Continuous Water distribution Network Analysis Using Epanet in Ambaji, Gujarat State, India

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Abstract - *The current study, titled "Continuous Water Distribution Network Analysis Using Epanet Software in Ambaji: A Case Study of Ambaji," was conducted with the express goal of effective design, development, and analysis of water distribution networks and systems using EPANET software. The current data on the water distribution system was obtained from the Ambaji taluka Panchayat for this investigation. Three methods were used to forecast Ambaji's population for the following three decades: Arithmetic Increase Method, Geometric Increase Method, and Incremental Increase Method. The expected population's water requirement for the following three decades was also calculated. The elevation of nodes and pipe length were recorded for 148 nodes and an equal number of pipes using a Google Earth image of Ambaji. The findings of data analysis in EPANET Software revealed that there is less head loss, which is critical for maintaining the constant pressure required for Ambaji's continuous water supply system.*

***Key Words*: EPANET 2.0; Pipe Network; Water Supply; Water Demand; Population Forecast, Google Earth Image, elevation of nodes, length of pipes**

1. INTRODUCTION

In India, population distribution is influenced by water availability. It is vital to deliver the requisite water amount through the effective design of pipe network to fulfil the increased water demand due to the growing urban population. The necessary pressure through a distribution network is the most critical task in distributing desired water quantity to individual consumers. Each location in the distribution network must be provided with a specific amount of water flow with all of the appropriate specifications. In most Indian towns, water is only available for a few hours each day, pressure is inconsistent, and the water is of dubious quality. A pipe network system's job is to deliver water at the right pressure and flow. Though pressure is lost due to friction on the pipe wall, the amount of pressure lost is also dependent on the water demand, pipe length, gradient, and diameter. The pressure–flow relationship is explained by a variety of well-established empirical equations, which have been incorporated into network modelling software packages.

As a result, while building a pipe network, the primary goal is to achieve appropriate pressure at the supply point in order to deliver the required amount of water to the user. The intended street plan and topography are often used to develop a water distribution network. The modeller simulates flows and pressures in the network, as well as flows into and out of the tank, using commercially available software. Ambaji has been chosen to analyse and investigate a network of piped water supply systems, which is done while considering a 24-hour water supply system to determine pipe pressure, velocity, and water age, among other things.

2. Study Area

Ambaji is a town in the danta taluka of the Banaskantha district of Gujarat, India. It is located at 24.33°N 72.85°E. At a height of 480 metres, it is the highest point in the area (1,570 ft). It is surrounded on all sides by the Araveli Hill Range. Ambaji is around 15 km2 in size. Ambaji enjoys all types of weather. Summers are hot and humid, with high winds and temperatures ranging from 26 to 46 degrees Celsius. In the winter, the temperature ranges from 6 to 36 degrees Celsius. The average rainfall during this cold time is 15 to 30 inches; during the monsoon season, the average rainfall is about the same as in the winter, with some heavy rains. The weather at Ambaji is pleasant all year because it is situated at an altitude of 480 meters.

3. METHODOLOGY

3.1 Justification for the use of EPANET

The EPANET software, developed by the United States Environmental Protection Agency, was chosen since it is free on the internet and is intended for general public and educational usage. It is capable of analysing an infinite number of pipes and tanks. In both industrialised and developing countries, EPANET has become a popular tool for studying complicated and basic water distribution networks. EPANET is a computer programme that simulates hydraulic and water quality behavior in pressurised pipe networks over a long period of time. Pipes, nodes (pipe junctions), pumps, valves, and storage tanks or reservoirs make up a network. The water flow in each pipe, the pressure at each node, the height of water in each tank, and the concentration of a chemical species are all tracked by EPANET. EPANET is a research instrument that will help us better understand the movement and destiny of drinking water elements inside distribution networks. It can be utilised for a wide range of distribution system study applications. It was employed in this report to do a hydraulic analysis of the subject area's distribution network. The obtained data are checked, and it is noticed that the pressures at all connections, as well as the flows and their velocities in all pipes, are sufficient to give adequate water to the research area's network.

3.2 Advantages of EPANET

Following are some basic advantages of EPANET for using in network and distribution analysis.

• The linear technique is used to calculate network flow rates.

• Friction head losses are calculated using the Darcy-Weisbach or Mannings equations, or the H-W Method.

• It can account for tiny losses caused by bends, fittings, and other factors.

• It can also duplicate needs that change over time.

• It can also cope with a variety of demand patterns for each node.

3.3. ANALYSIS OF RESULTS

Ambaji's water distribution system contains 149 connections, 148 nodes, and two overhead tanks. As depicted here, the pipe line network. Ambaji's distribution system The study's findings reveal that the pressure at all junctions and flow through all pipes is sufficient to supply water to every component of the network system.

