Q#01:- Part (a):-

Answer:- **Culvert:-** 1) Culvert is a structure that allow water to flow under a road, rail road, trail or similar obstruction from one side to another side.

2) The components of culverts are comparatively simpler and include concrete boxes or cells (single or multiple), pipes, a top deck or slab and supporting parts

3) Culverts are built at less then 20 feet high over the obstruction

4) Culverts can be pre-constructed or built at the site (In situ culverts)

5) Culverts are simpler in structure and design, so it can be constructed with less time and labor

6) No deep foundation is required for a culvert and its construction can be done with a low budget.

Cause Way:- 1) 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.

2)- A Causeway is Route raised upon an embankment

3)- It may have or may not have opening for low water to flow

4)- In Masonry Causeway constriction equal to the width of route and desired height may provided.

5)- It is made of Concrete, Masonry, Earth fill

6)- It is longer and narrower.

Q# 01:- Part B:-

Answer:- It is irrigation structures constructed for carrying the canal water safely over or under the drainage water are called as cross drainage works. When a canal is taken off from the reservoir it meets various natural drainage so cross drainage works are required to be constructed.

The various types of structures that are built to carry the canal water across the above mentioned obstructions or vice versa are called cross drainage work it is generally very costly item and should be avoided by.

See page # 03

1) Diverting one stream into another
2) Changing the alignment of the Canal so that it crosses below the Junction of two Streams

TYPES of Cross Drainage WORK

Depending upon levels and discharge, Cross drainage works may be grouped into following types

A. Canal crossing over a Drain

1) **An Aqueduct:-** It is an artificial channel for conveying water, typically in the form of a bridge across a valley or other gap

2) **Siphon Aqueduct:-** In a hydraulic structure where the Canal is taken over the drainage water cannot pass clearly below the canal it flows under Siphonic action. So it is known as Siphon aqueduct

B. Canal Crossing Under a Drain

1) **Super Passage:-** The hydraulic Structure in which the drainage is taken over the irrigation Canal is known as Super passage

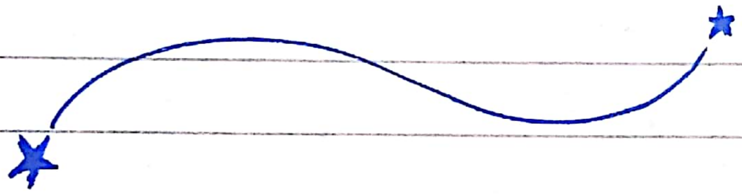
2) **Siphon:-** A Tube used to Convey liquid upward from a reservoir and then down to a lower level of its own accord. Once the Liquid has been forced into the Tube typically by suction or immersion flow continues unaided.

C- Canal Crossing a Drain at the Same Level

1) **Level Crossing:-** A place where a railway and a road, or two railway lines, cross at the same level.

2) **Drainage Inlet and Outlet:-**

Inlet and outlet features allow water to flow into and out of features and also limit the rate at which water flows along and out of the system.



Q#02:- Part# A:-

Answer:- Weir:→ In a weir the water overflows the weir, but in a dam the water overflows through a special place called spillway. weir have traditionally been used to create mill ponds

Barrage:- A barrage is a weir that has adjustable gates installed over top of it, to allow different water surface heights at different times

Q#02:- PART# B

Ans:- **Reynolds Number:-** The Reynolds number is the ratio of inertial forces to viscous forces. The Reynolds 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 patterns of a fluid.

The limit of Reynold's number for laminar flow is 2100.

The limit of Reynold's number for turbulent flow is 4000. ~~or above~~

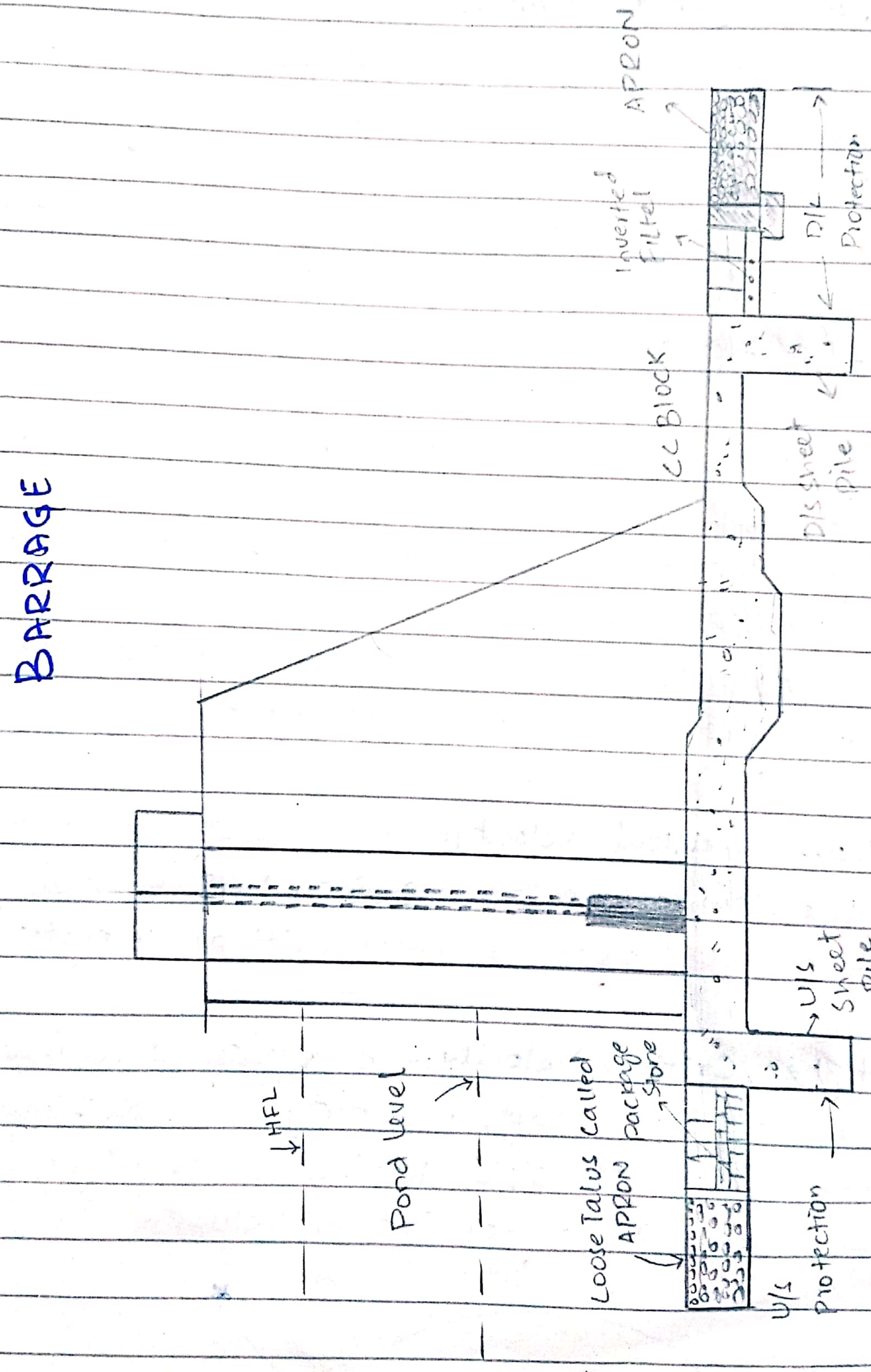
The limit of Reynold's number for transition flow is in between 2100 − 4000.

