load = D.L = 300 lb/ft
* Q = 30°
* Unit weight of Soil = 100 lb/ft²
* Dimensions = 15' x 15'
* fy = 60 ksi steel

Required:

* Design the box Culvert = ?

Solution:

1. Load Calculation:

Total load Carry on top Slab = Self wt of Slab + L.L + D.L

Self weight of Slab = 3 x 150 = 450 lb/ft²

total load = W = 450 + 1500 + 300 = 2250 lb/ft²

2. Co-efficient of Earth pressure:

$$Ka = \frac{1-\sin\phi}{1+\sin Q} = \frac{1-\sin 30}{1+\sin 30} = 0.33$$

$$\boxed{Ka = 0.33}$$

Latral pressure:

(I) Lateral pressure due to (DL + L.L)

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

= (300 + 1500) × 0.33 = 594

= 594 lb/ft²

(II) Lateral pressure due to Soil:

= ka × γ h

= 0.33 × 100 × 18

= 594 lb/ft²

(II) Lateral pressure:

ToP = Lateral pressure due to (DL + LL)

= 594 lb/ft²

Bottom:

Lateral pressure due to (DL+LL) +
Lateral pressure due to soil

= 594 + 594 = 1188 lb/ft² → **Answer**

End