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DESIGN & ANALYSIS OF WATER DISTRIBUTION NETWORK MODEL BY EPANET A CASE STUDY

Aniket Wadekar[1], Chaitrali Narsule[2], Ashish Sawant[3], Gitesh Parab[4]
[1](VIVA Institute of technology, India)
[2](VIVA Institute of technology, India)
[3](VIVA Institute of technology, India)
[4](VIVA Institute of technology, India)

Abstract : *Water is one of the primary needs of all living being of world. Water supply system is a system of engineered hydraulic and components which provide water supply. The water distribution network plays a virtual role in preserving and providing desirable life quality to the public, of which reliability of supply is the major component. A community can only thrive if it can ensure the availability of safe drinking water for its members. As the population of any community increases, the demand for water also increases and imposes additional load to the existing water distribution system. As a result, the existing water distribution system may become unreliable to meet the demand of the increased population. In order to fulfil the water demand of the continuously growing population, it is essential to provide the sufficient and uniform quantity of water through the designed network of pipes. EPANET is computer program that performs extended period simulation of hydraulic behaviour within pressurized pipe network. The study presents the hydraulic analysis of pipe line network of Narangi area in Virar city using EPANET 2.0. 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 and also help to understand the pipelines system of the study area in a better way. The study also deals with the future demand of the area.*

Keywords- *EPANET 2.0, Nodes, Pipe Network, Pressure, Water Supply*

I. Introduction

Hydraulic structure consisting of elements such as pipes, tanks pumps and valves etc. is a part of water distribution system. It is the component connected between the water supply sources and the consumer. It is a careful conveyance system that allows water to be moved through piping before reaching the consumer's tap. Water distribution systems which is important factor are usually owned and maintained by local governments such as cities but are irregularly operated by a commercial enterprise. The first step is planning of water distribution systems city planners' engineer who must consider many factors such as location, current demand, future growth, pipe sizes, head loss, firefighting, leakages, etc. using pipe network analysis and other tools. It is crucial to provide water to the consumers; effective water supply is of paramount importance in designing a new water distribution network or in expanding the existing one. It is also essential to investigate and establish a reliable network ensuring adequate head. Computation of flows and pressures in network pipes have been of great value and interest for those involved with designs, construction and maintenance of public water distribution systems. A water system has two primary requirements. Firstly, it needs to deliver adequate amounts of water to meet consumption requirements. Secondly, the water system needs to be reliable; the required amount of water needs to be available 24 hours a day. Significant progress has been made in recent times in various aspects of water supply and distribution.This study aimed to design and analyse the water distribution network using EPANET Software for Narangi area, Virar

II. Literature study

1) Extending EPANET capabilities with Add-In Tools (2016)
P.L. Iglesias, F.J. Martínez, J.V. Ribelles
Although EPANET is universally accepted as a reference model in the analysis of water distribution networks, its editing capabilities, information processing and post-processing features have been shown clearly insufficient. For this, in this work a new platform for information exchanging between EPANET and third parties' programs have been developed. This new link allows using EPANET's GUI and simultaneously extend its editing capabilities, its computing resources and its processing capabilities.

2) Water Distribution Network using EPANET: A Case Study of Olpad Village, Surat district, Gujarat (Feb 2019)
Nisha Patel, Ankita Parmar
In this work, the existing water distribution system is analyzed with the help of EPANET in which the number of nodes, pipes, elevation and demand of Olpad village used. The main focused of this study is to analyzed the water distribution and identify the results in its analysis. The analysis was found that the resulting pressures at all junctions and the flow with their velocities at all pipes are enough to provide the water to the study area. This study would help the water supple engineers in saving the time as it this process is fast and less difficult. To achieve base demand discharge should be increased.

3) EPANET MSX (2014)
L.Monteiro, D.Covas, J.Menaia, S.T.Coelhoa
While the 2R model conceptually approaches better the processes involved in bulk chlorine consumption in supply systems, namely by incorporating fast and slow decay terms, and depending less on wall decay calibration, similarly satisfactory descriptions of chlorine decay were produced with the 1st and nth order models. Hence, 2R and 1st and nth order fewer complex models may be successfully used alike for simulating chlorine decay in supply systems, provided that a sound calibration of wall reaction rate coefficient is performed.