Lower Critical Velocity: The velocity at which the flow enters from laminar to transition period is known as lower critical velocity

Higher Critical Velocity:- A velocity at which turbulent flow starts. A velocity in which flow enters from transition period to turbulent flow is known as higher critical velocity

Q#03:- Part# A

Ans:-



Q#03:- Part: B:-

Ans:- Several formulae based on experimental results have been proposed to predict the "maximum" or "equilibrium" scour depth (Y_s, below general bed level) around bridge piers. In general these assume the relationship

$$Y_s/b' = \phi(Y_o/b', Fr, d/b')$$

∴ b' = Pier width
∴ Y_o = upstream flow
∴ d = sediment size
∴ Fr = Froude number

Laursen's (1962) experimental result underestimate the scour depth compared to many Indian exp: (Inglis 1949) which suggest the formula

$$Y_s/b' = 4.2(Y_o/b')^{0.78} Fr^{0.52}$$

The Indian field data also suggest the scour depth should taken as twice

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

Predict the max: equilibrium scour depth

$$Y_s = 2.3 K_\alpha b'$$

K_α = angularity co-efficient which is function of the pier alignment i.e angle of attack of approach flow

Q#04:-

Sol:- **Given Data:**

Length = 15 ft

Width = 15 ft

Live load = L.L = 1.5 Kip/ft^2

Dead load = D.L = 300 lb/ft^2

≈ " = 0.3 kip/ft^2

Unit wt: of Soil, γ = 100 lb/ft^3

≈ " = 0.1 Kip/ft^3

Angle, $\theta = 30^\circ$

Mix design = 1:2:4

Steel f_y = 60 ksi

Thickness = 0.92 m ⇒ 3.02 ft

Required: Design Culvert

Sol:- Total load carrying on Top Slab

For self wt: of Slab = $\gamma \times h$

= 150 × 3.02

= 453 lb/ft^2

= 0.453 kip/ft^2

w = Total load = 1.5 + 0.3 + 0.453

w = 2.253 kip/ft^2

② Co-efficient of earth Pressure

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

$$Ka = \frac{1 - \sin 30}{1 + \sin 30} \qquad Ka = 0.333$$

③ Lateral Pressure due to (D.L+L.L)

$= $ Total verticle load

$= (L.L + D.L) \times Ka.$

$= (1.5 + 0.3) \times (0.333)$

$= 0.5994 \text{ Kip/ft}^2$

④ Lateral pressure due to Soil :-

$= Ka \times \gamma \times h$

$= 0.333 \times 0.1 \times 18.02$

$= 0.6 \text{ Kip/ft}^2$

Now lateral pressure @ top = lateral pressure due to (D.L+L.L)

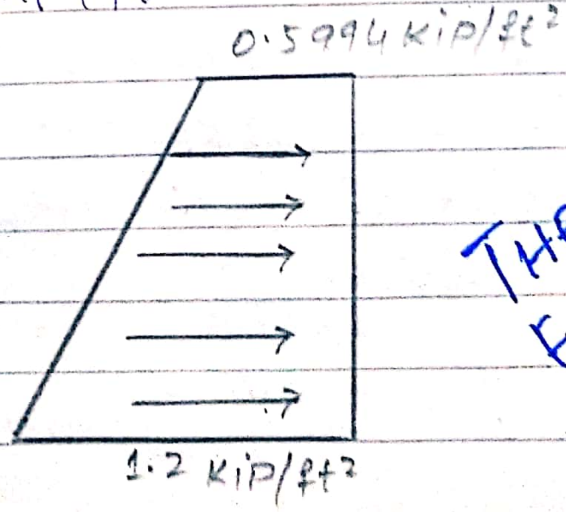
$= 0.5994 \text{ Kip/ft}^2$

Also

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

$= 0.5994 + 0.6$

$= 1.2 \text{ Kip/ft}^2$



THE END