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Section : B

Subject : HYDRAULIC STRUCTURES

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Ans:01 "a" "Difference between culvert and causeway."

Culvert	Causeway
• A Transverse or enclosed channel for the draining of water under a road or railway.	A raised path, Track or road crossing marshlad, water, Sand e.t.c
• Work as a bridge To pass on it	Don't work as a bridge because it Supports a roadway between piers.
• A structure than can allows water to flow under a road, railway or similar obstruction from one Side to other Typically embedded; Pipe reinforced concrete.	A Track, road or railway on the upper point of an embankment constructed of masonry wood, or concrete.

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Ans:02 "b"

"Cross Drainage Works"

In an irrigation project, when the network of main canals, distributaries, branch canals e.t.c are provided, Then the natural drainages like rivers, Streams, nallah etc may have to cross by these canals at different points within the command area of the project. The crossing of these canals with such obstacles cannot be avoided. So, at the crossing point for the easy flow of water of the canal and drainage in the respective directions, suitable structures should be constructed. While these structures are known as "Cross Drainage works"

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※ "Necessity of Cross Drainage Works";

The water-shed canals don't cross natural drainages. But this ideal condition may not be available in actual orientation of the canal network. Thus the obstacles like natural drainges may be present across the canal. So, for running the irrigation system the cross drainage works must be provided.

The water of the canal and drainage get intermixed at the crossing point. So, for the smooth running of the canal with its design discharge the cross drainage works are needed.

The site condition of the crossing point can be such that without any suitable structure, the water of drainage and canal can't be diverted to their natural directions.

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So, to maintain their natural direction of flow the cross Drainage works should be provided.

✲ "Types of cross Drainage works;"

Type-I

"Irrigation canal passes over the Drainage".

This condition involves the construction of following two types;

"i" Aqueduct
"ii" Siphon Aqueduct.

- **"Aqueduct";** The Type of hydraulic structures in which the irrigation canals is constructed over the drainage such as; stream, river e.t.c, is known as Aqueduct.

When bed level of canal is above the highest flood level of drainage, then this structure is suitable.

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• "Siphon Aqueduct";

The Type of hydraulic structures in which the canal is passes over the drainage, But the drainage water can't pass clearly below the canal, so it flows under 'siphonic action'. It is known as siphon aqueduct. when the bed level of canal is below the highest flood level, this Type of structure is more suitable.

Type-II

"Drainage passes over the irrigation canal".

• Super passage;

The Type of hydraulic structure in which the drainage is passes over the irrigation canal is known as super passage. when the bed level of drainage is above the full suply level of canal this structure is suitable.

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- **"Siphon Super passage";**

The Type of hydraulic structures in which the drainage is taken over the irrigation canal but due to siphonic action the canal water passes below the drainage is known as Siphon Super passage. When the bed level of drainage is below the full supply level of the canal, this structure will be more suitable.

Type-III Drainage and canal intersect each other at same level.

- **"Level crossings";**

When the Quality of water in canal and stream is not much different and also bed level of canal and stream are approximatly same, the cross drainage works constructed is called level crossing.

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• "Inlet and outlet";

When irrigation canal intersect a small stream or drain at same level, So drain is allowed to enter the canal as in inlet. A part of water is allowed to drain as outlet from this inlet point. which eventually meets the origional stream. At the inlet and outlet stone pitching is required.
By stone pitching the bed and banks between inlet and outlet are also protected. This Type of CDW is known as inlet and outlet.

Ans;02 "Difference between weir and Barrage;"
"a"

"Weir";

The Type of hydraulic structure which are commonly used to control the flow rates of rivers during high discharge periods. To increase or decrease the discharge of water going out a Sluice gate are used.

"Barrage;"

While Barrage is an artificial barrier across a river or estury and can be used for many purposes like; to prevent flooding, Navigation, aid irrigation or to generate electricity by tidal energy.

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"b"

"Reynolds Number";

The ratio of inertial forces to viscous forces is known as Reynolds number.

- It is a dimensionless number.
- Mathematically;

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

Where; ρ = density
v = velocity
d = diameter
μ = Viscosity.

- Reynolds number is used to categorize the fluid system i.e Laminar, Turbulent.
- Reynolds number less than or equal to 2100 indicates laminar flow and N_{Re} greater than 4000 indicates Turbulent flow.

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- While Re between 2100 - 2800 indicates that the flow is neither laminar nor Turbulent. (Transition state).

