7530

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Final Examination

Hydraulic structure

Sir Engr Adeed.

Q1(a)

Culvert:-

Culvert may be defined as the opening through an embankement for the conveyance or passing of water by the pipes or an any enclosed channel

⇒ It is totally enclosed drain. under a road.

Types of culverts

1) Arch culvert
2) pipe single or multiple
3) Pipe Arch single or multiple

Cause way:-

A causeway is a road or railway route across the body of the water or wetland raised up on the embankement.

⇒ It is a track or, road or railway on the upper point of an embankement across a low or wet place

⇒ It can be constructed of earth masonry, wood or concrete.

Types of Causeways

» Low level,
» High level causeways.

Q1 (b) Cross Drainage work

A(b)

In the ~~Drags~~ Irrigation, when the network of main canals, branch canals, distributries etc are provided, then these canals may have to cross the natural drainage like rivers, streams, nallah's etc at diffaent point with in the command area. The crossing of the canals with such obstacles cannot be avoided. so suitable structures must be constructed at the crossing point for the easy flow of the water of the canal & drainage in the respective direction. These structures are known as cross drainage works.

⇒ It is a structure carrying the discharge from a natural stream accross a canal intaccpting the stream. Canals come accross obstruction like rivers Eg natural drains etc.

## Necessity of Cross Drainage work:-

⇒ 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 obstacles like natural drainage may be present accross the canal. So the cross drainage works must be provided for the the irrigation system.

⇒ At the crossing point, the water of the canal & drainage get intermixed. So for the smooth running of the canal with its design discharge across drainage works are required.

⇒ Cross drainage work must be provided to maintain the natural direction of flow.

# Types of C.D.W

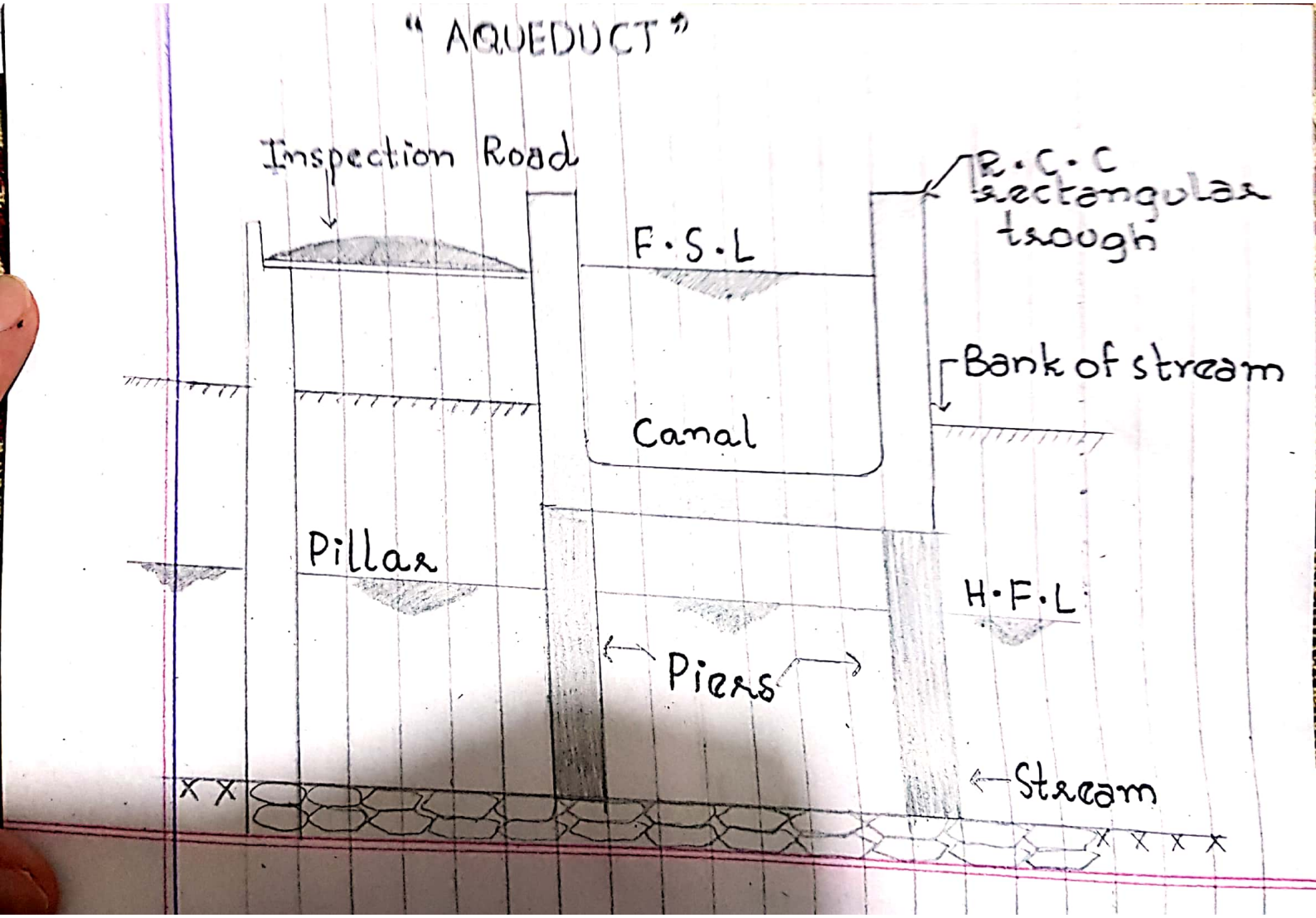
## Type 1 (Irrigation Canal Passess over the drainage.

