

Cross drainage works

- In an irrigation project, when the network of main canals, branch canals, distributaries, etc. are provided, then these canals may have to cross the natural drainages like rivers, streams, nullahs, etc at different points within the command area of the project.
- The crossing of the canals with such obstacle cannot be avoided. So, suitable structures must be constructed at the crossing point for the easy flow of water of the canal and drainage in the respective directions. These structures are known as cross-drainage works.

Necessity of Cross-drainage works:

- The water-shed canals do not cross natural drainages. But in actual orientation of the canal network, this ideal condition may not be available and the obstacles like natural drainages may be present across the canal. So, the cross drainage works must be provided for running the irrigation system.
- At the crossing point, the water of the canal and the drainage get intermixed. So, for the smooth running of the canal with its design discharge the cross drainage works are required.
- The site condition of the crossing point may be such that without any suitable structure, the water of the canal and drainage can not be diverted to their natural directions. So, the cross drainage works must be provided to maintain their natural direction of flow.

Types of Cross-Drainage Works:**(1) Type I (Irrigation canal passes over the drainage)**

- a) Aqueduct

- b) Siphon aqueduct

(2) Type II (Drainage passes over the irrigation canal)

- a) Super passage
- b) Siphon super passage

(3) Type III (Drainage and canal intersection each other of the same level)

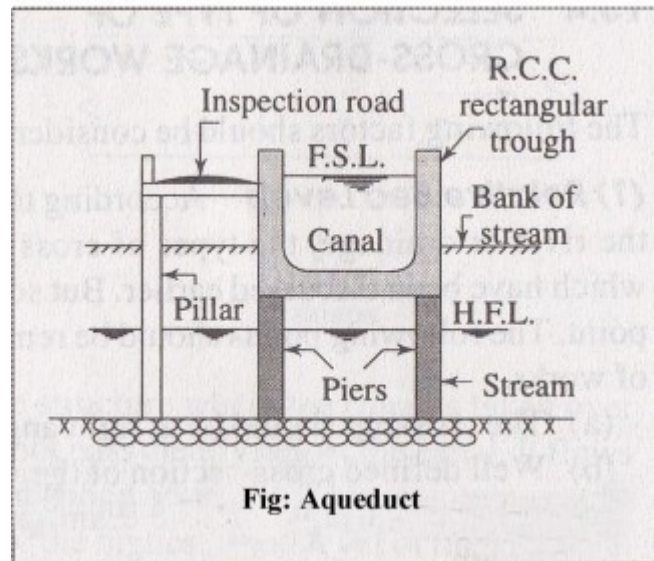
- a) Level Crossing
- b) Inlet and outlet

Selection of type of cross-drainage works

- Relative bed levels
- Availability of suitable foundation
- Economical consideration
- Discharge of the drainage
- Construction problems

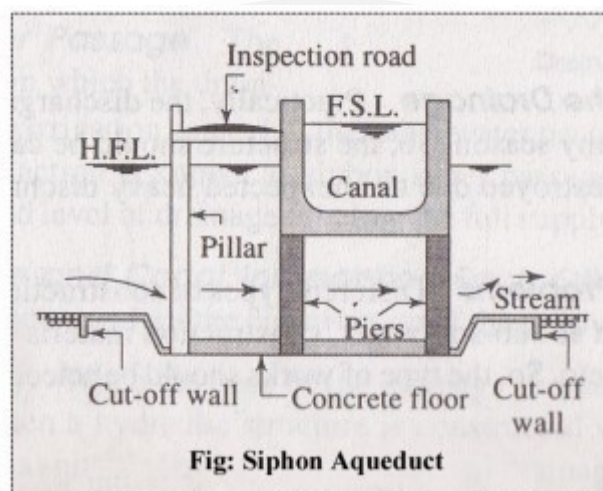
Aqueduct

- The aqueduct is just like a bridge where a canal is taken over the deck supported by piers instead of a road or railway.
- Generally, the canal is in the shape of a rectangular trough which is constructed with reinforced cement concrete. Sometimes, the trough may be of trapezoidal section.
- An inspection road is provided along the side of the trough.
- The bed and banks of the drainage below the trough is protected by boulder pitching with cement grouting.
- The section of the trough is designed according to the full supply discharge of the canal.
- A free board of about 0.50 m should be provided.
- The height and section of piers are designed according to the highest flood level and velocity of flow of the drainage.
- The piers may be of brick masonry, stone masonry or reinforced cement concrete.
- Deep foundation (like well foundation) is not necessary for the piers. The concrete



