

WATER AND INFRASTRUCTURE DEVELOPMENT WATER DISTRIBUTION SYSTEM AND ITS MANAGEMENT

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ABSTRACT

There are lot of innovations found in design and construction of dams for irrigation but when question of distributing this stored water arises, there are no much innovation. In Maharashtra there are no new sites to be exploited for large dams. Increasing area under irrigation by construction new dams may not be possible in future but it is possible to use and adopt new and simple innovative pipe distribution system to save conveyance losses and thus there is a lot of scope to increase efficiency of conveyance system. By adopting this new method of distribution at least 30 to 40% more land could be brought under irrigation without investing any more on construction of new dams. The innovative distribution system designed and constructed by group of farmers by forming Water Users Association is unique example of simple but efficient water distribution system adopted at Indore Minor Irrigation Tank Tq. Dindori, Dist. Nasik . Due to this method water loss in conveyance system is almost eliminated resulted in increasing area of irrigation twice. Equitable, proportionate and assured water distribution resulted in enhanced confidence in farmer to grow value added crops like grapes. Conjunctive use of well water resulted in overall increase in crop yields. By using the basic principles of this theme the author have proposed a new and innovative distribution system on canal irrigation on larger scale. The area of 1000 hector is selected for this study and all details of pipe line distribution are planned and designed including estimating its cost also. The cost comparisons are also carried by designing same area by conventional Open Canal Distribution system. It is found that pipe line distribution does not cost more than open canal distribution system but pipe line distribution system will eliminate following lacuna in conventional open canal water distribution system such as (i) Unequal distribution resulting in using more water on less area (ii) Tremendous losses in conveyance system (iii) Head portion gets more water and tail end gets no water (iv) Difficulty in preventing defaulter framer from taking water from water course . The new system now proposed will increase irrigation efficiency up to 98 % which is 40% in present open canal system.

INTRODUCTION

The total geographical area of Maharashtra State is 30.8 Million hector, out of which 22.5 Million hectores are cultivable. The irrigation potential created up to end of year 2011 in Maharashtra is 4.634 Million hectores. There is considerable gap between the potential created and actual utilization. Efforts are being made to bridge the gap between potential created and utilization. The state economy is dependent upon the agriculture production and irrigation facilities are regarded as the key element of irrigated agriculture. To fulfill the need of food and fiber of growing populations, it is very necessary to use water judiciously on equitable basis. In Maharashtra State most of the sites are already tapped. Hence there is no scope to bring more area under irrigation by constructing new dams. The only option available is to improve efficiency of conveyance system and to save water. It is generally observed that 50 to 60% water loss is occurred in conveyance system. Majority conveyance losses occurred in distribution network. To avoid these losses a total underground pipeline network is proposed. This pipeline network is based on the theme of already constructed and executed system at Indore Minor Irrigation Tank, Tq. Dindori, Dist. Nashik. This system at Indore is running smoothly from last 7 to 8 years successfully and efficiently. The planning of Indore M.I. tank and its experience is to be considered first so that further extension of this concept on larger area would be easy. At Indore the pipe line distribution is carried out for 115 Hector area and water is pumped by using 50 H.P. pumps to main distribution chamber. In this paper the proposed pipe line network system is totally based on gravity flow and there is no need of electricity to run this system. The proposed system is planned for 1000 Hector in a command area of Tapi basin between two local nalla. This system is proposed to be executed on pilot basis and after evolution further modifications, if required will be made in future planning.

SUCCESS STORY OF INDORE M.I. TANK'S PIPELINE DISTRIBUTION :

The Indore village is situated 25 km. away from the district headquarter (Nashik) Maharashtra (India). The water resource department constructed a minor irrigation tank in 1989 having gross storage capacity of 0.89 million cubic meters. Two irrigation sluices were provided on left and right flank side to irrigate 115 hector.

Initially the management of the project is handled by the Water Resourced Department. The maintenance, repairs and operation was done departmentally by water resources department. Irrigation was done in the rabi season i.e. October to February. Hot weather irrigation was not possible as tank was getting empty in two or three irrigation rotation. Due to insufficient and uncertain water supplying from the reservoir, the yield of crops were not enough.