4) Water supply network using EPANET through hydraulic modelling (March 2016)
Shivalingaswami.S.H., Vijaykumar.H, Nagaraj.S. Patil
In this research the distribution network of Bagalkot (Navanagar) sector was analyzed according to sector 64,65, and 66. The water distribution network has 186 links, 120nodes, and 01 tank.The main aim of this research was to check the water distribution network and find the deficiencies (if any) in the analysis. At the end of the analysis, it was found that the resulting pressures at all the nodes and the links velocities are satisfying enough to provide water to the study area.

2.1 Information about EPANET 2.0 Software:

Program version: EPANET Version 2.0 (Release 2.00.09a)
Distribution: Web downloads (http://www.epa.gov/ORD/NRMRL/wswrd/epanet.html)
OS requirements: DOS, MS-Windows (95, 98, ME, NT, 2000)
Hardware requirements:
Processor: 80486 or higher
Hard disk: 2 Megabytes
RAM: 16 Megabytes
Calculation method: Hazen-Williams, Darcy-Weisbach, Chezy-Manning
Calculation capacity: No limit on number of nodes, pipes, pumps, valves, reservoirs, etc.
Data Input: Graphic oriented input with optional import of ASCII text file
Data Output: Graphic and tabular output including export to Windows clipboard and files.
Network Layout: True scale or unscaled network layout with optional background map
Language: English
Handbook: English, 200 pages with tutorial (pdf-file, downloadable)
Support: On-line help, web page, EPANET Users Group list server
No. of installations: Thousands of users world-wide
Pricing: Free
Freely Available: Full source code and Programmer's Toolkit

III. METHODOLOGY

3.1 Study Area

The Narangi area, Virar City, Taluka: -Vasai, District: -Palghar selected for the study purpose. Narangi is located at 19.4742°N 72.8107°E. It has an average elevation of 11 metres (36 feet). The climate of the village is tropical. During Summer, the humidity level is very high and in winter the climate is almost always dry. Narangi falls in a

region of high to very high rainfall often experiencing devastating rainfall in the monsoon period of June to September, every year. Narangi falls under the jurisdiction of Vasai-Virar Municipal Corporation, a recently formed civic body in the region.

The existing Elevated Service Reservoir (ESR) of 20,00,000 lit. Capacity and Full Supply Level (FSL) is 36.04 meters and Low Supply Level (LSL) is 33.04 meters. The Ground Level (GL) of ESR is 27.04 meters.

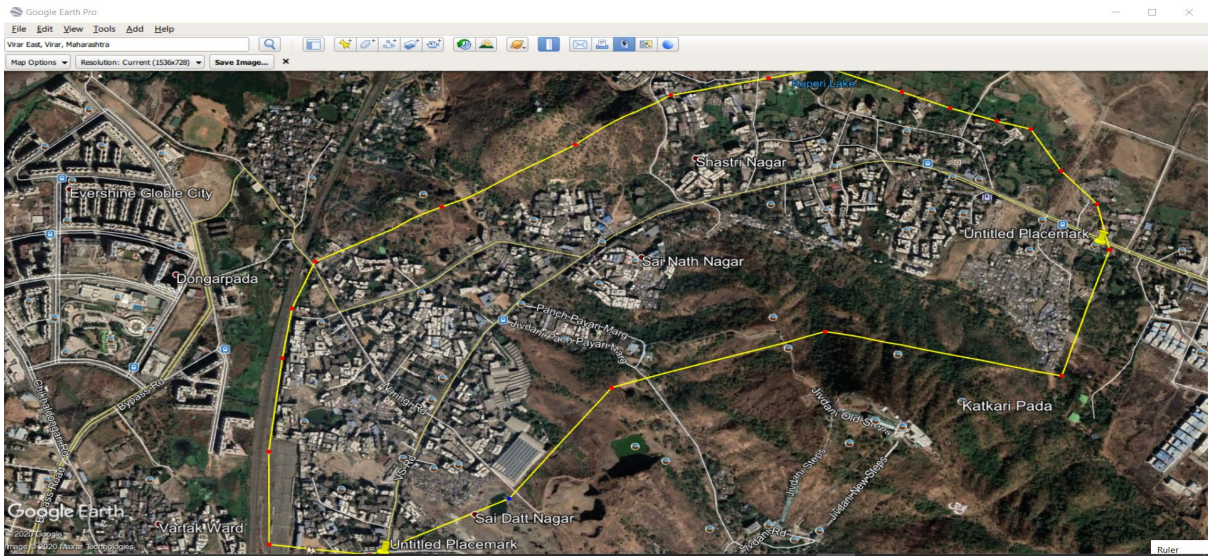

Fig. 2: Google map of Narangi area

3.2 Physical Components

A) Junctions- This are points where pipes join together and itis the place where water enters and leaves. The basic input data for junctions include elevation, water demand and initial water quality. The output data computed includes hydraulic head, Pressure and water quality

B) Reservoirs- These are the nodes that represents water sources like lakes, rivers and ground water aquifers. Hydraulic head and initial water quality a reservoir are the initial input properties of reservoir. It has no computed output parameters.

