DESIGN OF WATER DISTRIBUTION NETWORK BY USING EPANET SOFTWARE

Guide: Mrs. E. PHANI TEJA, M.Tech., Assistant professor

MR.GANNE SHANMUKHA[1]MR.GIDDALURU HARSHA VARDHAN[2]MR.SHAIK FAZIL AHAMED[3] MR. THULLURU DINESH[4]MR. MUTHALURI BHAVANI SHANMKAR[5]

[1,2,3,4,5&6]UGScholars,NarayanaEngineeringCollege,Nellore,AndhraPradesh,India

ABSTRACT

In order to fulfill 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. For this purpose we selected the area near New Municipality Office, Dargamitta, Nellore. The general features of the like information about main water source, population of area, demand of water, requirement of pumps, distribution network and water tanks are essential for efficient design of water distribution system.

According to Andhra Pradesh govt. per capita consumption of water demands by individual person is 110 liters per day and design will be made accordingly for this area. This area is about 1.52 square km., with the population of 17,442. With the help of all this information the design of the water supply scheme for the area with the help of software "EPANET".

This design of the water supply scheme for proper supply of water is efficient to meet the daily pumps, and valves. These need to be properly designed and optimized so that they can function adequately, delivering the required water volumes to consumers."

These systems mustn't only be capable of distributing water efficiently, they also need to be reliable—robust enough to weather time, the elements, and other forces. And for that to occur, engineering teams must carefully plan the design, operation, and proper maintenance.

KEY WORDS : Water distribution system, Water demand, Pipe network, EPANET Software.

1. INTRODUCTION

It was developed by "LEWIS ROSSMAN" the senior environmental engineer, under "USEPA" (united states environmental protection agency.),water supply and water resources division USA. EPANET -ENVIRONMENTAL PROTECTION AGENCY NETWORK EVALUATION TOOL. **EPANET.** EPANET is used to model water distribution networks all around the world. It may be applied to many different aspects of distribution systems analysis and was created as a tool for comprehending the flow and destiny of drinking water elements within distribution systems. EPANET is being used by engineers and consultants for the following purposes: designing and sizing new water infrastructure; retrofitting aged infrastructure; optimizing the performance of tanks and pumps; lowering energy consumption; looking into issues with water quality; and being ready for emergencies. Additionally, it may be used to assess resistance to security risks and natural catastrophes, as well as model contamination issues.

2. OBJECTIVE

- Identify and study the factors that impact mechanical and hydraulic reliability of water networks at various hierarchical levels, i.e. components, segments and ultimately networks.
- To analyse the existing water distribution system using EPANET to suggest some measures if network does not fulfill the present and future demand.
- To optimize the location and sizing of multiple network components like pipes, tanks, pumps and valves.

This work is licensed under a Creative Commons Attribution 4.0 International License

- To enable the pipe network sizes more economical but to accommodate the peak hour demand.
- The software seeks to enable network optimization by identifying optimal pipe layouts, pump schedules, valve settings, and control strategies to minimize energy consumption, reduce water losses, and enhance system reliability.
- EPANET is designed to assist engineers in optimizing the design of water distribution networks by sizing pipes, pumps, and other system components based on hydraulic and water quality criteria.

3. METHODOLOGY

1. Data collection
2. Population Forecasting
3. Design in software
4. Run Analysis
5. Result

4. RESULT AND DISCUSSION

In this section, perform the results of experimental work. The results are displayed as follows.

