An Overview: Water Distribution Network by Using Water GEMS Software

Ms. P. S. Salunke[1]* Ms. M. M. Dumane[2], Ms. S. P. Kamble[3], Mr. O. S. Nalvade[4], Mr. S. P. Pondkule[5], Prof. R. A. Binayke[6]

[1,2,3,4,5] UG Student, JSPM's Imperial College of Engineering and Research, Wagholi, Pune

[6]Assistant Professor, JSPM's Imperial College of Engineering and Research, Wagholi, Pune

Abstract – Water is essential element required for the sustenance of life. Demand for drinking is increasing on continual basis with corresponding increasing population. This ever increasing demand can be fulfilled by designing efficient water distribution networks based on advance computing systems include modern hydraulic modeling . In present study water distribution network of Bakori region of Wagholi is designed which is located at district Pune, State Maharashtra, India. For the design of Bakori Phata water distribution network, study of present population, population of the three decades, daily water demand, flow characteristics and also survey of the village is done with help of digital GPS .Water distribution network for the villages is analyzed and designed with help of Bentleys WATERGEMS software.Water distribution network systems are designed to deliver water from a source in the adequate quantity, quality and at satisfactory pressure to all individual consumers. Water distribution network are designed with an objective of minimizing the overall cost while meeting the water demand requirements at adequate pressures. The system is a pipeline network consisting of one source node and several demand nodes is considered to find its optimal geometrical layout which delivers known demands from source to consumers over a long period of time.

Keywords- Water Distribution Network, Bentleys Watergems, Pipeline Network.

----------X----------

1. INTRODUCTION

Water is essential for all living things, also it play important role in socio-economic development of a country. Water distribution network is necessary infrastructure for supply of water**.** For the present study of design of water distribution network of Pune districts Wagholi region which is located at Pune - Ahmednagar highway, covers an area of about 2879.96 hectare. Wagholi is considered as developing area. Wagholi takes many efforts to provide and reliable services to the citizens. Water supply is major part of it. It provides sufficient quality to the every citizen at optimal cost but quantity is not satisfactory. As per collected data from governmental organization quantity of water supplied to the consumers is not satisfactory as per our survey Bakori Phata areareceives water by tankers and bore wells. Although area is well planned there are certain problem reported by consumer and in order to tackle these problems we decided to design the water distribution network by Bentleys WaterGEMS software hence it will be helpful to Grampanchayat in future to laid pipe line and all essential elements of distribution network of water supply scheme in Bakori phata area BJS, Wagholi.

Bentley Systems Incorporated is an American-based software development company that develops, manufactures, licenses, sells and supports computer software and services for the design, construction, and operation of infrastructure. The company's software serves the building, plant, civil, and geospatial markets in the areas of architecture, engineering, construction (AEC) and operations. Their software products are used to design, engineer, build, and operate large constructed assets such as roadways, railways, bridges, buildings, industrial plants, power plants, and utility networks. The company re-invests 20% of their revenues in research and development Water GEMS provides full geodatabase integration, so you can create, display, edit, run, map, and analyze hydraulic models from a geospatial environment.

Fig. Map of Bakori Phata

2. LITERATURE STUDY

[2.1] Analyzing the existing water distribution system of Surat using Bentleys Watergems: Dilip Babubhai Paneria *et al* (2017) In this study, the existing water distribution system is simulated through construct of a model using Bentley Water GEMS. It helped in analyzing the entire network system, visualized the effects of constituent components and parameters as well as the pressure at end node is detected low, that shows the consumer near the reservoir having more advantages of water than the one that resides away from the reservoir.

[2.2] Review study: Experimental investigation by WaterGEMS software for redesign of water distribution system of Bhavani Mata ESR Prof. A.G.Chaudhari, *et al*(2017) has worked on WaterGEMS software will be used for obtaining optimal design of water supply network of a part of Nasik city. With the help of WaterGEMS software, design of optimal water supply network will be done with achieving objective of minimizing the overall cost while meeting the water demand requirements at sufficient pressures for specified maximum discharge over a long period of time. The software also gives different alternative optimal design solution considering pipe diameters, pipe material and roughness coefficient based on head dependent analysis.

