LECTURE 09

DIVERSION HEADWORKS

3. **The divide wall:**

- The divide wall is a masonry or concrete wall constructed at right angle to the axis of the weir.
- The divide wall extends on the upstream side beyond the beginning of the canal head regulator; and on the downstream side, it extends up to the end of the loose protection of the under-sluices.
- The divide wall is a long wall constructed at right angles in the weir or barrage; it may be constructed with stone masonry or cement concrete. On the upstream side, the wall is extended just to cover the canal head regulator and on the downstream side, it is extended up to the launching apron.

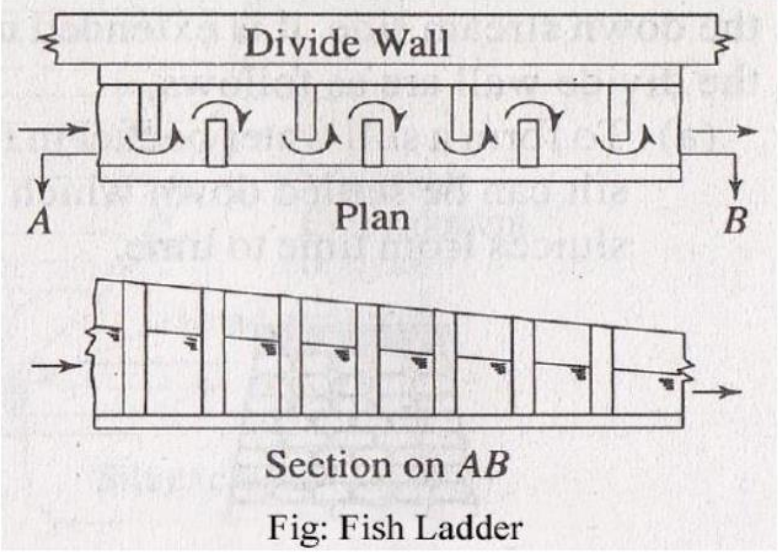

Fig: Fish Ladder

The main functions of the divide walls:

- It separates the 'under-sluices' with lower crest level from the 'weir proper' with higher crest level.
- It helps in providing a comparatively less turbulent pocket near the canal head regulator, resulting in deposition of silt in this pocket and, thus, to help in the entry of silt-free water into the canal.
- It helps to keep cross-current, if any, away from the weir.

4. **Fish Ladder**

- It is device by which the flow energy can be dissipated in such a manner as to provide smooth flow at sufficiently low velocity, not exceeding 3 to 3.5 m/s.
- A narrow opening including suitable baffles or staggering devices in it is provided adjacent to the divide wall.
- The fish ladder is provided just by the side of the divide wall for the free movement of fishes. Rivers are important source of fishes.
- There are various types of fish in the river. The nature of the fish varies from type to type. But in general, the tendency of fish is to move from upstream to downstream in winters and from downstream to upstream in monsoons. This movement is essential for their survival. Due to construction of weir or barrage, this movement gets obstructed, and is detrimental to the fishes.
- In the fish ladder, the fable walls are constructed in a zigzag manner so that the velocity of flow within the ladder does not exceed 3 m/sec
- The width, length and height of the fish ladder depend on the nature of the river and the type of the weir or barrage.

5. **Canal Head Regulator or Head sluices**

A structure which is constructed at the head of the canal to regulate flow of water is known as canal head regulator. It consists of a number of piers which divide the total width of the canal into a number of spans which are known as bays. The piers consist of

number tiers on which the adjustable gates are placed. The gates are operated form the top by suitable mechanical device. A platform is provided on the top of the piers for the facility of operating the gates. Again some piers are constructed on the downstream side of the canal head to support the roadway.

***Functions of Canal Head Regulator*:**

It regulates the supply of water entering the canal
It controls the entry of silt in the canal
It prevents the river-floods from entering the canal

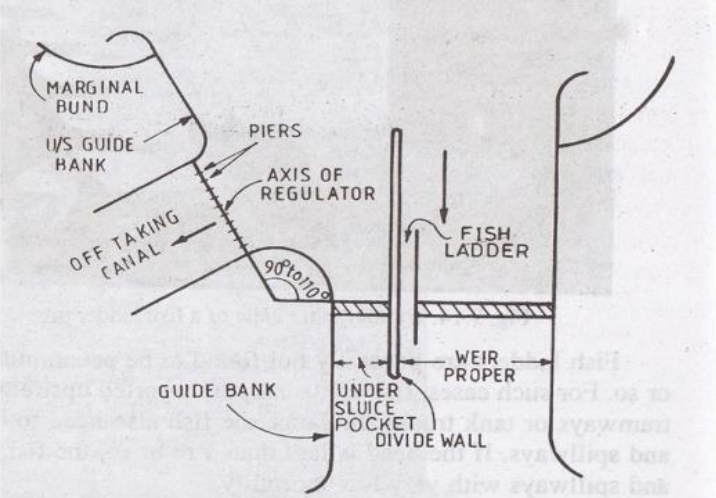

Fig: Alignment of a canal head regulator

The water from the under-sluice pocket is made to enter the regulator bays, so as to pass the full supply discharge into the canal. The maximum height of these gated openings, called head sluices will be equal to the difference of Pond Level and Crest Level of the regulator.

- The entry of silt into the canal is controlled by keeping the crest of the head regulator by about 1.2 to 1.5 meters higher than the crest of the under-sluices.
- If a silt-excluder is provided, the regulator crest is further raised by about 0.6 to 0.7 meter.
- Silt gets deposited in the pocket, and only the clear water enters the regulator bays.
- The deposited silt can be easily scoured out periodically, and removed through the under-sluice openings.

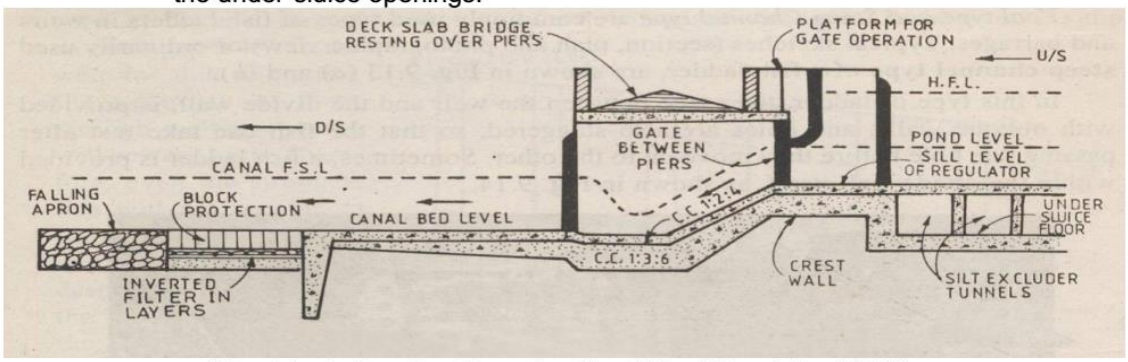

Fig: A typical section through a Canal Head Regulator (CHR)

6. **River Training Works**

River training works are required near the weir site in order to ensure a smooth and an axial flow of water, and thus, to prevent the river from outflanking the works due to a change in its course.

The river training works required on a canal headwork are:

(a) Guide banks
(b) Marginal bunds
(c) Spurs or groynes

(a) Guide Bank

When a barrage is constructed across a river which flows through the alluvial soil, the guide banks must be constructed on both the approaches to protect the structure from erosion.

Guide bank serves the following purposes:

- It protects the barrage from the effect of scouring and erosion.
- It provides a straight approach towards the barrage.
- It controls the tendency of changing the course of the river.
- It controls the velocity of flow near the structure.

(b) Marginal Bunds

The marginal bunds are earthen embankments which are constructed parallel to the river bank on one or both the banks according to the condition. The top width is generally 3 m to 4 m. The side slope on the river side is generally 1.5: 1 and that on the country side is 2:1.

The marginal bunds serve the following purposes:

- It prevents the flood water or storage water from entering the surrounding area which may be submerged or may be water logged.
- It retains the flood water or storage water within a specified section.
- It protects the towns and villages from devastation during the heavy flood.
- It protects valuable agricultural lands.

(c) Groynes

Groyns are impervious permanent structures constructed on the curve of a river to protect the river bank from erosion. They extend from the bank towards the bed by making an angle of 60o to 75o with the bank. The angle may be towards the upstream or downstream. Sometimes, it is made perpendicular to the river bank. These are constructed with rubble masonry in trapezoidal section and the surface is finished with stone pitching or concrete blocks.

- The stone pitching or the concrete blocks are set with rich cement mortar.
- The length of the groyne depends on the width and nature of the river.
- The top width varies from 3 m to 4 m. The side slope may be 1½: 1 or 2:1.
- The groynes are provided in series throughout the affected length of the river bank.
- The spacing between the adjacent groynes is generally kept as 2*L*, where *L* is the length of the groyne.

- These are recommended for the river where the permanent solution of erosion control is extremely necessary.

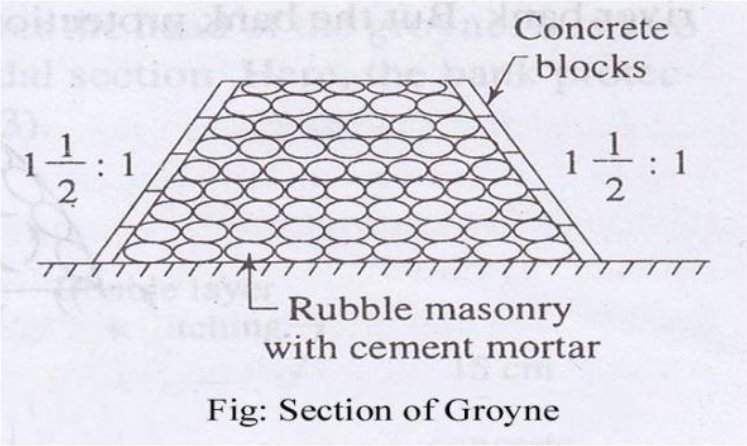

Fig: Section of Groyne

***The groynes may be designated as follows*:**

(a) **Attracting Groyne:** The groyne which is constructed obliquely to the bank by making an angle of 60 to 75o towards the downstream is known as attracting groyne, here the flow of water is attracted towards the bank, and the velocity of flow is reduced to such a extent that it can not cause any erosion to the bank. However, a bank protected of stone pitching is provided for safety.

(b) **Repelling Groyne:** A groyne which is aligned towards upstream at an angle of 60o to 75o with the river bank is known as repelling groyne. A still water pocket is formed on the upstream where silting takes place. Here, the bank protection is not necessary, because the flow of water does not touch the bank and there is no effect of erosion on the bank. But still boulder pitching should be provided for safety.

(c) **Deflecting Groyne:** The groyne which is constructed perpendicular to the river bank is known as deflecting groyne. Here the flow of water is deflected from bank by the perpendicular obstruction i.e. groyne. The flow of water follows an undulating path just outside the head of the groyne. An eddy current is formed on the upstream side of the groyne. This eddy current will not affect the river bank. But the bank protection is provided for safety.

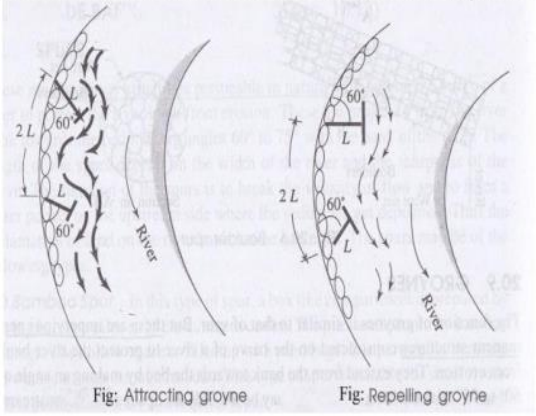

Fig: Attracting groyne

Fig: Repelling groyne

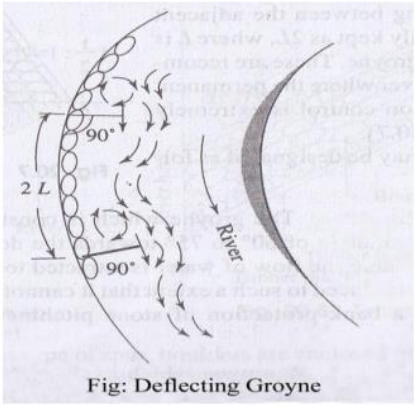

Fig: Deflecting Groyne

Shutters and Gates:

Functions of shutters and gates are:

They maintain pond level.

They raise water level during low flow.

Pond Level

The water level required in the under-sluice pocket upstream of the Canal Head Regulator, so as to feed the canal with its full supply, is known as Pond Level.

The FSL of the canal at the head depends upon the level of the irrigated areas and the slope of the canal.

Pond Level = Canal FSL + 1.0 to 1.2 m

Silt Regulation works

The entry of silt into a canal, which takes off from a head works, can be reduced by constructed certain special works, called silt control works.

These works may be classified into the following two types:

(a) Silt Excluders

(b) Silt Ejectors

(a) Silt Excluders

Silt excluders are those works which are constructed on the bed of the river, upstream of the head regulator. The clearer water enters the head regulator and silted water enters the silt excluder. In this type of works, the silt is, therefore,, removed from the water before in enters the canal

(b) Silt Ejectors

Silt ejectors, also called silt extractors, are those devices which extract the silt from the canal water after the silted water has traveled a certain distance in the off-take canal. These works are, therefore, constructed on the bed of the canal, and little distance downstream from the head regulator.

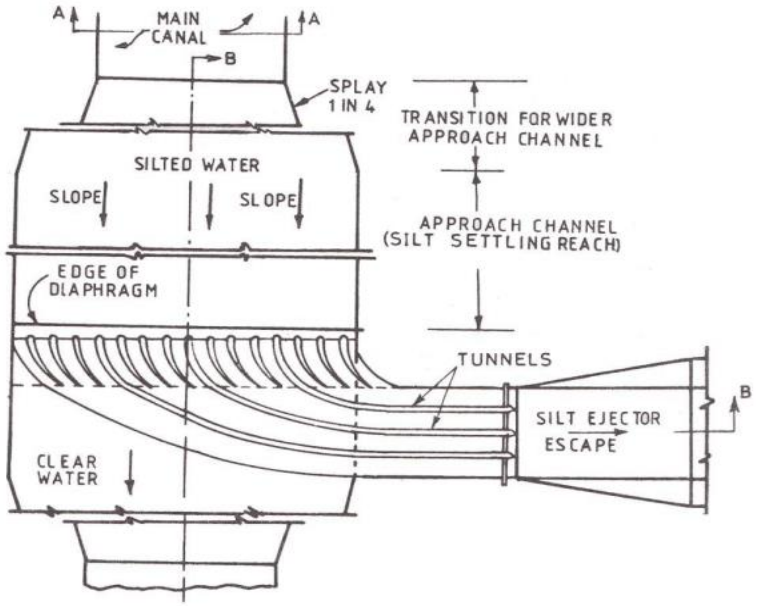

Fig: Plan of Silt Ejector

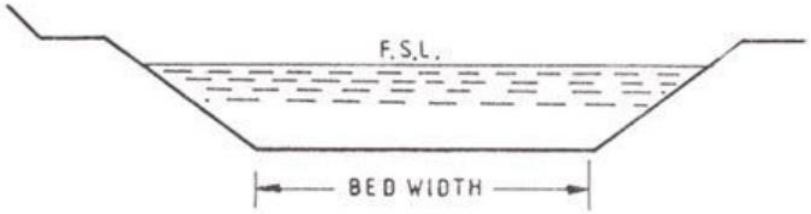

Fig: Section A-A
(Main Canal)

