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A Review on Canal Irrigation

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A B S T R A C T

A canal is a waterway that has been created by humans to allow boats and ships to pass from one body of water to another. Additionally, water is moved through canals for agriculture and other purposes by humans. Although the emergence of more environmentally friendly forms of transportation has reduced the need for canals, they still play a vital role asfacilitating international trade and serving as transportation channels.

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1. INTRODUCTION

An artificial channel filled with water and designed for navigation, or for irrigating land etc. an artificial water-course or extensively modified natural used for inland water transport or the control and diversion of water for drainage or irrigation. Generally trapezoidal in shape constructed on the ground to carry eater to the field either from the river of from a reservoir. Canals are classified into differ types based on different criteria:

- **Classification based on Size:**

Based on size, canals are classified into following types:

1. Main canal: The largest canal in the system is the main canal. Directly from the canal headworks, it takes off. There are often two main canals that branch off from either side. On either side, there may be two or more main canals. Normal operations do not include direct watering from a main canal.

2. Branch canal:rom the main canal or another branch canal, a canal branches off. A branch canal typically has a discharge capacity more than 5 cumecs. In general, a branch canal is not used for direct irrigation.

3. Major distributary: In order to supply water to minor distributaries and water courses, a major distributary branches out from a main canal, a branch canal, or another distributary. The discharge capacity is usually from 0.25 to 5 cumecs and these canals are generally utilized for direct irrigation.

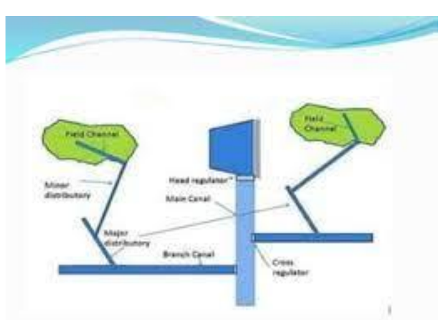

Fig 1 Classification of Canals based on size

4. Minor distributary: The discharge capacity of a minor distributary, which also originates from a major canal, a branch canal, or another distributary and delivers water to water courses, is typically less than 0.25 cumecs. Direct irrigation also utilizes the minor distributaries.

5. Water courses (or field channels): Water courses are tiny routes that transport water to agricultural fields from a branch canal, a large distributary, or a minor distributary. Cultivators are the ones who own, build, and manage the waterways.

- **Classification based on alignment**

Based on alignment, canals are classified into following types:

1. **Watershed (or Ridge Canals):**

A watershed canal is one that runs parallel to a watershed (or ridge). A canal should be as parallel to a ridge line as possible so that it can use gravity to irrigate on both sides of the ridge and therefore have a large controlled area.

- ✓ The watershed or Ridge is the line separating the catchment regions of two streams.
- ✓ Watershed canals are appropriate for plain regions with relatively homogeneous and flat slopes.
- ✓ Because most drainage come from the ridge and do not cross the canal, watershed canals have a minimal amount of cross-drainage works.

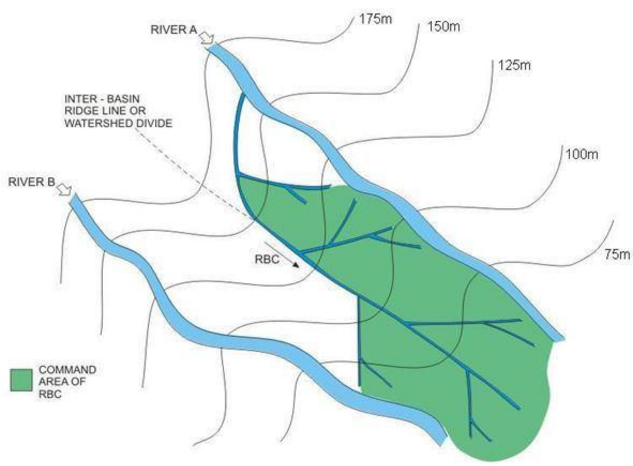

Fig 2 Command Area for a Typical Canal System

2. **Contour canals:**

A contour canal runs approximately parallel to the topographic contours.`

- ✓ The longitudinal slope needed for the gravity flow necessitates some dip in the bed level, hence a contour canal cannot be perfectly parallel to the contours.
- ✓ Due to the higher land on the other side, a contour canal can only irrigate on one side.
- ✓ They often line up when canals branch off of rivers.
- ✓ Since all drainages in a contour canal are at right angles to the contours, there are several cross-drainage works.

3. **Side-Slope canal:**

The alignment of a side-slope canal is perpendicular to the contours.

