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A DETAILED STUDY ON CANAL LINING

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Abstract – *In a dry state like Telangana, water storage is major task which helps further in agriculture and many other water needs. Canals are one of the major source of water storage and transportation .Canal lining is one of the important task for this purpose. In this context, we will be discussing about the canal, types, needs, lining, advantages and backdrops of canal lining.*

Key Words: *canal, lining, channel, irrigation, safety*

1. INTRODUCTION

Telangana State is situated in the central stretch of the Indian Peninsula on the Deccan Plateau. It is the 29th state of India and twelfths-largest state in the country with an extent of 114,840 square kilometers and a population of 35.3 Millions (2011 census). The region is drained by two major rivers namely Godavari and Krishna. The climate in this region is semiarid and has skewed distribution of rainfall in space and time necessitating water management for sustainable agriculture, drinking water and other uses. The cultivable area in the State is 75.21 lakh ha and net irrigated area is 22.89 lakh ha (30.43% of cultivable area) only.

1.1 BACKGROUND OF THE STUDY

The erstwhile Siddipet and Bhuvanagiri Districts of Telangana State are the worst drought prone and distressed areas in our country. There is tremendous shortage of drinking water, as these are fluoride affected areas. As a result, a large part of the population of these districts is being forced to migrate to other parts of the country. To redress this situation, the Government of Telangana have taken up the Kaleshwaram Lift Irrigation Scheme for alleviating the misery of these drought prone areas which will benefit 1428 villages where about 50 lakh people will get drinking water. The economy of Telangana is mainly driven by agriculture. About 61% of the population is rural. The economy of the state is

predominantly agrarian; agriculture contributes major share of the state's income and employs majority of the work force. Since agriculture is the main activity and Lift Irrigation it has close links with the development in other sectors For overall economic progress of the state, achieving faster agricultural growth is imperative.

1.2 NEED OF THE STUDY

The main purpose behind the lining of canal is to reduce the seepage losses. In some soils, the seepage loss in water in unlined canals is about 25 to 50% of total water supplied.

Benefits from the project includes increased agriculture yield, increase in crop intensity, increase in crop area, crop diversification, more commercial fish production, increased employment outside agriculture from increased crop output in related industries such as input industry (backward linkages) and output processing industries (forward linkages), increased farm forestry and vegetation in irrigated areas. This should create beneficial impact on wildlife, flora & fauna, assurance of food security and poverty eradication, transfer of technology, health and nutrition.

1.3 LOCATION & CONNECTIVITY

Kaleshwaram project package 15 irrigation canal. The canal network is approachable by road from the nearest towns. The nearest bus stop is siddipet at a distance of 35 km. The nearest airport is Hyderabad in at a distance of 93 km.

2. INTRODUCTION OF IRRIGATION CANALS

Canal is a artificial channel, generally trapezoidal in section, constructed to carry water to fields from source (River/ Reservoir).

Classification of canals based on

1. Nature of source of supply
2. Financial output
3. Function of canal
4. Discharge & Relative importance of canal in network
5. Canal Alignment

2.1 NATURE OF SOURCE OF SUPPLY

i. Permanent canal

ii. Inundation canal

2.2 FINANCIAL OUTPUT

1. Productive – once fully developed yields enough revenue to recover initial investment.
2. Protective – after construction serves as relief work during famine and protect area against future famines, generates employment.

2.3 FUNCTION OF CANAL

i. Irrigation canal – carries water to the agricultural field.

ii. Carrier canal – along with irrigation, carries water for other canals

iii. Feeder canal – it feeds two or more canals.

iv. Navigational canal – used for navigational purposes.

Power canal – carries water from reservoir to turbine houses, it is located on canal where fall is available.

2.4 CANAL ALIGNMENT

- Such that it commands entire area under irrigation with shortest length and least cost of construction.
- Shorter length- reduces frictional head loss, evaporation & seepage losses.
- Additional irrigation can be achieved by reduced losses.

3. TYPES OF CANALS

The canal system consists of the following

i.MAIN CANAL

Main Canal takes off directly from the upstream side of weir head works or dam. Usually no direct cultivation is proposed. Most of the main canals are aligned as contour canals to derive benefit.

ii.BRANCH CANAL

All off takes from main canal with head discharge of 14-15 cumecs and above are termed as branch canals.

