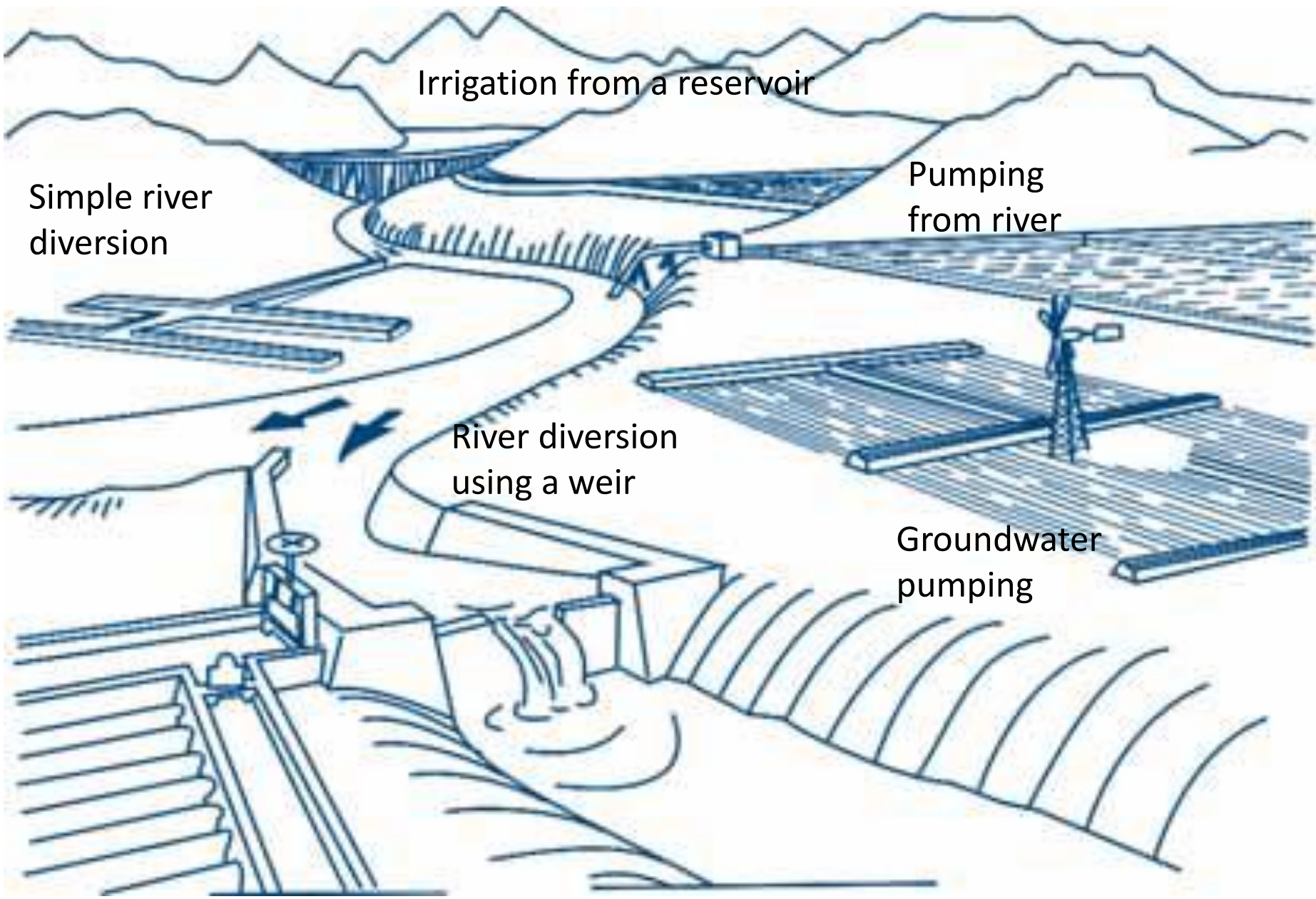


University of Salahaddin
College of Engineering
Dam and Water Resource Engineering Department

Hydraulic Structures
Lecture 4 part 1
Diversion Head Works



Irrigation from a reservoir

Simple river diversion

Pumping from river

River diversion using a weir

Groundwater pumping

Diversion Headworks

Introduction

Any hydraulic structure which supplies water to the off-taking canal is called a headwork.

Headwork may be

1. Storage headwork.
2. Diversion headwork.

A Storage headwork comprises the construction of a dam on the river. It stores water during the period of excess supplies and releases it when demand overtakes available supplies.

A diversion headwork serves to divert the required supply to canal from the river.

Diversion Headworks

- **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.**
- **Diversion headworks are generally constructed on the perennial rivers which have adequate flow throughout the year and, therefore, there is no necessity of creating a storage reservoir.**
- **A diversion head works differs from a storage work or a dam. A dam is constructed on the river for the purpose of creating a large storage reservoir. The storage works are required for the storage of water on a non-perennial river or on a river with inadequate flow throughout the year.**
- **On the other hand, in a diversion head works, there is very little storage, if any.**