a Aqueduct:-

The hydrulic structure in which the irrigation canal is taken over the drainage such as streams, rivers etc is known as aqueduct.

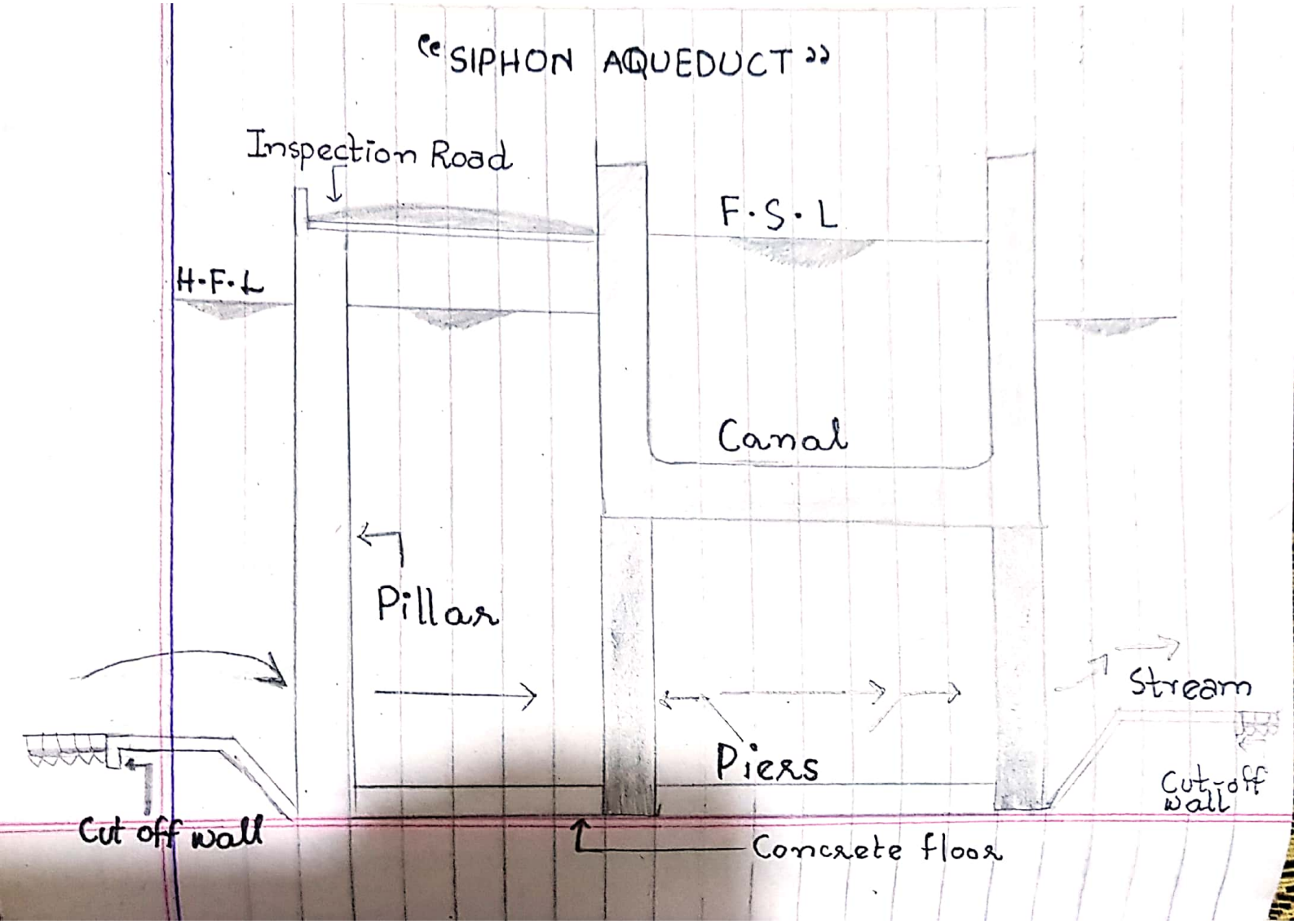
⇒ This structure is suitable when bed level of canal is above the highest flood level of drainage. On this the drainage water passess clearly below canal

