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Subject : Hydraulic Structure

Assignment # 02

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Q1 Part A

Causeway: A causeway is a track, road or railway on the upper point of an embankment across a low or wet place, or piece of water. it can be constructed of earth, masonry, wood or concrete. one the earliest known wooden causeway is the Sweet Track in the Somerest levels.

Culvert: A culvert is used primarily to convey water through any type of flow obstructions. it is also used as a passage for pedestrian, stock, wildlife and fish as well as for land access and to carry utilities. we mainly focuses on drainage application of culverts, i.e to convey canal water under road or rail way lines.

Q1 Part B

Cross Drainage Works :- structure are constructed at the crossing point of water bodies for the easy flow of water of the canal & drainage in the respective direction. these structure are known as cross drainage works.

Necessity of cross drainage works

- The water-shed canals do not cross natural drainage But it actual orientation of the canal network. This ideal condition may not be available and the obstacles like natural drainage may be present across the canal so, the cross drainage works must be provided for running the irrigation system.

- At the crossing point, the water of the canal & the 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 with out any suitable structure the water of the canal & drainage can not be diverted to their natural direction so, the cross drainage work must be provided to maintain their natural direction of flow.

Types of cross Drainage Works

1) Irrigation canal passes over the Drainage
this condition involves the construction of following

- **Aqueduct** :- The hydraulic structure in which the irrigation canal is taken over the drainage (such as river, stream etc) is know 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.

- **Siphon Aqueduct** : In a hydraulic structure where the canal is taken over drainage. but the drainage water cannot pass clearly below the canal. it flow under siphonic action. so it is known as siphon aqueduct. this structure is suitable when the bed level of canal is below the highest flood level.

2) Drainage Passes over the irrigation canal.

- **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 supply of the canal.

- **Siphon super passage** :- The hydraulic structure in which the drainage is taken over the irrigation canal. but the canal water passes below the drainge under siphonic action is known as siphon super passage

3) Drainage & canal intersect each other at same level.

- **level crossing** :- when the bed level of canal & the stream are approximately the same & quality of water in canal and stream is not much different. the cross drainge work is constructed in level where canal & stream water is allowed to mix.

- **inlet & out let** :- when irrigation canal meet at same level. drain is allowed to enter the canal as is inlet. At some distance from this inlet point a part of water is allowed to drain as outlet which eventully meets the orignal stream.

Q2 Part A

Weirs -weir is a solid obstrution put across the river to rise the level & diverts the water into the offtaking canal situated on one or both of the river bank just upstream of the weir.

- weir are usually aligned at right angles to the direction of Flow in the river.
- To increase the water level, the weir crest is raised above the river bed.
- part of the rising of the water level is obtained by shutter provided at the top of the weir crest.

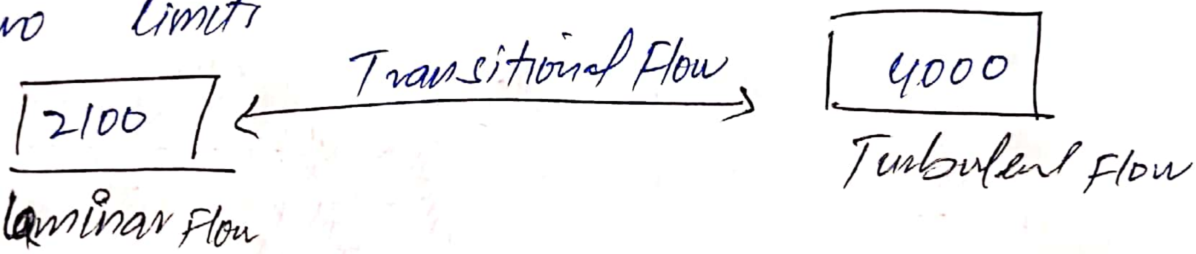
Barrages :- -controlling pond level by means of shutter becomes difficult when the difference b/w the pond level and the crest level is higher than 2m, in such cases a gate-controlled weir, better known as barrage is Prefered.

