Design and Cost Estimation of Water Distribution Network using EPANET Software for Village Dudhala-Gujarat

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Abstract— The main objective was to study and design the water distribution system requirements using EPANET, so that water is supplied equitably to the consumers with sufficient pressure head at the desired locations in dudhala village. Dudhala village is located in Amreli District of Gujarat State. At Dudhala, There is internal distribution network up to the user's house, but it is very old apart from the mentioned facts, existing network has become old and leakage & breakage has become common phenomenon. At present, people are not getting sufficient potable water through an old network in this village. Also people are not getting water with pressure and pipeline in some areas are damaged and some areas have no pipeline. Therefore, careful planning and design is thus needed to establish a strong management system, minimizing present problems and accommodating future demand. It is necessary to study existing water supply system and existing deficiencies of Dudhala Village and to implement efficient potable water distribution network for Dudhala village. To design proposed water distribution network using EPANET 2.0 software for Dudhala village in such a way that each node gets required quantity of water with sufficient pressure at end point of network. And also give the cost estimation of water distribution network for dudhala village.

Key words: Water Distribution Network, EPANET, Pipe Flow, Water Demand

I. INTRODUCTION

The purpose of the study is to assess the performance of the water distribution system at dudhala village at amreli district, Gujarat using EPANET software to control the variability of water delivered to the consumers. The study also aims to design a 24x7 water distribution system using EPANET for the entire campus. A water distribution system is a hydraulic infrastructure that conveys water from the source to the consumers.

The system consists of elements such as junctions, pipes, tanks, reservoirs and pumps [1]. The most important consideration in designing a water distribution system is satisfying consumer demands under a range of quantity and quality considerations during the entire lifetime for the expected demand conditions. A common purpose of a water distribution network is to deliver water to consumers based on demand quantities and desired pressures [2].

In order to fulfil the water demand of the continuously growing student's population we need to provide sufficient and uniform quantity of water through the designed network of pipes. Thus it is necessary to plan and construct a suitable water distribution network system.

EPANET have been widely utilised in the design, operations and improvement of various water network distribution systems. Computer program that performs extended period simulation of hydraulic and water quality behaviour within pressurized pipe networks. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of water in each tank, and the concentration of a chemical species throughout the network during a simulation period comprised of multiple time steps. The hydraulic analysis and simulation of water distribution system are prior steps that need to be accomplished before conducting water quality simulation.

II. STUDY AREA

The project site is Dudhala village situated at amreli district of Gujarat. The Dudhala village is 24 km from Dhari taluka and 65 km from Amreli district. Dudhala gram panchayat is acting as a governor body. The total geographical area of the village is1247 hectares. Dudhala has a total population of 1166 souls as per the 2011 year Census. There are about 278 houses in Dudhala village .

Location of Dudhala village is shown in fig.1.

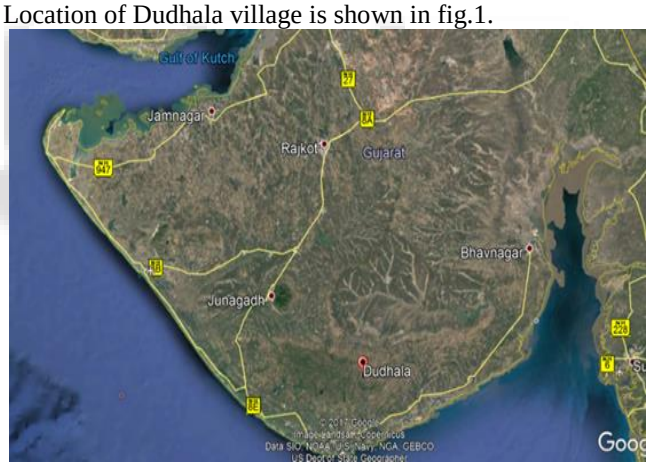

Fig. 1: Location of dudhala village in Gujarat state

Fig. 2: Google map of dudhala village

In Village, the Cluster water distribution system is found. The entire village area is divided into different two zones and Water is distributed from Cistern in each zone. 2 nos of wells and 3 nos of bores are existing water sources for the village. Topographical, water sources, water storage data of Village is collected from Water and Sanitation Management organization (WASMO).

III. METHODOLOGY

A. Materials

The materials used include map of village, water distribution parameters such as population, and water demand, distribution network parameters such as node elevations, and pipe length and EPANET software.

B. Levelling Work

Reduced levels (R.L) were calculated by the Height of Instrument method. Using these reduced levels the elevation at each node was determined.

C. Population Data and Water Demand Calculation

Population of Dudhala in 2017 is 1166 (as per Census).
Demand is 70 LPCD (As per CPHEEO Manual)
So Population in ultimate stage 2047as per
Arithmetical Increase Method = 1931
Incremental Increase Method = 2471
Geometric Progression Method = 2683

- Out of this Incremental Increase method is selected because in this method the combination of other two methods are present in its equation.
- So Water Demand of Ultimate stage 2047 is : 1,72,970 Litres Per Day

D. Water Storage Capacity

Water storage structure capacity is calculated at ultimate stage of the project according to government suggested rules for the rural area. Therefore proposed Elevated storage Reservoir capacity is considered 50,000liters with 12 m staging.

