LECTURE 08

DIVERSION HEADWORKS

The works, which are constructed at the head of the canal, in order to divert the river water towards the canal, so as to ensure a regulated continuous supply of silt-free water with a certain minimum head into the canal, are known as diversion heads works.

Objective of Diversion Head Works

- To rise the water level at the head of the canal.
- To form a storage by constructing dykes (embankments) on both the banks of the river so that water is available throughout the year
- To control the entry of silt into the canal and to control the deposition of silt at the head of the canal To control the fluctuation of water level in the river during different seasons

Selection of Site for Diversion Head Works

- At the site, the river should be straight and narrow
- The river banks should be well defined.
- The valuable land should not be submerged when the weir or barrage is constructed.
- The elevation of the site should be much higher than the area to be irrigated.
- The site should be easily accessible by roads or railways.
- The materials of construction should be available in vicinity of the site.
- The site should not be far away from the command area of the project, to avoid transmission loss.

1. Storage structure : Usually a dam, which acts like a reservoir for storing excess runoff of a river during periods of high flows and releasing it according to a regulated schedule.
2. Diversion structure: which may be a weir or a barrage that raises the water level of the river slightly, not for creating storage, but for allowing the water to get diverted through a canal situated at one or either of its banks? The diverted water passed through the canal may be used for irrigation, industry, domestic water needs or power generation.

Diversion Structures:

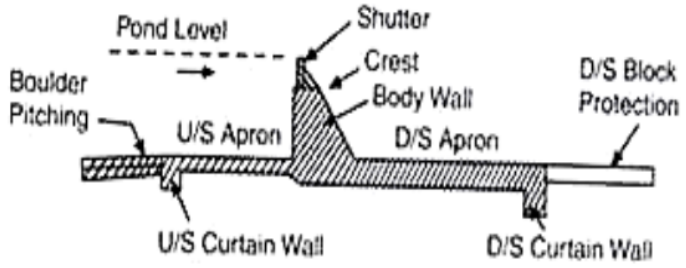


Fig. 12.5. Parts of weir

Layout of a Diversion Head Works and its components

A typical layout of a canal head-works is shown in figure below. *Such a head-works consists of*:

- Weir proper
- Under-sluices
- Divide wall
- River Training works
- Fish Ladder
- Canal Head Regulator
- River Training Works e.g. Guide bank, Marginal bunds, spur and groyne etc.
- Shutters and Gates
- Silt Regulation Works

Weir and Barrage

It is a barrier constructed across the river to raise the water level on the upstream side of the obstruction in order to feed the main canal.

The ponding of water can be achieved either only by a raised crest across the river or by a raised crest supplemented by gates or shutters, working over the crest.

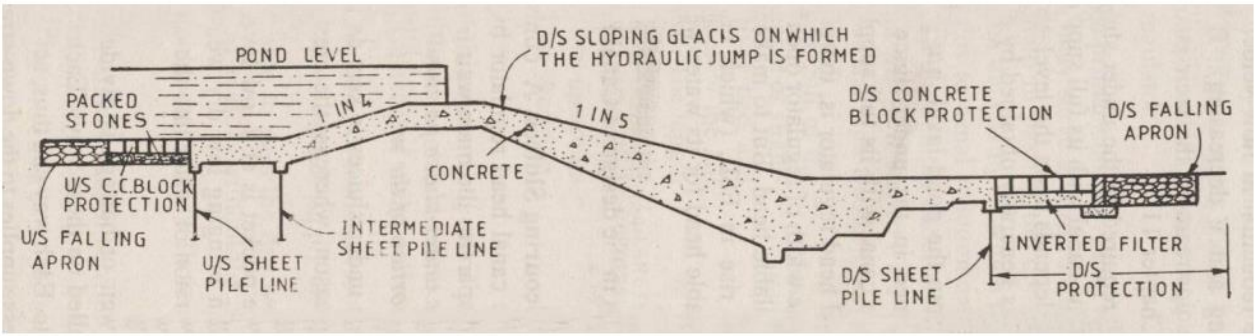


Fig: A typical cross-section of a modern concrete weir

Definition:

Weir

- If the major part or the entire ponding of water is achieved by a raised crest and a smaller part or nil part of it is achieved by the shutters, and then this barrier is known as a ***weir***.

