



Case Study on Designing Water Supply Distribution Network Using Epanet for Zone-I of Village Kherali

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ABSTRACT

This study presents the use of EPANET software in the design of water distribution network for Zone-I of Kherali Village. EPANET is a computer program that performs extended period simulation of hydraulic and water quality behavior 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. 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. In this paper it was used to carry out the hydraulic analysis of the distribution network in the study area. The results obtained verified that the pressures at all junctions and the flows with their velocities at all pipes are feasible enough to provide adequate water to the network of the study area.

KEYWORDS

EPANET, Water Distribution Network, System

INTRODUCTION

The resource management issues have become more critical in places where rainfall is less. The water distribution system is a component connected between the water supply sources and the consumer. It is a conveyance system that allows water to be moved through piping before reaching the consumer's tap. Water distribution systems are usually owned and maintained by local governments such as cities but are irregularly operated by a commercial enterprise. Firstly, planning of water distribution systems is a city planner's 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.

Water distribution system is a hydraulic infrastructure consisting of elements such as pipes, tanks, reservoirs, pumps, and valves etc. 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 has been of great value and interest for those involved with designs, construction and maintenance of public water distribution systems. This study aimed at performing the hydraulic analysis of Zone-I of Kherali Village water distribution network using Epanet Software.

LITERATURE STUDY:

Jacob (1991), proposed a technique for simulation of water distribution system in developing countries, where supply is less than demand i.e., intermittent supply.

Walski (2001), while discussing the issues related to water distribution system focused on some of the most compelling problems facing optimization viz. (i) Designer must strike a balance between cost minimization and net benefits (benefit minus costs) (ii) Reliability of the water distribution networks should not be reduced for the sake of cost reduction.

Chunping Yang, Zhiqiang Shen, Hong Chen, Guangming-Zeng, Yuanyuan Zhong (2006) A lot of technological problems including advanced treatment processes, pH regulation, sterilization, and pipe selection have been solved cost-effectively.

Vicki L. Van Blaricum and Vincent F. Hock (2007) This paper describes the demonstration and validation of multi-parameter water quality sensors and corrosion rate sensors that were permanently installed at a U. S. Army installation to detect corrosion problems and fine-tune the chemical treatment program. The use of water quality and corrosion rate sensors has been demonstrated and validated in the field.

Andrea Bolognesi, Cristiana Bragalli, Angela Marchi, Sandro Artina DISTART, (2009) This paper proposes a new model named Genetic Heritage Evolution by Stochastic Transmission GHEST, a multi-population evolutionary-strategy-like algorithm applied to the design of water distribution networks (WDN). GHEST makes use of hydraulic network solver EPANET 2

STUDY AREA:

In this paper, the brief notes about the study area selected, methodology adopted for data collection, population of Kherali village in 2043 and total water requirement in that year will be worked out. The methods adopted for obtaining the data are by direct measurements, quantitative estimates or by interview with staff of Water And Sanitation Management Organization (WASMO) & Gujarat Water Supply and Sewerage Board (GWSSB).



Figure 1: Google Map image of Kherali Village Sources:
<https://www.google.co.in/maps/place/Kherali,+Gujarat+363020/@22.6897398,71.6018435,1468m/data=!3m2!1e3!4b1!4m2!3m1!1s0x3959406c20d1f173:0x9619e6125dfb593?hl=en>

The Kherali village, Taluka: - Wadhwan, District:-Surendranagar is selected for the study purpose. The existing Elevated Service Reservoir (ESR) of 1,20,000 lit. Capacity and 12 m height and sump of 5,00,000 lit. Capacity in usable condition. During the summer and monsoon season, it become very difficult task to go for water because during summer season, the temperature raises up to 42 to 45° C, and during the monsoon season the surface became slippery & muddy. Hence, it becomes necessary to upgrade the existing system of water supply arrangement. Following data are collected for present study:

1. Hydrological data: Average rainfall of Surendranagar district is 760mm.
2. Geological data: Kherali is a village in Surendranagar district in the Indian state of Gujarat. It comes on the way from Surendranagar to Limli, and this route leads to Muli. The village is grown around one abandoned palace. The village has got one big lake and other many wells including one step-well. It has few temples including Swaminarayan temple, Rama temple and one well-built mosque. The village is mostly surrounded by farms.
3. Water quality data: The Available water is of good quality. The source of water is Dholidhaja Dam.
4. Public survey: Opinion poll regarding need of village people has been carried out.

**POPULATION FORECAST:
 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	5232	6208	7366

The demand is adopted as 70 lpcd. (Considering domestic requirements only without sewer line).

Types of Methods	Demand in year 2043 litres per day
Arithmetical Increase Method	5931 × 70=415170
Incremental Increase Method	8217 × 70=575190
Geometric Increase Method	7366 × 70=515620

Public Demand in LPCD In 2043

The population of Kherali is considered as per Incremental Increase Method 8217 (because in this method the combination of arithmetic & geometric comes.) and water demand is worked out as 575190 litres per day for year 2043. Here only

Zone-I is considered, so the Population of Zone-I is as 1826 considered as shown in Table.

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 (for customization).

EPANET Workspace:

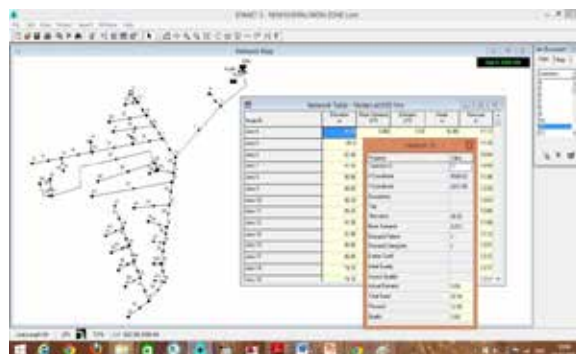


Figure 2: Print screen of EPANET in working mode.

RESULTS AND DISCUSSION:

In this research the distribution network of Zone-I of Kherali village was obtained and analyzed. It consists of 49 pipes of PVC materials, 49 junctions, 1 tank and 1 source reservoir from which water is pumped to the surface reservoir and later distributed to the network, as shown below:

7	36	110	1.19	0.13	0.2	0.028
8	25	90	0.52	0.08	0.12	0.031
9	21	90	0.32	0.05	0.05	0.033
10	26	90	0.14	0.02	0.01	0.038
11	17	75	0.04	0.01	0	0.049
12	51	90	0.59	0.09	0.15	0.03
16	11	75	0.02	0.01	0	0.042
13	70	90	0.45	0.07	0.09	0.031
17	15	75	0.03	0.01	0	0.049
19	70	75	0.15	0.03	0.03	0.036
20	63	75	0.14	0.03	0.02	0.037
21	21	75	0.05	0.01	0	0.044
14	53	90	0.27	0.04	0.03	0.034
18	21	75	0.05	0.01	0	0.038
15	51	75	0.11	0.03	0.02	0.037
22	25	140	2.72	0.18	0.29	0.025
23	26	110	0.91	0.1	0.12	0.029
24	15	75	0.03	0.01	0	0.049
25	13	90	0.82	0.13	0.27	0.029
26	100	75	0.22	0.05	0.06	0.034
27	224	90	0.58	0.09	0.14	0.03
30	13	140	1.75	0.11	0.13	0.027
31	137	75	0.3	0.07	0.1	0.033
32	37	125	1.43	0.12	0.15	0.028
33	59	75	0.13	0.03	0.02	0.037
34	34	125	1.22	0.1	0.11	0.028
35	32	75	0.07	0.02	0.01	0.04
36	26	125	1.08	0.09	0.09	0.029
37	18	75	0.04	0.01	0	0.039
38	32	110	0.98	0.1	0.14	0.029
39	14	75	0.03	0.01	0	0.042
40	28	110	0.89	0.09	0.12	0.029
41	16	75	0.04	0.01	0	0.039
42	40	110	0.79	0.08	0.09	0.03
52	42	75	0.09	0.02	0.01	0.038
43	40	90	0.61	0.1	0.16	0.03
44	28	90	0.46	0.07	0.09	0.031
45	25	90	0.34	0.05	0.05	0.033
46	30	90	0.21	0.03	0.02	0.035
47	36	75	0.08	0.02	0.01	0.04
48	29	75	0.06	0.01	0.01	0.042
49	30	75	0.07	0.01	0.01	0.039
50	32	75	0.07	0.02	0.01	0.04
51	32	75	0.07	0.02	0.01	0.042
28	25	75	0.05	0.01	0	0.04

29	34	75	0.04	0.01	0	0.045
5	26	75	0.06	0.01	0	0.041
6	111	160	4.15	0.21	0.33	0.024
1	97	180	4.38	0.17	0.21	0.025
Pump	#N/A	#N/A	30.66	0	-11	0

CONCLUSIONS:

At the end of the analysis it was found that the resulting pressures at all the nodes and the flows with their velocities at all links are sufficient enough to provide water to the study area.

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