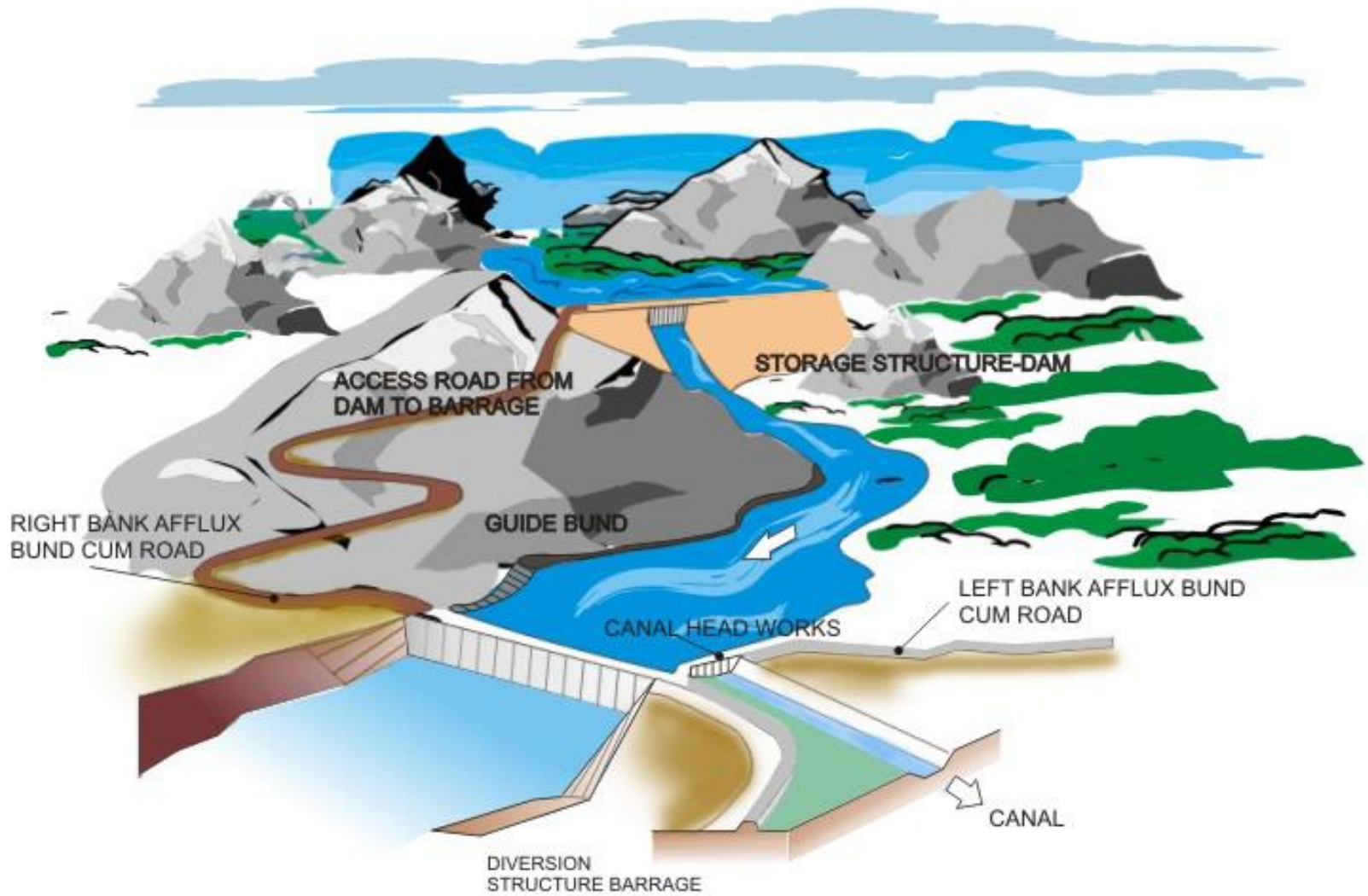


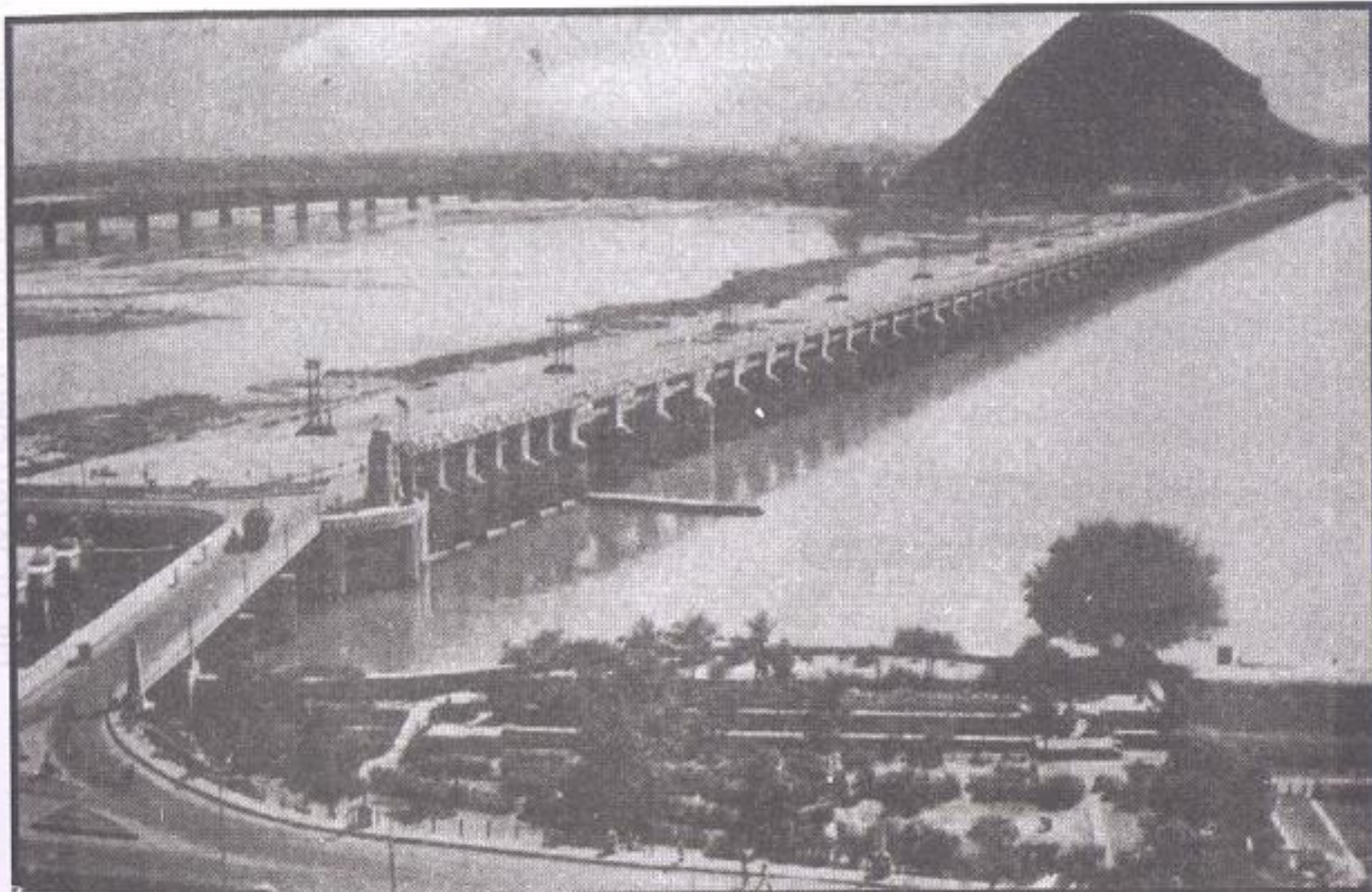
FIGURE 1. Structures for harnessing water resources potential of a river

Diversion Headworks

Functions of a Diversion Headworks

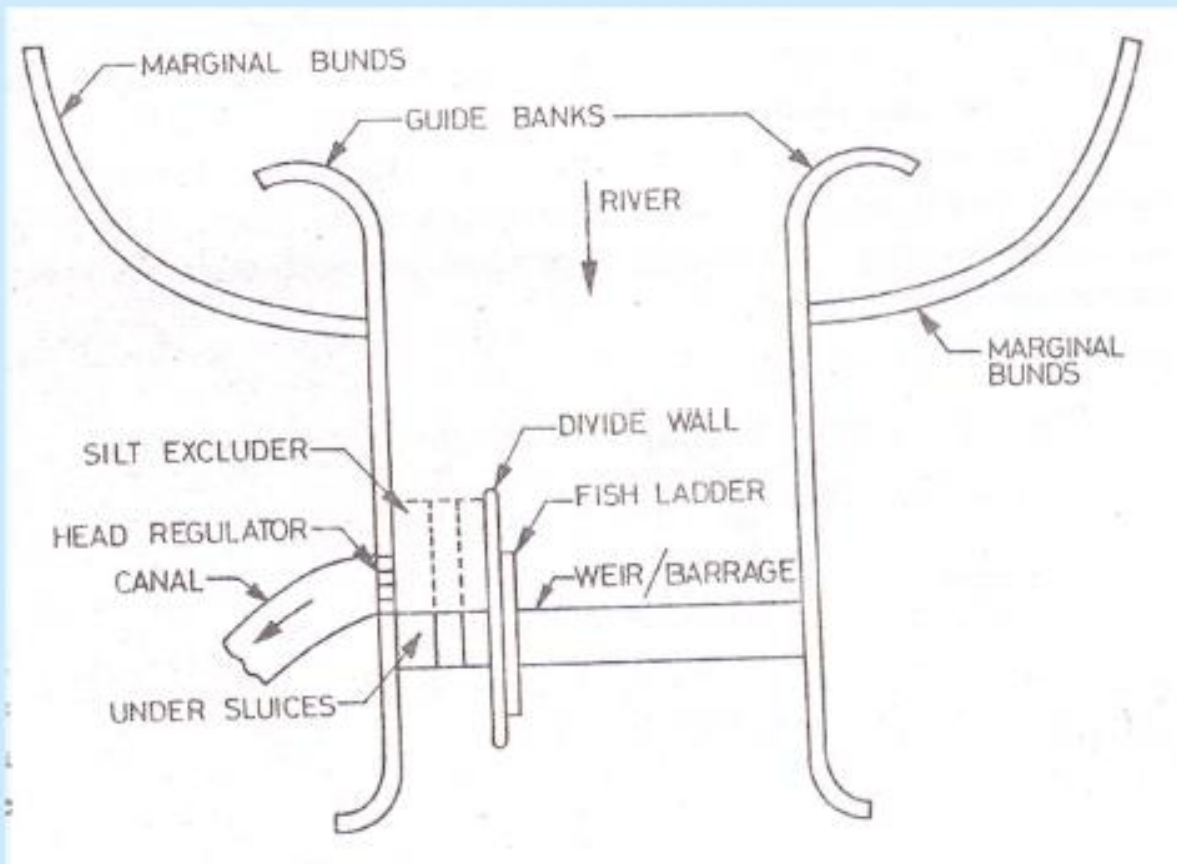
- ✓ It raises the water level on its upstream side.
- ✓ It regulates the supply of water into canals.
- ✓ It controls the entry of silt into canals
- ✓ It creates a small pond (not reservoir) on its upstream and provides some pondage.
- ✓ It helps in controlling the vagaries of the river.