# "AQUEDUCT"



## Siphon Aqueduct :-

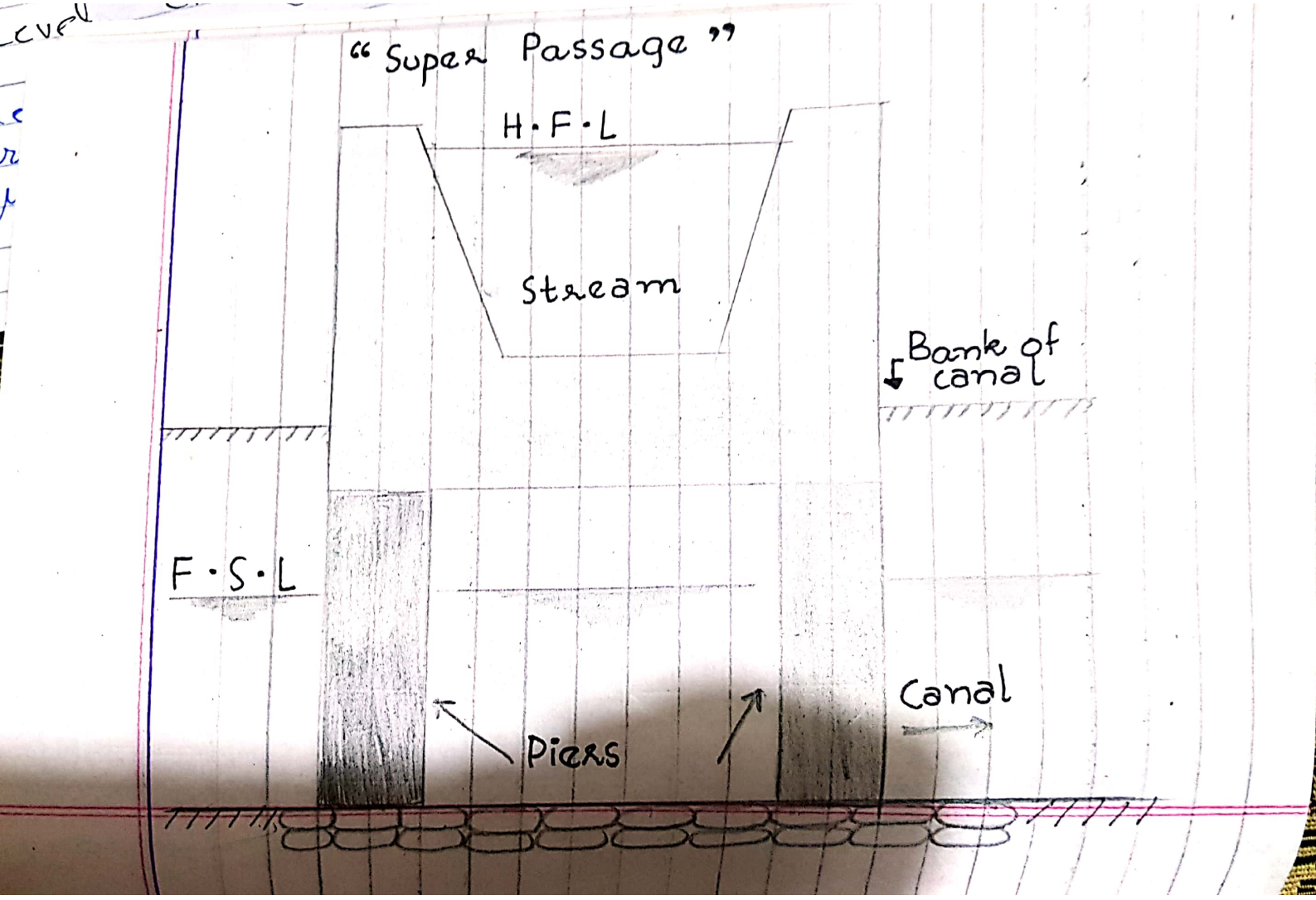
When the canal is taken over the drainage water cannot pass clearly below canal... It flows under siphonic action. This structure is suitable when the bed level of the canal is below the highest flood level.



