Water Distribution Network Analysis for A Sawale Village Near Rasayani With Application of Epanet Software - A GIS Approach

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Abstract

Water distribution System (WDN) is considered as an infrastructural necessity for upcoming future urban communities. To satisfy the Incremental water Requirement of the developing populace, it is basic to plan a workable WDN. Numerous research in this domain has been done in the past decades considering various parameters but poor WDN layout design results in increasing project cost in terms of execution , maintenance etc. Hence, the objective of this research was to overcome the above drawbacks by developing a real-time network of a rural upcoming village near Rasayani, Maharashtra with the application of Geographic Information System GIS by hydraulic simulation using EPANET. Satellite information from ISRO and water powered information from neighbourhood region experts were utilized to recreate a virtual WDN investigation to get an upgraded structure. Results mean that pressure driven re-enactment alongside the utilization of GIS helps in providing a less time consuming, supportable and enhanced WDN.

Keywords: *EPANET, Geographic information system, hydraulic simulation, water distribution system*

1. Introduction

Water supply structures should besides meet basics for open, business, and modern tricks. In all cases, the water must fulfill both quality and sum requirement for upcoming future cities [4].These days' commercial computer software applications are available to represent the formation of the distribution system and pipe network where comprehensive information about the pipe like Diameter and Length [5]. EPANET was developed by the Water Supply and Water Resources Division of the United States Environmental Protection Agency's National Risk Management Research Laboratory. It is open region programming that may be without restraint copied. The abilities for basic leadership promptly accessible in a solitary association make GIS an awesome device for coordinating into arranging forms. EPANET is a Windows-based program that plays out a broadened period reproduction of water powered and water superiority conduct inside under pressure pipe systems [9].

2. Literature Review

Montasir Maruf et al. (2015) [5] worked on the EPANET Programming .This paper offers a displaying procedure of Banani region which will likewise conquer the conceivable dangers and vulnerabilities. **Arjun Kumar et al. (2015) [4]** published paper on procedure to outline of water supply framework using EPANET .This work features the procedure did on the outline of water supply framework for a zone named KATHGARH with the assistance of this data the plan of the water supply conspire for the zone with the assistance of programming "EPANET". **Shivalinga swami. S. Halagalimath et al. (2016) [3]** work on water analysis of WDN. The main view of this

research was to analyze the WDN and look out the deficiencies in it was analysis, establishment and its usage. **Shiva prasad G. et al. (2017) [1]** the research talked about the present study shows the remodeling of the existing network and also designing the WDN using a programming tool, which plays out the broadened period recreation of water driven and water quality conduct inside the pressurized system of pipes called EPANET.

3. Methodology

The area for which are designing the WDN is village Sawale, Taluka –Panvel, Dist.-Raigad, state- Maharashtra. Latitude and longitude coordinates are 18° 54' 17.0958" & 73° 9' 23.3994. Figure 1 shows an area of study (i.e. Sawale village) obtained from GIS. Current water supply system in Sawale village was designed in 1991 in coordination with HOC Company in Rasayani. But in current situation HOC company has been shut down by the government.

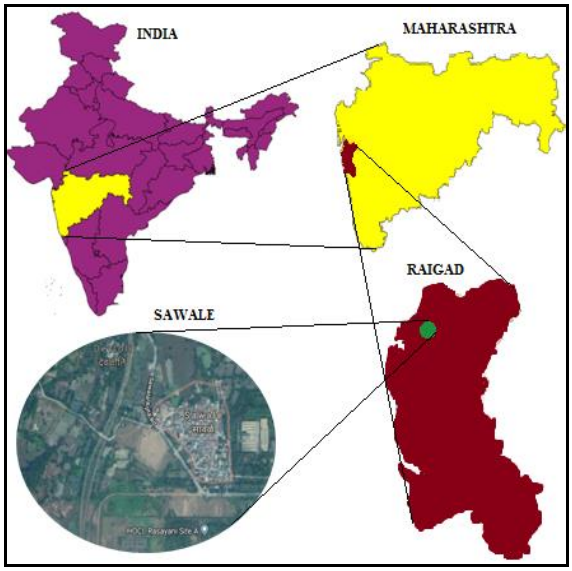


Figure 1. Satellite view of Sawale village [7]

Existing water supply is provided by MIDC which is costly and also does not fulfill current water supply demand of the village. The pipes used were of HOC Company and they are now buried under various new constructions like roads, house etc. It leads to wear and tear of the pipeline in current WDN. The basic aim of this research is to determine the best possible way in which a given WDN can be optimized and to meet current demands of water in Sawale village. The new WDN will be designed using the hydraulic software.

3.1. Objectives

The current WDN of the Sawale village in Panvel region has been observed, studied and analyzed. Following are some of the other objectives that have been dealt with in the research work.

i. To determine the Unit Head loss, Friction Factor, Pressure, Head, Velocity of the flow in the water distribution network.

ii. By the use of hydraulic software various relation are being found between Pressure v/s velocity, Pressure v/s flow, Demand v/s flow, Demand v/s Head-loss, etc. these relations can be understood by studying the graphs plotted.