[2.3] Feasibility Analysis of Water Distribution System for Yavatmal City using Water Gems Software:- Shinde Parmanand Bhaskar (2017), A study was undertaken to suggest measures for the improvement to the distribution system, which can easily fulfill the demand for water in the city and can lead to development of the city in near future. The paper presents results of analysis carried out using Bentley systems Water gems for basic design of distribution system which consist of reservoir, pipe network and ESR. Various materials' costs can be marked and cost estimation is not considered in this study as it depends on the authority to approve, but PVC cost is the lowest among the all materials and durable as well. Hence, PVC is suggested for adoption.

[2.4] Water distribution systems reliability: - A.Gheisi,M.forsyth, *et al* (2016),this study provides an in depth review of the relevant research literature. This research organized and classified the available techniques into three major categories and discussed which technique should be used depending upon the type of failure.

Failure in WDS was classified into mechanical/physical, hydraulic, and water quality failures. Occurrence probability or rates of failure in pipes, pipes failure combination, and criteria to measure reliability were the key factors that affect the WDS's reliability.

[2.5] A review of modeling and application of water distribution network softwares:- Mandar G. Joshi(2015),This ever increasing demand can be fulfilled by designing efficient water distribution networks based on advance computing systems include modern hydraulic modeling and designing software.This extensive of review softwares for designing and modeling WDN concludes that the choice of design softwares are entirely depends upon the availability of the data, time, financial implications, resources, applicability, compatibility and overall purview of the project.

[2.6] Optimal design of water distribution network by using WaterGEMS:- Sajedkhan S. Pathan, *et al* (2015), stated water distribution network systems are designed to deliver water from a source in the adequate quantity, quality and at satisfactory pressure to all individual consumers. Water distribution network are designed with an objective of minimizing. The overall cost while meeting the water demand requirements at adequate pressures. Water GEMS software algorithm is based on Gradient method gives optimal solution for the design of new as well as expansion of existing water distribution network. The primary variables are flow in the network while other decision variables includes design parameters i.e. pipe diameter, reservoir elevations etc. Head and velocity dependent analysis is used to determine the actual supply form each node to consumers. In this paper CIDCO N-8 a part of Aurangabad city is designed by Water GEMS software. With the help of WaterGEMS software an optimal water distribution network are designed and also helps in achieving objective of minimizing the overall cost while meeting the water demand requirements at adequate pressures for specified maximum design discharge over a long period of time.

[2.7] Design of Optimal Water Supply Network and Its Water Quality Analysis by using Water GEMS: -Sajedkhan S. Pathan, *et al* (2014),In this paper design of water supply network duly considering optimization in addition to the cost minimization,

minimum head requirement and minimum chlorine requirement is presented.

In this paper Water GEMS software is used for obtaining optimal design of water supply network of a part of Aurangabad city. With the help of Water GEMS software design of optimal water supply network and its water quality analysis (chlorine analysis) is done with achieving objectives of minimizing the overall cost which meeting the water demand requirement at sufficient maximum discharge over a long period of time.

[2.8] An EPANET analysis of WDN of the University of Lagos, Nigeria: - A.E.Adeniran *et al* (2013), stated the university of Lagos, Nigeria, one of the foremost university in Africa was established in 1962. The present WDN of the university was designed in 1982 when the population was about 12000, the current population of the university is about 85000. The water demand raised from 2.48 MLD in 1991 to 10.75 MLD in 2012. In this paper, a comprehensive analysis of WDS in the university of Logos was carried out by EPNET.s

[2.9] Feasibility analysis and design of WDS for Tirunelveli Corporation using loop and water gems software's:- Sumithra R.P, *et al* (2013) stated water distribution in Tirunelveli Corporation is not evenly distributed due to undulating terrain and increases in population density. A study was undertaken to suggest measures for improvement to the distribution system. The paper presents result of analysis carried out using computer package Bentley system, 2008 water gems for optimal design of distribution system including cost analysis and reorganization measures needed for the design year 2044.WaterGEMS software have graphical interface and more efficient and changes can be done very easily.

