LECTURE 06

IRRIGATION NETWORK

- **Irrigation network** represents the network of permanent and temporary waterways (canals, pipelines) that supply water to irrigated lands from an irrigation source
- It is the key component of the irrigation system. It consists of conducting and regulatory networks.
- It is equipped with the devices and facilities for water measurement (water gauges), rising of water level in canals, and control of water discharge (head regulators, checks), connection of canal reaches (check drops, chutes), retention of silt/debris (sediment tanks, guide systems), and so forth.

Canal structures are components of irrigation network;

- Head works,
- Control structure,
- Cross – drainage work,
- Bridges and culverts,
- Canal outlets

are part of irrigation network.

Headworks

- An irrigation canal takes its supplies from rivers or stream. In order to divert water from the river into the canal it is necessary to construct certain works or structures across the river at the head of off taking canal. These works are known as canal head works or head works.
- **Canal need works are classified into following two types:**
  - Storage head works
  - Diversion head works

Storage head works:

- It consists of a dam constructed across the river to create a reservoir in which water is stored during the period of excess flow into river.
- Storage head works stores water in addition to its diversion into canals.

Diversion head works:

- It serves to raise the water level into river and divert the required quantity into canal. Various function served by a diversion head works are as follow.
- It rises water level in the river so that command area increase.
- It regulates supply into the canal .
- It controls entry of silt into canal .
- It provides some storage for a short period.

Canal regulator

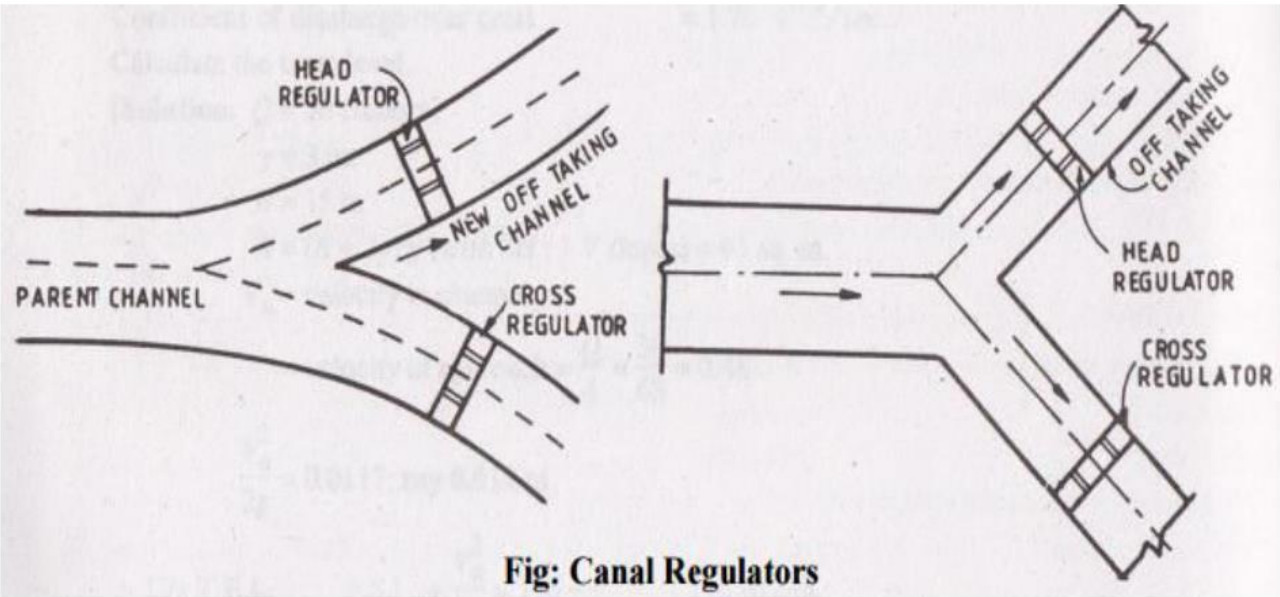


Fig: Canal Regulators

Canal regulator

- A head regulator provided at the head of the off-taking channel, controls the flow of water entering the new channel.
- While a cross regulator may be required in the main channel downstream of the off-taking channel, and is operated when necessary so as to head up water on its upstream side, thus to ensure the required supply in the off-taking channel even during the periods of low flow in the main channel.