- A barrage & weir are similar structure & differ only in a qualitative sense. The crest of a barrage is usually at lower level and the ponding up of the river for diversion into the offtaking canal is achieved by means of gates (instead of shutters)

Q2 Part B

Reynold's number is the ratio of inertial Forces to viscous Forces. The Reynold number is a dimensionless number used to categorize the fluid system in which the effect of viscosity is important in controlling the velocities or the Flow pattern of a Fluid

The Reynold's number (based on diameter of the pipe) is less than 2100 For laminar Flow. and greater than 4000 For Turbulent Flow and Transitional Flow prevails between the Two limits

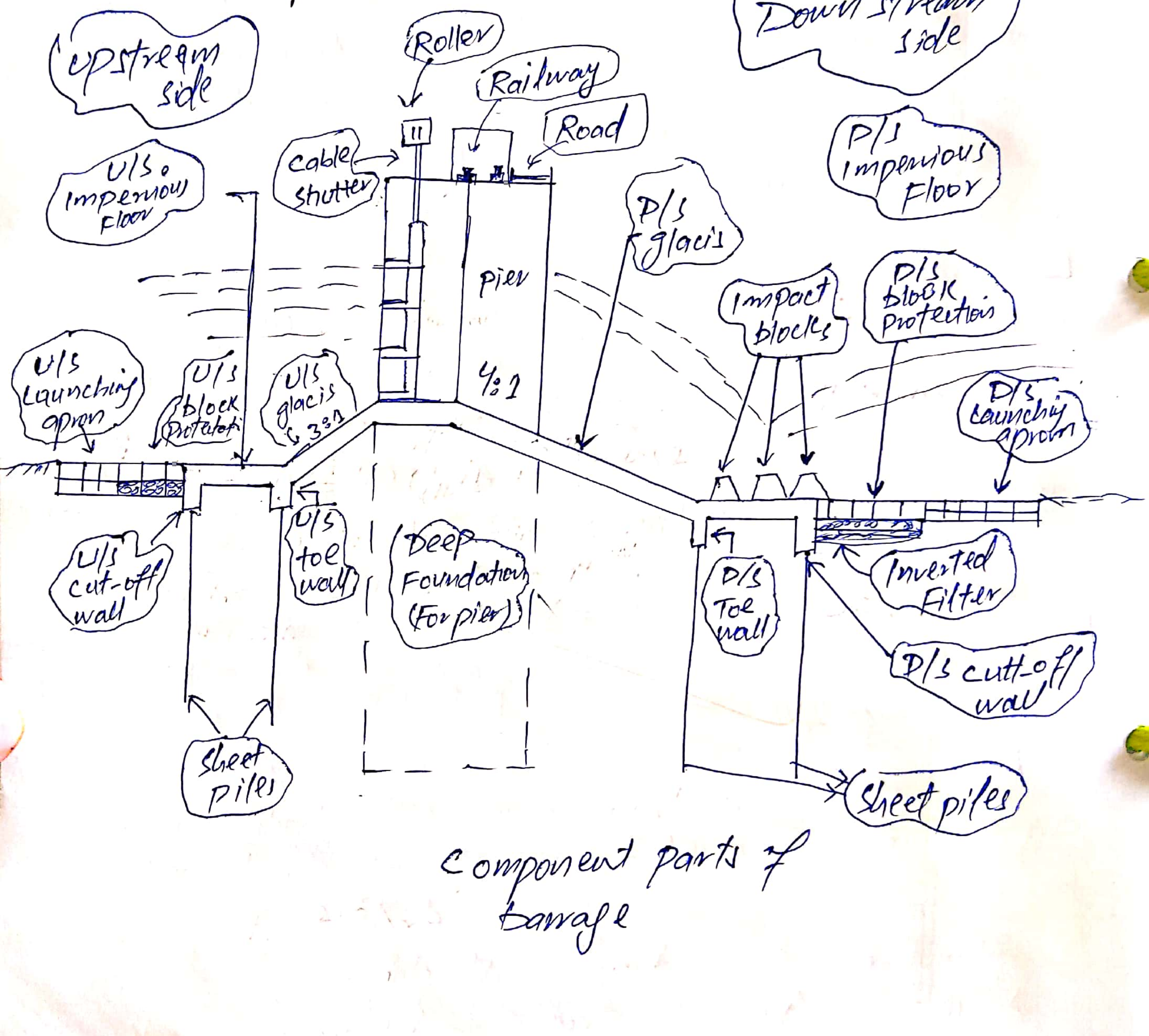


Critical velocity :- The velocity at which the Flow changes from laminar to turbulent is Known as critical velocity

low critical velocity :- A velocity at which laminar Flow stops "OR"
The velocity at which the Flow enters from laminar to Transition period is Known as lower Critical Velocity

Q3 Part A

Draw neat sketch of barrage showing different component?



Component parts of barrage

Q3 part B

several Formula based on experimental result have been proposed to predict the max or equilibrium scour depth (y_s, below general bed level) around bridge piers. In general, these assume the relationship

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

∴ b' is the pier width, y_0 is the upstream Flow depth, d is the sediment size, and Fr is the Flow Froude number.

Laursen's (1962) experimental results underestimate the scour depth, compared to many indian experimental (inglis 1949) which suggest the Formula (approch Flow is normal to the bridge piers)