TAKING OVER MANAGEMENT BY WATER USERS ASSOCIATION:

To overcome the problems of shortage of water, the beneficiaries united together. After lot of discussion and brain storming it is decided that (i) Water users association to take over the management of irrigation in their hand. (ii) To reduce the conveyance losses in the open channel, it is decided to close the sluice on right and left canal and to distribute the water only through underground pipe distribution network. (iii) Group of 3 to 7 farmers having fields side by side or as convenient are to be formed and each such group will carry water through common pipe from elevated main distribution chamber to field level small distribution chamber. Every individual will laid a separate pipe line from small distribution chamber to their own field at their own cost.

The water user association have constructed a main distribution chamber of 3 m. diameter and having a depth of 2 m. A pieces of PVC pipe having 63mm. diameter and 115 numbers are fixed in vertical wall all at equal level along the circumference of main distribution chamber. They work as a outlet. Each pipe represent 1 hector area and it is called one share. (The photograph-1 shows the pipe and circular chamber). The 115 share holders thus get water in equal and proportionate basis through 115 pipe outlet. Further individual distribution among small group of 3 to 7 were done by similar small distribution chambers constructed on the higher ground. (As shown in photograph-2). The small distribution chamber finally distributes water to individual farmer according to their share holding by making compartment in small distribution chamber as shown in drawing. Thus all the share holders get water at a time on equal and proportionate basis due to this unique method. This system resulted in almost no conveyance loss and farmers used this saved water to enhance their irrigation to other lands. Finally when irrigation department calculated the irrigation potential of 115 hectors farmers have succeeded in irrigating land of 287 hectors In actual. The farmers have used this water by drippers and sprinklers hence it can be conclude that if conveyance losses and modern technique of water utilization were used then irrigation could be doubled.

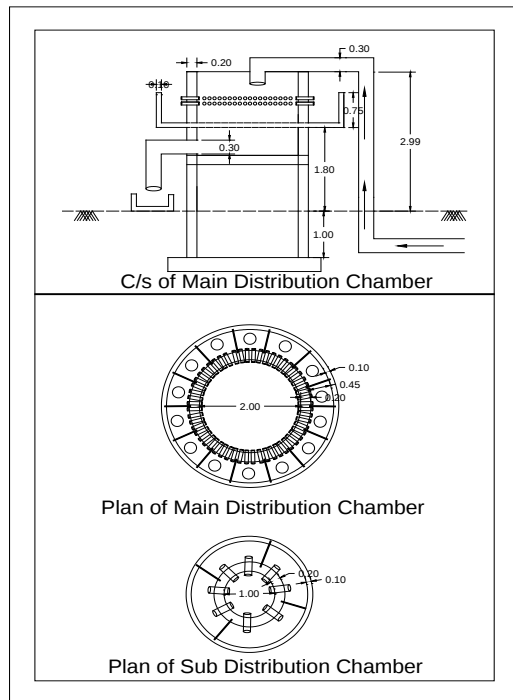
A group of farmers at Indore Tq. Dindori Dist. Nashik have designed and implemented a simple, cost effective, efficient, equitable pipe distribution system as shown below



Photograph-1 shows Main Distribution Chamber and vertical pipe carries water to Small Distribution Chamber



Photo No.2 Small Distribution Chamber of Small group of 3 to 7 farmers.



Modified Main distribution Chamber



Photo no. 4 shows Equal Diameter Pipes fixed at equal distributing equal quantity of water

Water from this chamber is distributed through equal diameter equal level pipes on circumference of circular chamber as shown above photo no.3 and 4 . All pipes is having equal diameter of 63 millimeter at equal level hence each pipe get equal quantity of water. One pipe is provided for one hector. At Indore this system is made for 115 hector therefore 115 pipes of 63 millimeter are provided. They have constructed an outer ring and have made small compartment according to their group and convenience as shown in photograph above . Water is then carried out to respective group through pipe line and further field level distribution is again done by similar method but at higher ground level with small chambers. By adopting this system this group succeeded in doubling the area in saved water.

In this system there is no head or tail reach. All the farmers gets water at a time on equal and proportionate basis. There is no any structure, no land acquisition and as system is underground it is free from interference of men, cattle or machinery. The defaulter farmer is easily prevented by capping his pipe at main distribution point itself. No costly maintenance is required. Man power required for management is also reduced as there is no frequent opening and closing of outlets.

