International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 07 | July 2020 www.irjet.net p-ISSN: 2395-0072

REPLACEMENT OF EXISTING CANAL BY PIPE DISTRIBUTION NETWORK SYSTEM

Miss Mane S.L[1], Prof. P.A.Hangargekar [2], Prof .D.C. Poul[3]

[1]ME Student, Department of Civil Engineering, ShriTuljaBhavani College of Engineering Tuljapur, India
[2]Assistant Professor , ME Environmental Engineering Department of Civil Engineering, ShriTuljaBhavani College of Engineering, Tuljapur, India.
[3]Assistant Professor , ME Environmental Engineering Department of Civil Engineering, ShriTuljaBhavani College of Engineering, Tuljapur, India.

Abstract - *This paper deals with designing of gravity main of the Pipe Distribution Network(PDN) System. It also includes estimation of increased irrigation potential of study area due to adoption the PDN. The project discusses about various available equation for calculation of the head loss in pipe. In this project the PDN system is designed with help of Modified Hazen William Formula. The project taken under consideration Keshegaon Minor Irrigation Project in Osmanabad district of Maharashtra state in India. It also helps in bringing 51.09 ha of land under irrigation.It minimizes loss of water up to 30% during conveyance. And proves economical as cost saving up to 80%.*

Key words: PDN Design, Modified Hazen William equation

1. INTRODUCTION:

Agricultural sector is a big buyer of water resources, conveyance and application of water by conventional canal distribution system has inherent problem i.e. Minimum irrigation efficiency, more conveyance losses, unequal distribution of water, improper management of distribution of water, land acquisition etc. Modernization techniques can be used to improve the efficiency of existing and ongoing irrigation system also the development strategy should include better operation and maintenance and flexible regulation. Also the application of improved irrigation network and techniques on small farm is necessary.

1.1 Problem statement

In our Marathwada region canal distribution system is not properly sustain. Farmers are not paying attention to utilize full irrigation canal due to uncertainty about water availability in canal and government policies regarding lifting pumps. Irrigation canals are built to distribute the water in organized manner. Water is supposed to be distributed from main canal to distributory to minor to field channels. Due to uncertainty of rainfall, water availability is less and evaporation loss is more. Presence of unlined canal system which may leads to seepage loss in permeable soil strata. Due to inappropriate maintenance of canal system sediments are collected resulting in reduction of canal capacity. Uneven distribution of water. Now it is emerging as the dominant irrigation model as there was very few ha area has been irrigated as quarter of total area. Hence management of available water is necessary.

1.2 Objective of study

- To increase area under irrigation ,to achieve maximum irrigation potential
- To minimize losses such as evaporation loss, seepage loss etc
- To minimize cost of construction.
- To increase crop yield ie increase in Benefit to water holder.
- To generate maximum revenue to the government.

2. LITERATURE REVIEW:

M.M. Satpute , P. V. Khandve , M.L. Gulhane.(2012) In this paper shows that all most command area of irrigation project can be irrigated by conventional canal system, it may include main canal , branch canal, distributory , sub-minor , turnout. In that system almost 50% of water is loss during distribution and storage. This system has many more drawback as it has less overall project efficiency up to 41 to 48% only.

Pradeep Bhalage , B B Jadia , S T Sangale (2015) in this paper modernization of existing canal system by PDN done for the Jai Malhar WAU ,Indore Minor irrigation Project ,Dist Nashik .In ate and minimize losses during distribution .The water should be distribute equally to all share holder provided equals to share holders in that survey number Hence all share holder get equal quantum of water at same time. It may help for proper management with increasing efficiency of distribution.

Sandesh B. , Kulavmode , Dr. S.S. Valujkar (2017) The use of pipe distribution network system for conventional distribution system helps to reduce water stress on irrigation system by increasing overall project efficiency. To achieve maximum benefit for PDN system proper planning, designing

and execution is necessary. In This paper proper guidelines for planning designing and installation of PDN are given. It is recommended that PDN system is efficient as operating and economical point of view. This system is more suitable for implementation as new PDN system or used to convert existing CDN Demand of water for industrialization increases to reduce this water available for irrigation is less to reduce theses water stress optimum use of irrigation water is necessary which will irrigate maximum area and due to this purpose modernization of existing CDN system PDN system can be recommended PDN system is more suitable for modern techniques of irrigation such as drip and sprinkler system which will help to precise use of available water with maximum benefits of the system can be utilized.