3.1 DISTRIBUTARIES

i..MAJOR DISTRIBUTARIES

All off takes from main canal or branch canal with head discharge from 0.028 to 15 cumecs are termed as major distributaries.

ii. MINOR DISTRIBUTARIES

All off takes taking off from a major distributaries serving more than 40.47 hectares are termed as minor distributaries. They are named after a prominent place near about their tail ends.

iii. FIELD CHANNEL

All pipe off takes serving less than 40.47 hectares are called field channels and are denoted by numbering as left or right side pipes.

3.2 ALIGNMENT OF CANALS

Irrigation canals can be aligned in any of the three ways:

1. As watershed canal
2. As contour canal and
3. As side slope canal

1. WATERSHED CANAL

The dividing line between the catchment area of two drains (streams) is called the watershed (Or) The canal which is aligned along any natural watershed (ridge line) is called as watershed canal. Thus, between two major stream, there is the main watershed which divides the drainage areas of the two.

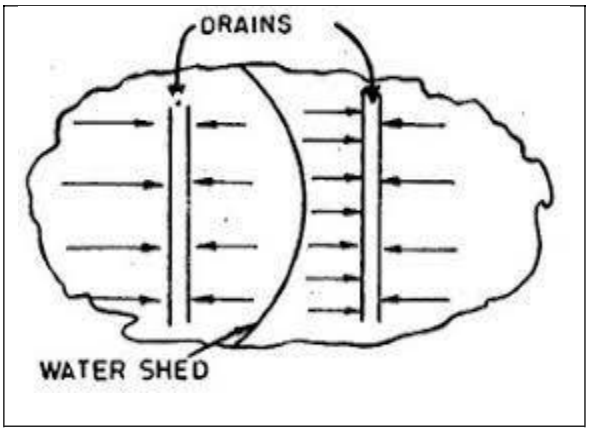

Fig -1: **Alignment of a Watershed canal**

2. CONTOUR CANAL

The contour canal is an artificially-dug navigable canal which closely follows the contour line of the land it traverses in order to avoid costly engineering works.

The above arrangement of providing the canals along the watershed is not possible in hill areas. In the hills, the river flows in the valley, while the watershed or the ridge line may be hundred of metres above it. It

becomes uneconomical to take the canal on top of such a ridge.

The maximum designed slope that can be provided in the canal without generating excessive velocities, is generally less than the available country slope. The difference is accommodated by providing canal falls at suitable places. A contour channel irrigates only on one side, because the areas on the other side are higher

3. SIDE SLOPE CANAL

A side slope channel is that which is aligned at right angles to the contours, i.e. along the side slopes. Such a channel is parallel to the natural drainage flow and hence, does not intercept cross drainage, and hence no cross drainage works are required.

4. CANAL LINING

Capacity of canal known as canal lining. Generally seepage can result in losses of 30 – 40 % of irrigation water in canals An impermeable layer is provided at the bed and sides of canal to improve the life and discharge, so we can reduce the effect of seepage by providing lining to the canal.

Fig2 . : unlined canal

4.1 TYPES OF CANAL LININGS

Mainly there are two types of canal linings:

1. Earthen type lining
2. Hard surface lining

1. EARTHEN TYPE CANAL LININGS

It is sub-divided into two major types:

a.Compacted earth lining

b.Soil cement lining

a.COMPACTED EARTH LINING

If suitable earthen material is available near the site of construction, or is in-situ, a lining of compacted earth is an inexpensive and efficient means of controlling seepage. Compaction reduces soil pore sizes by displacing air and water. Reduction in void size increases the density, compressive strength and shear strength of the soil and reduces permeability. This is accompanied by a reduction in volume and settlement of the surface..

b. SOIL CEMENT LINING

Soil-cement linings are constructed with mixtures of sandy soil, cement and water, which harden to a concrete-like material. The cement content should be from 2-8% of the soil by volume. However, larger cement contents are used. For the construction of soil-cement linings two methods are in general use: (1) the dry-mix method and (2) the plastic mix method. For erosion protection and additional strength in large channels, the layer of soil-cement is sometimes covered with coarse soil. It is recommended the soil-cement lining should be protected from the weather for seven days by spreading approximately 50mm of soil, straw or hessian bags over it and keeping the cover moistened to allow proper curing. Water sprinkling should continue for 28 days following installation.

2. HARD SURFACE LININGS:

a.CEMENT CONCRETE LINING:

Canal Linings are provided in canals to resist the flow of water through its bed and sides. These can be constructed using different materials. such as compacted earth, cement, concrete, plastics, boulders, bricks etc. The main advantage of canal lining **is** to protect the water from seepage loss.

