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Section : B

Subject : Hydraulic Structure

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Q No 1 (a)

## Culvert :-

It is a tunnel structure constructed under roadways or railways to provide cross drainage or to take electrical or other cables from one side to other.

## Causeway :-

A causeway is a raised path or road that crosses water or wet land.

## Difference b/w culvert and a causeway

→ Culvert is used to for drainage in front of our homes gates.
→ It will used for drainage of water flowing in front of our homes.
→ It will gives us better way for drainage in roadways

→ Causeway a is road above the water.
→ It is also a road or path above wet land.

Q No 1. (b) :-

## Cross drainage Works :-

In an irrigation project, when the network of canals, branch canals, distributries, etc are provided then these canals may have to cross the natural drainage like rivers, streams, nallah etc. at different points within the command area of the project. The crossing of the canals with such obstacle cannot be avoided. So suitable structures must be constructed at the crossing point for the easy flow of water of the canal and drainage in the respective directions.

These structures are known as cross-drainage works.

## Necessity of Cross Dreinage works:-

→ The water shed canals do not cross natural drainage. But in actual orientation of the canal network. this ideal condition may not be available and the obstacle like natural drainages may be pressent across the canal. So. the cross drainage works must be provided for running the irrigation system.

→ All the crossing point, the water of the canal and drainage get intermixed. So. for the smooth running of the canal with its design discharge the cross drainage works are required

→ The site condition of the crossing point may be such that without any suitable structure. the water of the canal and drainage can not be diverted to their natural directions. So, the cross drainage works must be provided to maintain their natural direction of flow.

## Types of cross drainage works.

Type I.

**Aqueduct**:- The hydraulic structure in which the irrigation canal is taken over the drainage (such as river, stream etc) is known 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. If flows under siphonic action, it is known as siphon aqueduct.

Type II

**Super passage:-** The hydraulic structure in which the drainage is taken over the irrigation canal is known as super passage.

**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.

Type III

**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 with the help of regulators both in canal and stream.

## Inlet and outlet:-

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

Q NO 2.

## Difference between Weir Barrages.

**Weir** is an impervious barrier constructed across a river to raise the water level on the upstream side. The water raised up to the required height and the height and the water then flows over the weir. In a weir the water overflows in the weir.

**Barrage** is a weir that has adjustable gates installed over top of it to allow different water surface heights at different times. The water level is adjusted by operating the adjustable gates.

Q No 2. (b)

## Reynold's Number:-

It is the ratio of inertial forces to the viscous forces.
The Reynold's number is a dimensionless number used to categorize the fluids systems in which the effect of viscosity is important in controlling the velocities or the flow pattern of a fluid

$$Re = \frac{\rho v L}{\mu}$$

**Turbulent flow** occurs over a range of Reynolds numbers from approximately 2,00 to 4,000, regardless of the nature of the fluid or the dimensions of the pipe or the average velocity.

If Reynold's No. is greater than 4000, flow will be turbulent.