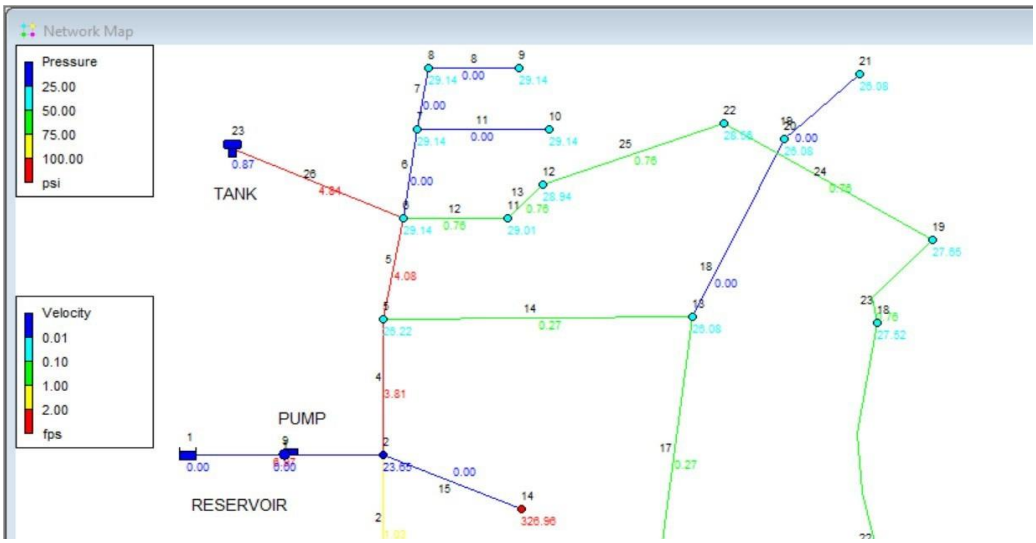


Figure 1: Network showing the Pressure v/s Velocity results after the successful run analysis

This work is licensed under a Creative Commons Attribution 4.0 International License

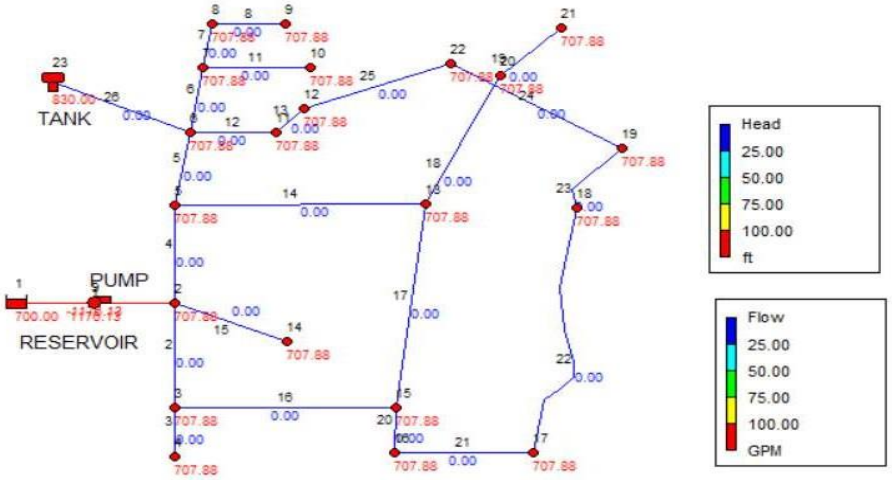


Figure 2 : Network showing the Head v/s Flow results after the successful run analysis