Main functions of a head regulator:

- To regulate or control the supplies entering the off-taking canal
- To control the entry of silt into the off-taking canal
- To serve as a meter for measuring discharge.

Main functions of a cross regulator:

- To control the entire Canal Irrigation System.
- To help in heading up water on the upstream side and to fed the off-taking canals to their full demand.
- To help in absorbing fluctuations in various sections of the canal system, and in preventing the possibilities of breaches in the tail reaches. Cross regulator is often combined with bridges and falls, if required.

Components of irrigation structures – regulation works:

- Regulation works which includes falls, off take structure, cross regulator and distributory head regulator.
- Canal Falls.
- Surplus water escape.
- Canal outlets.

Canal drop/ canal fall

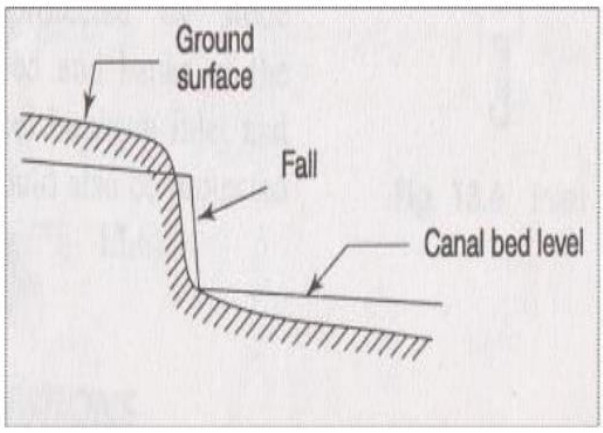
- Whenever the available natural ground slope is steep than the designed bed slope of the channel, the difference is adjusted by constructing vertical ‘falls’ or ‘drops’ in the canal bed at suitable intervals.
- Irrigation canals are constructed with some permissible bed slopes so that there is no silting or scouring in the canal bed. But it is not always possible to run the canal at the desired bed slope throughout the alignment due to the fluctuating nature of the country slope. Sometimes, the ground surface may be steep and sometimes it may be very irregular with abrupt change of grade.

