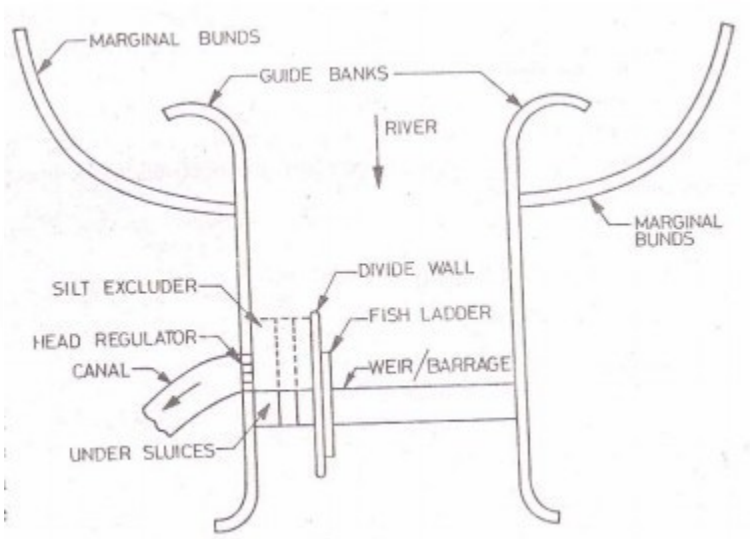
COMPONENT PARTS OF A DIVERRSION HEADWORK

A diversion headwork consist of the following component parts

1. Weir or barrage
2. Undersluices
3. Divide wall
4. Fish ladder
5. Canal head regulator
6. pocket or approach channel
7. Silt excluders/ Silt prevention devices/
8. River training works (Marginal bunds and guide banks)

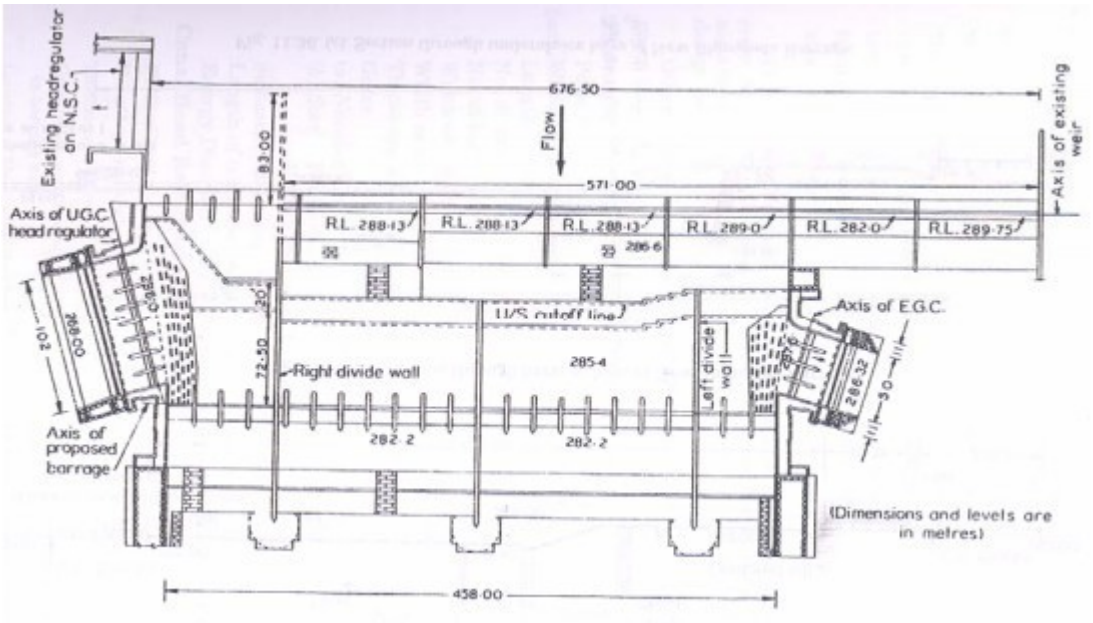


Undersluices

- Undersluice sections are provided adjacent to the canal head regulators.
- The undersluices should be able to pass fair weather flow for which the crest shutters on the weir proper need not be dropped.
- The crest level of the undersluices is generally kept at the average bed level of the river.

