

A Review Paper on Study And Design Of Water Distribution Network System

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Abstract- This paper aims at providing an effective network for supply of water through pipes. The water to be supplied in the area of KHANDOBA MAL ROAD, LOHEGAON must be safe hygienic and good quality. Thus this process is done with the help of EPANET software. This software is capable of doing the hydraulic modeling as well as quality analysis. The paper briefs hydraulic modeling of the selected location. The collection of data is done as per guided in Irrigation and Public Health (IPH) Department and IS code 1172:1993. The skeleton of pipelines and node is marked and positions of valves and tanks is fixed the result is obtained after successful run of the hydraulic model.

Keywords- Water Distribution Network, EPANET, Hydraulic Analysis

I. INTRODUCTION

Designing a water supply system for a township requires a systematic approach that considers several factors such as water demand, water source availability, water quality, pipe network design, and water storage. The effecting factors like the location of, its current water demand, the future demand growth, leakages in the conduits, required pressure in pipes, losses in the pipes, etc. The infrastructure of a water distribution network refers to the physical components and facilities required to transport potable water from a water source to the consumers. This includes the water treatment plants, pumping stations, storage facilities, transmission mains, distribution mains, service connections, and appurtenances such as valves, hydrants, and meters. The infrastructure is designed to ensure that the water is transported at the appropriate pressure and flow rate to meet the demands of the consumers, and that the water quality is maintained throughout the distribution system. The infrastructure of a water distribution network can vary in size and complexity depending on the size of the community it serves and the availability of water resources.

1) Aim of Study

To study and design an efficient water distribution network that can provide a reliable supply of safe, hygienic and good quality of water to the consumers.

2) Objective of Study

The main objective of study is as follows:

- To identify the terrain for development of township.
- To study requirement of water as per development plan.
- To design Water Distribution Network using the software.

3) Study Area

The study area is opted in the surrounding of KHANDOBA MAL ROAD situated in LOHEGAON, which is at a distance of 6.3 km from Pune Airport

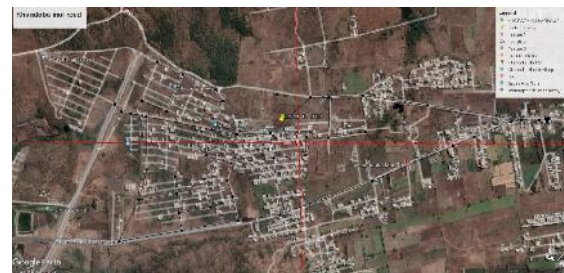


Fig.1.Khandoma Mal Road Area

4) Overview of EPANET

EPANET is a widely used software application for modeling water distribution systems. It is designed to help engineers and consultants to understand the movement and fate of drinking water constituents within distribution systems, and can be used for various types of applications in distribution systems analysis. With EPANET, users can perform extended-period simulation of the hydraulic and water quality behavior within pressurized pipe networks, which consist of pipes, nodes (junctions), pumps, valves, storage tanks, and reservoirs. It provides a visual network editor that

simplifies the process of building pipe network models and editing their properties and data. EPANET also offers robust hydraulic modeling capabilities such as modeling constant or variable speed pumps, computing pumping energy and cost, modeling various types of valves, and allowing storage tanks to have any shape. Additionally, it provides water quality modeling capabilities such as modeling the movement and fate of reactive materials, age of water throughout a network, and reactions in the bulk flow and at the pipe wall.

II. LITERATURE REVIEW

1. "Optimal design of a water supply network for a rural community using an integrated GIS and hydraulic model" by N. Y. Nwachukwu and C. U. Nwoye discusses the use of GIS and hydraulic modeling to optimize the design of a water supply network for a rural community. The authors reviewed the current state of water supply in rural areas and proposed a methodology for the design of the water supply network using ArcGIS and EPANET software. They presented the results of their analysis, which showed that the proposed design was cost-effective and could adequately meet the water demand of the community. The paper concludes that the use of GIS and hydraulic modeling can improve the efficiency of water supply network design in rural areas.
2. "Multi-objective optimization of water distribution networks using a genetic algorithm" by S. Soroushnia et al. (2021) discusses the application of a genetic algorithm (GA) for multi-objective optimization of water distribution networks (WDNs). The authors review previous research in the field of WDN optimization, highlighting the need for efficient and effective methods to improve the performance of water systems. The paper presents a methodology for optimizing WDNs that considers multiple objectives, including minimizing the capital and operating costs, maximizing water quality, and minimizing energy consumption. The proposed approach uses a GA to generate a set of Pareto-optimal solutions, which represent the best trade-offs between the conflicting objectives. The authors describe the GA implementation and the fitness function used to evaluate the solutions.
3. "Modeling and optimization of water distribution networks using a hybrid NSGA-II algorithm" by A. G. Karamousantas et al. (2020) presents a study on the modeling and optimization of water distribution networks using a hybrid algorithm based on the Non-dominated Sorting Genetic Algorithm II (NSGA-II). The authors first introduce the problem of optimizing water distribution

networks and the challenges associated with this task. They then present the NSGA-II algorithm and describe the modifications they made to the algorithm to make it more suitable for the water distribution network optimization problem.