$$Y_s/b' = 4.2\,(y_0/b')^{0.78}\,Fr^{0.52}$$

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

In this case of live beds (a stream with bedload transport) the Formula

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

Predicts the max equilibrium scour depth.

In a relatively deep Flow a First-order estimate of (clear) local scour (around pier) may be obtained by

$$y_s = 2.3\,K_\alpha\,b'$$

where K_α = angularity coefficient which is a Function of the pier alignment i.e: angle of attack of approch Flow.

Given Data

$L.L = 1.5\ Kip/ft^2$

$D.L = 300\ lb/ft^2$

$\theta = 30^\circ$

unit weight of soil = $100\ lb/ft^3$

Dimension = $15' \times 15'$

$f_y = 60\ Ksi$ steel

Concrete = 1:2:4 = M_{15}

sol

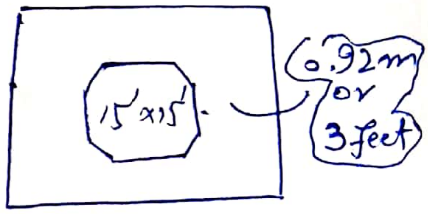
① Load calculation

Total load on Top = Self weight + L.L + D.L

~~self wt ff~~ = ~~0.3~~ x

Consider thickness is 0.92m

~~self~~ self wt = $3 \times 15 = 45\ KN/m^2$



$45\ KN/m^2 = 0.939\ Kip/ft^2$

W = Total load = 1.5 + 0.939 + 0.3

$W = 2.739\ Kip/ft^2$

② coefficient of earth pressure

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

$K_a = 0.33$

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

= Total vertical load (L.L + D.L) x Ka

= (1.5 + 0.3) 0.33

= **0.594 Kip/ft²** or **28.4 KN/m²**

Lateral pressure due to soil

$= Ka \times \gamma_{soil} \times h$

~~= 0.33 × 100 × 18~~

= 0.33 × 0.1 × 18

= **0.594 Kip/ft²** or **28.4 KN/m²**

Lateral pressure at top

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

= **0.594 Kip/ft²** or **28.4 KN/m²**

at Bottom → Lateral pressure due to (L.L + D.L)

+ Lateral pressure due to soil

= 0.594 + 0.594

= **1.188 Kip/ft²** or **56.88 KN/m²**