Siphon Aqueduct

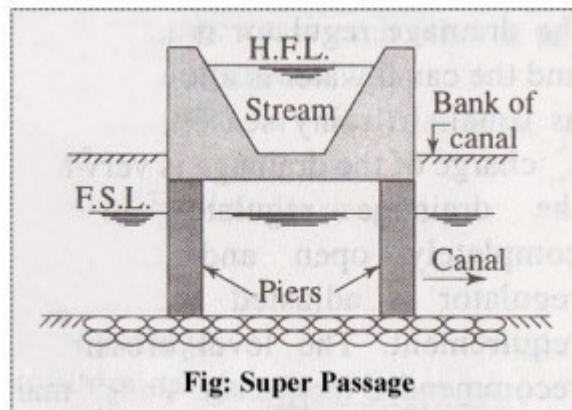
- The siphon aqueduct, the bed of the drainage is depressed below the bottom level of the canal trough by providing sloping apron on both sides of the crossing.
- The sloping apron may be constructed by stone pitching or cement concrete.
- The section of the drainage below the canal trough is constructed with cement concrete in the form of tunnel. This tunnel acts as a siphon.
- Cut off walls are provided on both sides of the apron to prevent scouring.
- Boulder pitching should be provided on the upstream and downstream of the cut-off walls.
- The other components like canal trough, piers, inspection road, etc. should be designed according to the methods adopted in case of aqueduct.



Super Passage

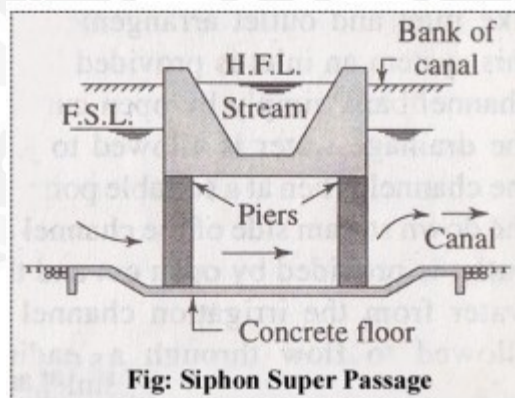
- The super passage is just opposite of the aqueduct. In this case, the bed level of the drainage is above the fully supply level of the canal.

- The section of the drainage trough depends on the high flood discharge.
- A free board of about 1.5 m should be provided for safety.
- The trough should be constructed of reinforced cement concrete.
- The bed and banks of the canal below the drainage trough should be protected by boulder pitching or lining with concrete slabs.
- The foundation of the piers will be same as in the case of aqueduct.



Siphon Super Passage

- It is just opposite siphon aqueduct. In this case, the canal passes below the drainage trough. The section of the trough is designed according to high flood discharge.
- The bed of the canal is depressed below the bottom level of the drainage trough by providing sloping apron on both sides of the crossing.
- The sloping apron may be constructed with stone pitching or concrete slabs.



- The section of the canal below the trough is constructed with cement concrete in the form of tunnel which acts as siphon.
- Cut-off walls are provided on upstream and downstream side of sloping apron.

Level Crossing

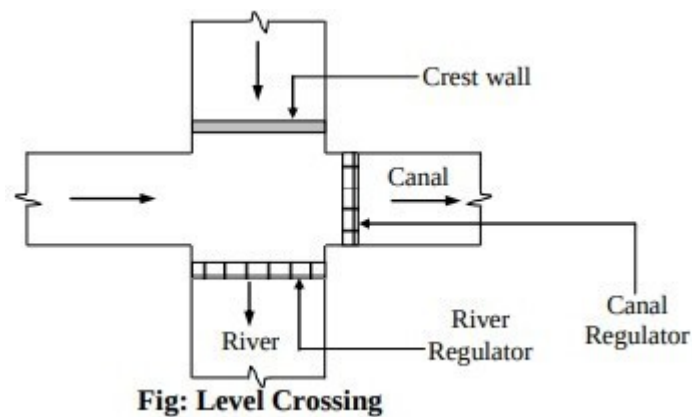
The level crossing is an arrangement provided to regulate the flow of water through the drainage and the canal when they cross each other approximately at the same bed level.