Diversion Headworks



Diversion Headworks

Component Parts



- ✓ Weir or barrage
- ✓ Undersluices
- ✓ Divide wall
- ✓ Fish ladder
- ✓ Canal head regulator
- ✓ Approach channel
- ✓ Silt excluders
- ✓ River training works (Marginal bunds and guide banks)

Diversion Headworks

Undersluice

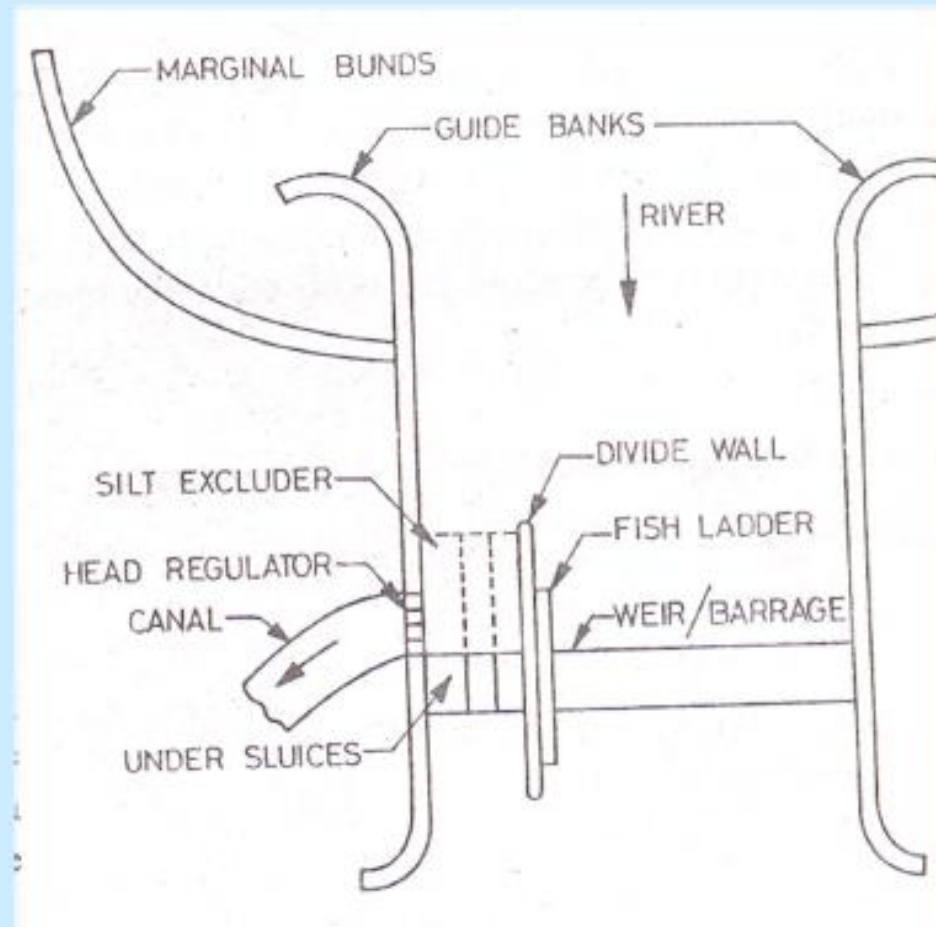
- ✓ Undersluice sections are provided adjacent to the canal head regulators.
- ✓ The undersluices should be able to pass fair weather flow for which the crest shutters on the weir proper need not be dropped.
- ✓ The crest level of the undersluices is generally kept at the average bed level of the river

Diversion Headworks

Divide Wall

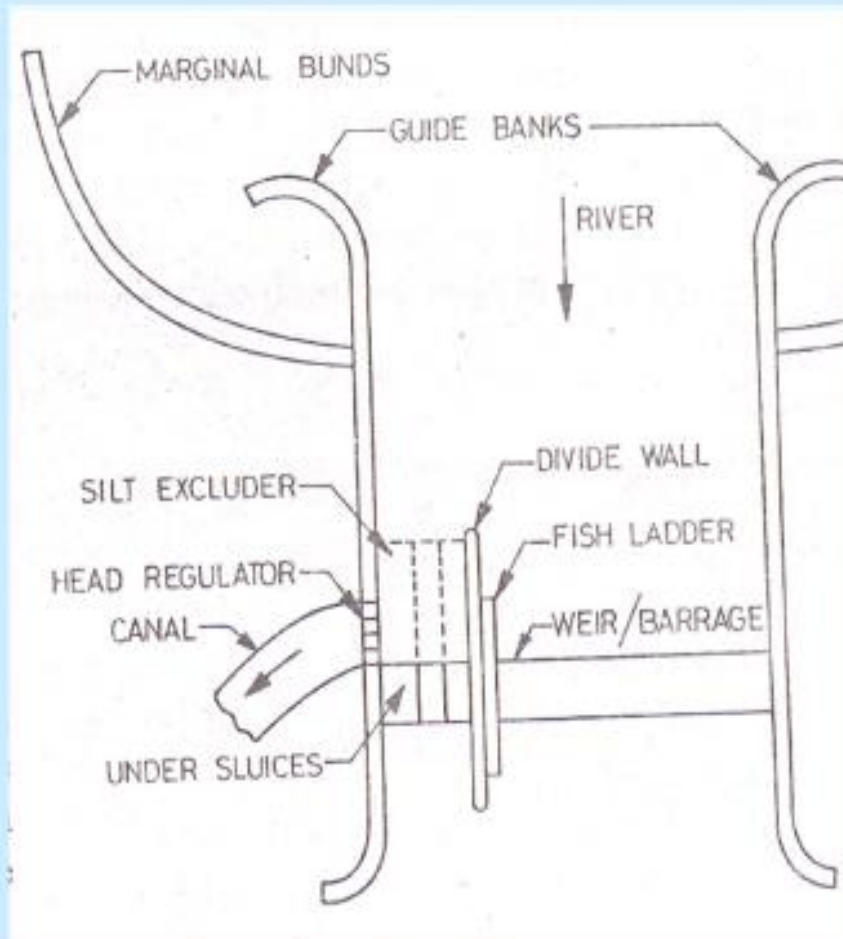
✓ A divide wall is constructed parallel to the direction of flow of river to separate the weir section and the undersluices section to avoid cross flows.

✓ If there are undersluices at both the sides, there are two divide walls



Diversion Headworks

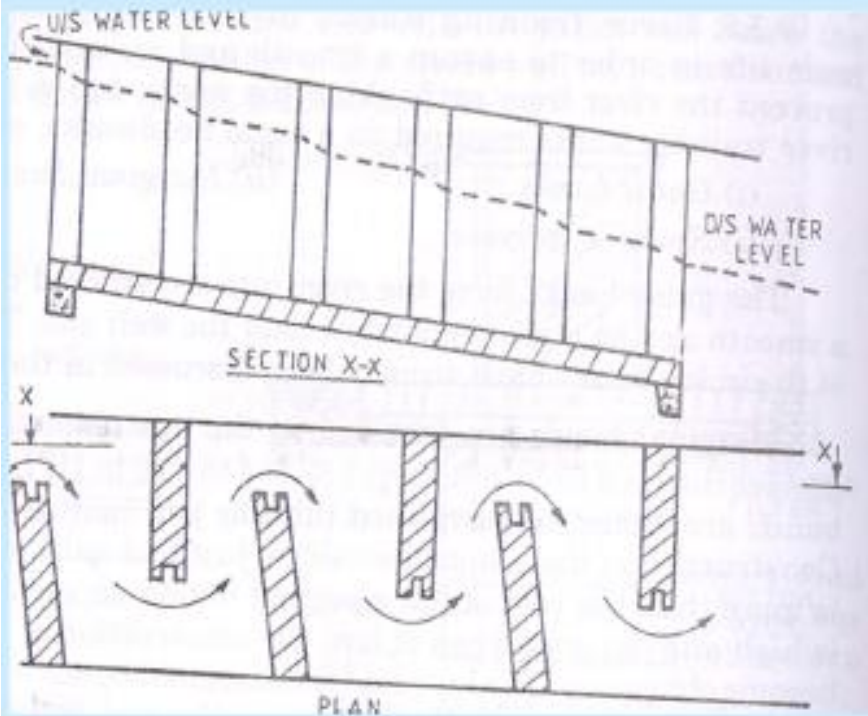
Fish Ladder



- ✓ A fish ladder is a passage provided adjacent to the divide wall on the weir side for the fish to travel from u/s to d/s and vice versa.
- ✓ Fish migrate u/s or d/s 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.

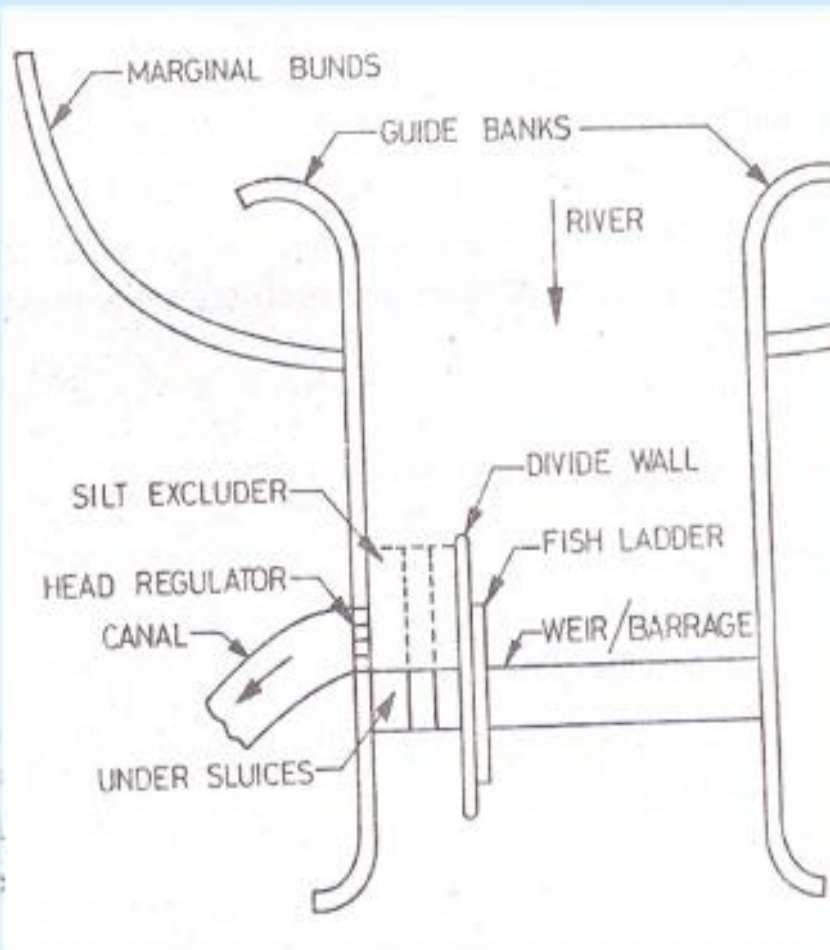
Diversion Headworks

Fish Ladder



Diversion Headworks

Canal Head Regulator

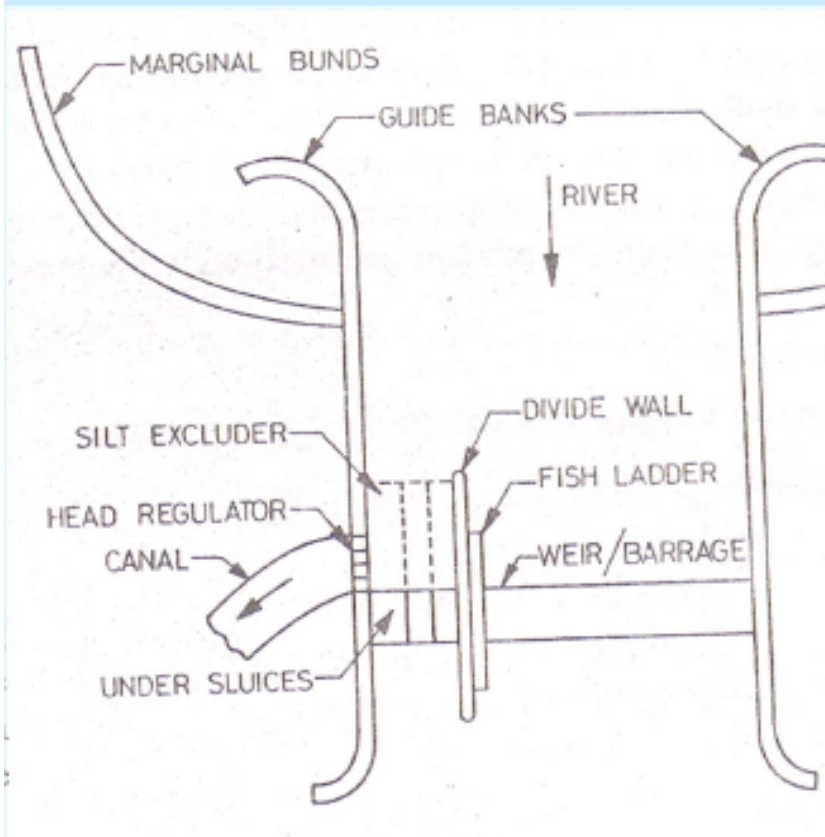


✓ A canal head regulator is provided at the head of the canal offtaking from the diversion headworks.

✓ It regulates the supply of water into the canal, controls the entry silt into the canal, and prevents the entry of river floods into canal.

Diversion Headworks

Silt Excluder

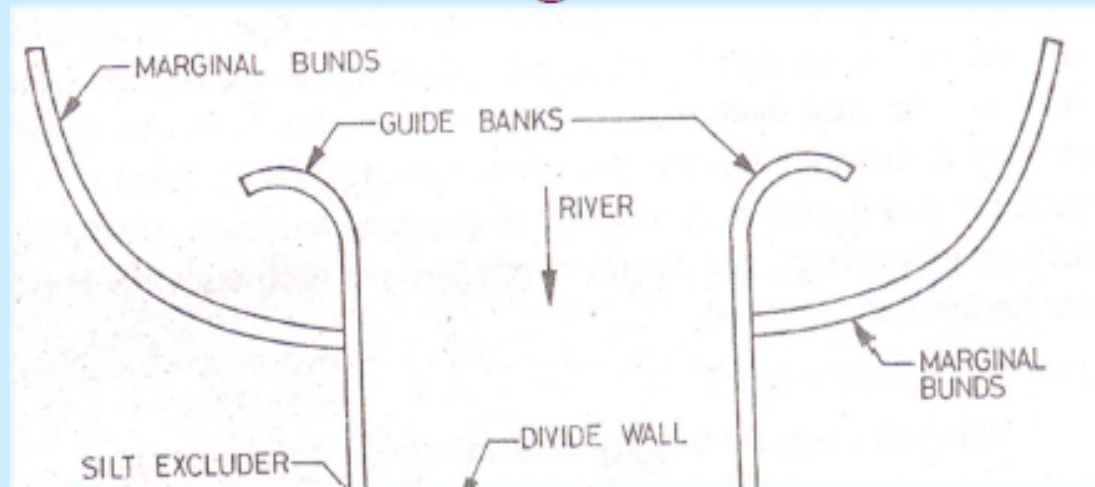


✓ A silt excluder is a structure in the undersluices pocket to pass the silt laden water to the downstream so that only clear water enters into the canal through head regulator.