C) Tanks- Storage tanks used to store water. The input properties include bottom elevation, diameter, and initial and maximum water level. The output data computed are hydraulic head.

D) Pipes- Links that carry water from one network to another. The input parameters include start and end nodes, length, diameter and roughness coefficient. Computed output parameters include head loss, velocity, flow rate and Darcy-Weisbach friction factor.

E) Pump- Links that impart energy to a fluid thereby raising its hydraulic head. The primary input data includes pump curve and start and end nodes. The principal output data includes flow and head gain. Pump offers unidirectional flow only.

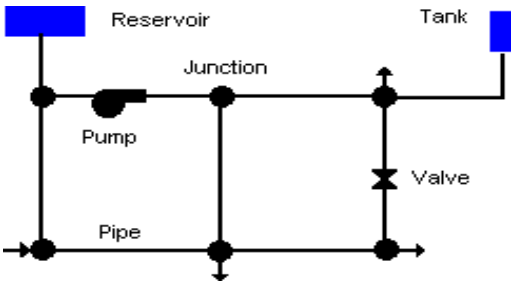

Fig. 4: Physical Components in a Water Distribution System

3.3 POPULATION FORECAST

Table 1: Population for the year of 2023 ,2033 and 2043

Types of methods	2023	2033	2043
Arithmetical Increase Method	4917	5424	5931
Incremental Increase Method	5298	6567	8217
Geometric Increase Method	5732	6203	7366

IV. RESULT & Conclusion

table 2:

PIPE NO.	NODE		D (mm)	LENGTH (M)
	FROM	TO		
1	1	2	600	478
2	2	3	600	21
3	3	4	500	45
4	4	5	500	142
5	5	6	450	89
6	6	7	450	166
7	7	8	450	118
8	8	9	450	152
9	9	10	150	110
10	10	11	150	63
11	4	12	150	112
12	12	13	150	42
13	13	14	150	98
14	3	15	150	123
15	15	16	150	178
16	16	17	150	87
17	8	18	150	164

PIPE NO.	NODE		D (mm)	LENGTH (M)
	FROM	TO		
18	18	19	150	71
19	20	20	150	46
20	20	21	150	71
21	22	22	150	234
22	9	23	150	193
23	10	24	150	224
24	24	25	150	143
25	24	26	150	63
26	27	28	300	68
27	28	29	150	88
28	28	30	250	112
29	30	31	150	98
30	30	32	150	56
31	32	33	150	51
32	32	38	150	44
33	38	39	150	24
34	39	40	150	24

PIPE NO.	NODE		D (mm)	LENGTH (M)
	FROM	TO		
35	39	41	150	50
36	34	42	150	27
37	41	43	150	57
38	38	44	150	52
39	44	45	150	51
40	45	46	150	85
41	45	47	150	44
42	44	48	150	98
43	36	49	150	90
44	49	50	150	36
45	50	51	150	41
46	50	52	150	64
47	49	53	150	171
48	53	54	150	217
49	53	55	150	64
50	6	56	150	132
51	7	57	300	106
52	57	58	150	138
53	57	59	300	102
54	59	60	150	104
55	60	61	150	76

The modelling provides information such as flows in pipes, pressures at junctions, propagation of a contaminant, water age, and even alternative scenario analysis. This helps to compute pumping energy and cost and then model various types of valves, including shutoffs, check pressure regulating and flow control.
The main objective of this project is to analyse the flow of water in water distribution network throughout the selected Area and check whether there is any shortage of water at particular node. And also explains about the daily usage of water in the selected Area. This study would help the water supply engineers in saving time as it this process is fast and less tedious. Discharge should be increase to achieve the base demand. The allowable leakage in the system up to 10% can be design using EPANET model. To stimulate leakage above 10% the EPANET extensions are required. Using tools like EPANET, the analysis can be done within time even for complex network. Designed network can also withstand for 5% increase in population. The resulting pressure at all node & the flows with them velocities at all links are sufficient enough to provide water to studied area

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