Concrete linings are widely used, with benefits justifying their relatively high cost. They are tough, durable, relatively impermeable and hydraulically efficient. Concrete linings are suitable for both small and large channels and both high and low flow velocities. They fulfill every purpose of lining. The in situ concrete lining is one of the most conventional type of lining which has successfully been used in India and other parts of the world. When unexpected water pressures are encountered, un-reinforced lining will crack more easily than the reinforced lining and will relieve the pressure thereby reducing the area of damage.

5. CONCRETE LINING

5.1 CLEARING SITE

The area proposed for lining the canal as a whole shall be

cleared of all objectionable material. Any waste material obtained from such site clearance shall be disposed off in a manner directed by the Engineer - incharge. The cost of this operation shall be deemed to have been covered under the rates quoted for canal lining.

5.2 MATERIALS

1. Cement
2. Fine Aggregate
3. Coarse Aggregate
4. Water
5. Air Entraining Admixtures

5.3 CAST-IN-SITU CONCRETE LINING

This work shall generally conform to I.S. 3873-1978. All concrete for lining work shall be governed by I.S :456-1978. Concrete for lining works shall be of controlled grade with suitable admixtures of approved air entraining agents, using well graded aggregate with maximum size of aggregate of 20 mm.

i.BATCHING

a) The contractor shall provide such means and equipment as are required to accurately determine and control the relative amounts of the various materials including water, cement, admixtures, sand and each specified size of coarse aggregate for the concrete.

b) Such means and the equipment and its operation shall be subjected at all times, to the approval of the Engineer-in-charge. The amount of cement, fly ash if required, sand and each size of coarse aggregate entering each batch of concrete shall be determined by weighing and the amount of water shall be determined by weighing and the amount of water shall be determined by weighing or volumetric measurement.

c) The weighing equipment shall conform to the requirement of IS: 2772-1964 and the batching and mixing plant to the requirement of IS : 4925-1968. The contractor may provide central batching plant for supplying concrete.

ii.MIXING

a) Concrete shall be mixed in a mechanical mixer and shall be as dense as possible, plastic enough to consolidate well and stiff enough to stay in place on the slopes.

b) Mixing shall be continued until there is a uniform distribution of materials and the concrete is uniform in colour and consistency.

iii.CONSISTENCY

The amount of water used in the concrete shall be fixed a required from time to time during the course of concreting work to secure concrete of the proper consistency and to adjust for any variation in the moisture content or grading of the aggregates as it enters the mixture. Addition of water to compensate the stiffening of the concrete resulting from over mixing or objectionable drying before placing shall not be permitted. Uniformity in concrete consistency from batch shall be required. Where concrete is laid from bottom to the top of the slope. A slump 50-70 mm shall be allowed for lining. Where canal lining machines are used the slump shall be 50 mm. To have a close control of the consistency and workability of concrete, the slumps of concrete shall not vary by more than 20 mm which would otherwise, interfere with the progress and quality of the work.

iv.CONVEYANCE

Concrete shall be conveyed from the place for batching to the place of final deposit as rapidly as practicable so that it may be laid and compacted before the initial setting time.

v.PLACING AND COMPACTION

- Concrete shall be placed only in the presence of a duly authorized representative of the department. Concrete shall be placed and compacted before initial setting time and should not be subsequently disturbed.
- Placing of concrete shall not be started until all form work is completed and all parts to be embedded are placed and preparation of surface upon which concrete is to be laid, has been completely inspected and then so directed by the Engineer-in-charge. All absorptive surfaces against which concrete is to be laid shall be moistened adequately so that moisture will not be withdrawn from freshly placed concrete. The surfaces however, shall be free from standing water and mud.
- Concrete shall be deposited and spread on the bed and sides of the canal as indicated on the drawings, in alternate panels. It shall be well compacted by using tampers vibrators and screeds and finished smooth by wooden floats and trovel to get smooth and hard

Fig 3. :Batching Plant

- All exposed concrete surfaces shall be cleaned of impurities, lumps of mortar or grout and unsightly stains. Finished surface shall be even, smooth and free from pockets and equivalent to that obtainable by effective use of a long handle steel trowel. Surface irregularities shall not exceed 6 mm for bottom slab and 12 mm for side slopes, when tested with a straight edge of 1.5 meter length.
- The surface of concrete finished against form shall be smooth and shall be free from projections, honeycombing and other objectionable defects. Immediately on the removal of forms, all unsightly ridges or lips shall be removed and under desirable local bulging on exposed surfaces shall be remedied by tooling and rubbing.
- Repairs to concrete surface and additions where required shall be made by cutting regular opening into concrete and placing fresh concrete to the required lines. Chipped opening shall be sharp and shall not be less 75 mm in depth. Plastering of concrete surface will not be allowed.

vi.CURING

a.Water Curing

b.Membrane Curing

vii.JOINTS

Joints shall be spaced and located as shown in the drawing or as directed by the Engineering charge. The joints shall be formed in the manner as specified below when the concrete is hand placed.