✓ The bottom layer of water which are highly charged with silt pass down the silt excluder an escape through the undersluices.

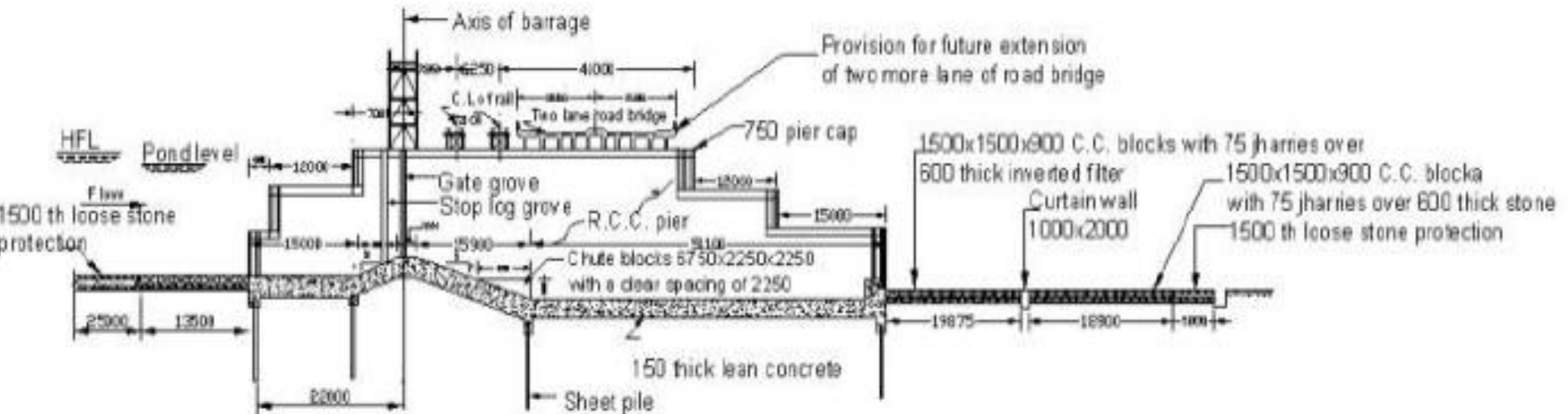
Diversion Headworks

Guide Banks & Marginal Bunds

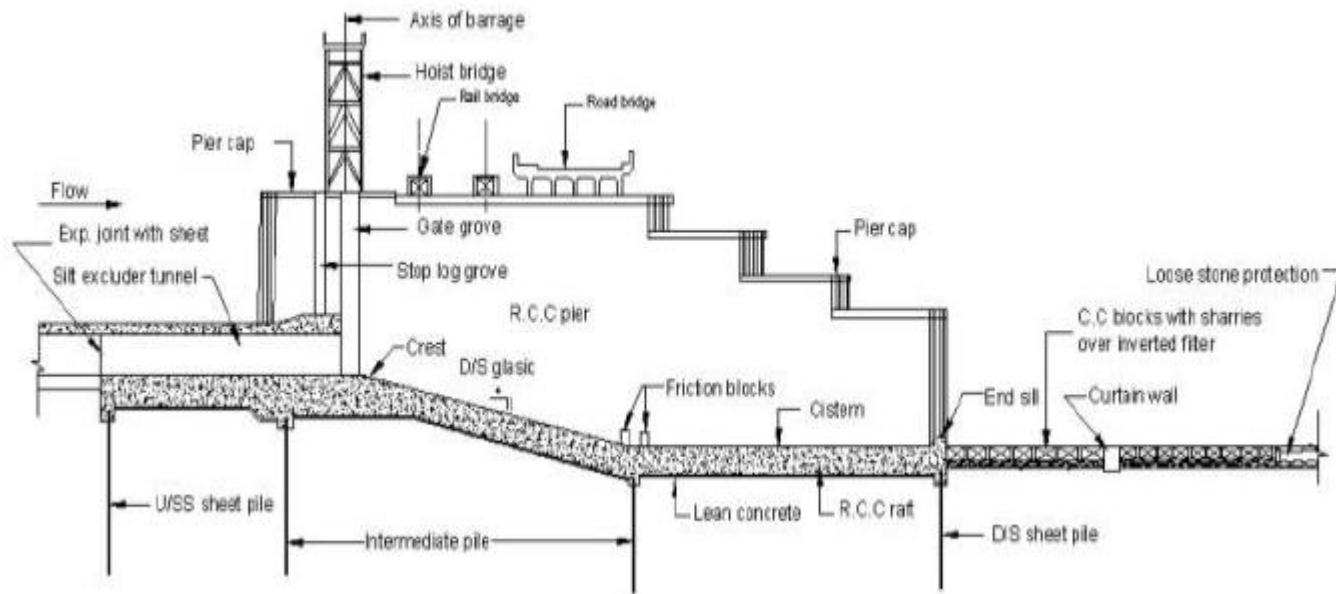


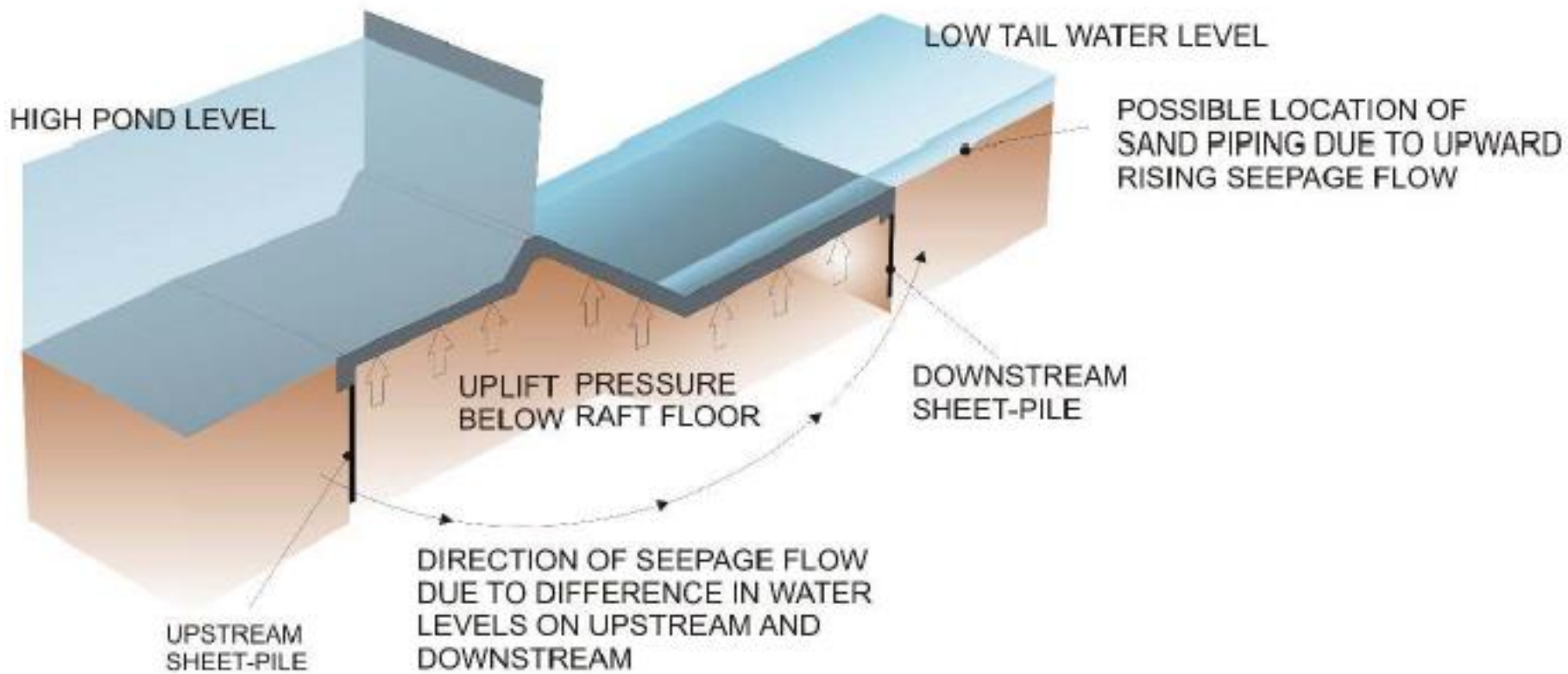
- ✓ **Guide banks are provided on either side of the diversion headworks for a smooth approach and to prevent the river from outflanking.**
- ✓ **Marginal bunds are provided on either side of the river u/s of diversion headworks to protect the land and property which is likely to be submerged during ponding of water in floods.**