4. "Design of water distribution networks for sustainable urban development" by H. F. Abd-Elhamid et al. (2018) presents a study on the design of water distribution networks for sustainable urban development. The study includes a case study based on a real-world urban area in Egypt. The authors propose a methodology for designing water distribution networks that takes into account the sustainability criteria, such as minimizing energy consumption and maximizing the use of renewable energy sources.
5. Design of Water Distribution Network. [Journal Of Water Resource Research And Development, Vol 4, Issue 3.] Raja Vamsi, Satish Kumar B, Uppendra P, Raviteja K, Vijaykumar A. This paper concern for the quite aware that the ample quantities of treated or wholesome water has to be supplied for the various needs of human at the point of consumption. This paper mostly depends on EPANET software. It is achieved by the properly planned and perfectly functioning distribution system of the protected water supply schemes. At end of 19 century community is not getting water at their residence in the village. It is applicable for plane areas only.

III. DESIGN CRITERIA

The major factors required for design purpose are Velocity, Pressure, Head loss, Design Period, Average Water Consumption, Pipe sizes. The water demand is taken on the basis of IS code 1172:1993. In this paper the water demand for per head is 135 liters for middle class and economically weaker sections and that for the Higher class people is 200 liters per head. [Irrigation and Public Health Department IPH]

IV. METHODOLOGY

1. Selection of Study area: KHANDOBA MAL Road, LOHEGAON
2. Data collection: The first step is to collect all the necessary data related to the water distribution network system, such as pipe diameter, length, material, Roughness coefficient, elevation at each node, population, demand.
3. Model development: The next step involves creating a computer model of the water distribution network system using EPANET software. The model should accurately

represent the network's physical layout, including all pipes, pumps, valves, and other components.

4. Calibration and validation: Once the model is developed, it needs to be calibrated and validated using field data. This involves comparing the model's results to the actual measurements taken at various locations within the network to ensure that the model accurately reflects the system's behavior.
5. Data Analysis: With a calibrated and validated model, various analyses can be performed, such as hydraulic analysis. The nodal demand estimation is carried out at each node by multiplying the population at each node with per capita demand of the node.
6. Skeletonization of the network: With reference to the road network provide nodes at junction and join them with links i.e. pipelines. Then place the overhead tank (ESR) at a suitable height.
7. Assigning distribution and network Parameters: After skeletonizing the network, define all network parameters to the nodes, links and tank.
8. Run Analysis: the last step to run the analysis. If the inputs are correct software prompts successful else it shows pop up a status report about the errors.

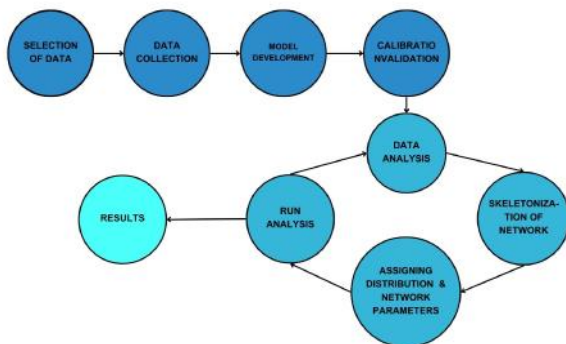


Fig 2: Flowchart of Methodology

V. CONCLUSION

The study and design of a water distribution system for a specific area using EPANET software involve a comprehensive and systematic approach that considers various factors such as water demand, water source, treatment process, distribution network layout, and water storage. The use of software tools such as EPANET can aid in the efficient and accurate design of the system, ensuring the delivery of potable water to consumers sustainably and reliably.

VI. ACKNOWLEDGMENT

We hereby take this opportunity to express my profound thanks and deep sense of gratitude towards our guide

Mrs. Kshitija Tikhe, Department of Civil Engineering. She gave us precious time from her busy schedule & her valuable guidance has been a constant encouragement.

I would also like to thank Dr. Lalit Kumar Wadhawa, Principal DYPIT, Dr. Deepa A. Joshi, Head of the Department of Civil Engineering, Dr. J. D. Agrawal, Professor, Mrs. Manisha Surve, Assistant Professor, Dr. Amar Chipde, Assistant Professor and the faculty members of Department of Civil Engineering whose constant encouragement and expert guidance was instrumental in the completion of this project work.

Let us, at the end, express gratitude to all those from whom I received co-operation, help & motivation during project work

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