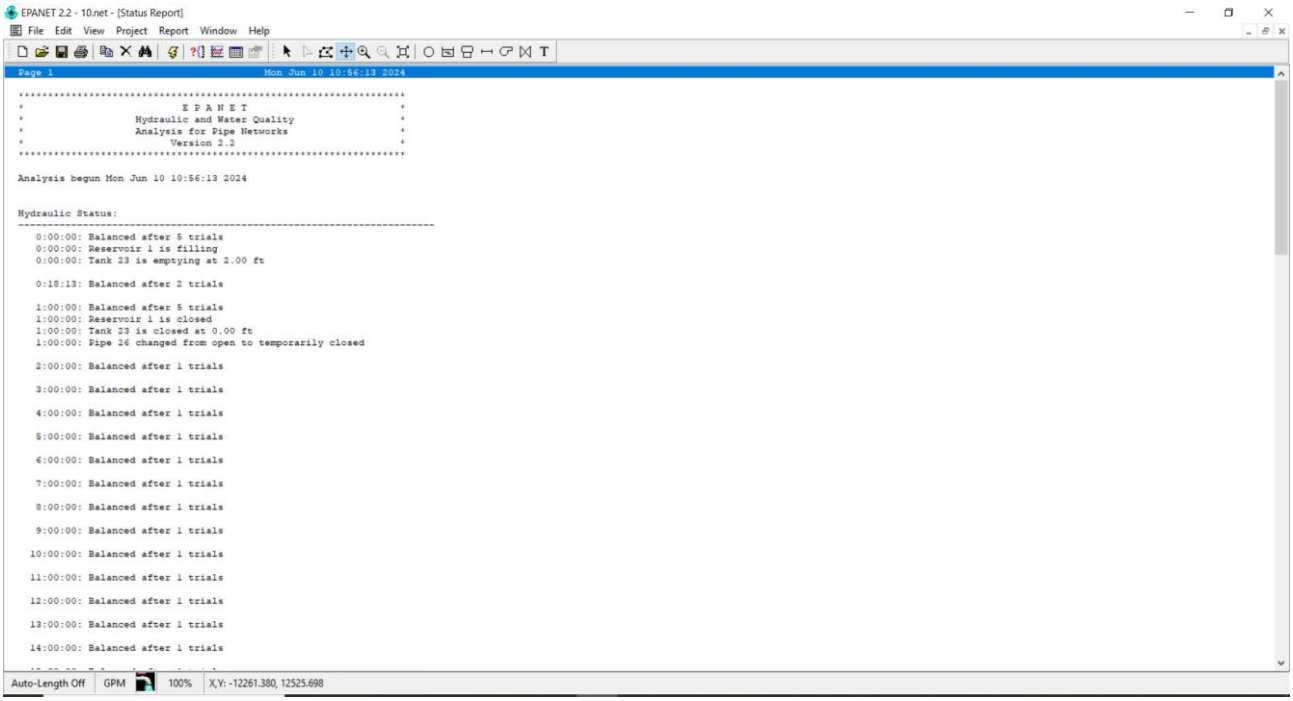


Figure 3 : Report showing the status of the network after the successful run analysis

This work is licensed under a Creative Commons Attribution 4.0 International License

Page 1 10-06-2024 10:04:16

E P A N E T
Hydraulic and Water Quality
Analysis for Pipe Networks
Version 2.2

Input File: 10.net

sl
Link - Node Table:

Link ID	Start Node	End Node	Length ft	Diameter in	
1	1	2	3000	14	
2	2	3	3000	14	
3	3	4	1000	14	
4	2	5	1000	14	
5	5	6	1000	14	
6	6	7	1000	14	
7	7	8	1000	14	
8	8	9	1000	14	
11	7	10	1500	14	
12	6	11	1000	14	
13	11	12	500	14	
14	5	13	7000	14	
15	2	14	1000	14	
16	3	15	7000	14	
17	15	13	7000	14	
18	13	20	1000	12	
19	20	21	1000	14	
20	15	16	1000	12	
21	16	17	3000	14	
22	17	18	7000	14	
23	18	19	1000	14	
24	19	22	7000	14	
25	12	22	3000	14	
26	6	23	7000	14	
9	1	2	#N/A	#N/A	Pump

Energy Usage:

Pump	Usage Factor	Avg. Effic.	Kw-hr /Mgal	Avg. Kw	Peak Kw	Cost /day
9	100.00	75.00	35.69	2.49	14.04	0.00

Demand Charge: 0.00
Total Cost: 0.00

Figure 4 : Report of the network after the successful run analysis

Page 2
Node Results at 0:00 Hrs:

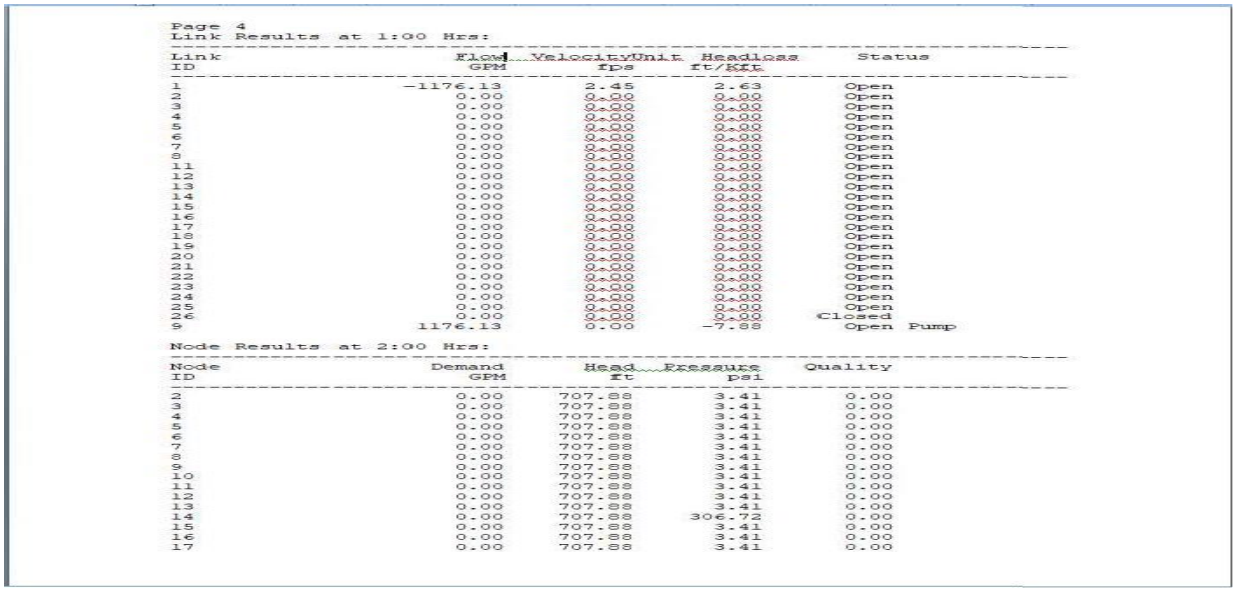
Node ID	Demand GPM	Head ft	Pressure psi	Quality	
2	0.00	754.58	23.65	0.00	
3	0.00	756.17	24.34	0.00	
4	0.00	756.17	24.34	0.00	
5	0.00	760.51	26.22	0.00	
6	0.00	767.25	29.14	0.00	
7	0.00	767.25	29.14	0.00	
8	0.00	767.25	29.14	0.00	
9	0.00	767.25	29.14	0.00	
10	0.00	767.25	29.14	0.00	
11	0.00	766.95	29.01	0.00	
12	0.00	766.80	28.94	0.00	
13	0.00	760.19	26.08	0.00	
14	0.00	754.58	326.96	0.00	
15	0.00	759.87	25.94	0.00	
16	0.00	760.51	26.22	0.00	
17	0.00	761.41	26.61	0.00	
18	0.00	763.50	27.52	0.00	
19	0.00	763.80	27.65	0.00	
20	0.00	760.19	26.08	0.00	
21	0.00	760.19	26.08	0.00	
22	0.00	765.90	28.56	0.00	
1	2321.24	700.00	0.00	0.00	Reservoir
23	-2321.24	832.00	0.87	0.00	Tank

Link Results at 0:00 Hrs:

Link ID	Flow GPM	VelocityUnit fps	Headloss ft/Kft	Status
1	-3344.49	6.97	18.19	Open
2	-495.47	1.03	0.53	Open
3	0.00	0.00	0.00	Open
4	-1825.77	3.81	5.93	Open
5	-1956.98	4.08	6.74	Open
6	0.00	0.00	0.00	Open
7	0.00	0.00	0.00	Open
8	0.00	0.00	0.00	Open
11	0.00	0.00	0.00	Open
12	364.26	0.76	0.30	Open
13	364.26	0.76	0.30	Open
14	131.21	0.27	0.05	Open
15	0.00	0.00	0.00	Open
16	-495.47	1.03	0.53	Open
17	-131.21	0.27	0.05	Open
18	0.00	0.00	0.00	Open
19	0.00	0.00	0.00	Open
20	-364.26	1.03	0.63	Open

Figure 5 : Report of the network showing the result at 0 hours after the successful run analysis

This work is licensed under a Creative Commons Attribution 4.0 International License