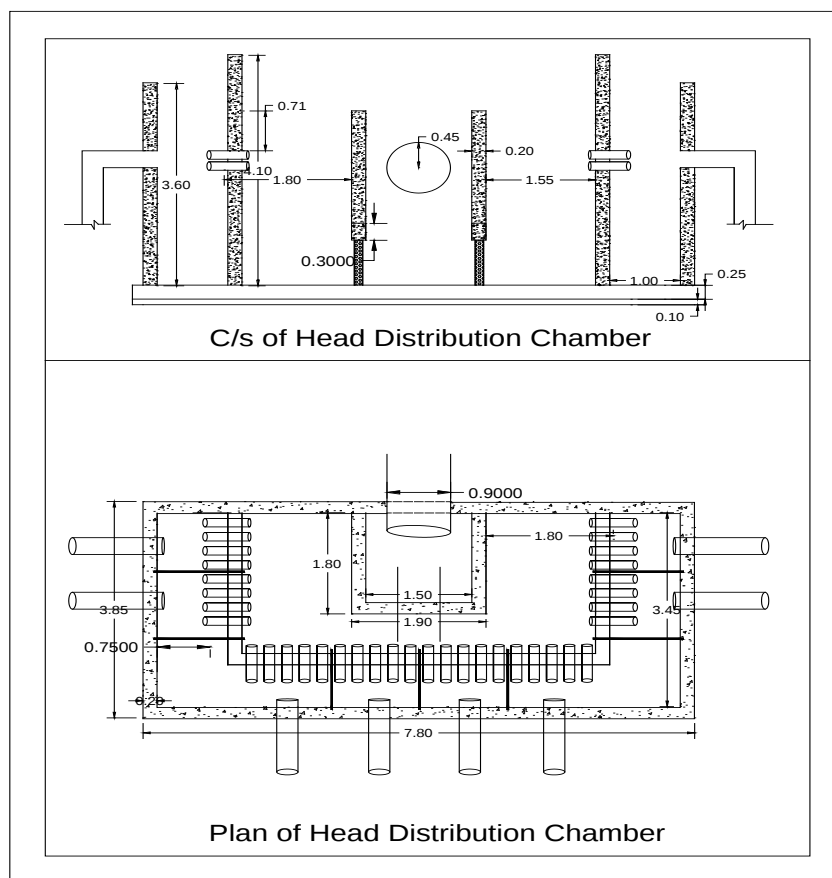
Taking the inspiration and clue the author have suggested pipe line distribution method for large area of 1000 hector. The main distribution on equal and proportionate basis is to be done on the same principle near Head

Regulator as shown in drawing. The ten pipes will carry water to main circular distribution chamber by gravity. A discharge received from head regulator will be distributed equally and proportionally by fitting pipes of equal diameter at equal level. The diameter of pipes will be so designed that it will carry a discharge sufficient to feed discharge of main distribution chamber. The main distribution chamber will distribute water to small distribution named as sub distribution chamber.

METHOD AND WAYS TO USE INDORE SYSTEM ON LARGER AREA OF 1000 HECTOR. :-

At Indore Minor Irrigation Tank the water conveyed up to Main Distribution chamber is through rising main of 300 mm. of P.V.C. pipe by help of 50 H.P. For pumping of water the scare electricity is consumed. The author have planned and designed a pipeline distribution system on pilot basis for 1000 hector by gravity flow. Thus in this proposed new system there is no use of electricity. For this purpose one Minor from command area of Tapi Narmada Project, Tq. Shahada, Dist. Nandurbar is selected. The catchment area is divided in 10 blocks.

The minimum area of block is 38 hector and maximum area of block is 130 hector. On an average 100 hector area per block is provided. This system is designed on the basis of crop water requirement of an one liter per second /hector. The total distribution between 10 blocks is distributed at Head Distribution Chamber by making compartment. The equal pipes of 150 mm diameter will be provided at equal level for 15 Hector area. For example for 75 hector area one compartment of 4 pipes will be provided as shown below. (Two rows are shown in cross section to size of chamber for economy)



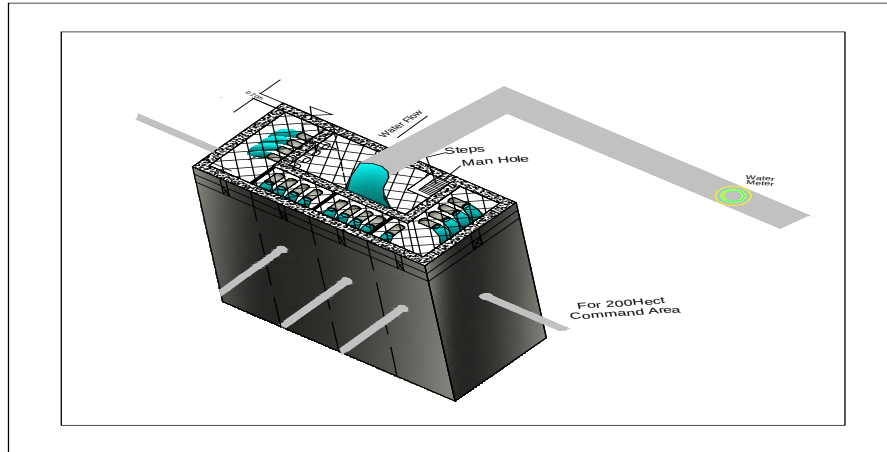


Figure shows section of Head Distribution Chamber and pipe leading to Main Distribution Chamber