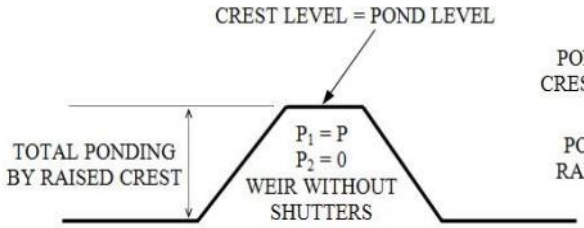
1. A solid obstruction put across river to raise its water level and divert water into canal (low head structure)
2. Vertical drop wall or crest wall
3. Upstream, downstream cut off wall at the ends of impervious floor
4. Launching apron for prevention of scour
5. Graduated inverted filter on downstream surface floor end to relieve the uplift pressure

Gravity and Non-gravity weirs:

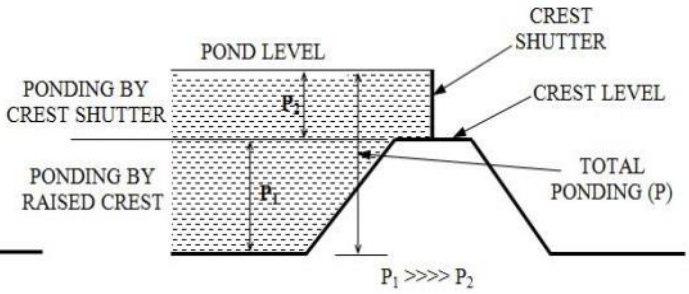
When the weight of the weir (i.e. its body and floor) balances the uplift pressure caused by the head of the water seeping below the weir, it is called a gravity weir.

On the other hand, if the weir floor is designed continuous with the divide piers as reinforced structure, such that the weight of concrete slab together with the weight of divide piers keep the structure safe against the uplift then the structure may be called as a non-gravity weir.

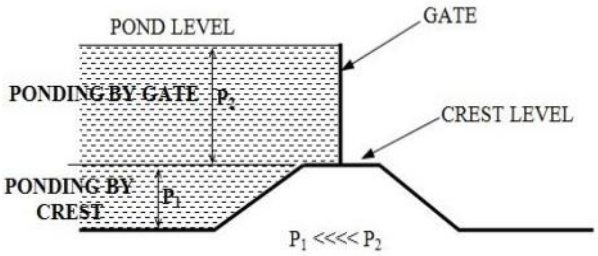
In the latter case, RCC is to be used in place of brick piers Considerable savings may be obtained, as the weight of the floor can be much less than what is required in gravity weir.



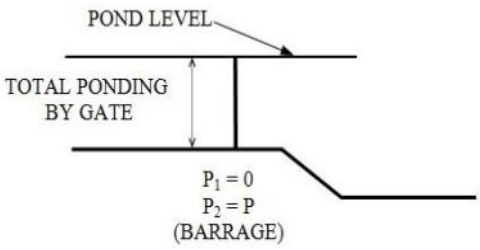
(a) Fig: Weir without shutters



(b) Fig: Weir with shutters



(c) Fig: Barrage with a small raised crest



(d) Fig: Barrage without any raised crest

Types of weirs

(a) Masonry weirs with vertical drop

(b) Rock-fill weirs with sloping aprons

(c) Concrete weirs with sloping glacis

Masonry weirs with vertical drop

Masonry weir wall is constructed over the impervious floor. Cut-off walls are provided at both ends of the floor. Sheet piles are provided below the cut off walls. The crest shutters are provided to raise the water level, if required. The shutters are dropped down during flood. The masonry weir wall may be vertical on both face and sloping on both face and vertical on downstream face and sloping in upstream face.

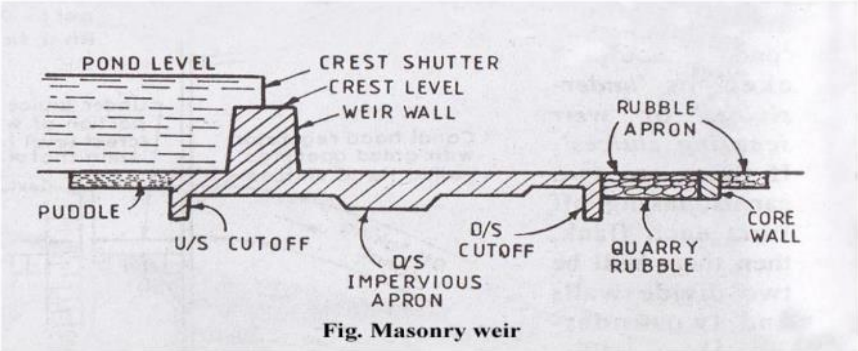


Fig. Masonry weir

Rock-fill weirs with sloping aprons

It consists of masonry breast wall which is provided with adjustable crest shutter. The upstream rock-fill portion is constructed with boulders forming a slope of 1 in 4. The boulders are grouted with cement mortar. The downstream sloping apron consists of core walls. The intermediate spaces between the core walls are filled up with boulders maintaining a slope of 1 in 20. The boulders are grouted properly with cement mortar.

