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Section A

Subject Hydraulic Structure

Department BE(C)

Instructor Engr. Adeed.

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QNo 1
part (a)

Difference b/w Culvert and Causeway:-

Culvert:

Culvert is a tunnel carring a stream under a road or railway. A culvert may act as bridge for traffic to pass on it. They are typically found in a natural flow of water and serves the purposes of bridge or a current flow controller.

→ They also control flood in rainy season.

Causeway:

It is a road paved dip which may have open passage to step or allow lower water flow. The bed of stream which allows flood water to pass alway over its flow.

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QNo1
part (b)

Cross-drainage work:-

It is the structure carring the discharge from a natural stream across a cannal intercepting the stream as known as cross drainage work.

→ Cannal comes across obstructions like rivers, natural drains and other canals.

→ CWD is a costly item and should be avoided by.

★ Diverting one stream into another.

★ Changing adjacent of canal so that it crosses below the junction of two stream.

Necessity of cross drainage works:-

→ The water-shed cannals do not cross natural drainage. But in actual orientation of the cannal network this ideal condition may not be available and obstacles like natural drainages may be present across the cannal.

→ At the crossing point, the water of the cannal and the drainage get intermined The Smooth running of the Cannal 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 Cannal and drainage can not be divereted to their natural direction. so the cross drainage works must be provided to maintain their natural direction of flow.

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Types of cross drainage works:-

cross drainage have the following types.

(1) Type 1:- Irrigation cannal passes over the drainage.
(a) Aqueduct
(b) Siphon Aqueduct.

(a) Aqueduct:-

→ The hydraulic structure in which the irrigation cannal is taken over the drainage (such as river, stream etc) is known as ~~ad~~ aqueduct. In this case the drainage water passes clearly below the cannal.

(b) Siphon Aqueduct:

The cannal is taken over the drainage, but the drainage

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water cannot pass clearly below the cannal. It flows under siphon action. So it is known as siphons aqueduct.

→ This structure is suitable when the bed level of cannal is below the highest flood level.

Type- II

Drainage passes over the irrigation cannal:

(a) Super passage:- A super passage is similar to aqueduct except that in this case the drain is over the irrigation cannal.

→ This drainage is suitable when the bed level is much above the supply level of cannal.

→ Most of the water are clearly passes below the drainage.

(b) Siphon Super passage:
In the hydraulic structure the drainage is taken over the irrigation cannal.

→ while the cannal water is passes below the drainage under siphon action is known as siphon super passage.

→ The structure are suitable when the bed level of drainage is below the full supply of the cannal.

Type III
Drainage and cannal intersect each other at the same level.

(a) Level crossing.
(b) Inlet and outlet.

(a) Level crossing:-

When the bed level of cannal and the stream are approximately the same quality of water in cannal and stream is not much different, the cross drainage work constructed is called level crossing where water of cannal and is stream is allowed to mix. Leveling crossing consists of following components

(i) Crest wall
(ii) Stream regulator
(iii) Cannal regulator.

(b) Inlet and outlet:-

The irrigation cannal meets a small stream at same level, drain is allowed to enter the

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Cannal as in inlet.
~~A~~ At Some distance from this inlet point, a part of water is allowed to drain as outlet which is eventally meets the orignal stream.
The beds and banks between inlet and outlet are also protected by stone pitching.

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QNo2

Part (a)

Difference b/w weir and barrage:-

Weir	barrage.
→ It is a solid construction put across a river to raise the water level.	No solid construction is put across the river. Heading up of water is affected by gates.
→ Less costly	Mostly costly
→ No control over the water level.	Better control over the water level.
→ No attention is required at the time of flood	At the time of floods the gates are raised and lowered.

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→ After long time, silting problem is there.	No silting problem.
→ Weir is generally a structure which is of concrete or masonary and constructed across the open channel to change its water flow characterics	A barrage is a type of low head, diversion dam which consist of a number of large ~~ch~~ gates that can be opened or closed to control the amout of water passing through.
→ Weir is built to raise the level of water upstream or regulate its flow.	There are gates or sluices, that open to let water in as the tide rises and out after its falls.

Q No 2
part b.

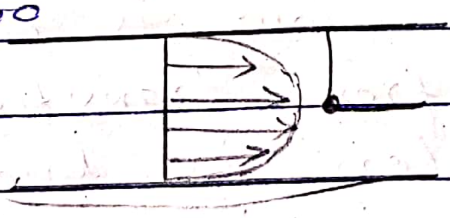
Reynold's number:
The reynold's number is an important dimensionless quantity in fluid mechanics used to help predict flow patterns in different fluid flow situations.

$$Re = \frac{\rho . V . D}{\mu}$$

Limit of Reynold's number for laminar, turbulent & transition Flow:-

- **Limit for Laminar flow:** The limit for laminar flow is lower than 2000.

i.e $Re < 2000$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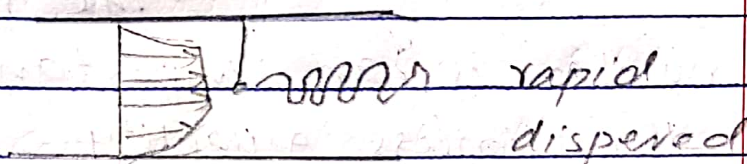
Laminar flow.

Limit for turblent Flow:-

The limit for turblent flow is greater 4000

$Re > 4000$



Flow Neither Laminar nor turbulent

The flow which is neither laminar nor turbulent are called transition flow.