Type 2 (Drainage passess over the irrigation canal)

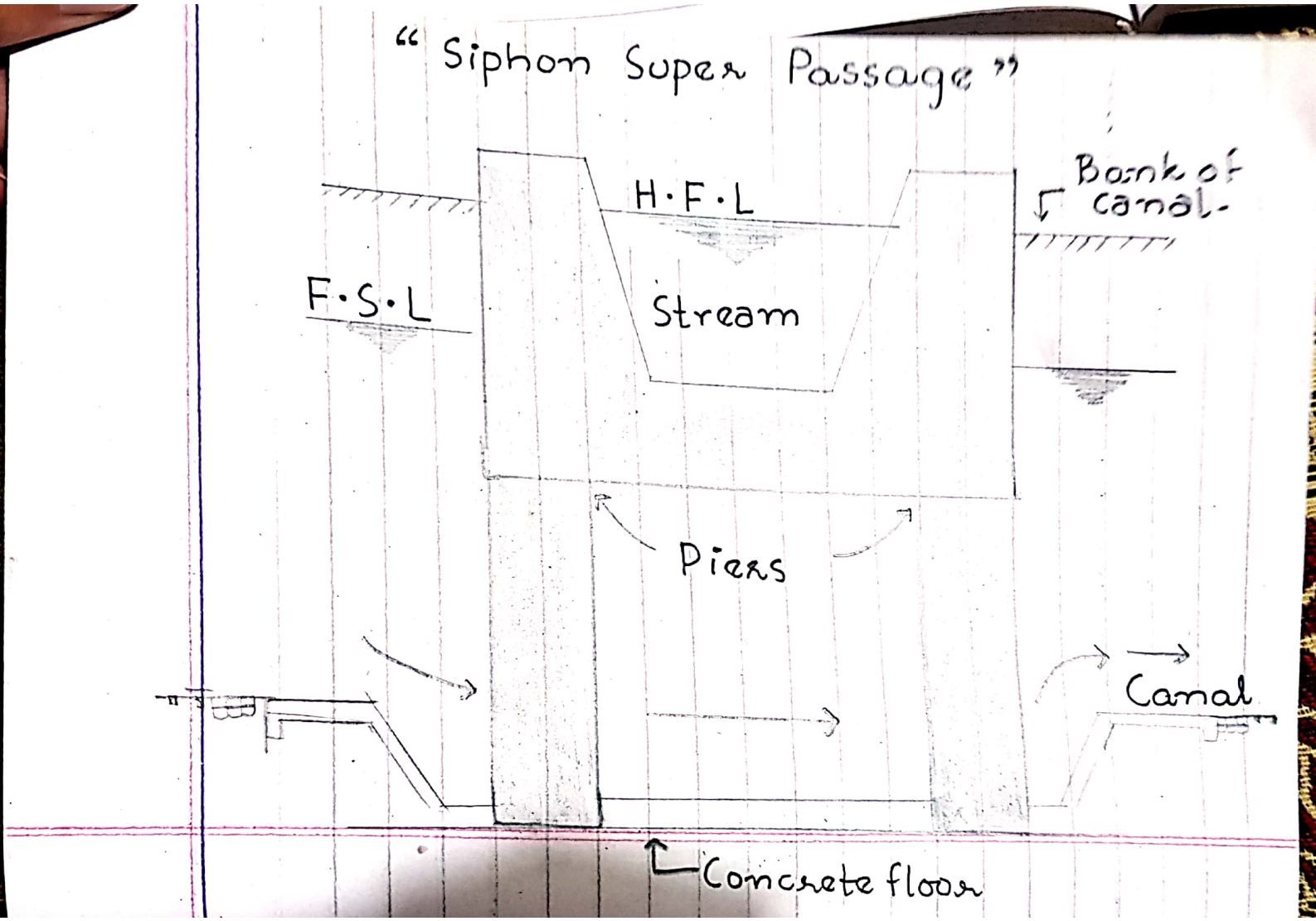
(a) Supa passage :-

The hysdraulic structure in which the drainage is taken over the irrigation canal is known as supce passage



(b) Siphon supa passage:-