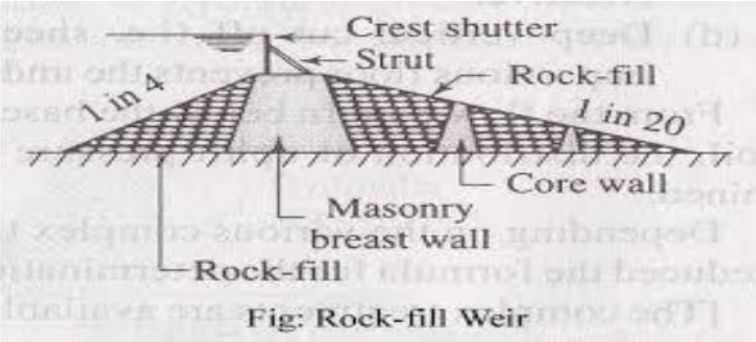


Fig: Rock-fill Weir

Concrete weir

Now-a-days, the weir is constructed with reinforced cement concrete. The impervious floor and the weir are made monolithic. The cut off walls are provided at the upstream and downstream end of the floor and at the toe of the weir. Sheet piles are provided below the cut-off walls. The crest shutters are also provided which have dropped down during the flood.

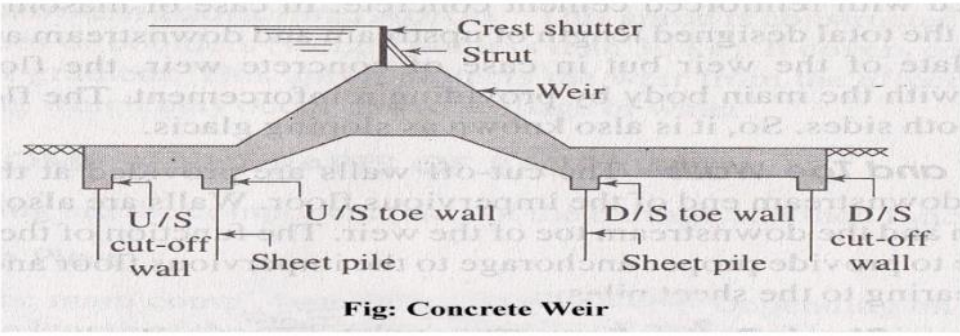


Fig: Concrete Weir

Location of Weirs

- A weir should be located in a stable part of the river where the river is unlikely to change its course.

- The weir has to be built high enough to fulfill command requirements. During high floods, the river could overtop its embankments and change its course. Therefore, a location with firm, well defined banks should be selected for the construction of the weir.
- Where possible, the site should have good bed conditions, such as rock outcrops.

Barrage

If most of the ponding is done by gates and a smaller or nil part of it is done by the raised crest, then the barrier is known as a ***barrage*** *or a river regulator*.

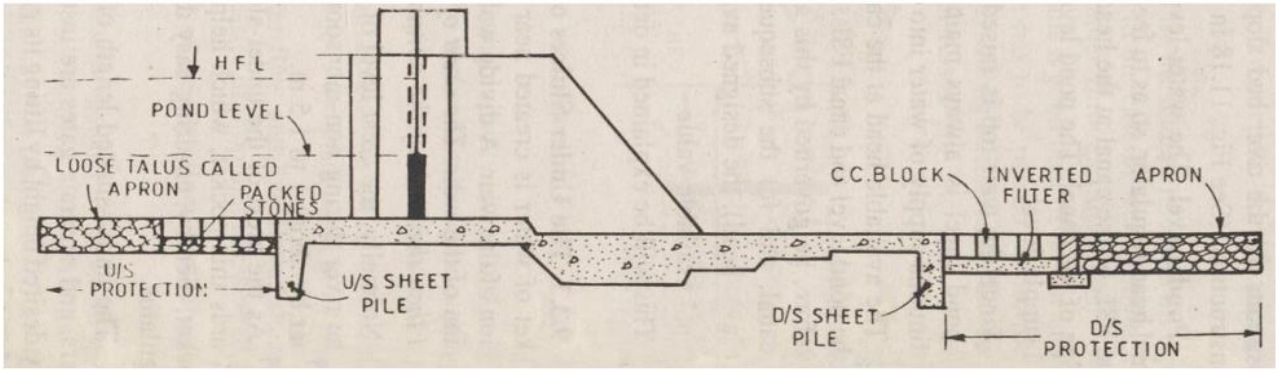


Fig: A typical cross-section of a barrage

Afflux:

- The rise in the highest flood level (HFL) upstream of the weir due to construction of the weir across the river is called.
- In case of weir, the afflux caused during high floods is quite high. But in case of a barrage, the gates can be opened during high floods and the afflux will be nil or minimum.

Choice between a weir and a barrage

- The choice between a weir and a barrage is largely governed by cost and convenience in working.
- A shuttered weir will be relatively cheaper but will lack the effective control possible in the case of a barrage.
- A barrage type construction can be easily supplemented with a roadway across the river at a small additional cost. Barrages are almost invariably constructed now-a-days on all important rivers.