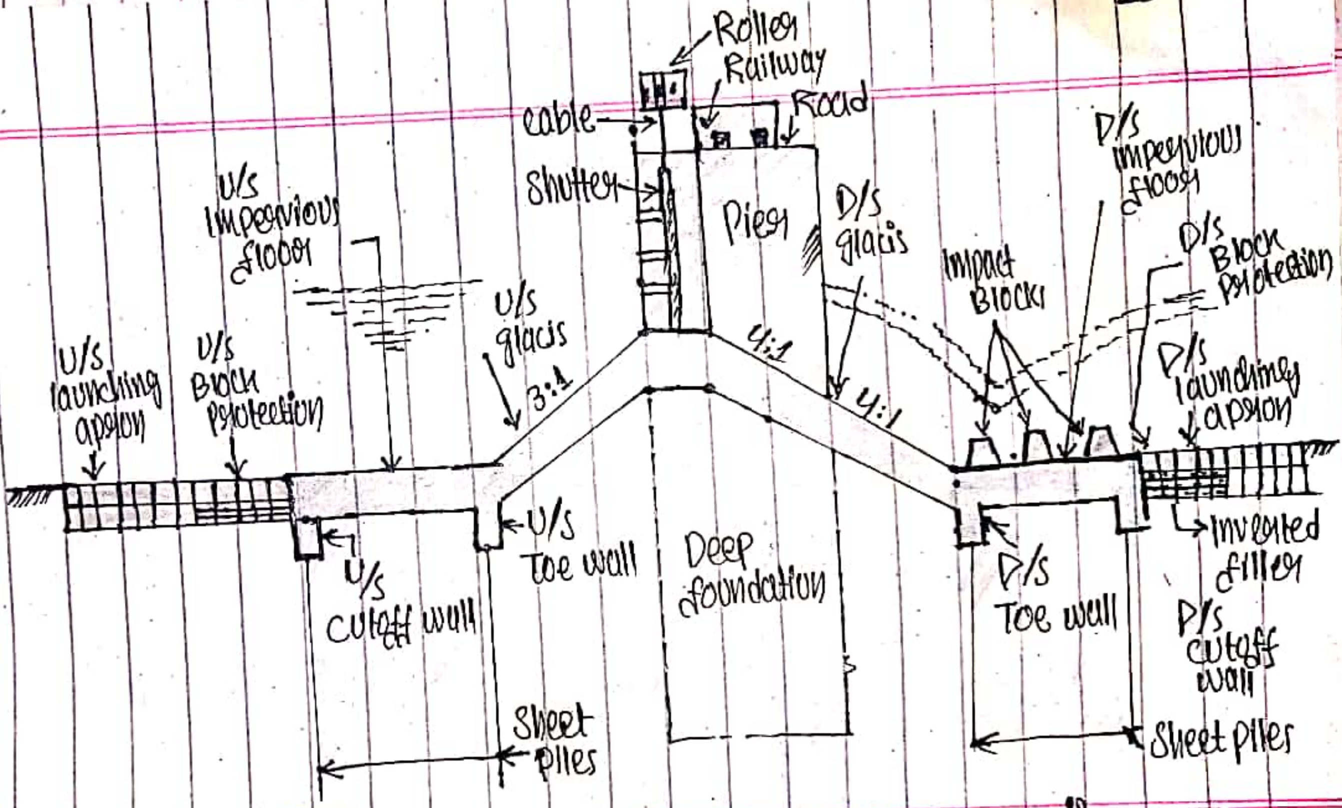
"Lower critical velocity";

The velocity at which the flow changes from laminar to Transition period is called lower critical velocity.

"Upper critical velocity";

The velocity at which the flow changes from transition period to Turbulent flow is called upper or higher critical velocity,"

Ans:03
"a"



"Different Components of Barrage"

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Ans:03 "b" "Equilibrium scour depth based on experimental formulas"

- To predict the maximum or equilibrium scour depth around bridge piers several formulas based on experimental results have been proposed.
In general, these assume relationship;

$$y_s/b' = \phi(y_o/b' \cdot F_r \cdot d/b')$$

b' = Pier width
y_o = upstream flow depth
d = Sediment size
F_r = flow Froude number.

- Laursen's (1962) suggested the formula;

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

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- Indian field suggest the formula;

$$Y_s/Y_0 = (B/b')^{5/7} - 1$$

Predicts the maximum scour depth.

- Local scour around the pier may be obtained by;

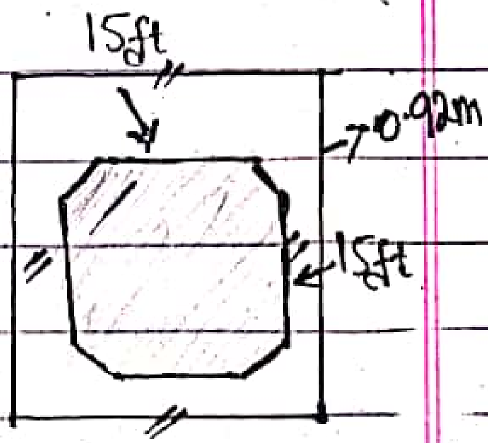
$$Y_s = 2.3 K_0 b'$$

K_0 = angularity co-efficient which is the function of pier alignment

Ans;04 "Designing a Box culvert"

Given data;

Dead Load = 300 lb/ft²
Live load = 1.5 Kip/ft²
θ = 30°
fy = 60 ksi
γ = 100 lb/ft³
concrete = 1:2:4



Solution;

Dead load = 300 lb/ft² = 0.3 Kip/ft²
Thickness = 0.92m = 3.0176 ft
Wt of concrete = 25 KN = 5.6202 Kips
γ = 100 lb/ft³ = 0.100 Kip/ft³

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"Load Calculation";

Total load coming on Top slab

= Self weight of slab + L.L + D.L —— (A).

⇒ Self weight of slab = Thickness × wt (concrete)

$= 3.0176 \times 5.6202$

$= 16.96 \ kip/ft^2$

Now By putting values in (A)

$W = 16.96 + 1.5 + 0.3 = 18.759 \ kip/ft^2$

Co-efficient of earth pressure.

$$K_a = \frac{1 - \sin\theta}{1 + \sin\theta} = \frac{1 - \sin 30^\circ}{1 + \sin 30^\circ} = 0.33$$

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Lateral pressure due to (D.L + L.L)

$$= K_a (D.L + L.L)$$

$$= 0.33 (1.5 + 0.3)$$

$$= 0.594 \text{ kip/ft}^2$$

Lateral pressure due to Soil.

$$= K_a (\gamma h)$$

$$= 0.33 (0.1)(15 + 3.0176)$$

$$= 0.594 \text{ kip/ft}^2$$

Lateral pressure at top;

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

$$\boxed{= 0.594 \text{ kip/ft}^2}$$

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※ "Lateral pressure at Bottom";

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

= 0.594 + 0.594

= 1.188 kip/ft²