→ The limit for transition flow is in between the laminar and turblent flow, or greater than laminar and less than turbulent flow.

$$2000 < Re < 4000$$

Lower and higher critical velocity :-

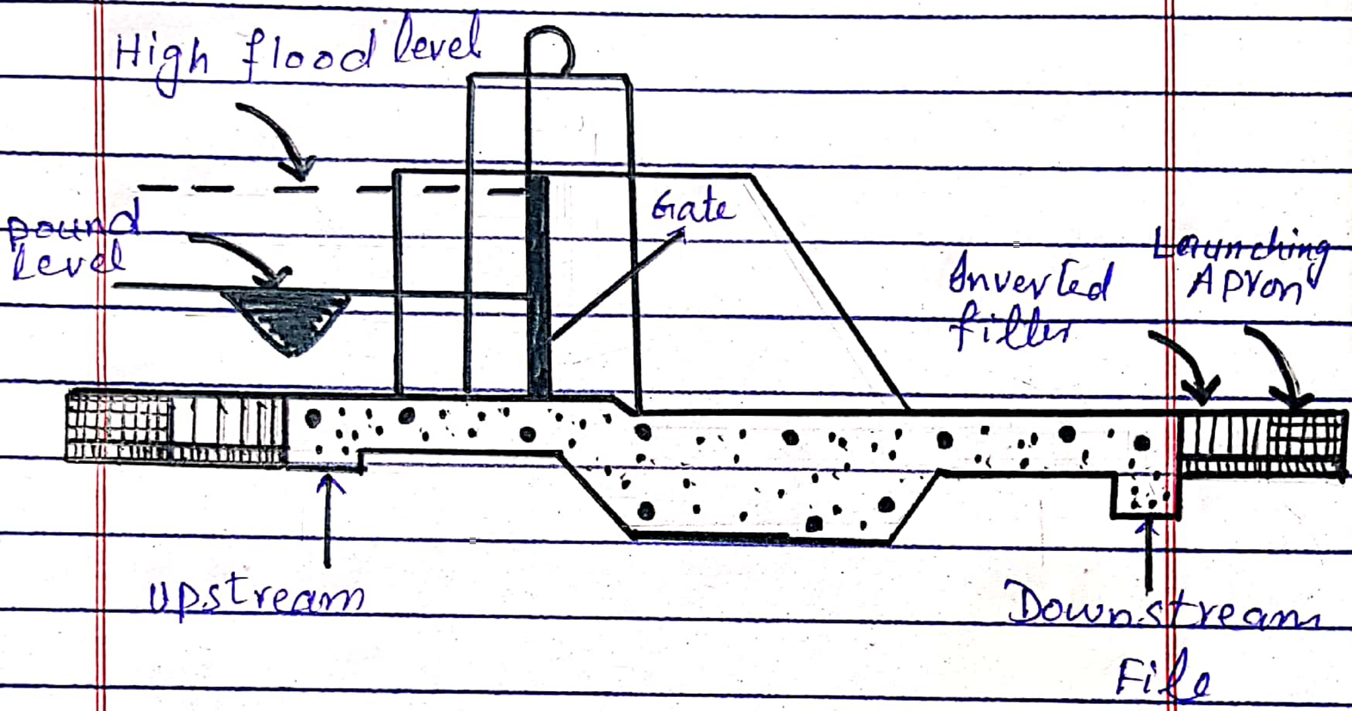
Lower critical velocity :-

The velocity at which flow converted/enter from laminar to transition as known as lower critical velocity.

Higher critical velocity :-

Higher critical velocity is that velocity in which flow is converted or enter from transition to turbulent is known as higher critical velocity.

QNo3
part (a)



Component of Barrage.

Q No 3
part (b)

To predict the maximum or equilibrium scour depths, several formulae based on experimental results have been proposed. In general these assume the relationship.

$$y_s / b' = \phi \left(y_0 / b', Fr, d/b' \right)$$

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

Lauren's (1962), his experimental results underestimate the scour depths, compared to many Indian experiments (Inglis, 1949) which suggest the formula (approach flow

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is normal to the bridge piers).

$$y_s/b' = 4.2 (y_o/b')^{0.78} Fr^{0.5}$$

The India field data also suggests that that scour depth should be taken as twice the regime scour depth.

In the case of live feds (a stream with bedload transport the formula

~~ys=/~~

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

This formula predicts the maximum equilibrium scour depth.

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Q No 4

Given data:

Live load = 1500 lb/ft^2

Dead load = 300 lb/ft^2

Angle of repose, θ = 30°

Dimension = 15' x 15'

Thickness = 0.92m ⇒ 3ft

Unit weight of soil = 100 lb/ft^3

f_y = 60 ksi

Unit weight of ~~self~~ RCC concrete = 156 lb/ft^3

(Plain concrete unit weight is 150 lb/ft^3 but we consider R.C.C concrete i-e 156 lb/ft^3).

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Solution:-

→ Self wt of slab =

= thickness × Unit wt of RCC Concrete

$= 3\,ft \times 156\,lb/ft^2$

$= 468\,lb/ft^3$

→ Total load = L.L + D.L + Self wt

$= 1500 + 300 + 468$

$= 2268\,lb/ft^2$

→ Co-efficient of earth pressure =

$$= \frac{1 - \sin\theta}{1 + \sin\theta}$$

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

$= 0.33$

→ Lateral pressure

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→ Vertical pressure at top

$(L.L + D.L) Ka$

$(1500 + 300) 0.33$

$= 594\ lb/ft^2$

→ pressure of soil

$Ka \times h \times$ unit wt of soil

$0.33 \times (15' \times 3') \times 100$

$0.33 \times 18 \times 100$

$= 594\ lb/ft^2$

→ Lateral pressure at top = $594\ lb/ft^2$

→ pressure at bottom

= top + pressure of soil

$= 594 + 594$

$= 1188\ lb/ft^2$