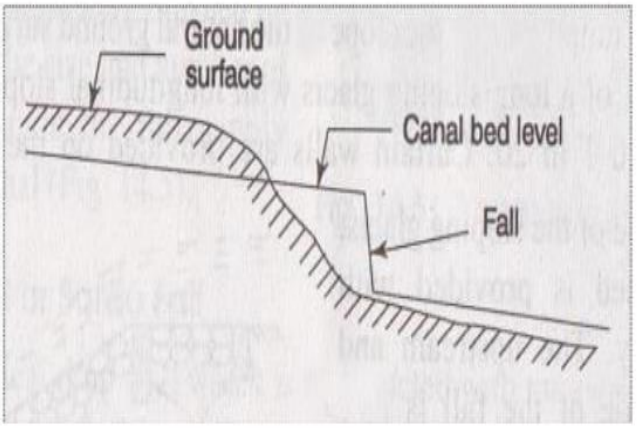
Canal drop/ canal fall

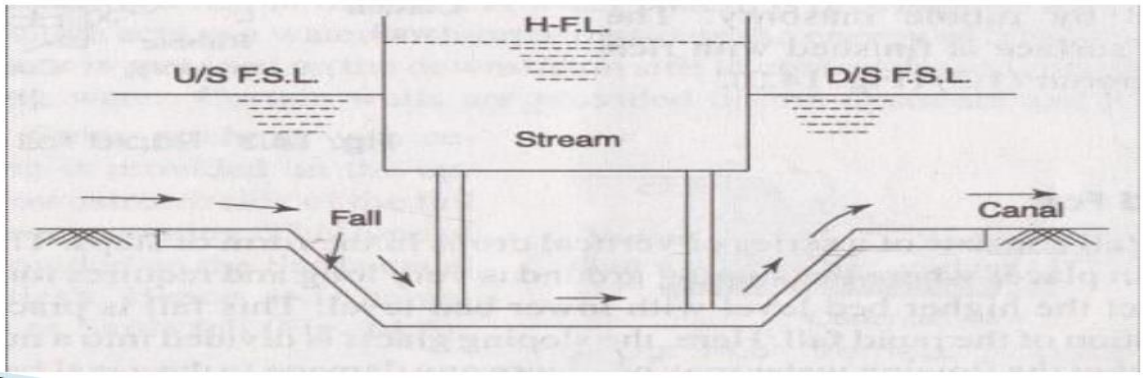
In such cases, a vertical drop is provided to step down the canal bed and then it is continued with permissible slope until another step down is necessary. This is done to avoid unnecessary huge earth work in filling. Such vertical drops are known as **Canal falls or Canal drops.**

Necessity of Canal Falls

- When the slope of the ground suddenly changes to steeper slope, the permissible bed slope can not be maintained. It requires excessive earthwork in filling to maintain the slope. In such a case falls are provided to avoid excessive earth work in filling.
- When the slope of the ground is more or less uniform and the slope is greater than the permissible bed slope of canal. In that case also the canal falls are necessary.
- In cross-drainage works, when the difference between bed level of canal and that of drainage is small or when the F.S.L of the canal is above the bed level of drainage then the canal fall is necessary to carry the canal water below the stream or drainage.







Types of canal fall/ drop

Depending on the ground level conditions and shape of the fall the various types of fall are:

- **Ogee fall**
- **Rapid fall**
- **Stepped fall**
- **Trapezoidal Notch fall**
- **Vertical drop fall**
- **Glacis fall**
- **Montague type fall**
- **Inglis type fall**

Ogee fall

- In this type of fall, an ogee curve (a combination of convex curve and concave curve) is provided for carrying the canal water from higher level to lower level.
- This fall is recommended when the natural ground surface suddenly changes to a steeper slope along the alignment of the canal.
- The fall consists of a concrete vertical wall and concrete bed. Over the concrete bed the rubble masonry is provided in the shape of ogee curve.
- The surface of the masonry is finished with rich cement mortar (1:3).The upstream and downstream side of the fall is protected by stone pitching with cement grouting.
- The design consideration of the ogee fall depends on the site condition.

Rapid fall

- The rapid fall is suitable when the slope of the natural ground surface is even and long.
- It consists of a long sloping glacis with longitudinal slope which varies from 1 in 10 to 1 in 20.
- Curtain walls are provided on the upstream and downstream side of the sloping glacis.
- The sloping bed is provided with rubble masonry.
- The upstream and downstream side of the fall is also protected by rubble masonry.
- The masonry surface is finished with rich cement mortar (1:3).