[2.10] Analysis of existing water distribution network by using Water GEMS a case study of Rajkot city :- Prashant Virjibhai Vaghela*, et al*(2010). The Water distribution network plays vital role in supplying water to end user. Water GEMS is hydraulic modeling software which is used for analysis and design of water distribution network. The result obtained verified that the pressure at all junction and the flows with their velocities at all pipes are feasible enough to provide adequate water to the network of study area. The end result will help to understand the pipelines system of the study area in a better way.At the end of the analysis it was found that the resulting pressure at all nodes and the flows with their velocities are sufficient to provide to the study area.

3. EQUATIONS USED IN WATERGEMS SOFTWARE:

Following are the equations with the help of which flow of water is calculated. Darcy-Weisbach equation is viewed by many engineers as the most accurate method for designing water distribution network their head losses in pipes:

The Hazen-Williams Formula is frequently used in the analysis of pressure pipe systems.

1) Hazen-Williams Equation:- $Q= k.C.A.R_0.63.S_0.54$

Manning's equation is used for analysis of the roughness coefficient.

1) Manning's Equation:- $Q= k/n. A. R^{2/3}. S^{1/2}$

2) Darcy-Weisbach Equation:-$hL= f LV^2 / 2gd$

4. CONCLUSION

The purpose of present study is to design water distribution network for Bakori region. In this study it is observed that storage capacity of ESR located at Wagheshwar which is not satisfactory so by considering demand of water for Bakori region design of new water distribution network is necessary to install, so proposed network is planned and need to execute for effective distribution with sufficient pressure.

5. ACKNOWLEDGEMENTS

We would like to thank our Principal of institute Prof. Dr. D. D. Shah, HOD Civil Department Prof. Dr. A. W. Dhawale and Asst. Prof. A. K. Kulkarni and Asst. Prof.V.P.Bhusare for software training, all faculty members and all our dear friends for their support.

REFERENCES

Dilip Babubhai Paneria (2017). "Analyzing the existing water distribution system of Surat using Bentlys Watergems", International Journal of Advance Research in Engineering, Science Management.

Prof. A. G. Chaudhari (2017). "Experimental investigation by Water GEMS software for redesign of water distribution system of Bhavani Mata ESR", International Journal OfAdvance Research in Engineering, Science Management.vol.no.6, issue no.03, March 2017.

Shinde Parmanand Bhaskar (2017). "Feasibility Analysis of Water Distribution System for Yavatmal City using Water Gems Software", International Journal Of Innovative Research in Science, Engineering and Techomolgy.vol.6,issue7, July 217.

A. Gheisi, M. Forsyth (2015). "Water distribution systems reliability", International Journal Of Technical Research and Application.www.ijtra.com vol3,issue-5(Sep-Oct 2015), pp. 174-178.

Mandar G. Joshi, Nitin P. Sonaje: "A review of modeling and application of water distribution network softwares".

Sajedkhan S. Pathan, Dr. U. J. Kahalekar (2015). "Optimal design of water distribution network by using Water GEMS", IJPRET, 2015; vol3(8): pp. 308-319.

Sajedkhan S. Pathan., Dr. U. J. Kahalekar (2015)."Design of Optimal Water Supply Network and Its Water Quality Analysis by using Water GEMS", Internation Journal Of Science and Research (IJSR) ISSN (Online): 2319-7064.

A. E. Adeniran and M.A. Oyelowo (2013). "An EPANET analysis of WDN of the university of Lagos, Nigeria", Journal of Engineering Research, volume 18 no. 2 June 2013.

Sumithra R.P., Nethaji Mariappan V.E., Joshua Amaranath (2013). "Feasibility analysis and design of WDS for Tiruunelveli Corporation using loop and water gems software's" International Journal on Applied Bioengineering, vol. 7 no. 1 January 2013.

Prashant Virjibhai Vaghela, Sejal S. Bhagat (2013). "Analysis of existing water distribution network by using Water GEMS a case study of Rajkot city", International Journal of Advance Research in Engineering, Science Management.

www.bentley.com

Corresponding Author

Ms. P. S. Salunke*

UG Student, JSPM's Imperial College of Engineering and Research, Wagholi, Pune

E-Mail – salps1996@gmail.com