3. METHODOLOGY

Various factors like crop water requirement, irrigation methods, water distribution scheduling, and flow control mechanism and socio-economic settings are considered in determining the design discharge. Various methods are available for the design of PDN. Some use basic principles of hydraulics for calculating Head loss in pipe and velocity are calculated by Modified hazen willaman formula. HGL line is calculated with respect to pipe top and respective ground levels with the help of Ms Excel sheet.

3.1Equations used for calculation of head loss and velocity of pipe

Modified hazen –William formula used for calculation of head loss of pipe and velocity as below

$Hf = L*\{(Q* Cr)^{1.81}/ (994.62*D^{4.81})\}$

$V = 143.534\ CR * r^{0.6575} * S^{0.5525}$

Where V= velocity of flow in m/sec

Cr = pipe roughness coefficient,(1 for smooth pipe).

D =internal diameter of pipe in m.

Hf =frictional head loss in m.

Q= Discharge in m3/ sec

L=length of pipe in m

r = hydraulic radius in m (for circular pipe, r =internal radius)

S= frictional slope (i.e. slope of HGL)

3.2 Planning criteria

To plan chak (40-60) ha / sub chak (5 to 8) ha suitable to rotational water Distribution schedule for PDN.
Location of turnout is kept on field boundary to minimize length of field channel.
Alignment of PDN system along the contours should be generally avoided.

3.3 Design criteria

3.3.1The hydraulic gradient at any point is normally at least 0.30m above the top of RL of pipe. The hydraulic gradient should not run below the elevation of pipe at any point.
3.3.2The minimum velocity shall be 0.6m/s to avoid silting and chocking in pipe. Otherwise provide scour valve.
3.3.3The maximum velocity shall be 1.2 m/s to avoid extra head loss in pipe.
3.3.4The FSL of the turnouts should be kept at least 20cm above the highest ground level of sub chack.
3.3.5The air vents should be provided in between locations if length of pipe line exceeds 200m or where air trapping is possible.
3.3.6All possible measures should be taken to facilitate the flushing of the system by providing appropriate low level outlets in the structure (wells) of the pipe line.
3.3.7For calculation of head loss and diameter of pipe use modified hazen willamn formulae.
3.3.8 In general for PDN loss due to bends and valves is considered as10 of friction loss.
3.3.9 Pipe top is laid below 1.5m of ground level.

3.4. Pipe material of the pipe line

Pipe used for construction should be economical, durable and dimensionally stable; it should be corrosion resistant, resistant to high pressure flushing, temperature resistant etc. In recent years use of plastic pipes has also been rapidly increasing as plastic pipes posses inherent and leak proof. Due to lower frictional losses, plastic pipe has better flow characteristics**.** Poly vinyl chloride (PVC) and polyethylene (PE) are used to great extent in irrigation. However, the availability of low cost PVC pipes and easy handling because of their light –weight, gives them the potential of being the alternative to replace the concrete open channel.PVC pipes are not affected by any of the chemical. Concrete pipe are affected by chemical conditions of soil. The cost of PVC pipe depends on the pipe diameter and thickness.

3.5 Site Selection

While selecting the sites, preference was given to Area where rabbi and kharif crops are grown through canal irrigation only, as deficiency of water generally occurs in rabbi season .for study Minor 02 of Keshegaon M. I. tank is taken having length 1440 m existing minor ,having CCA 64.5 ha, ICA 52.49 ha. Cost of Maintenance of canal for 1Ha is 135000 .Irrigation potential of study area is near about20% it covers only average 10.56 Ha area under irrigation. Losses during conveyance are up to 40 %.Discharge at head available at minor is 30LPS.

3.6 Planning of PDN

52.49 Ha of study area under minor 02 of keshegaon M.I. selected for design it can be divided into six sub chak having area between 7.8 to 10.5 Ha. Length of pipeline is decided by considering minimum length of pipe covers maximum area of chak.

3.7 Crop water requirement

Study area having CCA 64.15 Ha & ICA 52.49 Ha .Peak NIR (forth night) for 1 Ha ICA is 999 Cum & Peak NIR (forth night) per ha CCA at root zone is 817.42 Cum by considering water application efficiency is 75%.Forth nightly water requirement at farm head per Ha CCA is 1089.9 Cum. Per day NIR at farm head per Ha CCA within 12 days is 90.82 Cum. Discharge through pipe per ha considering 5 % losses as per GR no 2015 dt Feb. 2017 of state govt of Maharashtra is 0.001 Cumecs /ha.