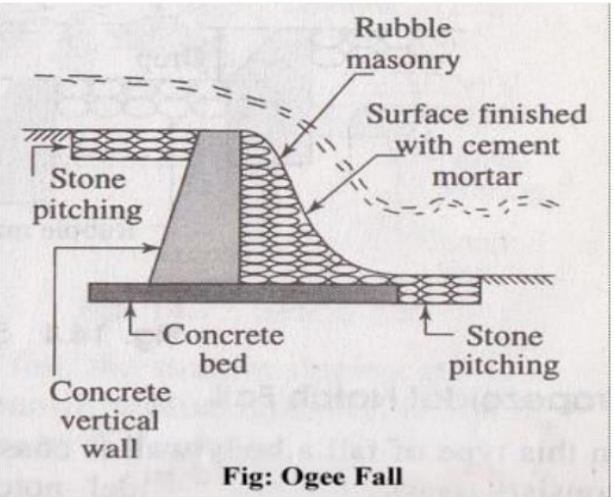


Fig: Ogee Fall

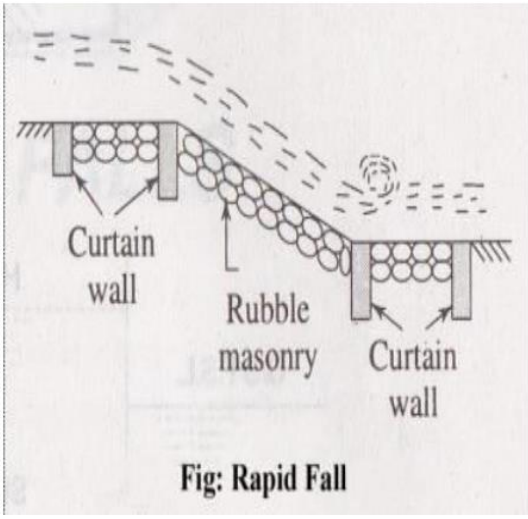


Fig: Rapid Fall

Stepped Fall: Stepped fall consists of a series of vertical drops in the form of steps. This fall is suitable in places where the sloping ground is very long and requires long glacis to connect the higher bed level with lower bed level. This fall is practically a modification of the rapid fall. The sloping glacis is divided into a number of drops so that the flowing water may not cause any damage to the canal bed. Brick walls are provided at each of the drops. The bed of the canal within the fall is protected by ru cement mortar (1:3).

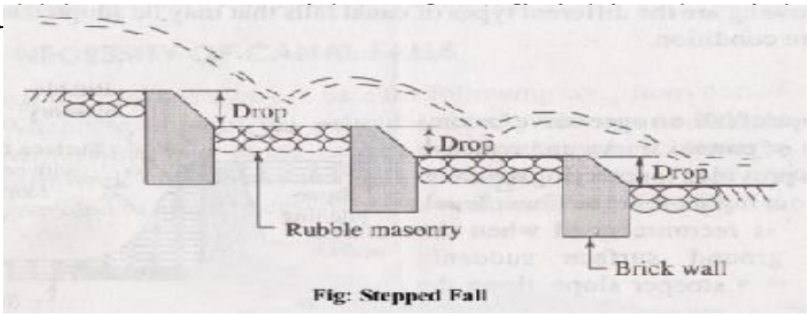


Fig: Stepped Fall

- **Trapezoidal Notch Fall:** In this type of fall a body wall is constructed across the canal. The body wall consists of several trapezoidal notches between the side piers and the intermediate pier or piers. The sills of the notches are kept at the upstream bed level of the canal. The body wall is constructed with masonry or concrete. An impervious floor is provided to resist the scoring effect of the falling water. The upstream and downstream side of the fall is protected by stone pitching finished by cement grouting. The size and number of notches depends upon the full supply discharge of the canal.

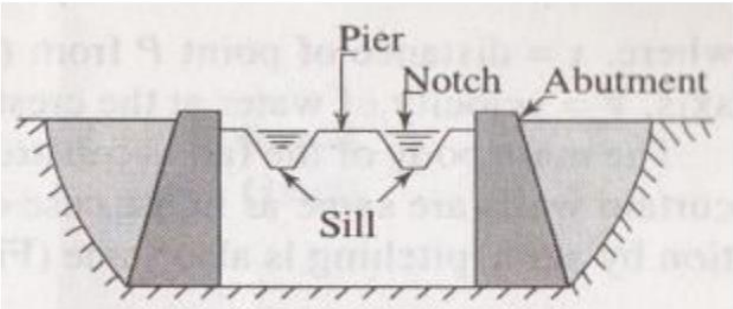


Fig: Trapezoidal Notch Fall

- **Vertical Drop Fall:** It consists of a vertical drop walls which is constructed with masonry work. The water flows over the crest of the wall. A water eastern is provided on the downstream side which acts as a water cushion to dissipate the energy of falling water. A concrete floor is provided on the downstream side to control the scouring effect of the flowing water. Curtain walls are provided on the upstream and downstream side. Stone pitching with cement grouting is provided on the upstream and downstream side of the fall to protect it from scouring.