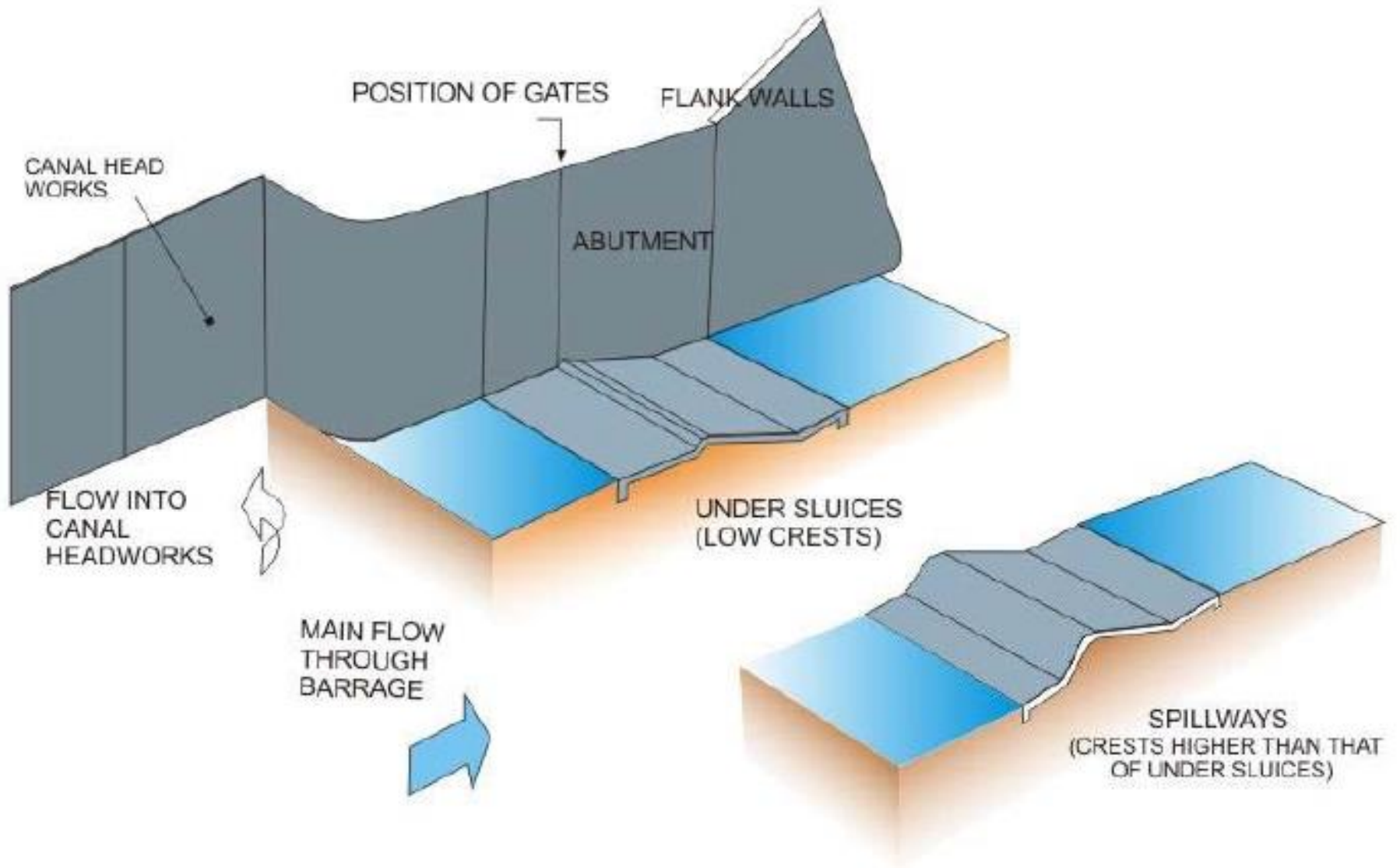
Spillway / Barrage



Under Sluices/ Barrage







Diversion Headworks

Weir or Barrage

Fig. 9.6.1: Barrage

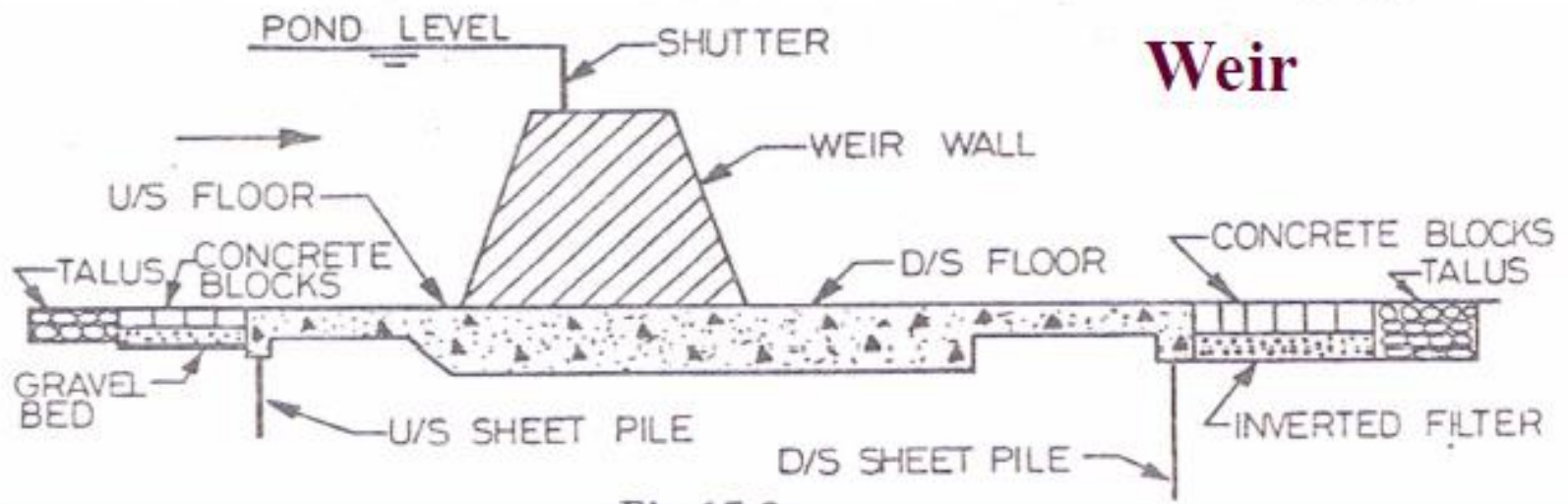
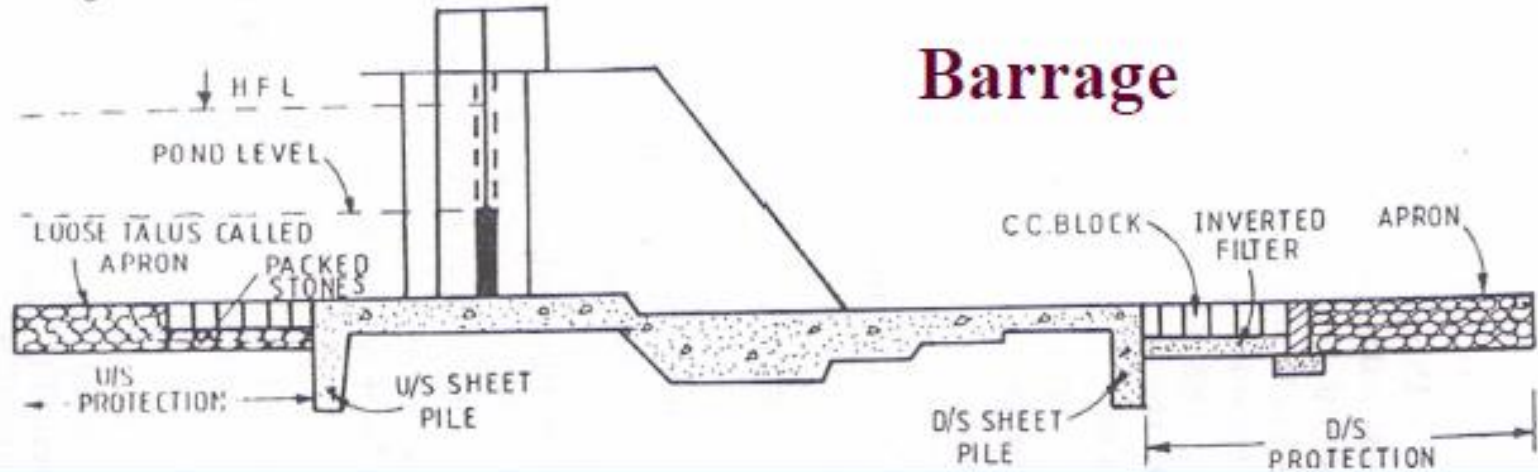
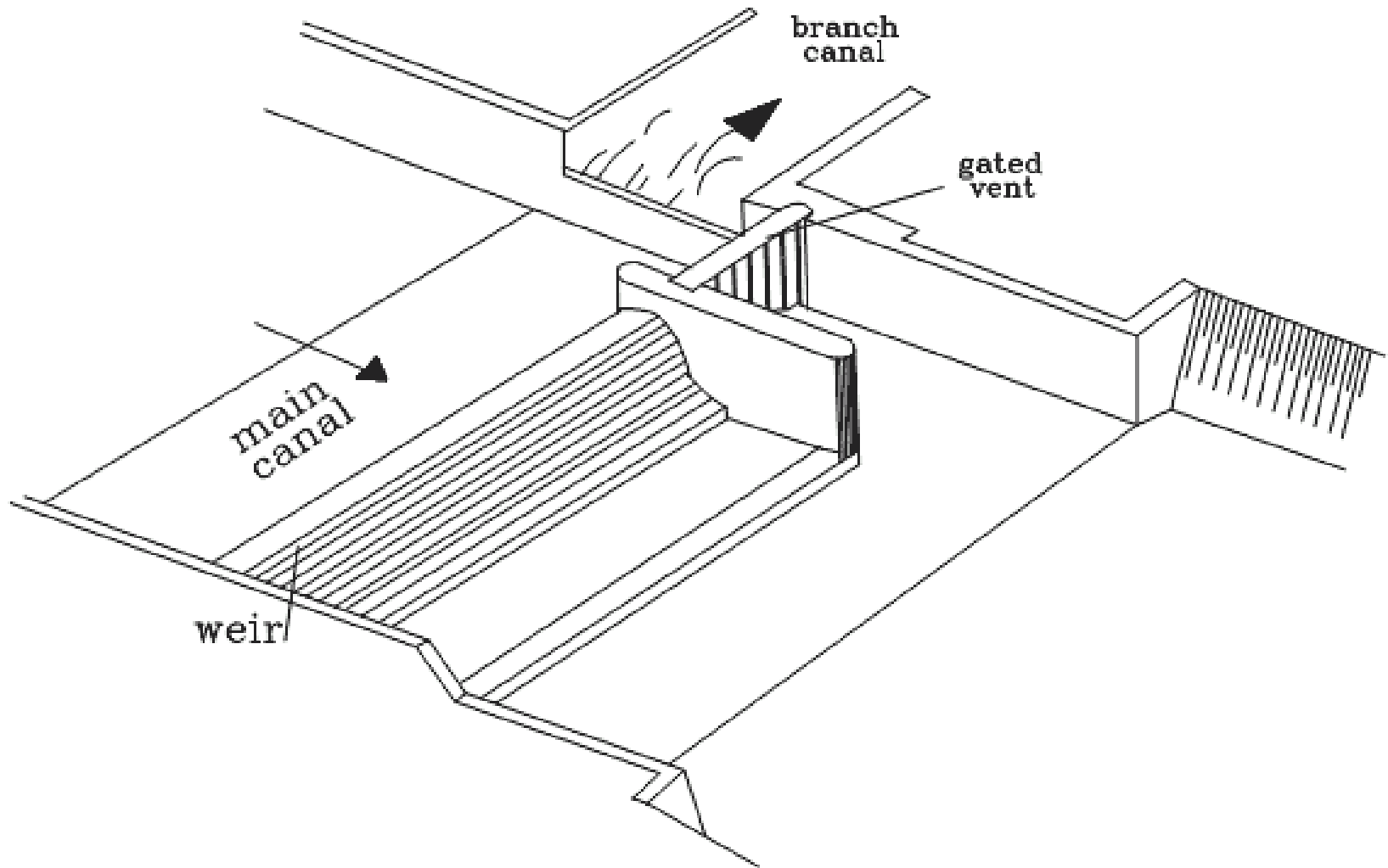


Fig. 9.6.2

Diversion Headworks

Weir or Barrage

- ✓ 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

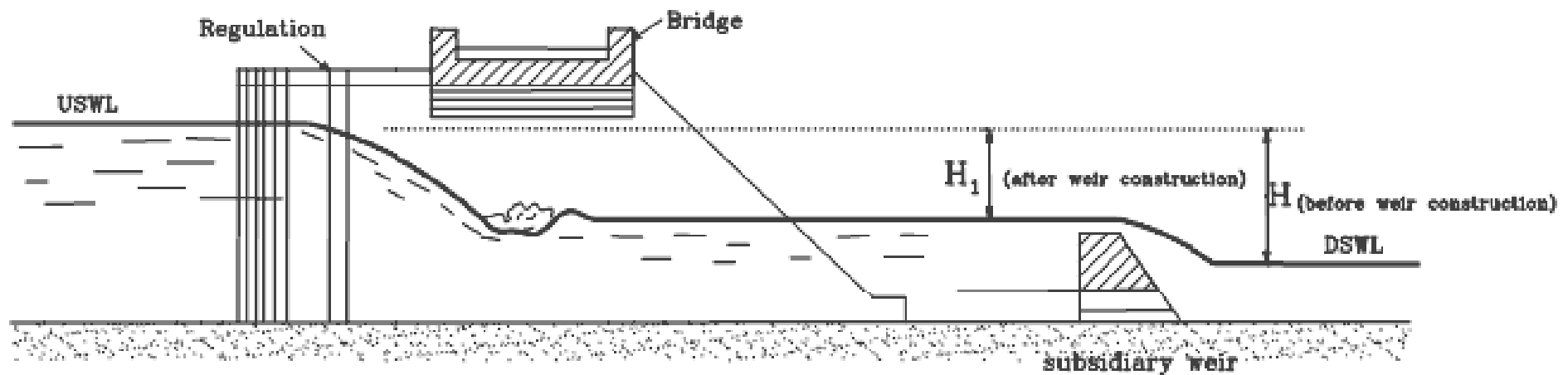


A Weir constructed to raise USWL in a Main Canal

Diversion Headworks

Weir or Barrage

- ✓ 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.
- ✓ 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 dropping the shutters.
- ✓ On the other hand, in the case of a barrage, the control of pondage and flood discharge is achieved with the help of gates which are mechanically operated



A Weir constructed for decreasing Head on an existing Structure

Diversion Headworks

Barrage – Advantages and Disadvantages

Advantages:

- ✓ The barrage has a good control on the river during floods. The outflow can be easily regulated by gates.
- ✓ The afflux during floods is small and, therefore, the submerged area is less.
- ✓ There is a good control over silt entry into the canal.
- ✓ There is a good control over flow conditions, shoal formations and cross-currents on the upstream of the barrage.
- ✓ There are better facilities for inspection and repair of various structures.
- ✓ A roadway can be conveniently provided over the structure at a little additional cost.