1.Expansion Joints

2.Contraction Joints

3.Construction Joints

viii.DEWATERING

Canal reaches where water in encountered above canal bed level shall be dewatered continuously during preparation of sub-grades and placing of concrete for lining till the concrete has attained necessary strength. No separate payment shall be made for dewatering operations, as the same shall be deemed to have been included in rate of related finished item of work

ix.PLAIN CEMENT CONCRETE LINING

Measurement will be on the basis of volume of concrete lining for the thickness specified on the drawing and payment will be at the unit rate quoted in schedule B. The correct thickness shall be maintained at the time of concreting by taking necessary care at the time of setting up form works and the placement, compaction and finishing of concrete. The thickness shall be cross checked by :

1. Volume of concrete placed and area covered.
2. Use of probe when concrete is green.
3. Coring

6. ADVANTAGES & DRAWBACKS OF CANAL LINING

6.1ADVANTAGES OF CANAL LINING

1. It reduces the loss of water due to seepage and hence the duty is enhanced.
2. It controls the water logging and hence the bad effects of water-logging are eliminated.
3. It provides smooth surface and hence the velocity of flow can be increased.
4. Due to the increased velocity the discharge capacity of a canal is also increased.
5. Due to the increased velocity, the evaporation loss also can be reduced.
6. It eliminates the effect of scouring in the canal bed.
7. The increased velocity eliminates the possibility of silting in the canal bed.
8. It controls the growth of weeds along the canal sides and bed.
9. It provides the stable section of the canal.

6.2 DRAWBACKS:

Though the benefits derived from the lined canal are so great there are some disadvantages also.

They are the following:

- Once the lining is damaged it is difficult to repair it.
- The lined canals are constructed without berms. Moving vehicles, pedestrians, animals are liable to fall in the canal directly in the absence of safety berms.
- The lined canal is a permanent structure hence it is difficult to shift the outlets often.
- Lining of a canal can be done only after incurring heavy expenditure.

7. SAFETY

"Relative freedom from danger, risk, or threat of harm, injury, or loss to person or property, whether caused deliberately or by accident".

7.1 BE VIGILANT WITH ELECTRICITY AND EQUIPMENT

- Construction sites require a lot of electrical installations.
- Lifting equipment mostly involves electricity and weights.
- When working with such equipment, you need to be extra cautious to see there is no wear and tear in the machine.
- Never stand or work immediately below a heavy suspended load.

8. CONCLUSIONS

1. Canals are the major system of any irrigation project, which delivers the irrigation water to fields. Most of these canals are earthen so considerable water losses take place due to seepage. These losses can be overcome by lining the bed and sides of the canal cross- section with an impervious material. Lining of canal reduce the operation and maintenance cost, erosion and also improves the flow velocity. Different materials are available for lining the canal like concrete lining
2. In this report, I have tried to explain the advantages and disadvantages of the various canal lining system. The factors affecting the decision for selection of the canal lining material is also discussed in this report. The main objective is to find out the most economical method of canal lining based on the cost criteria in relation to the wastages.
3. The conservation of water is becoming increasingly important as the demand for this vital natural resource continues to rise rapidly and new sources of supply become scarcer. The importance of lining irrigation channels with the view to save these losses cannot be over used.
4. Canals are very effective to reduce the agricultural water demand in an area. Canals can carry water easily from source to the destination. However canals can lose its water between 10-40% due to losses. Hence canal lining is required to reduce these losses.

This problem is more increased due to urban water demands and increased agriculture production in remote areas around the world. To overcome this problems canals have been constructed to transport the water from its source to where it is needed.

9. FUTURE SCOPE

More detailed site-specific investigation of input parameters such as .2specific yield, saturated infiltration, canal seepage, canal capacities etc is required for accurate estimation of parameters; The model predictions can be made even more realistic by use of most up-to-date groundwater, rainfall and canal discharge data.

Real time linkage with daily climate data, canal roster, canal and drain flow along with field wise soil parameters and irrigation requirement depending upon crop, as required by Water Users Associations.

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