The hydraulic structure in which the drainage is taken over the canal, but the canal water passes below the drainage under siphonic action is known as Siphon supa passage.



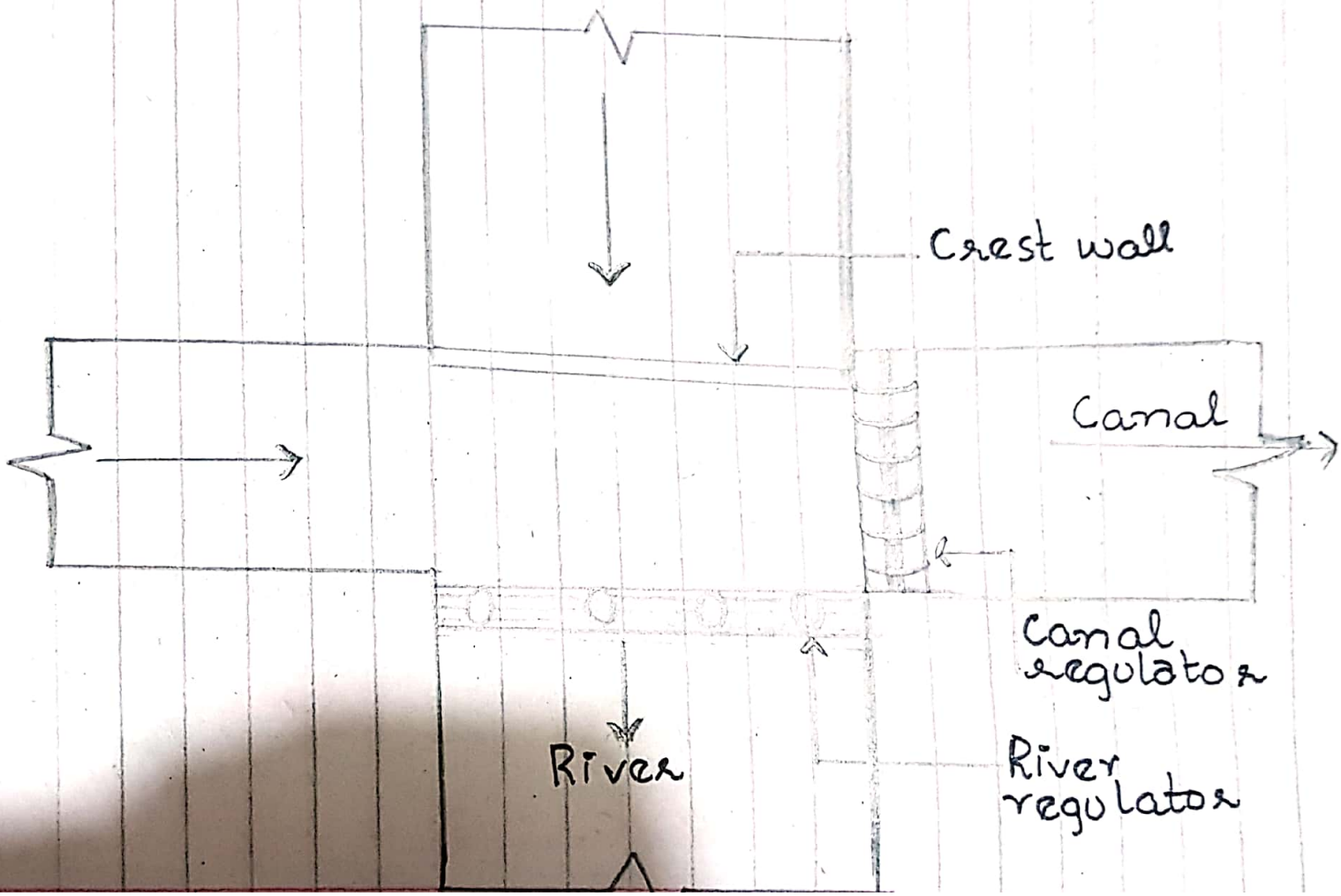
Type 3 (Drainage & canal intersect other at same level