- ✓ A side-slope canal typically does not intercept drainages because they also follow the contours at right angles, so cross-drainage work is not necessary.
- ✓ It can only irrigate one side.

- **Classification based on canal surface**

Based on the canal surface, canals are categorized into following types:

1. Lined canal:A lined canal is one that has an impervious material covering its surface on its bed and sides to stop water seepage. Additionally, high velocity can be allowed in lined canals, resulting in a smaller cross-sectional area.

2.Unlined canal: An unlined canal is one without a surface liner and one having a surface made of the natural material through which it was built. They further fall into two categories:

•**Alluvial canals:**These canals are built through the alluvial soils that rivers have left behind. The alluvial soils are incoherent silty soils which can be easily scraped as well as deposited. These canals are constructed to prevent scouring and silting. Because of the low velocity in these canals and the high cross-sectional area.

• **Non-alluvial canals:**Hard soils or crumbled rocks are used to build these canals. The velocity in these canals is high since scouring typically does not occur due to the firm surface of the canal.

- **Classification based on Purpose:**

The following types of canals are classed according to the purpose they serve:

1. Irrigation canals:A canal built to transport water for irrigation is known as an irrigation canal.

2. Power canals:A power canal is one that is built to transport water to produce hydropower. Another name for it is a hydel canal.

3. Navigation canals: In order to provide inland navigation, a canal is built. These canals are suitable for steamers and small ships.

4. Water supply canal: Water for industrial usage and drinking is provided by a water supply canal.

5. Feeder canals: To supply water to another canal, a feeder canal is built. It is situated outside of the canal system's commanded area.

6. Carrier canals:A carrier canal serves as both an irrigation system and a water supply for another canal.

7. Multipurpose canal:A multipurpose canal can be used for navigation, hydropower, irrigation, and water supply, among other things.

- **Classification based on financial returns:**

The following categories of canals are determined on the financial returns:

1. Protective canals: To safeguard those in the region who are most vulnerable to famines, a protective canal is built. These canals do not give any revenue to the state.

2. Productive canals: These are such canals which yield revenue to the state. When fully developed. A productive canal yields enough revenue to cover up its maintenance and running cost as well as a minimum rate of return (6% to 8%) on the initial cost. Thus, the entire cost is recovered in 12 to 16 years.

1.1. Parts of canal irrigation system:

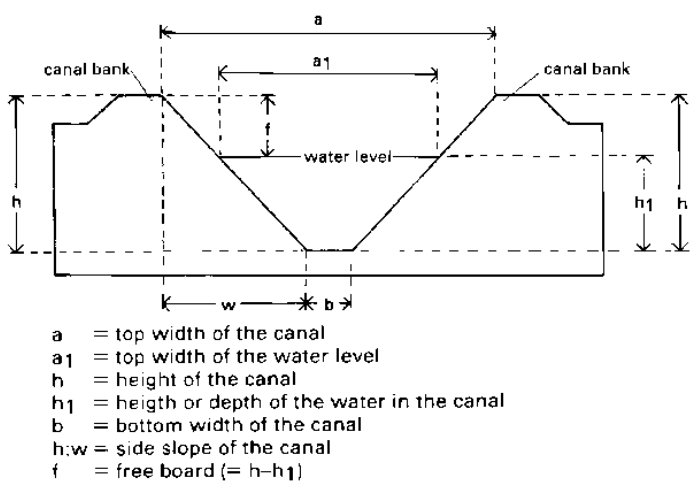

Fig 3Parts of Canal irrigation system

On the canals, several buildings are built for a variety of functions and can be categorized as:

1. Conveyance structures
2. Regulatory structures

1. Conveyance structures: Large distances must be covered by a canal that transports water from the source while maintaining the proper water levels. After being divided among branches and distributaries, the water that enters the main canal eventually travels along water courses to the agricultural fields. The canal must traverse a variety of slopes and other obstructions, including natural waterways, railroad tracks, and other surfaces. Cross-drainage construction is needed for this reason. To eliminate the drainage water and maintain an uninterrupted supply to the canal, cross-drainage work is necessary. At a cross-drainage work, the canal is typically taken over, below, or at the same level as the drainage.The cross-drainage works can be broadly divided into three groups based on the relative positions of the canal and the drainage:

a) Canal over the drainage:

- **Aqueduct:**It is a structure where the drainage is above the canal and the drainage below is flowing in an open channel. When the canal bed level is higher than the drainage system's HFL, it is offered.
- **Syphon aqueduct:**The canal is taken over the drainage in a syphon aqueduct as well, but the drainage flow is under pressure.When the HFL of the drainage is higher than the canal bed level, it is built.

b) Canal below the drainage:

- **Super passage:**The canal is taken below the drainage in this construction, and the flow in the canal is open channel flow. When the canal FSL is lower than the drainage bed level, it is necessary.
- **Canal Syphon:**A device known as a "canal syphon" takes the canal below the drainage and allows pipe flow to occur in the canal (i.e., under pressure). When the canal FSL is higher than the drainage bed level, it is built.

c) Canal at the same level as drainage:

• **Level crossing:**When the canal and the drainage system are almost level, a level crossing is offered. In this instance, the drainage water enters the canal at one bank and exits at the other.