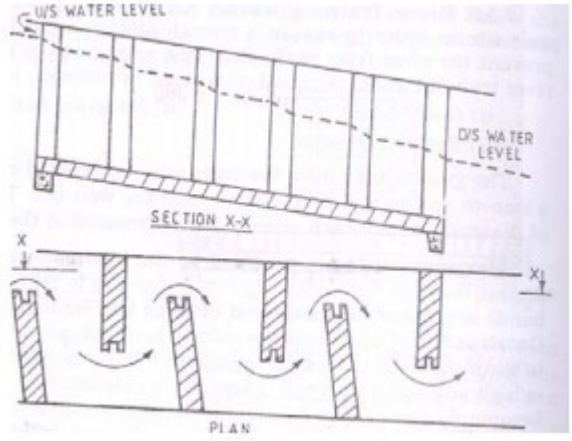
Divide Wall

- A divide wall is a wall constructed parallel to the direction of flow of river to



Fish Ladder

- A fish ladder is a passage provided adjacent to the divide wall on the weir side for the fish to travel from the upstream to the downstream and vice versa.
- Fish migrate upstream or downstream of the river in search of food or to reach their sprawling places.
- In a fish ladder the head is gradually dissipated so as to provide smooth flow at sufficiently low velocity.
- Suitable baffles are provided in the fish passage to reduce the flow velocity.



Canal Head Regulator

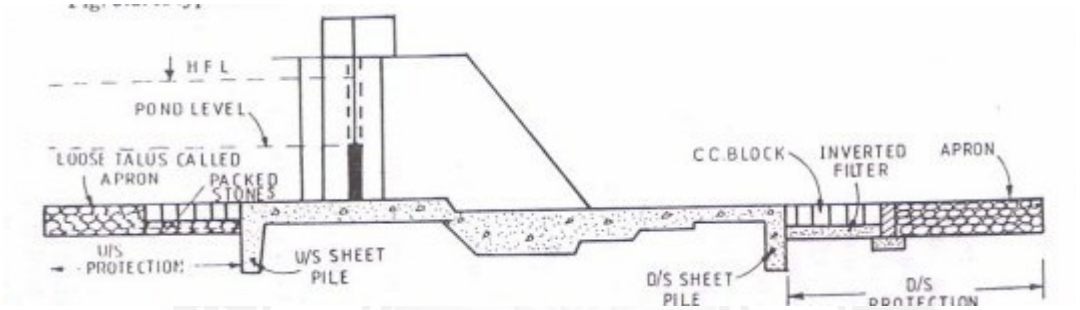
- A canal head regulator is provided at the head of the canal offtaking from the diversion headworks.
- It regulates the supply of water into the canal, controls the entry silt into the canal,

Silt Excluder

- A silt excluder is a structure in the undersluices pocket to pass the silt laden water to the downstream so that only clear water enters into the canal through head regulator.
- The bottom layer of water which are highly charged with silt pass down the silt excluder an escape through the undersluices.

Guide Banks and Marginal Bunds

- Guide banks are provided on either side of the diversion headworks for a smooth approach and to prevent the river from outflanking.
- Marginal bunds are provided on either side of the river upstream of diversion headworks to protect the land and property which is likely to be submerged during ponding of water in floods.
- **Weir or Barrage**
- A diversion head works is a structure constructed across a river for the purpose of raising water level in the river so that it can be diverted into the offtaking canals.
- A weir is a raised concrete crest wall constructed across the river.
- It may be provided with small shutters (gates) on its top. In the case of weir, most of the raising of water level or ponding is done by the solid weir wall and little with by the shutters.



- A barrage has a low crest wall with high gates. As the height of the crest above the river bed is low most of the ponding is done by gates. During the floods the gates are opened so afflux is very small.
- A weir maintains a constant pond level on its upstream side so that the water can flow into the canals with the full supply level (F.S.L.). If the difference between the pond level and the crest level is less than 1·5 m or so, a weir is usually constructed.
- On the other hand, if this difference is greater than 1·50 m, a gate-controlled barrage is generally more suitable than a weir. In the case of a weir, the crest shutters are dropped during floods so that the water can pass over the crest.
- During the dry period, these shutters are raised to store water upto the pond level. Generally, the shutters are operated manually, and there is no mechanical arrangement for raising or

ADVANTAGES AND DISADVANTAGES OF WEIRS AND BARRAGES

1. Weirs Advantages: The initial cost of weirs is usually low.

Disadvantages:

i. There is a large afflux during floods which causes large submergence.

ii. Because the crest is at high level, there is great silting problem

iii. The raising and lowering of shutters on the crest is not convenient. Moreover, it requires considerable time and labour.

iv. The weir lacks an effective control on the river during floods.

2. Barrages Advantages

i. The barrage has a good control on the river during floods. The outflow can be easily regulated by gates.

ii. The afflux during floods is small and, therefore, the submerged area is less.

iii. There is a good control over silt entry into the canal.

iv. There is a good control over flow conditions, shoal formations and crosscurrents on the upstream of the barrage.

v. There are better facilities for inspection and repair of various structures.

vi. A roadway can be conveniently provided over the structure at a little additional cost.

Disadvantages:

The initial cost of the barrage is quite high.

Conclusion: A barrage is generally better than a weir. Most of the diversion headworks these days usually consist of barrages.

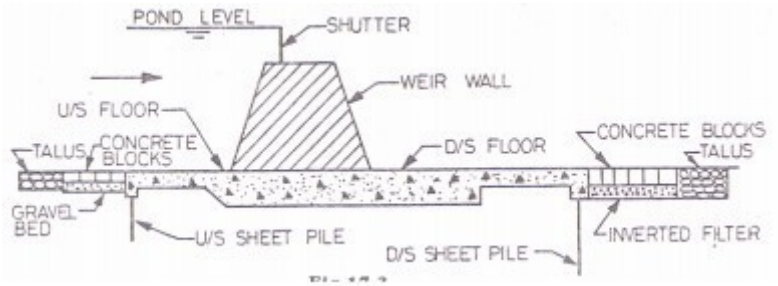
TYPES OF WEIRS

The weirs may be broadly divided into the following types

1. Vertical drop weirs.
2. Rockfill weirs.
3. Concrete glacis or sloping weirs.

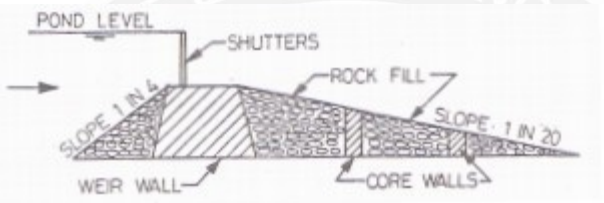
1. Vertical drop weirs

- The shutters are provided at the crest, which are dropped during floods so as to reduce afflux. The water is ponded upto the top of the shutters during the rest of the period.
- Vertical drop weirs were quite common in early diversion headworks, but these are now becoming more or less obsolete.
- The vertical drop weir is suitable for hard clay foundation as well as consolidated gravel foundations, and where the drop is small.
- The upstream and downstream cutofIwalls (or piles) are provided upto the scour depth. The weir floor is designed as a gravity section.



2. Rockfill weirs:

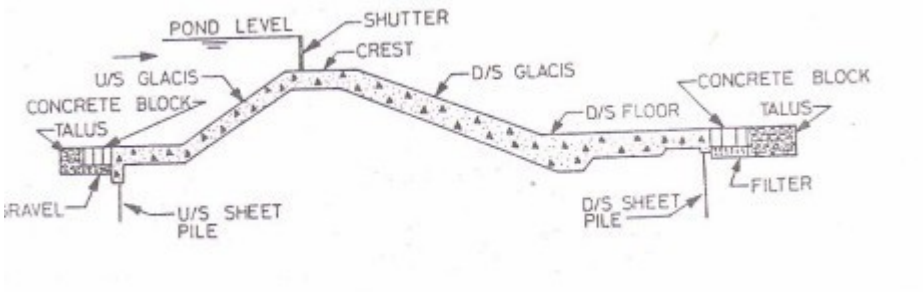
- In a rockfill type weir, in addition to the main weir wall, there are a number of core walls. The space between the core walls is filled with the fragments of rock (called rockfill).
- A rockfill weir requires a lot of rock fragments and is economical only when a huge quantity of rockflll is easily available near the weir site.
- It is suitable for fine sand foundation. The old Okhla Weir across the Yamuna river is a rockfill weir.
- Such weirs are also more or less obsolete these days.



3. Concrete sloping weir :

- Concrete sloping weirs (or glacis weirs) are of relatively recent origin.
- The crest has glacis (sloping floors) on upstream as well as downstream.
- There are sheet piles (or cut off walls) driven upto the maximum scour depth at the upstream and downstream ends of the concrete floor.

- The main advantage of a sloping weir over the vertical drop weir is that a hydraulic jump is formed on the d/s glacis for the dissipation of energy.
- Therefore, the sloping weir is quite suitable for large drops.



Modes of Failure :

- Irrigation structures (or hydraulic structures) for the diversion and distribution works are weirs, barrages, head regulators, distributary head regulators, cross regulators, cross-drainage works, etc.
- These structures are generally founded on alluvial soils which are highly pervious. Moreover, these soils are easily scoured when the high velocity water passes over the structures.
- The failures of weirs constructed on the permeable foundation may occur due to various causes, which may be broadly classified into the following two categories:

  1. Failure due to- subsurface flow

  2. Failure due to surface flow

1. Failure due to subsurface flow:

The failure due to subsurface flow may occur by piping or by rupture of floor due to uplift.

(a) Failure by piping:

- Piping (or undermining) occurs below the weir if the water percolating through the foundation has a large seepage force when it emerges at the downstream end of the impervious floor.
- When the seepage force exceeds a certain value, the soil particles are lifted up at the exit point of the seepage.
- With the removal of the surface soil particles, there is further concentration of flow in the remaining portion and more soil particles are removed.
- This process of backward erosion progressively extends towards the upstream side, and a pipe-like hollow formation occurs beneath the floor.

(b) Failure by rupture of floor:

- The water percolating through the foundation exerts an upward pressure on the impervious floor, called the uplift pressure.
- If the weight of the floor is not adequate to counterbalance the uplift pressure, it may fail by rupture.

2. Failure due to surface flow

The failure due to surface flow may occur by suction pressure due to hydraulic jump or by scouring of the bed.

(a) Failure by suction pressure :

- In the glacis type of weirs, a hydraulic jump is formed on the d/s glacis. In this case, the water surface profile in the hydraulic jump trough is much lower than the subsoil H.G.L.
- Therefore uplift pressure occurs on the glacis. This uplift pressure is known as the suction pressure. If the thickness of floor is not adequate, the rupture of floor may occur.

(b) Failure by scour :

- During floods, scouring occurs in the river bed. The bed of the river may be scoured to a considerable depth.
- If no suitable measures are adopted, the scour may cause damage to the structure and may lead to the failure.

Design aspects

The basic principles for the design of all irrigation structures on pervious foundations are as follows:

(a) Subsurface flow

1. The structure should be designed such that the piping failure does not occur due to subsurface flow.
2. The downstream pile must be provided to reduce the exit gradient and to prevent piping.
3. An impervious floor of adequate length is provided to increase the path of percolation and to reduce the hydraulic gradient and the seepage force.
4. The seepage path is increased by providing piles and impervious floor to reduce the uplift pressure.
5. The thickness of the floor should be sufficient to resist the uplift pressure due to subsurface

6. A suitably graded inverted filter should be provided at the downstream end of the impervious floor to check the migration of soil particles along with water. The filter layer is loaded with concrete blocks. Concrete blocks are also provided at the upstream end.

(b) Surface flow

1. The piles (or cutoff walls) at the upstream and downstream ends of the impervious floor should be provided upto the maximum scour level to protect the main structure against scour.

2. The launching aprons should be provided at the upstream and downstream ends to provide a cover to the main structure against scour.

3. A device is required at the downstream to dissipate energy. For large drops, hydraulic jump is used to dissipate the energy.

4. Additional thickness of the impervious floor is provided at the point where the hydraulic jump is formed to counterbalance the suction pressure.

5. The floor is constructed as a monolithic structure to develop bending resistance (or beam action) to resist the suction pressure.