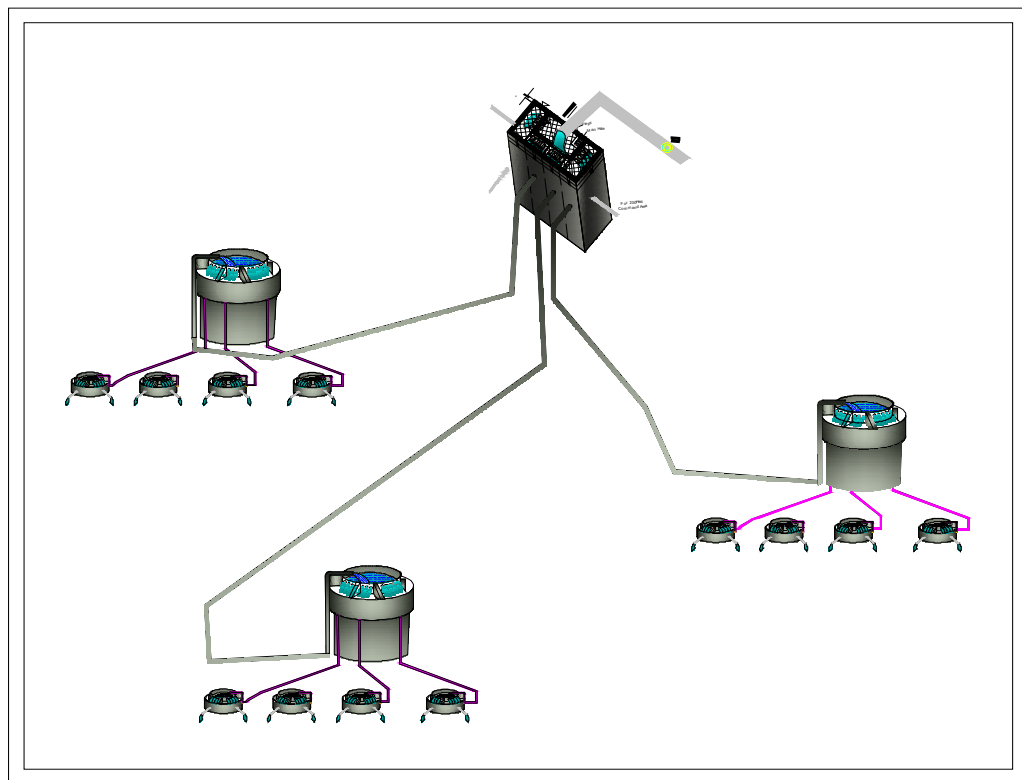


Figure shows the Head Distribution chamber , Main Distribution chamber and Small Distribution Chambers and its interconnections.

BLOCK LEVEL DISTRIBUTION

Water from Head Distribution Chamber will be carried to elevated Main distribution chambers similar to Indore M. I. Tank. At this chamber equal diameter pipe of 63 mm will be placed at equal level. Thus if a particular chamber is provided for 100 hector then 100 PVC pieced of pipes of 63 mm. will be placed equal level. From this elevated chamber the water will be carried out to farmers field either individually or by creating group of 3 to 7 farmers. Field level distribution is again done on similar logic by constructing small ground chamber and making compartment according to individual share. Compartment according to share will be prepared at outlet sides and thus water up to individual level on equal and proportionate basis on entire area of 1000 hector at a

time.

The new pipe line distribution system is economical than open canal system as seen below which is worked out by detailed design and estimate.

Cost Comparison of open canal water distribution system with pipe line distribution system.