Level crossing :-

when the bed level of canal & the stream are approximately the same & quality of water in canal

Eg stream is not much different
the cross drainage work
constructed is called level crossing
where canal water stream
is allowed to mix. water is
disposed through canal Eg stream
in required quantity.

"Level crossing"

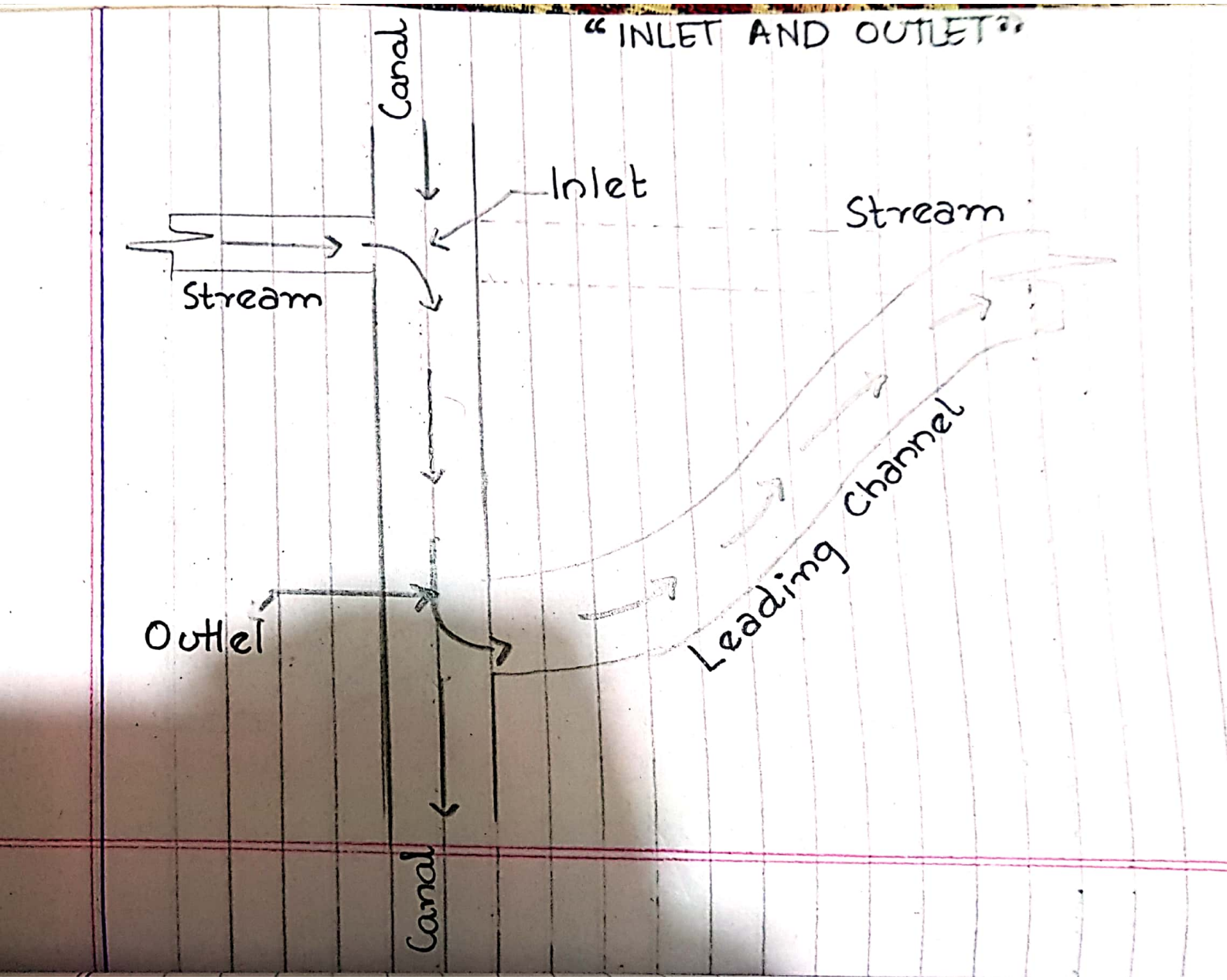


# Inlet & outlet:-

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

⇒ Stone pitching is required at the inlet & outlet.

"INLET AND OUTLET"



Q2 (a)

Weir :-

are commonly used to control the flow rates of rivers during periods of high discharge

=> Sluice gates are used to increase or decrease the volume of water going out.

Barrages :-

It is used to convert the tidal energy into the electrical energy by forcing water through turbines by activing the generator.

Q2 (b)

Reynold's Number:-

It is the ratio of inertial forces to viscous forces.

⇒ It is a dimensionless number

⇒ used to categorize the fluid systems in which the effect of viscosity is important in controlling the flow pattern of fluid.

Laminar flow:-

The flow in a pipe in which all the particles are flowing uniformly

⇒ Flow will laminar if reynold's number is less than 2100

Tuebulant flow:-

The flow of a fluid in a pipe in which all particles of fluid in not in a uniform way.

⇒ Flow will be tuebulant if reynold's number is greater than 4000

## Neither laminar nor turbulent flow:-

When the Reynolds number is in between 2100 to 4000. Flow will be neither laminar not turbulent.

