

**ECONOMICS OF PIPE DISTRIBUTION NETWORK OVER CANAL
DISTRIBUTION NETWORK BY OPTIMAL UTILIZATION OF WATER**

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Abstract— Water which is a valuable, finite, renewable and shared resource required by various sections. The best possible alternative to overcome limitations of canal distribution networks (CDN) by using pipe distribution network (PDN) system .The main aim of this research paper is to improve efficiency of water use by PDN method. As present water efficiency is 25-40 % it can be improved to 70-80 % by PDN.

The main purpose of this research is concentration of use of PDN instead of CDN. As the flexible conversion of existing CDN into PDN or construct a new PDN. Hence PDN is economical and feasible than the CDN. This paper is based on the design of PDN of Lower Pedhi Irrigation Project, located at Amravati district of Maharashtra state, which is initially designed to irrigate C.C.A. of 12230 Hecter by CDN and we now research for gravity PDN.

Keywords— Canal Distribution Networks (CDN), Pipe Distribution Network (PDN), Overall Project Efficiency (OPE), Cohesive Non-Swelling (CNS), Field Canal (FC).

Introduction

Water is the lifeline for the existence of the environment on the earth. As we know 71% of the earth’s surface is covered with water and remaining 29% of the earth surface is covert with the land. Only 2.5% of total available water is freshwater. Water needs for various purposes e.g.; domestic, commercial, industrial , fire fighting, and irrigation. There is water scarcity occurs due to the increasing demand of water because of industrialization and the civilization. Which is found as the water is found as the water available. In India, as 80% of water demand is for irrigation purpose that means irrigation sector is the biggest consumer of water.

I. Therotical content :-

1. Design Requirements And Qualifying Criteria For PDN :-

A) Basic Layout Of PDN :- ¹

- i. Control Head :- regulating valves should placed above 60cm from the round surface.
- ii. Pipe distribution Network :- The main and sub main pipelines (distribution network) can be of rigid P.V.C. buried underground.
- iii. Hydrants :- The hydrants are equipped with a gate valve and raised on surface.

B) Flow Velocity :- ¹ Because of possibility of silt deposition ;

- i. General flow velocity 0.8 to 1 m/s.
- ii. Smaller length section flow velocity 0.6 m/s.
- iii. Maximum flow velocity is 1.5 m/s and minimum is 0.6 m/s.

C) Diameter Of Pipe :- ^{1,2} Smaller diameter pipe fails to provide enough water to command area larger diameter pipe is uneconomical, Hence the optimum diameter is economical is provided.

D) Installation Requirement :- ¹

- i. 1.2 of filling material is kept over pipe.
- ii. @summit point, Air Vacuum relief valves as well air vent is @300 m interval and upto 0.6 above HGL extended.
- iii. PDN should provided in sloping topography of ground as steeper than 1 to 500.

TABLE I:

Sr. No.	Diameter Of Pipe(Mm)	Minimum Depth Of Cover(Mm)
1.	25-60	450
2.	75-100	600
3.	For 125 Or More	760

II. Methods :-

1. Comparison PDN over CDN :-

A) Efficiency of project :-²

It is estimated by doing multiplication of efficiencies of various individual components of the irrigation project ex. main canal, minors, distributaries, Etc.

- i. Field efficiency :- 60-70% and water losses = 20-27%, average water losses in canal is 33%, i.e. efficiency = 40-50%.
- ii. PDN :- it increases efficiency to 60%.

B) Steps in Design of PDN :-²

- i. Conducting topographic survey and preparation of maps :-
For the fixing of alignment of main pipeline the levels of ground is surveyed from the source of water supply and distribution area. Detailed maps showing roads, streets, residential areas, industrial and commercial areas, lanes, etc. and topographical map for R.L. of ground i.e. Locate low and high areas.
- ii. Tentative layout preparation :-
This should be done for showing location of valves, distribution, minors, sub-mains, laterals, and hydrants, etc. complete areas divided into small chunks of size 3 to 4 ha. The pipeline should be shorter as possible.
- iii. Calculation for pipe diameter :-
 - For the steady incompressible flow, Darcy-Weisbach formula use, as friction factor is appear There. For friction factor Colebrook-white formula is used. As the smooth and rough pipes the moody diagram is used.
 - PDN is based on head available, distribution point to outlet, length, area under outlet, cropping pattern, Etc.
 - Reducing diameter pipes are proposed in PDN as to keep equal discharge in all outlets in the command.

C) Experience and case study in PDN :-²

TABLE III :

Sr. No.	Description	Conventional CDN System	PDN	Percentage Increase	Percentage Decrease
1]	Discharge	1040 LPS	1040 LPS	-	-
2]	OPE	41%	77%	36%	
3]	Land Acquisition	31.58 Ha	7.00 Ha	-	77%
4]	Culturable Command Area	643 Ha	1207 Ha	88%	-
5]	Discharge At Chak Head	30 LPS	82 LPS	73%	

D) Cost comparison between conventional CDN and PDN system for Nagthana-2 MI project :-²

TABLE IIIII :

Sr. No.	Description	Conventional CDN System	PDN System	Percentage Decrease
1	Land Acquisition Cost	109.73 Lakh	24.50 Lakh	77%
2	Construction Cost	422.18 Lakh	404.34 Lakh	4%
3	Total Cost	532.01 Lakh	428.84 Lakh	19%

E) Cost comparison between conventional CDN with provision of CNS layer and PDN system for Dongarwadi LI Project :-²

TABLE IVV :

Sr.No.	Description	Conventional Cdn System	Pdn System	Percentage Increase	Percentage Decrease
1.	Land Acquisition Cost	441.72 Lakh	90.23 Lakh	-	79 %
2.	Construction Cost	679.35 Lakh	778.03 Lakh	14 %	-
3.	Total Cost	1121.07 Lakh	868.26 Lakh	-	22

2. *The need of CCDN over CDN is as follows :-*³

- a) It saves the cost of land acquisition.
- b) It saves the maintenance cost of canal, structure and earthquake.
- c) It can prevent losses due to evaporation seepage, phreatophytes, leakage in gates, spillways.
- d) Water logging is minimized.
- e) CCDN is feasible in any type of strata i.e. Hard rocky, BC soil, saline land, etc
- f) It may be operated 24*7*365 basis.
- g) Advanced technologies can be applied.
- h) It minimises manual control involved in operation.

4. *Alternatives while implementing PDN on existing CDN system :-*⁴

TABLE V :

Alternative	CDN	PDN
1	Main Canal, Distributory, Minor	Only Field Channel
2	Main Canal And Distributory	Minor And Field Channel
3	Main Canal	Distributory, Minor And FC

*Limitations :-*¹

- a) Great care is needed in design and construction of PDN.
- b) Silt should be removed before water supply.
- c) It saves water, Labor, maintenance , land and permanence of installation but it's initial invest is high in pipeline. It is feasible and economical in the long run pipeline.

CONCLUSIONS

OPE of an irrigation project improves by the PDN system as it is a one of the best way to increase efficiency. The study concludes that the conventional CDN have less water use efficiency i.e. 25% to 40%, in other hand gravity based PDN make improvement i.e. overall water use efficiency to 70% to 80%. As PDN system saves water than CDN system. It is useful where there is land cost is high Also where the channel passes through the deep cut of black cotton soil and it is suitable where the modern technique like sprinkler as well as drip irrigation is use.

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