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Analysis and design of pipeline system instead of the canal system

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ABSTRACT

Canals enhanced irrigation water losses and the annual cost of maintenance became uneconomical for the long term. Easy maintenance, durability, modification capability and flexibility of pipelines give them the potential to be an economical alternative to replace the Canals. Pipes were selected to construct a network of the pipeline due to the availability of Plastic Irrigation Pipes and Reinforced Concrete Pipes. This study has been undertaken to analyze canal system and to design a pipeline system to replace it. The study area is Khadka Irrigation Project, located on Mule river basin in Ahmednagar district, Maharashtra. The overall efficiency of pipeline system was found out to be much better than Open Canal System also the distribution efficiency by use of lift irrigation was found out to be boundless.

Keywords: *Enhanced water losses, Maintenance, Design of pipelines, Boundless distribution via Lift irrigation.*

1. INTRODUCTION

This Practice is about the replacement of district irrigation canal or lateral canals with a buried pipeline to convey water from the source to a form or irrigation turnout. District irrigation pipelines can be used to replace most types of small canals or lateral canals.

The conveyance and the distribution efficiencies can be increased due to the installation of pipeline and the water use with illegal outlets can also be reduced by the pipeline system. However, in many cases, the replacement of open channels is done with pipes. The various reports noted the advantages of pipeline system over the open-channel system; this advantages can be summarized as follow:

- Reduce losses of water from the system by seepage and leakage (transit losses)
- Reduce time of water flow through the fields (travel time)
- Increased equity od distribution
- Reduce water logging

- No necessity of land acquisition and construction of canal regulation works
- No necessity of tailing work for disposal of access water
- Reduce overall cost of the project

2. LITRETURE REVIEW

Schulze et al. (1985) Reported that two types of irrigation delivery system are currently being utilized in the Texas Rice Belt, (1) Conventional Surface Canals and (2) Subsurface Pipeline Systems. Surface canals have been used for many years and are commonly in use today. Water losses in surface canal delivery systems, however, range from 25% to 65%, thus indicating potential advantages of a more efficient water delivery system, such as an underground pipe line irrigation delivery system.[1]

Mniruzzaman, et al.(2002) assess the performance of PVC and plastic pipe water distribution system for command area development and irrigation time saving by minimizing water losses. In the system, total discharge from deep tube well (DTW) was diverted to two or three directions by using PVC and plastic pipe of different length and diameters. Technical and economic feasibility of the system was also evaluated. The conveyance loss was 2.8 to 9.5% in PVC and plastic pipe whereas in the earthen channel it varied from 30 to 33% in silty-clay loam soil, which indicate that on an average 83% water can be saved by improved pipe distribution system.[2]

Shah et al. (2010) carried out study on Sardar Sarovar Project (SSP) and reported that against an ultimate potential of 1.8 million hectares (Mha), Gujarat's famous Sardar Sarovar Project (SSP) is irrigating less than 100,000 hectares (ha) by gravity flow 5 years after the dam, and the main and branch canals were completed. The key problem is that farmers who are to benefit from irrigation refuse to part with the land needed to construct a surface distribution system below the outlet. They argue that the government should consider a buried piped distribution system as an alternative to sub-minors and field channels. The idea, however, is strongly criticized by irrigation engineers, based on the poor track record of piped distribution under government management.[3]

Kolhe (2012) carried out a study on Optimal Utilization of Irrigation Water by Use of Pipe Distribution Network (PDN) instead Of Canal Distribution Network (CDN) in Command Area. The objective of the study is to an emphasis on the use of Pipe Distribution Network (PDN) instead of Canal Distribution Network (CDN) in the command area of irrigation project to improve the efficiency of water use. By virtue of PDN, the water use efficiency can be improved to 70 to 80 % from existing 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. This study based on the design of PDN of Nagthana-2 Minor Irrigation (MI) project, located at Amravati district of Maharashtra state, which was initially designed to irrigate Cultural Command Area (CCA) of 600 ha by conventional CDN, and now planned for gravity PDN and result implies that same volume of water could irrigate CCA of 1200. In his study, the focus is placed on the use of PDN instead of CDN in the command area of irrigation project to improve the efficiency of water use. By virtue of PDN, the water use efficiency can be improved to 70 to 80 % from existing efficiency of 25 to 40 %.[4]

Satpute et al. (2012) studied that conventionally on almost all command area of irrigation projects in India, the water for irrigation is supplied through the network of turnout, sub-minor, distributor, branch canal and main canal. Here, almost 50 % of water is lost during the storage and distribution. There are many disadvantages of the conventional system of irrigation. Their design overall project efficiency (OPE) of the conventional system is obliviously low and ranges between 41 to 48 % only. Actual OPE, is only 20-35 % in most of the irrigation projects due to many difficulties and constraints. From his study, it is concluded that as compared with traditional open channel gravity irrigation system, in PDN Water application efficiency on Farm is 85 %, Efficiency of lateral is 95 %, Efficiency of sub-main is 98% and Efficiency of Main is 98 %. which shows that there is a potential increase in efficiency of the overall system. Likewise, culturable command area which is 643 ha was covered under irrigation using open channel irrigation system increased by 2 times, i.e. 1207 ha of the area now being irrigated using PDN system. [5]

Jadhav et al. (2014) conducted a study on water loss from the tank as well as canal network through seepage was determined and evaporation loss was estimated for Panchnadi Minor Irrigation Project in Konkan region. The conveyance efficiency of the lined, unlined section of the main canal and field channel was observed as 75.3, 52.1 and 34.8%, respectively. He developed Scenario for increasing conveyance efficiency by canal lining or adaption of the closed conduit and concluded that, if whole canal network is converted in closed conduit then and an additional area of 92.6 ha can be brought under irrigation i.e. about 2.6 times more than the existing area.[6]

3. STUDY AREA

This Project describes a field case study on the use of pipeline system instead of the canal system in Khadka irrigation project which is in Mula Basin in Ahmednagar district of Maharashtra. In this project, there are two main canal systems i.e. Left bank canal and

right bank canal. The right bank canal having length 52 km. The right bank canal having two branch canal i.e. Branch 1 & Branch 2 having length 30.5 km & 30 km respectively. The Canals at Khadka irrigation project i.e. distributary no.4 on branch 1.
Khadka distributary of length about 14 km off taking from RBC This distributary consist of 8 minors of different length from which we study the comparative study on Minor no.4 having length 0.730 km. "Jagdhambha Pani Wapar Sanstha" having the authority distribution and revenue collection.

DATA:

1. Name of Project: Khadka irrigation Project
   State: Maharashtra
   District: Ahmadnagar
   Taluka : Newasa
   Location: Newasa phata
2. Name of River : Mula river
   Name of Sub Basin : Mula
3. Catchment area: 2275.86 Sq. K.m.
4. Storage
   Gross storage : 736.23 Mm^3
   Live storage : 608.81 Mm^3
   Dead storage : 127.42 Mm^3
5. Controlling levels
   Length of embankment : 2826.22 M
   M.D.D.L : 534.00 M
   F.R.L. : 522.30 M
   M.W.L. : 553.21 M
   T.B.L. : 555.65 M
6. Detail of Dam
   Type of / dam: Earthen dam with central gated spillway
   Length of embankment : 2826.22 M
7. Details of Spillway
   Type of spillway : Central gated ogee spillway
   Length of Spillway : 358 m
   No of Gates : 11 No's of 12.19m x 7.62m
   Maximum flood discharge : 5947.32 cu.m/sec

4. METHODOLOGY

4.1. Design of Canal

Various factors like crop water requirement, irrigation methods, water distribution plans, flow control mechanism and socio-economic settings are considered in determining the design discharge. Various methods are available for the design of canals. Some use basic principles of hydraulics and soil stability to determine the geometry of the canal. Tractive force methods (Fortier and Scobey, 1926, Lane, 1955), rational methods (Chang, 1980, White, et al., 1981b) are some of the methods in this category. Some methods have been evolved from the study of relatively stable canals around the world. These methods are known as regime methods and the works of Lacey (1930) and Simons and Albertson (1963) are few examples in this field.

Section design calculation

Khadka irrigation minor-4 offtake of main canal
Reach -1: 0 to 1020
Reqd. Discharge =0.162 cumes
Design Discharge=0.179 cumecs
Proposed Section For Canal:

1) Bed Width(B)= 1.00 M
2) F.S.D (D)=0.50 M
3) Free Board = 0.50 M
4) Bed gradient(I)=1:1500
5) Rugocity Coeff.(N) =0.04
6) Side Slopes(n)=0.50:1

Area (A) = (B + n. D) x D
wetted perimeter(P) =
Hydraulic Perimeter (P)= A/P
Velocity by Manning's Formula:

$$(1/N) \text{ X } R^{2/3} \text{ X} (I)^{1/2}$$

Discharge (Q)= A X V
Transit Losses= P x L x 0.000007

Chak wise area statement of Khadka irrigation minor no.4
Off taking from the main canal at rd.1020 M