E. EPANET Software

EPANET is a computer program that performs extended period simulation of hydraulic and water quality behaviour within pressurized pipe networks. A network consists of pipes, nodes (pipe junctions), pumps, valves and storage tanks or reservoirs. EPANET tracks the flow of water in each pipe, the pressure at each node, the height of water in each tank, and the concentration of a chemical species throughout the network during a simulation period comprised of multiple time steps. In addition to chemical species, water age and source tracing can also be simulated.

EPANET was developed by the water supply and water resources division (formerly the drinking water research division) of the U.S Environmental protection agency's national risk management research laboratory. It is public domain software that may be freely copied and distributed.

EPANET is designed to be a research tool for improving our understanding of the movement and fate of drinking water constituents within distribution systems. It can be used for many different kinds of applications in distribution systems analysis. Sampling program design, hydraulic model calibration, chlorine residual analysis, and consumer exposure assessment are some examples. EPANET can help assess alternative management strategies for improving water quality throughout a system.

Running under windows, EPANET provides an integrated environment for editing network input data, running hydraulic and water quality simulations, and viewing the results in a variety of formats. These include color-coded network maps, data tables, time series graphs, and contour plots.

IV. RESULT

Junction Id	Elevation	Demand (Lpm)
4	129.1	21.14
5	127.9	9.58
6	123.1	8.65
7	126.9	7.38
8	127	4.13
9	124.1	2.24
10	123.1	1.85
11	124.1	1.60
12	125.7	1.94
13	125.9	1.94
14	126.7	11.5
15	126.5	6.75
16	125.9	4.81
17	124.1	2.23
18	123.9	2.57
19	123.9	1.94
20	122.1	2.57
21	124.2	2.23
22	124.3	3.35
23	119.5	1.65
24	118.2	22.6
25	117.9	3.84
26	117.1	1.94
27	117.1	1.94
28	116.75	2.57
29	113.2	1.26
30	112.9	3.84
31	111.6	3.84
32	112.3	1.94
33	112.9	2.57
34	112.4	2.57
35	109.15	1.26
36	168.2	1.26

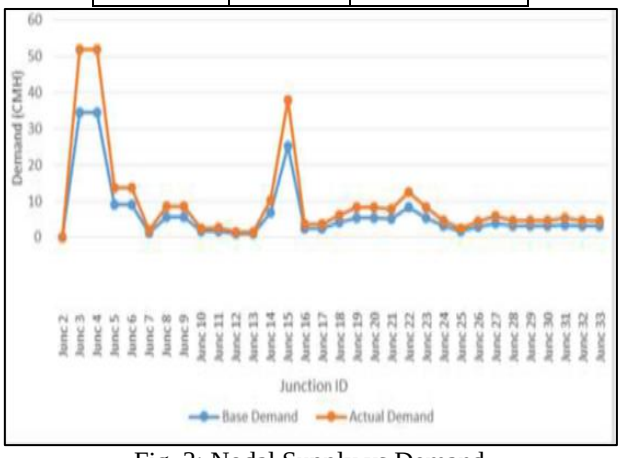

Fig. 3: Nodal Supply vs Demand

Node 1	Node 2	Length	Diameter	Roughness
4	5	200	65	100
5	6	150	50	100
6	7	150	50	100
7	8	105	40	100
8	9	80	32	100
9	10	90	20	100
9	11	80	20	100
8	12	100	20	100
7	13	90	20	100
6	14	100	32	100
5	15	100	40	100
15	16	100	40	100
16	17	100	32	100
17	18	100	25	100
18	19	90	25	100
16	20	100	25	100
15	21	60	25	100
15	22	100	25	100
23	24	100	25	100
24	26	70	25	100
27	28	200	65	100
29	30	100	50	100
30	31	100	25	100
30	32	100	25	100
33	34	100	25	100
35	36	100	20	100
27	29	1320	50	100
29	30	100	20	100
30	31	200	20	100
24	25	200	25	100
29	33	1250	50	100
33	35	1100	40	100
4	23	1133	50	100

V. CONCLUSION

The main focused of this research is to analyze the water distribution network and identify deficiencies (if any) in it is analysis, implementation and its usage. At the end of the analysis it was found that the resulting pressures at all the junctions and the flows with their velocities at all pipes are adequate enough to provide water to the study area.

The method of distribution used here is combined gravity and pumping system. The distribution layout used here is tree system or dead end system which is according to the layout of the Dudhala village. The newly laid network is laid according to the road pattern.

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REFERENCES

[1] Jain N.R., S.V.N.I.T, Surat, A project report, Design of water distribution system.
[2] Water supply engineering: A Book by Dr. B.C. Punmia
[3] AviOstfeld (2001). Reliability analysis of regional water distribution systems, Urban Water, 3, 253-260.
[4] Central Public Health and Environmental Engineering Organization .Manual on Water Supply and Treatment. Ministry of Urban Development, New Delhi, 199
[5] Manual on Water Supply and Treatment, III Edition, May 1999, CPHEEO, Govt. of India, Ministry of Urban Development, New Delhi.