The level crossing consists of the following components:

Crest Wall: It is provided across the drainage just at the upstream side of the crossing point. The top level of the crest wall is kept at the full supply level of the canal.

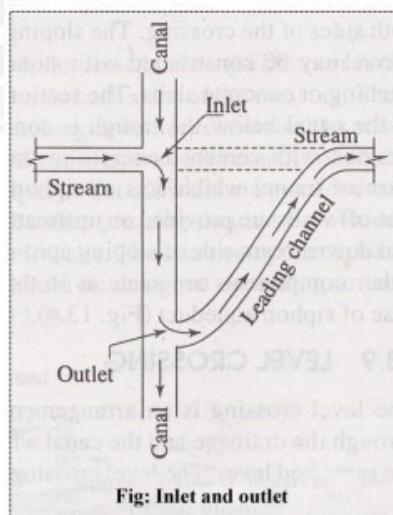
Drainage Regulator: It is provided across the drainage just at the downstream side of the crossing point. The regulator consists of adjustable shutters at different tiers.

Canal Regulator: It is provided across the canal just at the downstream side of the crossing point. This regulator also consists of adjustable shutters at different tiers.



Inlet and outlet

- In the crossing of small drainage with small channel no hydraulic structure is constructed. Simple openings are provided for the flow of water in their respective directions. This arrangement is known as inlet and outlet.
- In this system, an inlet is provided in the channel bank simply by open cut and the drainage water is allowed to join the channel
- At the points of inlet and outlet, the bed and banks of the drainage are protected by stone.



Canal Outlets/Modules:

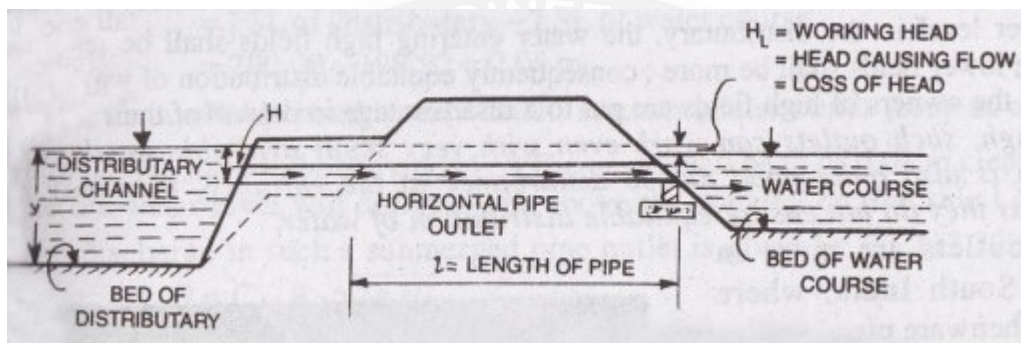
- A canal outlet or a module is a small structure built at the head of the water course so as to connect it with a minor or a distributary channel.
- It acts as a connecting link between the system manager and the farmers.

Requirements of a good module:

- It should fit well to the decided principles of water distribution.
- It should be simple to construct.
- It should work efficiently with a small working head.
- It should be cheaper.
- It should be sufficiently strong with no moving parts, thus avoiding periodic maintenance.
- It should be such as to avoid interference by cultivators.
- It should draw its fair share of silt.

Types of Outlet/modules:

(a) Non-modular modules:



Non-modular modules are those through which the discharge depends upon the head difference between the distributary and the water course.

Common examples are:

- Open sluice
- Drowned pipe outlet

(b) Semi-modules or Flexible modules:

Due to construction, a super-critical velocity is ensured in the throat and thereby allowing the

The formation of hydraulic jump makes the outlet discharge independent of the water level in water course, thus making it a semi module.

Semi-modules or flexible modules are those through which the discharge is independent of the water level of the water course but depends only upon the water level of the distributary so long as a minimum working head is available.

Examples are pipe outlet, open flume type etc.

(c) Rigid modules or Modular Outlets:

Rigid modules or modular outlets are those through which discharge is constant and fixed within limits, irrespective of the fluctuations of the water levels of either the distributary or of the water course or both.

An example is Gibb's module:

