Design of PDN for Minor no. 10 of left bank canal of Akkalpada project and Comparison with existing CDN

[1] Varsha Bhivsan Khalane,[2]Prof. S. D. Agarwal,[3]Prof. P. N. Patil
[1]P.G. student,[2]Assistant Professor,[3]Associate Professor
[1]Department of Civil Engineering,
[1]SSVPS BSD college of Engg. Dhule, India

***Abstract*—Water is life for the existence of all living being on earth. Water is an important, valuable, finite, natural resource demanded by many sectors. The stresses because of water inadequacy are multiplied today. Irrigation sector is the biggest consumer of water so there's scope for raising efficiency by reducing the loss of water. In this paper, the study has been dispensed to investigate traditional canal distribution system of direct minor no. 10 of the left bank canal of Akkalpada project and to design pipe distribution network for the same. the cost construction is found more for pipe distribution system but in view of water thefts, conveyance losses, evaporation losses for canal distribution system, pipe distribution system is desirable for direct minor no. 10 of the left bank canal of Akkalpada project. There's a decrease in land acquisition cost for pipe distribution system.**

***IndexTerms*—PDN, Pipeline Distribution network, CDN.**

I. INTRODUCTION

Water is life for the existence of all living being on the earth. Water ensures food security and fulfills domestic and industrial requirements. Being the second most populated country in the world India requires water for domestic, industrial uses, recreational activities to support its growing economy. A demand for water for civilization and industrialization is increasing at a terrible rate. Increase in demand reduces the water availability for irrigation.[1] Nature has blessed our country with plenteous Water Resources; However, because of limitations of topography, geology, political influence and the present state of technology, only a part of accessible water resources will be utilized. it's a matter of great concern that this is happening at a time when there is an inflated demand for varied agricultural products due to phenomenal growth in the population.

To overcome this problem water must be conserved and must be utilized to increase food production capacity to satisfy Indian population need at reasonably low cost. To improve food production, irrigation is one of the tools[5]. Irrigation sector is the largest consumer of water as more than 80 percent of available water resources in India are being presently utilized for irrigation purpose[1].

In this paper study has been carried out to analyze traditional canal distribution system of direct minor no. 10 of left bank canal of Akkalpada project and to design pipe distribution network for the same. The paper is divided in following sections section 1 gives brief overview of current irrigation scenario and reasons for low efficiency of current cannel distribution system. Section 2 will explain necessity of PDN. In section 3 design considerations for minor no. 10 of left bank canal of Akkalpada project and cost comparison between CDN and PDN are discussed. In section 4 we conclude our paper.

Ultimate irrigation potential of India is 140 million hectare. Irrigation potential to the tune of about 102 million hectare has been created through major/medium/minor surface water irrigation projects and use of ground water[6]. However, potential utilization is about 87 million hectare only. The average water use efficiency of Irrigation Projects is assessed to be only of the order of 30 - 35%. Thus there is a gap between irrigation potential created and utilized, and it is up most important to minimize the gap. This can be achieved by use of pipe distribution network[7].

The following major reasons identified for low water use efficiency of Irrigation projects.

1. Poor or no maintenance of canals irrigation systems which results in growth of weed & vegetation, siltation, damages in lining etc.
2. Distortion of canal sections due to siltation or collapse of slopes which results variation in their design discharges.
3. Leakages in gates and shutters of canals which results in loss of water.
4. Damaged structures of canals also results in loss of water.
5. No regulation gates on head regulators of minors causing uneven distribution of water.
6. Poor management practices.
7. Lack of awareness among farmers about correct irrigation practices and cropping pattern.

II. NECESSITY OF PDN

PDN is necessary to improve Overall Project Efficiency (OPE) of gravity irrigation systems. With the help PDN the water use efficiency can be improved to 70 to 80 % from existing open channel systems efficiency of 25 to 40 %. Thus there is about two

to three times increase in the water use efficiency for irrigation, which means that there will be 55 to 65 % improvement in overall water use efficiency. In other words, from the same reservoir, double the command areas could be irrigated, or additional equal volume of water is made available which can be distributed to other purposes.

The PDN system provides effective control on the distribution of water for the crops leading to achievement of diversification of crop pattern namely horticultural, cash crops and other than traditional crops. Two operating systems namely, one rotational water supply (R.W.S) and the other on demand scheduling are technically reliable to ensure water at farm gate.