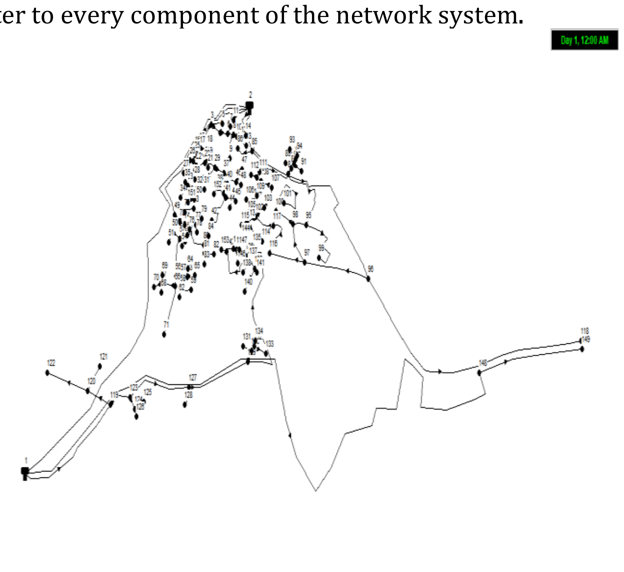

Fig 3.1 The Pipe line Network of Ambaji

Node ID	Elevation m	Base Demand LPS	Demand LPS	Head m	Pressure m
Junc 3	438	0.69	0.69	476.74	38.74
Junc 4	443	0.17	0.17	476.72	33.72
Junc 5	447	0.11	0.11	476.72	29.72
Junc 6	446	0.10	0.10	476.71	30.71
Junc 7	451	0.11	0.11	476.71	25.71
Junc 8	454	0.09	0.09	476.69	22.69
Junc 9	464	0.35	0.35	476.67	12.67
Junc 10	454	0.05	0.05	476.69	22.69
Junc 11	447	0.27	0.27	476.68	29.68
Junc 12	448	0.07	0.07	476.69	28.69
Junc 13	451	0.13	0.13	476.69	25.69
Junc 14	448	0.06	0.06	476.69	28.69
Junc 15	440	0.34	0.34	476.72	36.72
Junc 16	444	0.06	0.06	476.72	32.72
Junc 17	441	0.04	0.04	476.71	35.71
Junc 18	446	0.08	0.08	476.71	30.71
Junc 19	451	0.04	0.04	476.64	25.64
Junc 20	449	0.18	0.18	476.63	27.63
Junc 21	446	0.04	0.04	476.63	30.63
Junc 22	453	0.09	0.09	476.62	23.62
Junc 24	452	0.09	0.09	476.61	24.61
Junc 25	453	0.09	0.09	476.61	23.61
Junc 26	448	0.09	0.09	476.61	28.61

Fig 3.2 Example of Network Table of Nodes

Link ID	Diameter mm	Flow LPS	Velocity m/s	Unit Headloss m/km	Status
Pipe 1	250	0.00	0.00	0.00	Closed
Pipe 2	250	6.08	0.12	0.14	Open
Pipe 3	150	1.51	0.09	0.13	Open
Pipe 4	100	0.11	0.01	0.01	Open
Pipe 5	150	1.23	0.07	0.09	Open
Pipe 6	100	0.11	0.01	0.01	Open
Pipe 7	100	1.02	0.13	0.45	Open
Pipe 8	100	0.35	0.04	0.06	Open
Pipe 9	150	0.58	0.03	0.02	Open
Pipe 10	100	0.27	0.03	0.04	Open
Pipe 11	150	0.26	0.01	0.00	Open
Pipe 12	100	0.13	0.02	0.01	Open
Pipe 13	100	0.06	0.01	0.00	Open
Pipe 14	250	3.88	0.08	0.06	Open
Pipe 15	100	0.06	0.01	0.00	Open
Pipe 16	150	3.48	0.20	0.61	Open
Pipe 17	100	0.08	0.01	0.00	Open
Pipe 18	150	3.36	0.19	0.57	Open
Pipe 19	100	0.78	0.10	0.27	Open
Pipe 20	100	0.04	0.01	0.00	Open
Pipe 21	100	0.56	0.07	0.15	Open
Pipe 22	100	0.30	0.04	0.05	Open
Pipe 23	100	0.09	0.01	0.01	Open

Fig 3.3 Example of Network Table of Links

4. CONCLUSIONS

The findings of an analysis of the existing water distribution network using a 24-hour water supply demonstrate that it meets the necessary limitations of hydraulic and water quality criteria. The following are the findings of the investigation:

(1) The current pipeline network was examined using EPANET 2.0 software in order to realise the concept of a continuous water supply system with proper pressure and minimal head loss.

(2) The results of the EPANET 2.0 programme, such as pressure, head loss, and so on, were checked using the hydraulic equation and confirmed to be accurate.

(3) The EPANET-remodeled water distribution network produces satisfactory results for the proposed pipe diameter, pressure, head loss, and velocity.

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