Table no.1: Chak wise area statement

Sr. no	Name of chak	R D	GCA Ha	Deleted Area	CCA Ha	I C A Ha
1	2	3	4	5	6	7
1	OR- 1	60	18.81	0.00	18.81	16.93
2	OL - 1	155	16.44	0.00	16.44	14.80
3	OL-2	790	10.40	0.00	10.40	9.36
4	TAIL	1020	17.76	0.00	17.76	15.98
		TOTAL	63.41	0.00	63.41	57.07

4.2. Design of Pipeline

For designing of the pipeline, discharge required is collected from irrigation department. According to discharge, we provide 400mm, 315mm, 250mm, 90mm diameter of High-Density Polyethylene Pipe.
Pipe diameter is determined by using Darcy Weisbach formula: $D= (flV^2/2h_Lg)$
Where,

h = head loss
f = friction factor
l = pipe length
v = velocity of flow
D = pipe diameter
g = acceleration due to gravity.

4.3. Cost Components for Canal

For computation of canal cost, most of the methods from quantity, survey, evolution & valuation was used for estimation of earthwork and foundation. Land cost is calculated according to rates before construction was started. Abstract for calculation of Canal Cost is:

- Site Clearance for Canal Lining
- Land purchasing for construction of the canal
- Excavation for canal way
- Providing and fixing RCC boundary stone
- Miscellaneous; sign boards, outlets, service road, etc.

4.4. Cost Components for Pipeline

The main share of Pipeline system's cost is the material of pipeline itself. Rest for the share is taken by the foundation, joints, etc.

- Initial cost: pipes, foundation, excavation for foundation, other fitments, etc.
- Running cost: periodic check-ups, repair work if required.

5. RESULT

The pipeline is designed with a various diameter as per given discharge. Their pipes are providing any particular gradient through

which water flow by gravity and required velocity is maintained in the pipe to achieve pressure at every outlet. From the comparative study of canals and pipe line system we come to know that overall efficiency of the project will increase by 18.52% as discharge as required case of canal system is 0.162 m^3/s which reduce the losses The all overall cost for considered distributor including minors in case of canal system is about 23lacs while for pipeline system is about 52lacs. But the average annual cost of the project for the long term in case of the pipeline is about 1 lac and for canals is about 5lac.Which means in case of pipeline system cost of the project is less as compared to the canal system. The quantity of water save in case of the pipeline is 0.12m/s which can be used for irrigation purpose in nearby are. The I.C.A. of kaniMirzapir Minor -2 is 1835 Ha which will increase in case of pipeline system by giving permission of lift for the quantity of water which will increase save due to the pipeline system.

6. CONCLUSION

For study, we have designed only one minor i.e. Khadka irrigation Minor -4 off taking from R.D.1020 m from the main canal for pipeline system which is feasible in case of saving water and money for long term. So if we can replace overall canals, distributor and minors by pipeline system it will be more feasible to reduce water logging in command area and to save the soil from losing its fertility, in addition, to increase in command area and optimum use of water. Hence, the future detailed study by water resource department may validate the conclusion.

7. REFERENCE

[1] IS: 10430 – 1982 “Criteria for design of lined canals and guidelines for selection of the type of lining”.
[2] IS: 5968-1987 “Guidelines for planning and layout of canal system for irrigation” (Reaffirmed 1992).
[3] B.C. Pnumia (water resources), sixteenth edition, Jodhpur, India.
[4] R.K. Bansal (fluid mechanic)
[5] B.N. Datt a (estimating and coasting)
[6] Current schedule rate of Maharashtra Jeevan pradhikaran.
[7] Replacement of Irrigation District Canals and Lateral Canal with Pipelines by Water District Delivery System, 2004.
[8] Improving water-efficient irrigation: Prospects and difficulties of innovative practices Les Levidowa, Daniele Zaccaria, Rodrigo Maiac, Eduardo Vivas, Mladen Todorovic, Alessandra Scardigno.
[9] Comparison of Piped and Open Channel Distribution of Irrigation Water Supplies Published by The Ritso Society (Inc) PO Box 75, Darfield, Canterbury August 2007.
[10] Chaudhry, M.H. 1993. Open-Channel Flow. Prentice Hall, Inc.
[11] Updated Rules For Pipe Sizing By Alejandro Anaya Durand, Jorge Arroyo.
[12] Feasibility of Replacing Irrigation Canals with Pipes in Sudan Abdallah.
[13] Piping Components and Fittings Finbar Smith © SOLAS 2014.