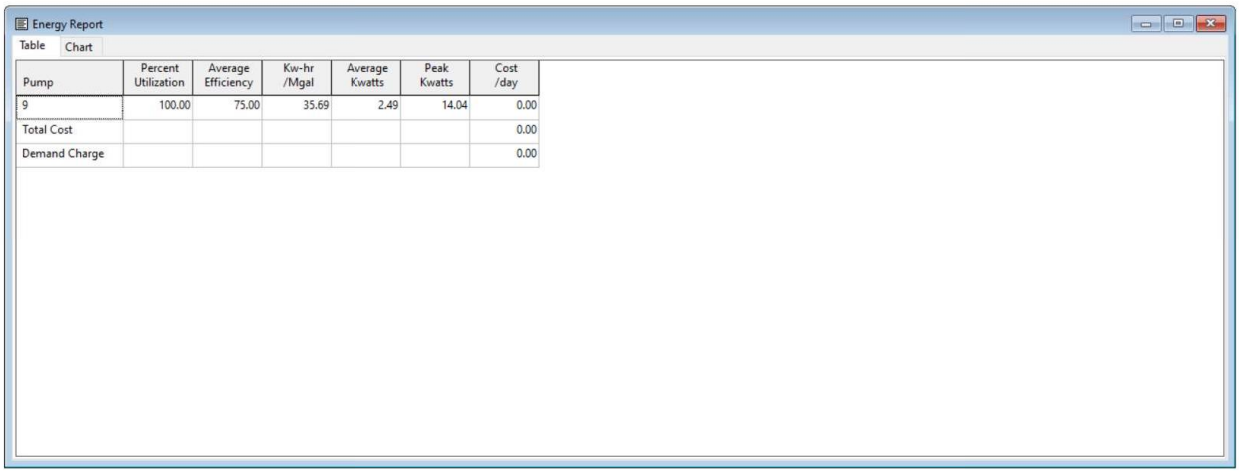
Page 4
Link Results at 1:00 Hrs:

Link ID	Flow GPM	Velocity fps	Unit Headloss ft/Kft	Status	
1	-1176.13	2.45	2.63	Open	
2	0.00	0.00	0.00	Open	
3	0.00	0.00	0.00	Open	
4	0.00	0.00	0.00	Open	
5	0.00	0.00	0.00	Open	
6	0.00	0.00	0.00	Open	
7	0.00	0.00	0.00	Open	
8	0.00	0.00	0.00	Open	
11	0.00	0.00	0.00	Open	
12	0.00	0.00	0.00	Open	
13	0.00	0.00	0.00	Open	
14	0.00	0.00	0.00	Open	
15	0.00	0.00	0.00	Open	
16	0.00	0.00	0.00	Open	
17	0.00	0.00	0.00	Open	
18	0.00	0.00	0.00	Open	
19	0.00	0.00	0.00	Open	
20	0.00	0.00	0.00	Open	
21	0.00	0.00	0.00	Open	
22	0.00	0.00	0.00	Open	
23	0.00	0.00	0.00	Open	
24	0.00	0.00	0.00	Open	
25	0.00	0.00	0.00	Open	
26	0.00	0.00	0.00	Closed	
9	1176.13	0.00	-7.88	Open	Pump

Node Results at 2:00 Hrs:

Node ID	Demand GPM	Head ft	Pressure psi	Quality
2	0.00	707.88	3.41	0.00
3	0.00	707.88	3.41	0.00
4	0.00	707.88	3.41	0.00
5	0.00	707.88	3.41	0.00
6	0.00	707.88	3.41	0.00
7	0.00	707.88	3.41	0.00
8	0.00	707.88	3.41	0.00
9	0.00	707.88	3.41	0.00
10	0.00	707.88	3.41	0.00
11	0.00	707.88	3.41	0.00
12	0.00	707.88	3.41	0.00
13	0.00	707.88	3.41	0.00
14	0.00	707.88	306.72	0.00
15	0.00	707.88	3.41	0.00
16	0.00	707.88	3.41	0.00
17	0.00	707.88	3.41	0.00

Figure 6 : Report of the network showing the result at 1 & 2 hours after the successful run analysis



Pump	Percent Utilization	Average Efficiency	Kw-hr /Mgal	Average Kwatts	Peak Kwatts	Cost /day
9	100.00	75.00	35.69	2.49	14.04	0.00
Total Cost						0.00
Demand Charge						0.00

Figure 7 : Report of the network showing the Energy result

This work is licensed under a Creative Commons Attribution 4.0 International License

5. CONCLUSION

- The Hydraulic model EPANET is used for designing the optimized water supply system to the selected Dargamitta area in Nellore District, Andhra Pradesh.
- The main aim is to provide adequate water to the public consumers in an economic way. There can be lot of advancements in the system but it have to be carried in stages according to the availability of resources.
    1. Area Name : Dargamitta area, Nellore district, Andhra Pradesh.
    2. Total area : 1.52 km^2 .
    3. Total population : 17,742.
    4. Population density per km^2 : 11,525.
    5. Per capita demand : 135 lt/day.