## Lower Critical velocity.

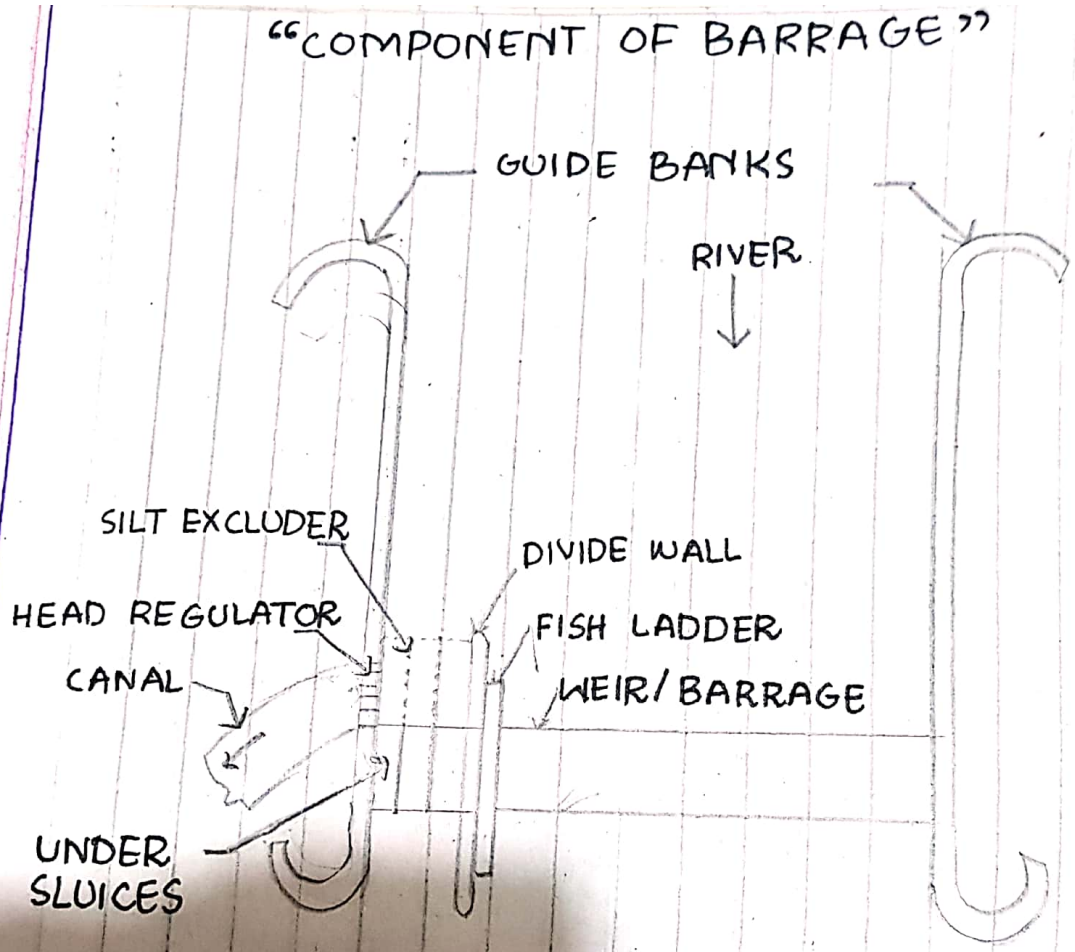
The velocity at which flow changes from laminar to transition is called lower critical velocity.

## Higher critical velocity:-

The velocity at which the flow changes from the transition to the turbulent flow is called higher critical velocity.

Q-3(a)

"COMPONENT OF BARRAGE"



Q3(b)

Q3(b) Answer to Q3 (b).

A3 (b) Several formulae based on the experimental results have been proposed to predict the maximum or equilibrium scour depth. In General, these assume the relation

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

where $b'$ is the pier width, $y_0$ is the upstream flow depth, $d$ is the sediment size and $Fr$ is the flow froude number.

⇒ Lauson's experimental results underestimate the scour depth, compare to many indian's experiments which suggest the formula

$$y_s/b' = 4.2(y_0/b')^{0.78} Fr^{0.52}$$

⇒ The Indian field data also suggest that the scour depth should be taken as the twice the regime scour depth

On the case of live ~~beeds~~ beds (a stream with bed load transport) the formula

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

Predicts the maximum equilbeivm scoue depth.