A strong argument against pipelines is that they are costlier to lay than digging canals, especially earthen ones. But most of such back-of-the-envelope calculus of cost-effectiveness does not consider the market value of the land that canals use and pipelines save. In spite of massive efforts by the government to acquire the land needed for the surface distribution, due to farmers' resistance to leave their agricultural land the original plan is not working. PDN system will provide solution for above stated problem.

III. Design Consideration

The study area, lies at Shirdhane village in Dhule district of Maharashtra. The area comes under canal command of Lower Panzara (Akkalpada) Medium Irrigation Project . The field lies at 74º27' 22'' E longitude and 20º 56' 28'' N latitude in Shirdhane village.

Command area considered for this study is flat terrain, and land slope is from 1 to 2.5 percent. Soil type is deep black soil. This type of topography is more suitable for PDN. The project is already implemented as a CDN. The length of main canal is 32.085 km and length of direct minor no. 10 is 900 m. The head discharge for direct minor 10 is 4.32 Cusecs. Total existing area under cultivation is 98.18 ha. But in the view of all aspects such as topography and limitations of CDN etc. study is done for a gravity flow PDN for irrigation. Some of the important design aspects of project are compared in TableI. Table II shows cost comparison between PDN and CDN

It is seen that with the implementation of PDN water application efficiency on farm is 85 percent, efficiency of lateral is 95 percent, efficiency of sub- main is 98 percent and efficiency of main is 98 percent, which shows that there is remarkable increase in efficiency of overall system. Similarly CCA will become doubled for the same quantity of water.

Table I: Comparison of design aspects of minor no. 10 of left bank canal of Akkalpada project

Sr. No.	Description	Conventional CDN System	PDN system	Percentage Increase	Percentage Decrease
11	Discharge at head regulator	4.32 Cumecs	4.32 Cumecs	-	-
2	OPE	56.7%	81.23%	24.53%	-
3	Land acquisition	1.62ha	0.27ha	-	83.33%
4	Cultivable command area (CCA)	79.13ha	98.18 ha	24.074%	-
5	Discharge at chak head	0.1050 Cumecs	0.1220 Cumecs	16.19%	-

Table II: Cost comparison between conventional CDN and PDN system for minor no. 10 of left bank canal of Akkalpada project

Sr No.	Description	CDN	PDN	Percentage increase	Percentage Decrease
1.	Land Acquisition cost	25.92 Lac	4.32 Lac		83.33%
2.	Construction cost	199.40 Lac	329.11 Lac	65.01%	

The construction cost of PDN system includes cost of P.V.C pipes, excavation and refilling, laying and jointing, accessories, and cost of distribution chamber etc. From Table II, we can conclude that the land acquisition cost will be reduced to great extent by implementing PDN instead of CDN.

IV. Results and Conclusion

In this paper experimental results are presented to evaluate the feasibility of utilizing Pipe irrigation network over canal distribution network system. The present study has been planned to assess the losses in present irrigation method and use of pipe distribution network to reduce the conveyance losses. The pipe irrigation network system is designed for the study area i.e. Direct Minor No.10 of left bank canal of Akkalpada Dam which has total length of 900 m and ICA of 79.19 Ha. The Initial cost of construction for canal distribution system is Rs.2052432.00/- whereas it is Rs.59970407.98/- for Pipe irrigation network. Design and results showed that adoption of buried pipeline distribution systems will to the reduction in water conveyance and distribution losses Also there will be reduction in the land area taken up by the distribution system.

A chak of 12 ha having 900m length was selected for design of underground pipe distribution network. The inlet structure of rectangular shape having $1m^2$ area and 2.7m height is designed just below the canal bank to trap silt. A screen is fixed to the inlet through that water enters into underground pipeline to keep the thrash out of pipeline. 200 mm, 250 mm, and 300 mm diameter pipes are used . The head loss calculated from Modified Hazzen-Williams equation is 4.392 m and 3.78 m. The head loss found

to be less than that of available head of 4.77 m. Air vents of 5 cm diameter were also provided at appropriate points to release entrapped air. Nine number of outlets were proposed in the design of the underground pipeline system. Two field distribution chamber, one for right hand side of fields and other for left side fields for delivering irrigation water directly to the farmer's fields.

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