• **Inlet and outlet:**When the drainage and the canal are nearly at the same level and there is a small discharge in the drainage, an inlet-outlet structure is constructed. A appropriate location is chosen for the canal's admission of drainage water, and a location downstream of the junction is designated for the outlet of any excess water.

2. Regulatory structures: To manage and control the discharge, velocity, etc. in the canal, many types of buildings are built on the canal. These things are referred to as regulatory structures. These consist of:

a) Distributary head regulator: It is available at the start of each branch and distributary canal. It regulates how much water gets into the off-taking channels.

b) Cross Regulator: It is supplied on the parent channel just downstream of the offtake point of the off taking channel to raise water level in the parent channel, so that the whole supply can be taken into the off taking channel even while the parent channel is running partly full. There are other canal regulators available downstream of the canal escape and in a few other places.

c) Canal falls:A abrupt drop in the channel bed is created when the slope of the natural land is significantly steeper than the slope of the canal. The canal fall is the name of this abrupt descent. The fall's position must be carefully chosen in order to strike a balance between the amounts of excavation and filling.

d) Canal escapes: These are the buildings that are intended to drain the canal of water in cases of excessive rains or canal breaches upstream. They function as a kind of safety valve in the canal system, emptying the canal during emergencies or when doing repairs to eliminate extra water.

1.2. Canal alignment:

The following factors should be taken into account when aligning a canal:

- As much as practicable, a canal should be positioned on a watershed (or ridge) to ensure irrigation on both sides of the canal and prevent cross drainage projects.
- Efforts should be taken to ensure that the main canal ascends the ridge from the site of offtake in the shortest amount of time practicable.
- Even though the watershed forms a tight loop, the canal should still travel straight.
- The alignment ought to be such that there are the fewest possible cross drainage works.
- The canal's length ought to be as short as possible. The absorption and seepage losses are reduced and the cost of maintenance decreases as the canal gets smaller.
- The canal alignment should stay clear of populated areas, sacred sites, priceless assets, and other significant landmarks.
- To minimize the expense of the distribution system to a minimal, the canal should, to the greatest extent possible, pass through the center of the commanded area.
- Curves in the canals should be avoided wherever possible.
- The soil should not be difficult to excavate, and the canal should avoid locations that are sandy, alkaline, or wet.
- The canal should be positioned so that it crosses at right angles with roads, railroad tracks, and drainage systems.
- So that the dirt removed during the cutting may be used for filling, the canal should have a balanced depth of cutting. Thus, the cost of earthwork is kept to a minimum.
- The canal should not be significantly cut because the flow irrigation would be unprofitable.

1.3. Loses of water in canal:

i. Evaporation loss:

When compared to seepage loss, the amount of water lost by evaporation is typically extremely little.These losses are generally 2-3% of total loss (max 7% in summer).

ii. Seepage loss:

Percolation: there exist a zone of continuous saturation from canal to water table and direct flow is established. Almost all water lost from canal reduces ground water reservoir. Los of water depends on the difference of the top water surface level of channel and level of water table.

Absorption: Around the canal section, there is a small saturated zone that is surrounded by a zone of diminishing saturation.Capillarity is saturated in a specific area that is barely above the water table. Thus, there exists an unsaturated soil zone between two saturated zones. It results in seepage loss.

1.4. Canal lining:

It is the treatment given to the canal bed and banks to make the canal section impervious. It is process of reducing the seepage loss of irrigation water by adding an impermeable layer to the edges of the trench. Seepage can result in losses of 30 to 50 percent of irrigation of water from canals, o adding lining can make irrigation systems more efficient. Common lining materials include compacted earth, concrete, and plastic membranes.

2. CONCLUSION

After carefully examining every aspect of the irrigation canal system, we have concluded that it is the primary supply of water for irrigating crops and meeting farmer needs. It will be necessary to do a more thorough analysis of the economic effects of both inaction and various combinations of the options. These economic studies will not only emphasize the effects of salinity on development and the environment.

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