On a relatively deep flow a first ordee estimate of local scoue (around pie) may be obtained by

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

where $K_\alpha$ = angulae co-efficient which is function of pier alignment i.e. angle of attack of approch flow.

Q4

Data

Dimensions = 15' x 15'

L.L = 1.5 k/ft² = 1500 lb/ft²

D.L = 300 lb/ft²

unit weight of soil = 100 lb/ft³

Angle of repose, Θ = 30°

Concrete ratio = 1:2:4

fy = 60 ksi

Thickness = 0.92m = 3'

Design a box culvert.

Sd

① Load Calculations

Total load carry on top slab = Self wt of slab + L.L + D.L

Self wt = 3 x 150 = 450 lb/ft²

W = 450 + 1500 + 300 = 2250 lb/ft²

(2) Co-efficient of Earth Pressure

$$ka = \frac{1-\sin\phi}{1+\sin\phi} = \frac{1-\sin(30)}{1+\sin(30)}$$

$$ka = 0.33$$

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

= Total vertical load $(D.L)+(L.L) \times ka$

$= (1500+300) \times 0.33$

$= 594 \ \frac{lb}{ft^2}$

(4) Lateral pressure due to soil

= $k_a \times \gamma h$

= $0.33 \times 100 \times 18$

= Say $lb/ft^2$

(5) Lateral pressure.

Top

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

= Say $\frac{lb}{ft^2}$

Bottom

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

= Say + Say

= 1188 $lb/ft^2$