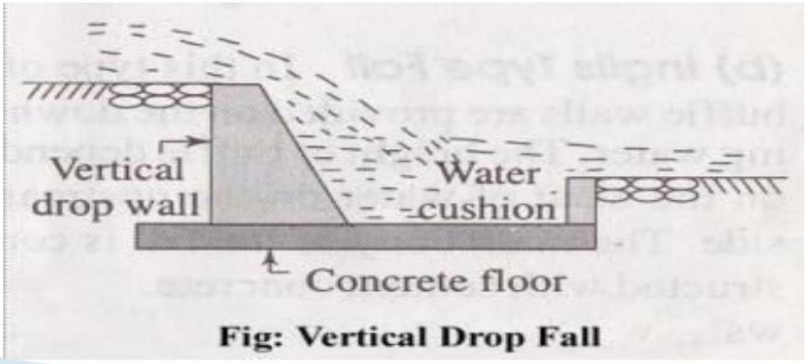


Fig: Vertical Drop Fall

- **Glacis Fall:** It consists of a straight sloping glacis provided with a crest. A water cushion is provided on the downstream side to dissipate the energy of flowing water. The sloping glacis is constructed with cement concrete. Curtain walls and toe walls are provided on the upstream and downstream side. The space between the toe walls and curtain walls is protected by stone pitching. This type of fall is suitable for drops up to 1.5 m.

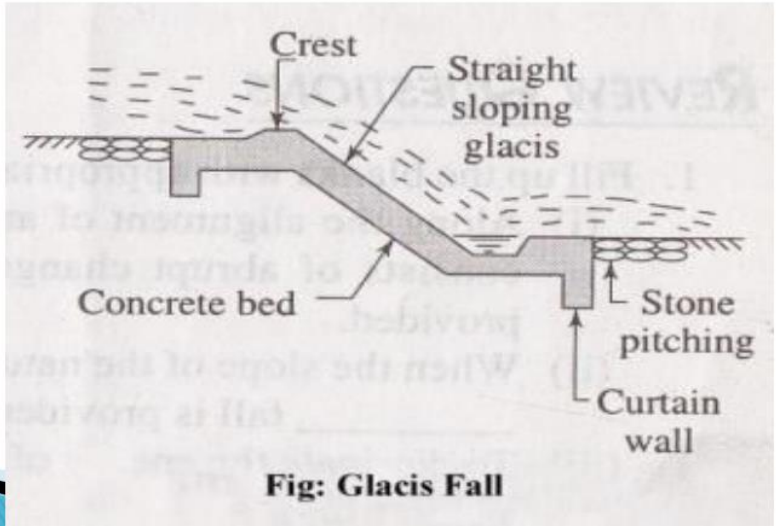


Fig: Glacis Fall

- **Montague Type Fall:** In this type of fall, the straight sloping glacis is modified by giving parabolic shape which is known as Montague profile.

Montague profile is given by the equation,

$$X = \upsilon\, g\, 4y + Y$$

Where, x = distance of point P from OX axis,

Y = distance of point P from OY axis,

υ = velocity of water at the crest,

g = acceleration due to gravity.

The main body of the fall is constructed with cement concrete. Toe walls and curtain walls are same as in the case of straight sloping glacis. The bed protection by stone pitching is also same.

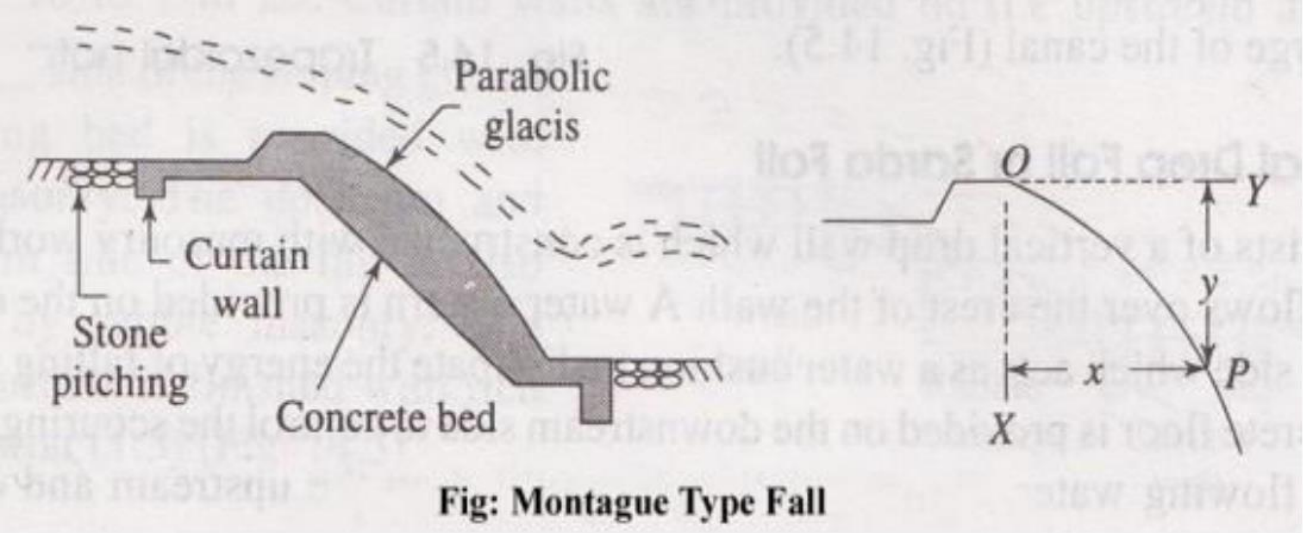


Fig: Montague Type Fall

- **Inglis Type Fall:** In this type of fall, the gracis is straight and sloping, but buffle walls are provided on the downstream floor to dissipate the energy of flowing water. The height of buffle depends on the head of water on the upstream side. The main body of the fall is constructed with cement concrete. The toe walls and curtain walls are same as straight glacis. The protection works with stone pitching are also same. Sometimes, this fall is known as buffle fall.

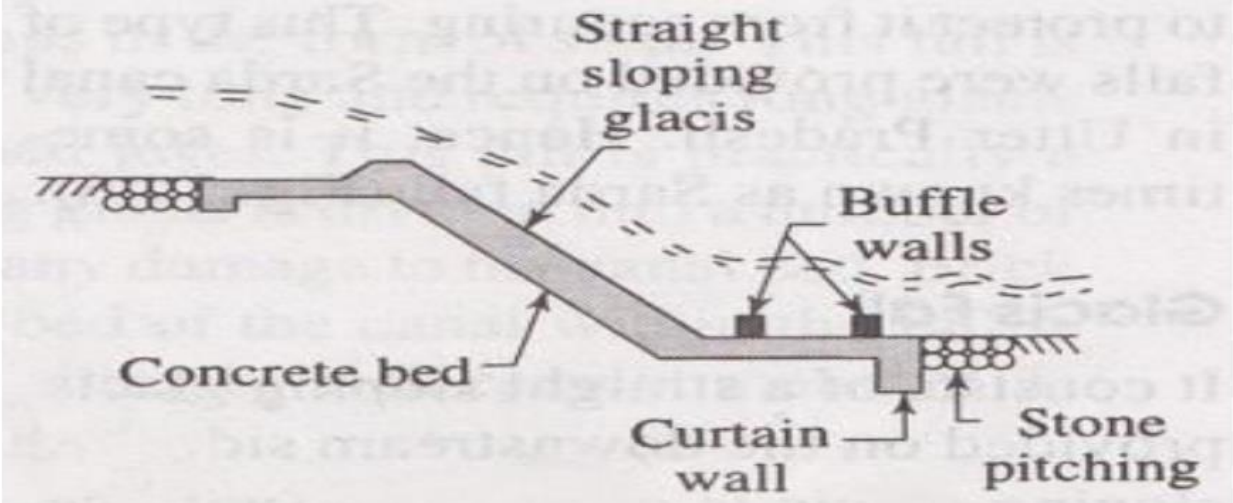


Fig: Inglis Type Fall