Difference between Barrage and Weir SL	**Barrage**	**Weir**
(a)	Low set crest	High set crest
(b)	Ponding is done by means of gates	Ponding is done against the raised crest or partly against crest and partly by shutters
(c)	Gated over entire length	Shutters in part length

(d)	Gates are of greater height	Shutters are of smaller height, 2 m
(e)	Gates are raised clear off the high floods to pass floods	Shutters are dropped to pass floods
(f)	Perfect control on river flow	No control of river in low floods
(g)	Gates convenient to operate	Operation of shutters is slow, involve labour and time
(h)	High floods can be passed with minimum afflux	Excessive afflux in high floods
(i)	Less silting upstream due to low set crest	Raised crest causes silting upstream
(j)	Longer construction period	Shorter construction period
(k)	Silt removal is done through under sluices	No means for silt disposal
(l)	Road and/or rail bridge can be constructed at low cost	Not possible to provide road-rail bridge
(m)	Costly structure	Relatively cheaper structur

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1. **Weir Proper:**
   It is a barrier constructed across the river. It aims to raise the water level in order to feed the canal.
2. **Under-sluices:**

   The under sluices are the openings provided at the base of the weir or barrage. These openings are provided with adjustable gates. Normally, the gates are kept closed. The crest of the under-under sluice portion of the weir is kept at a lower level (1 1.5 m) than the crest of the normal portion of the weir. The suspended silt goes on depositing in front of the canal head regulator. When the silt deposition becomes appreciable the gates are opened and the deposited silt is loosened with an agitator mounting on a boat. The muddy water flows towards the downstream through the scouring sluices. The gates are then closed. But, at the period of flood, the gates are kept opened.

The main functions of under-sluices are:

- To maintain a well defined deep channel approaching the canal head regulator.
- To ensure easy diversion of water into the canal through the canal head regulator even during low flow.

- To control the entry of silt into the canal
- To help scouring and of the silt deposited over the under-sluice floor and removing towards the downstream side.
- To help passing the low floods without dropping the shutters of the weir

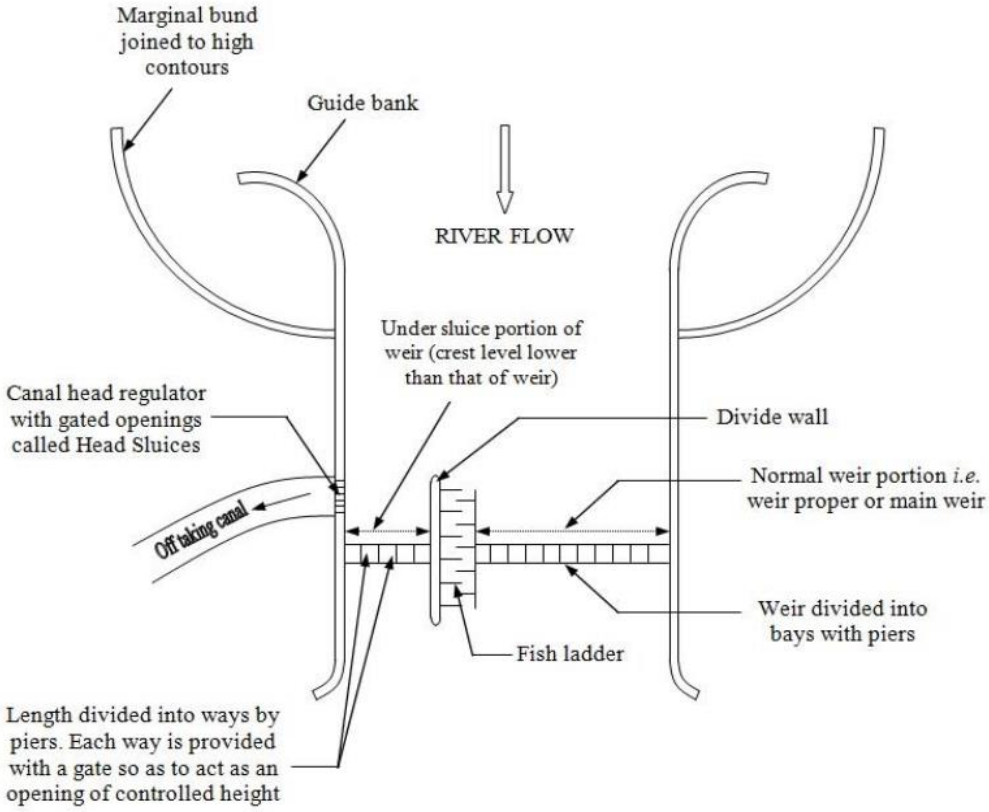

Fig: Typical layout of diversion head-works