3.8 Design of PDN

For design of PDN consider various calculations are carried out for that program designed for obtaining head loss, diameter of pipe , HGL ,velocity, pressure at various joint for this pipe segment converted into node at each node velocity diameter and head loss is calculated and pressure calculated at every junction. The program is developed in tabular form .the calculation of any segment of pipeline are carried in single row. Details of such sheet are shown below.

Column01: Name of segment /Node

Column 02: Length of pipe

Column 03: Starting Ground level of pipe

Column 04: Ending Ground level of pipe

Column no 04: Area under irrigation of particular node.

Column 05: discharge required for each node (it taken from separate calculation where discharge is calculated according to crop water requirement)

Column 06: Diameter of pipe (Considering pipe flow at maximum velocity) for respected area.

Column07: Diameter adopted as per sizes available in market

Column 08: Head loss occurred between two nodes is carried out by modified Hazzen williamn formulae as discussed in previous chapter.

Column 09: Slope of line(column no 03 - Column no 03)/(column no 02)

Column 10: Hydraulic Radius of pipe (Colum no 07/4)

Column 11: Velocity of pipe calculated by modified hazen willam formulae as discussed in previous chapter.

The check for maximum and minimum velocity is verified for every segment .If check does not full fill the criteria then change the diameter of pipe according to full fill criteria. Pressure at junction is calculated in extra sheet.

3.9 Estimation of construction cost of pdn and Benefit cost ratio for study area

As we replace existing canal by PDN there is no issue of land acquisition hence only construction cost of project including installation and planning is calculated by considering all joints fittings material labor etc as per MJP CSR of Aurangabad region and estimation done which is Around 303000 for all study area.which gives benefit of 5418070 through the crop yield of 51.09 Ha. The cost benefit ratio of study area is 1.75 which is more than 1 which proves implementation of PDN to existing canal is beneficial.

4. RESULT AND DISCUSSION:

In this study network model is designed for irrigation system, main pipelines are laid and sub mains are connected to individual field outlets. The optimized network is designed for 52.49 CCA. The use of computer application gave new approach to this study which gives may result as follows

Area under irrigation CCA	51.09 Ha
Irrigation potential	97%
Discharge at Head	60LPS
Losses	10%
Material Used in PDN	PVC
Cost of construction of project	3030000
Benefit Cost Ratio	1.75

Table: Result of Application of PDN to existing canal.

5. CONCLUSION

This study concludes that area under irrigation is increased by 40 Ha as in CDN area under irrigation is 10.478 Ha and in PDN it is increased upto 51.09 Ha, hence irrigation potential increased by 77%, available discharge at head is double than existing. Losses minimized up to 30%.Material selected for study area is p v c which has less frictional loss, life span is near about 40 year which is more durable and maintenance is also easy using some acids ,liquids, than existing earthen unlined canal which have life span of 10 to 15 years which required maintenance for each 3 years. This system proves cost effective than maintenance and repair of existing canal structures. Which save cost up to 80%.Hence replacement of CDN by PDN proves cost effective, increase in irrigation potential, minimizes losses during conveyance i.e. optimization of available network is done.

References

[1] Satpute M. M., Khandve P. V., and Gulhane M. L.,(2015). Pipe Distribution Network forIrrigation – an Alternative to Flow Irrigation, Section VII: Environmental Sciences, Proc.99th Indian Science Congress, Part-II: Abstracts of Poster Presentation. Pp72-81

[2]R.S Bhoir ,N.B Mhatare,R.B. Mahatre, A.S. Shinde(2018),Analysis and design of Pipeline system instead of the canal system, International Journal of advanced engineering and Research Development Volume & Issue PP22-30

[3]S.B. Kulavmode, Dr. S.S. Valunjkar, (2017), Guide lines for Construction of Pipe Distribution Network (PDN) for Irrigation, Irrigation. International journal for research in applied science & engineering technology (IJRASET) volume 4.issue 3, PP217-221.

[4] R. Raghuwanshi (2016),Design of pipe distribution network in the command of a canal outlet for optimal crop planning, International Journal of advance engineering and research development, volume 2,issue 3,PP.224-229

[5] Government of India, Central Water Commission, New Delhi.(2017) Guideline for Planning and Designing of Piped Irrigation network May2017. Page 1- 99

[6] Government of Maharashtra State, India (2017) Guidelines for adoption of Pipe

Distribution system dated 2 February 2017. Page 1-11

[7] Kolhe P. (2012). "Optimal Utilization of Irrigation Water by Use of Pipe Distribution Network (PDN) instead of Canal Distribution Network (CDN) in Command Area", India Water Week 2012 – Water, Energy and Food Security: Call for Solutions, New Delhi.