Open Canal Water Distribution System	Cost in Lacs	Pipe Line Distribution System	Cost in Lacs
1. Earthwork	33.41	1. Earthwork	26.00
2. Lining	174.97	2. Providing and supplying pipes of various diameter	278.17
3. Structures	149.39	3. Lowering and laying of pipes	33.55
4. Land acquisition	119.76	4. Head distribution chamber	6.00
		5. Main elevated distribution chambers	9.00
		6. Small distribution Chambers	100.0
Total	477.53		452.72

CONVENTIONAL WATER DISTRIBUTION SYSTEM AND ITS LIMITATIONS:

In Maharashtra state on majority part of command area, a conventional Open Water Distribution System consisting of Distributory, Minor, outlets, field channels and turnout is provided. Water required for one chalk of 15 to 20 Hectors area is released at outlet head and further distribution between 10 to 15 farmers is left to themselves. This conventional system is having following shortcoming.

- (1) Whole system is open to sky hence open to interference to anybody. This "Open to All" system therefore, requires a lot of manpower for maintenance and management. The farmers at head reach portions takes water even though rule is tail to head. This inequality in distribution resulted in social unrest, use of more water on less area wastage of water on large scale.
- (2) Water to 10 to 15 farmers are given without deciding individual's share
- (3) Open canal requires number of structures such as falls, road bridges, outlets, turnouts.
- (4) Defaulter cannot be prevented from taking water because it is difficult to prevent them due to remote inaccessible area and domination of local farmers.
- (5) Volumetric distribution to each farmer is not possible efficiently as measuring water in open canal is not so easy in field as water head is constantly changing, hence crop area is measured every time. This resulted in repetition of work. No encouragement to use less water on large area possible.
- (6) For minor, field channel certain land width is necessary, acquiring small strip of land is having same hurdles that of large piece of land. The open canal system have to follow certain gradient and ridges, the land under cultivation gets divided due to minors and creates obstacles in land framing activities. Pipeline distribution system eliminates this drawback of the system, as no land acquisition is required for pipeline. The speed of work will be more and there will be no disturbance in farming. In open canal system all types of agriculture waste such as leaves and remains of crops easily mixes with flowing water. This debris accumulates in christen of falls and water cushion effect is hampered, the energy dissipation does not happens effectively and it results in increasing velocity of canal flow. Removing of debris in fall increase operation and maintenance cost.
- (7) In open canal system distribution of water to different chalk does not remains in proportion to area of land. The discharge is a function of driving head. A simple obstacle in open flow changes driving head instantly. Due to this obstruction the flow could not remain in proportion to area of land. In pipeline distribution system distribution is done perfectly in a chamber in proportion of area of land and hence, there is no any chance of unequal distribution. The perfectness in distribution results in equality. Due to equal and proportional distribution in respect of area of land result in judicious use of water.
- (8) In Maharashtra the present practice of water charges is based on "area irrigated" instead of volumetric basis. The electricity boards count units consumed by the customer similarly the telephone service provider counts talk time where as water resource department counts the area of crops under irrigation. Naturally the tendency of using more water on less area is grown. This resulted in inefficient use of water. The exact counting of water in open canal system is also difficult as depth of flowing water doesn't remains constant. In pipeline distribution system this measuring of water is very simple and

unique. The water up to head distribution chamber is easily counted with the help of water meter. Further measuring of water is not necessary as it can be done by dividing supplied quantity to number of open of opening. Thus by simply counting number of open pipe quantum of water can be counted accurately.

CONCLUSION

For increasing water distribution efficiency the distribution method should be improved. . Distribution at centralized water distribution chamber is one of the method proposed for larger area. Simple Pipeline distribution method which is easy to construct ,easy to understand , easy to operate by the farmers is proposed.

BRIEF PROFILE OF THE AUTHORS

Arun Anantrao Ghate have passed A.M.I.E.(India) in Civil Engineering from Institution Of Engineers (India) Kolkata in 1988 and also completed his Law graduation (LL.B.) in 2002 from Dr.B.R.Ambedkar Marathwada, University Aurangabad. He joined Water Resource department Government Of Maharashtra in 1982 and presently working as Assistant Engineer in the office of Chief Engineer and Chief Administrator CADA Aurangabad(M.S.) . He have constructed many small irrigation tanks and also worked in construction of Majalgaon Right Bank Canal and its distribution network. He is having experience of survey, design of canal network. His expertise is in survey and planning multipurpose project. He have discovered new site of Main dam, Saddle dam, open cut link canal of Sahastrakund Hydro (Multipurpose) project having installed capacity of 20 Mw and irrigation potential of 24950 Hectors. He worked on this project right from initial planning , survey and investigation, up to allotting work order to contactor.