**Laminar flow** is the flow that corresponds with low velocities and Reynolds numbers less than 2100.

## Lower critical velocity:-

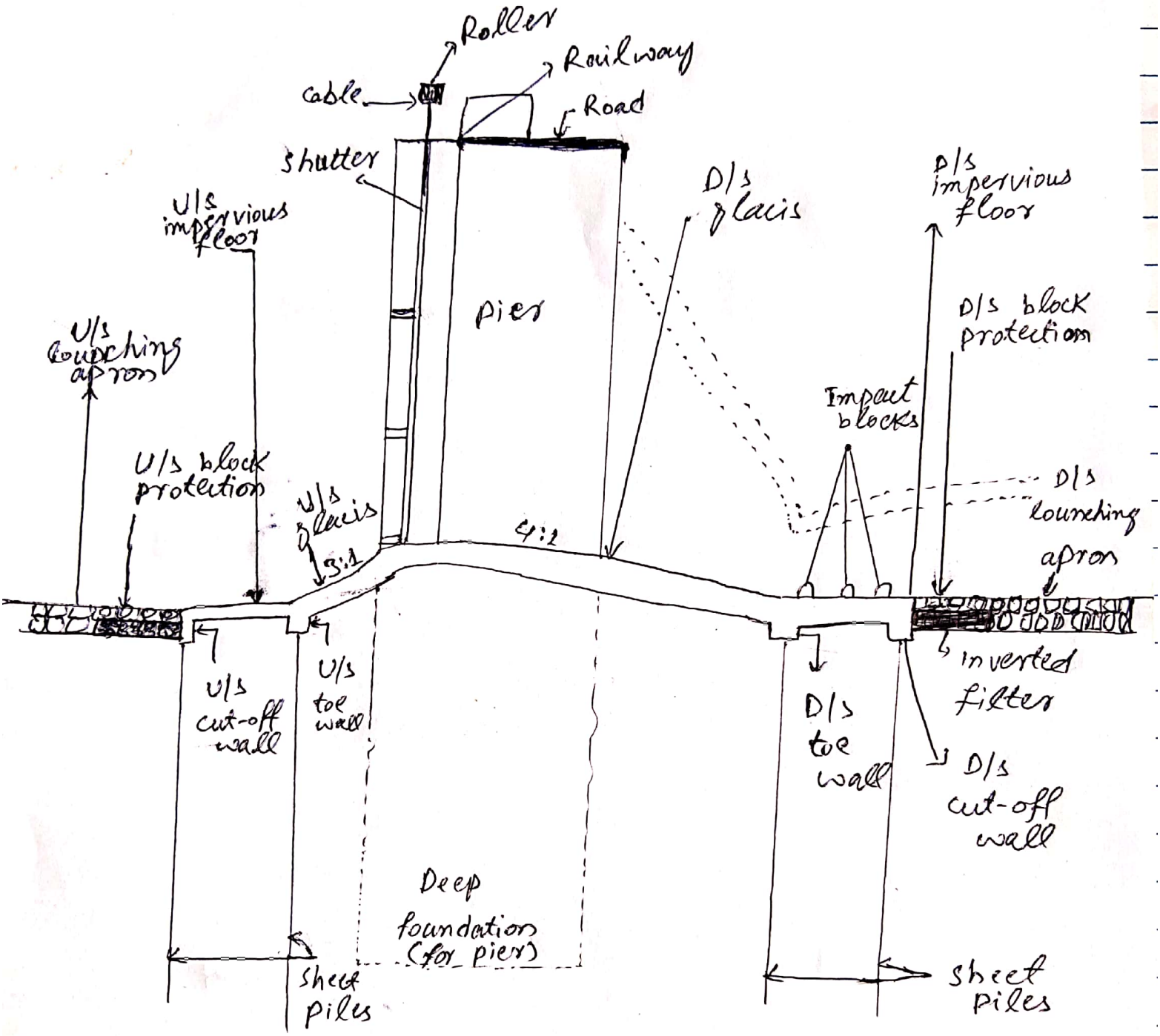
A velocity at which laminar flow stops.
OR The velocity at which the flow enters from laminar to transition period.

## Higher critical velocity:-

A velocity at which turbulant of flow starts.
OR A velocity during which flow enters from transition period to turbulent flow is known as higher critical velocity.

Q no 3 (a) (11)

Net sketch of Barrage.




(Component parts of Barrage)

## Q NO 3 (b)

**Answer:-** If the contracted width the bridge length L is less than the regime width the normal scour depth is then given by equation.

$$D_n = R_s (W/L)^{1} 0.61$$

where R is the regime scour depth. The maximum scour for single span bridge is 25% more than the normal depth if the bridge is multi span then the scour will be 100% more than the normal scour.

If the contraction is predominant the maximum scour depth is maximum from case 1 and case 2 and is given by

$$D_{max} = R_s (W/L)^{1} 1.56.$$

QNO 4.

Given data

Diamension = 15 ft x 15 ft

Live load = 1.5 Kip/ft$^2$ ⇒ 1500 lb/ft$^2$

Dead load = 300 lb/ft$^2$

Unit wt of soil = $\gamma_s$ = 100 lb/ft

Angle of response = 30°

grade of concrete = 1:2:4 = M15

fy = 60 Ksi

Thickness of slab = 0.92 ft.

Required:-

Design the box culvert = ?

**Solution:-**

(1) Load calculation

Total load carryin on top slab = self wt of slab + L.L + D.L — (1)

self wt of top slab

⇒ Thickness x grade of concrete.

= 0.92 x 25.1

= 13.8 lb/ft²

Now put in eq (1)

⇒ 300 + 1500 + 13.8 ⇒ 1813.8 lb/ft²

(ii) Co-efficient of earth pressure:

$$K_a = \frac{1 - \sin\phi}{1 + \sin\phi} \Rightarrow \frac{1 - \sin 30^\circ}{1 + \sin 30^\circ}$$

⇒ 0.33

(i) Lateral pressure due to dead and live load.

Total vertical load (Dead + live) x Ka

⇒ (300 + 1500) x 0.33

594 lbf·ft²

(2) Lateral pressure due to soil:

$K_a \times \gamma_b$

$\Rightarrow 0.33 \times 100 \times 15 + 0.92$

$\Rightarrow$ 525.36 lb/ft²

Lateral pressure due to top:

D.L + L.L

which are also calculated is = 594 lb/ft²

Lateral pressure due to bottom:

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

594.36 + 525.36

1119.75 lb/ft²