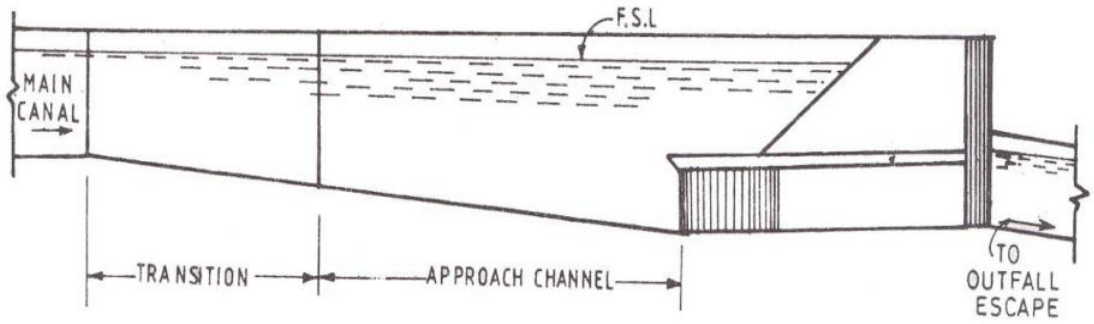

Fig: L-section along tunnel
(Section B-B)

Water logging

Definition:

When the conditions are so created that the crop root-zone gets deprived of proper aeration due to the presence of excessive moisture or water content, the tract is said to be waterlogged. To create such conditions it is not always necessary that under groundwater table should enter the crop root-zone. Sometimes even if water table is below the root-zone depth the capillary water zone may extend in the root-zone depth and makes the air circulation impossible by filling the pores in the soil.

The water logging may be defined as rendering the soil unproductive and infertile due to excessive moisture and creation of anaerobic conditions. The phenomenon of water logging can be best understood with the help of a hydrologic equation, which states that

Inflow = Outflow -I- Storage

Here inflow represents that amount of water which enters the subsoil in various processes. It includes seepage from the canals, infiltration of rainwater, percolation from irrigated fields and subsoil flow. Thus although it is loss or us, it represents the amount of water flowing into the soil.

The term outflow represents mainly evaporation from soil, transpiration from plants and underground drainage of the tract. The term storage represents the change in the groundwater reservoir.

Causes of Water logging:

After studying the phenomenon of water logging in the light of hydrologic equation main factors which help in raising the water-table may be recognized correctly.

They are:

i. Inadequate drainage of over-land run-off increases the rate of percolation and in turn helps in raising the water table.

ii. The water from rivers may infiltrate into the soil.

iii. Seepage of water from earthen canals also adds significant quantity of water to the underground reservoir continuously.

iv. Sometimes subsoil does not permit free flow of subsoil water which may accentuate the process of raising the water table.

v. Irrigation water is used to flood the fields. If it is used in excess it may help appreciably in raising the water table. Good drainage facility is very essential.

Effects of Water logging:

The water logging affects the land in various ways. The various after effects are the following:

1. Creation of Anaerobic Condition in the Crop Root-Zone:

When the aeration of the soil is satisfactory bacteriological activities produce the required nitrates from the nitrogenous compounds present in the soil. It helps the crop growth. Excessive moisture content creates anaerobic condition in the soil. The plant roots do not get the required nourishing food or nutrients. As a result crop growth is badly affected.

2. Growth of Water Loving Wild Plants:

When the soil is waterlogged water loving wild plant life grows abundantly. The growth of wild plants totally prevents the growth of useful crops.

3. Impossibility of Tillage Operations:

Waterlogged fields cannot be tilled properly. The reason is that the soil contains excessive moisture content and it does not give proper tilts.

4. Accumulation of Harmful Salts:

The upward water movement brings the toxic salts in the crop root-zone. Excess accumulation of these salts may turn the soil alkaline. It may hamper the crop growth.

5. Lowering of Soil Temperature:

The presence of excessive moisture content lowers the temperature of the soil. In low temperature the bacteriological activities are retarded which affects the crop growth badly.

6. Reduction in Time of Maturity:

Untimely maturity of the crops is the characteristic of waterlogged lands. Due to this shortening of crop period the crop yield is reduced considerably.