- The pressure at all the junctions has been maintained approximately equal to 24. This EPANET software has been run successfully by maintaining the pipe diameters of maximum 14 cm and minimum of 12 cm.

6. FUTURE SCOPE

- These reviews states the “EPANET” software usage is quietly increasing. As they describes he design of water distribution network by using EPANET gives a drastic change in the controlling the leaks in the water distribution system.
- As per case studies, water distribution network by using EPANET software supported many areas to get rid of water leakages, proper pressure control, velocity of flow, quality of water.
- As this EPANET software makes the analysis of network easier and deficiencies can be found out in the analysis easier.
- EPANET enables the editing capabilities, information processing and post processing features to the users in the easily understandable way.
- The water distributed through these designed network delivers the water at a known pressure in the designed time intervals.

REFERENCES

1. L. Iglesias, F.J. Martínez, J.V. Ribelles, 2016, Extending EPANET capabilities with add-in tools.
2. Bhave, P. R. 1991. Analysis of flow in water distribution networks. Technomic publishing. Lancaster, PA.
3. Clark, R. M. 1998. “Chlorine demand and trihalomethane formation kinetics: a second-order model”, j. Environ. Eng., vol. 124, no. 1, pp. 16-24.
4. Davis, M. J., Janke, R., And Taxon, T. N. 2018. “Mass imbalances in epanet water-quality simulations”, drinking water engineering and science, vol. 11, pp. 25-47.
5. Dunlop, E. J. 1991. Wadi users manual. Local government computer services board, Dublin, Ireland.
6. Koechling, M. T. 1998. Assessment and modeling of chlorine reactions with natural organic matter: impact of source water quality and reaction conditions, Ph.d thesis, department of civil and environmental engineering, university of Cincinnati, Cincinnati, Ohio.

This work is licensed under a Creative Commons Attribution 4.0 International License

7. Liou, C. P. And Kroon, J. R. 1987. “Modeling the propagation of waterborne substances in distribution networks”, j. Awa, 79(11), 54-58.
8. Liu, J. W-H. 1985. ”Modification of the minimum-degree algorithm by multiple elimination”. Acm transactions on mathematical software, 11(2), 141-153
9. Notter, R. H. And Sleicher, C. A. 1971. “The eddy diffusivity in the turbulent boundary layer near a wall”, chem. Eng. Sci., vol. 26, pp. 161-171.
10. Rossman, L. A., Boulos, P. F., And Altman, T. (1993). “Discrete volume-element method for network water-quality models”, j. Water resource. Plan. And manage., vol. 119, no. 5, 505-517.
11. Rossman, L. A., Clark, R. M., And Grayman, W. M. (1994). “Modeling chlorine residuals in drinking-water distribution systems”, j. Environ. Eng., vol. 120, no. 4, 803-820.
12. Rossman, L. A. And Boulos, P. F. (1996). “Numerical methods for modeling water quality in distribution systems: a comparison”, j. Water resource. Plan. And manage., vol. 122, no. 2, 137-146.
13. Rossman, L. A. And Grayman, W. M. 1999. “Scale-model studies of mixing in drinking water storage tanks”, j. Environ. Eng., vol. 125, no. 8, pp. 755-761.
14. Todini E. And Pilati S. (1988). “A gradient method for the solution of looped pipe networks.” In b. Coulbeck and c. H. Orr (editors) computer applications in water supply. Volume 1 – system analysis and simulation, John Wiley & sons, pp. 1-20.
15. Todini E. And Rossman L.A. (2013). “Unified framework for deriving simultaneous equation algorithms for water distribution networks.” J. Hydraulic. Eng., 139(5), 511-526.
16. Wagner, J. M., Shamir, U., And Marks, D. H. 1988. “Water distribution reliability: simulation methods.” J. Water resource. Plan. Manage., vol. 114, no. 3, 253-275.
17. MAPS.GOOGLE.CO.IN
18. WWW.EPA.GOV/ORD/NRMRL/WSWRD/EPANET.HTML
19. WWW.EPA.GOV/EPANET/0EN2MANUAL.
20. EPANET SOFTWARE USER MANUAL

This work is licensed under a Creative Commons Attribution 4.0 International License