Disadvantages:

- ✓ The initial cost of Barrage is very high.

Diversion Headworks

Weir – Advantages and Disadvantages

Advantages:

- ✓ The initial cost of weirs is usually low.

Disadvantages:

- ✓ There is a large afflux during floods which causes large submergence.
- ✓ Because the crest is at high level, there is great silting problem
- ✓ The raising and lowering of shutters on the crest is not convenient. Moreover, it requires considerable time and labour.
- ✓ The weir lacks an effective control on the river during floods.
- ✓ A roadway can not be conveniently provided over the weir.

Diversion Headworks

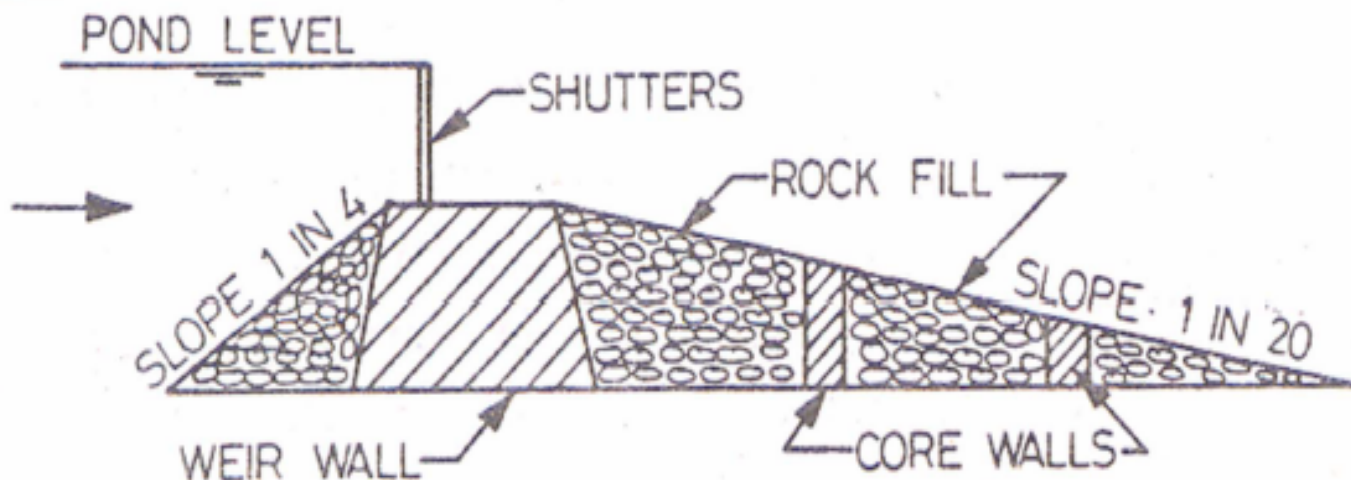
Types of Weirs

- ✓ Vertical drop weirs.
- ✓ Rockfill weirs.
- ✓ Concrete glacis or sloping weirs.

Diversion Headworks

Rockfill Weirs

- In a rockfill type weir, there are a number of core walls. The space between the core walls is filled with the fragments of rock.
- A rockfill weir requires a lot of rock fragments and is economical only when a huge quantity of rockfill 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.



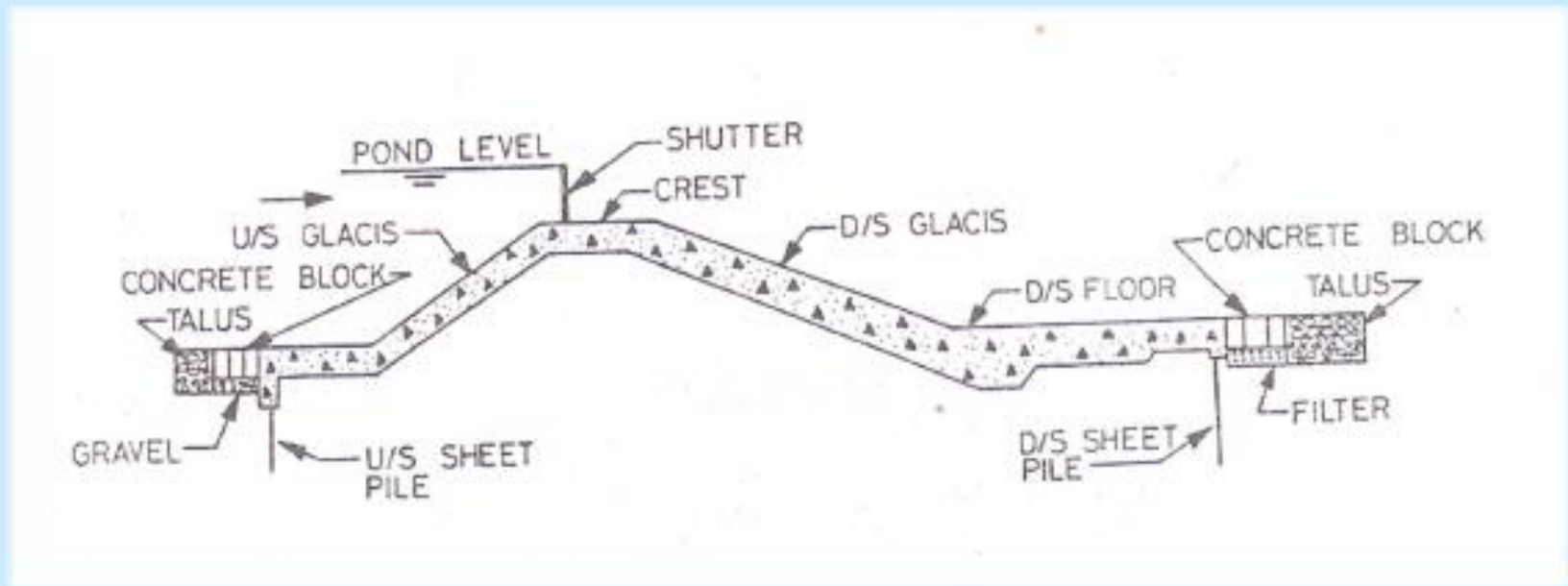
Diversion Headworks

Sloping/Glacis Weirs

- Concrete sloping weirs (or glacis weirs) are of relatively recent origin.
- The crest has glacis (sloping floors) on u/s as well as d/s. There are sheet piles driven upto the maximum scour depth at the u/s and d/s ends of the concrete floor.
- Sometimes an intermediate pile is also driven at the beginning of the u/s glacis or at the end of d/s glacis.
- 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

Diversion Headworks

Sloping/Glacis Weirs



Diversion Headworks

Location or Site Selection

- ✓ **The river section at the site should be narrow and well-defined.**
- ✓ **The river should have high, well-defined, inerodible and non-submersible banks so that the cost of river training works is minimum.**
- ✓ **The canals taking off from the diversion head works should be quite economical and should have a large commanded area.**
- ✓ **There should be suitable arrangement for the diversion of river during construction.**
- ✓ **The site should be such that the weir (or barrage) can be aligned at right angles to the direction of flow in the river. uniform flow and length of the weir - minimum.**

Diversion Headworks

Location or Site Selection

- ✓ **There should be suitable locations for the undersluices, head regulator and other components of the diversion headworks.**
- ✓ **The diversion headworks should not submerge costly land and property on its upstream.**
- ✓ **Good foundation should be available at the site.**
- ✓ **The required materials of construction should be available near the site.**
- ✓ **The site should be easily accessible by road or rail.**
- ✓ **The overall cost of the project should be a minimum.**