After a thorough study of literature, the appropriate methodology is fragmented for upcoming future village. The area for which are designing the WDN is village Sawale. The initial step of the methodology of a proposed system involves data collection. Data divided in to two parts such as a Data Preparation for Study Area and then Data Collection for Field Survey. First Data Preparation for Study Area including information like Google & Satellite Image, Road network map and Land Use or Cover area then Data Collection for Field Survey include Population, Source and Water Tank, Pipe and Nodal these all data collect to Department of Rural water supply and construction, Panvel. The next step is setting up the network based on the observation. This network can be drawn using EPANET software. After finalizing the network diagram, it is then materialized in this software. The other important details are necessarily provided for such a network in hydraulic software. This important detail is categorized into link/pipe input and node/junction input. Link/pipe details include length, roughness and diameter of pipe and Node/junction detail includes elevation of ground and demand of water at that node. This is fair enough to run EPANET software with the provided details. After running the network with given details the output is analyzed. This analyzed report would then tend to give the answer to a simple but effective question that whether it is satisfactory or not. If the analysed result tends to unsatisfactory result then the details provided are returned and again the output is analysed. If the analyzed result is satisfactory then the output is extracted in the form of graphs and tables. Figure 2 shows the flowchart of methodology.

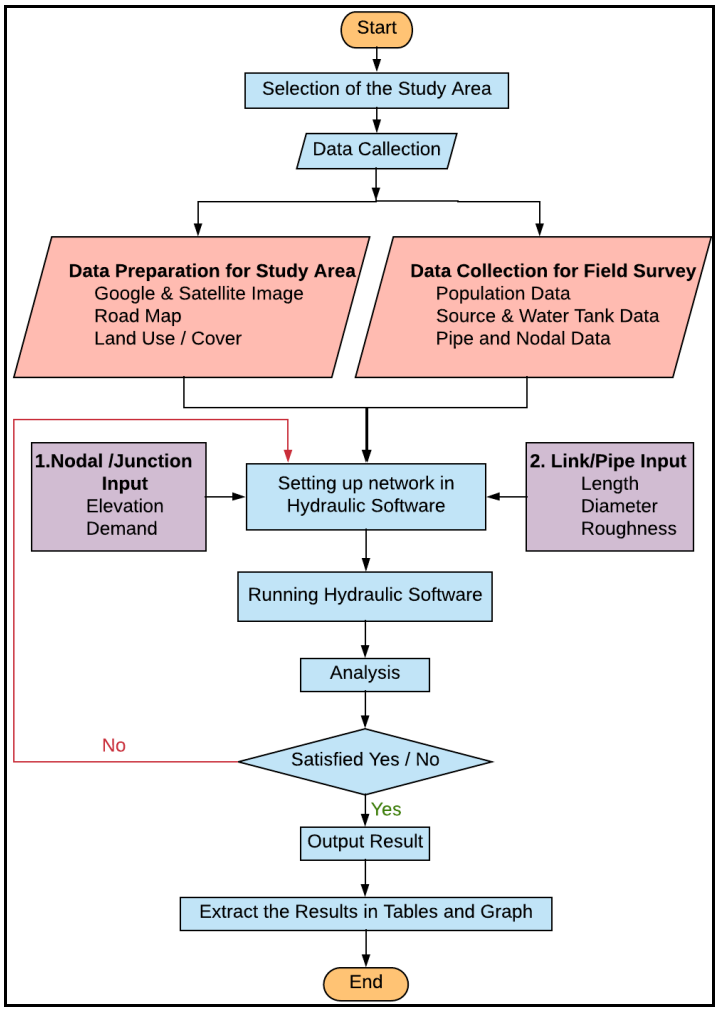


Figure 2. Flowchart of methodology

3.2. Setting up the network in Software

Different figures show steps involved in setting up the network using EPANET software. Figure 3 shows the relative position of a junction on Google earth image of the corresponding area. Next steps to load and unload Google earth image as a background image in EPANET respectively.

Figure 3. Google Earth-image Joint Photographic Experts Group converts to a Bitmap image [7]

Different roughness coefficients for different types of pipes. Galvanized Iron (GI) pipe Roughness of link is 120, these pipes are modest, light in weight and simple to deal with and transport and simple to join, there for use in GI pipe. Following Figure 4 shows various data like length, diameter and data of junction like the elevation and demand to be given as input to hydraulic software.

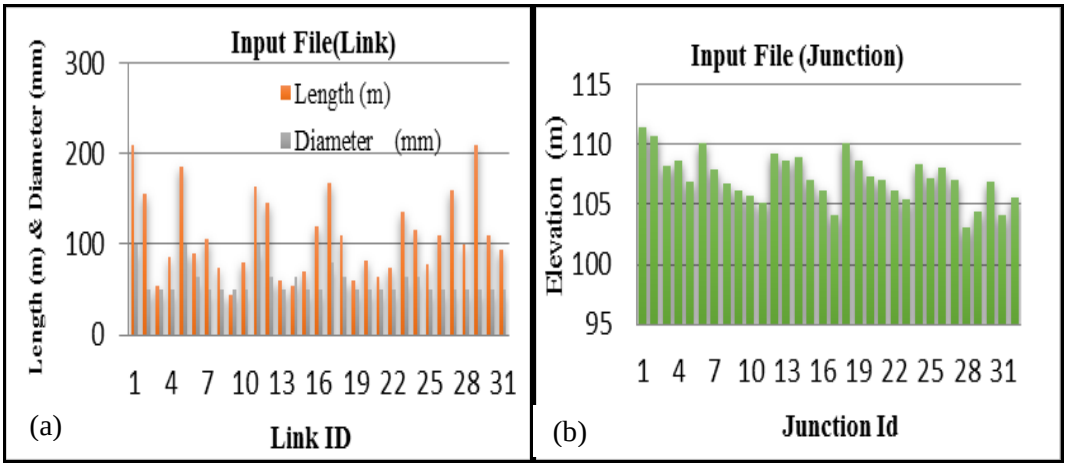
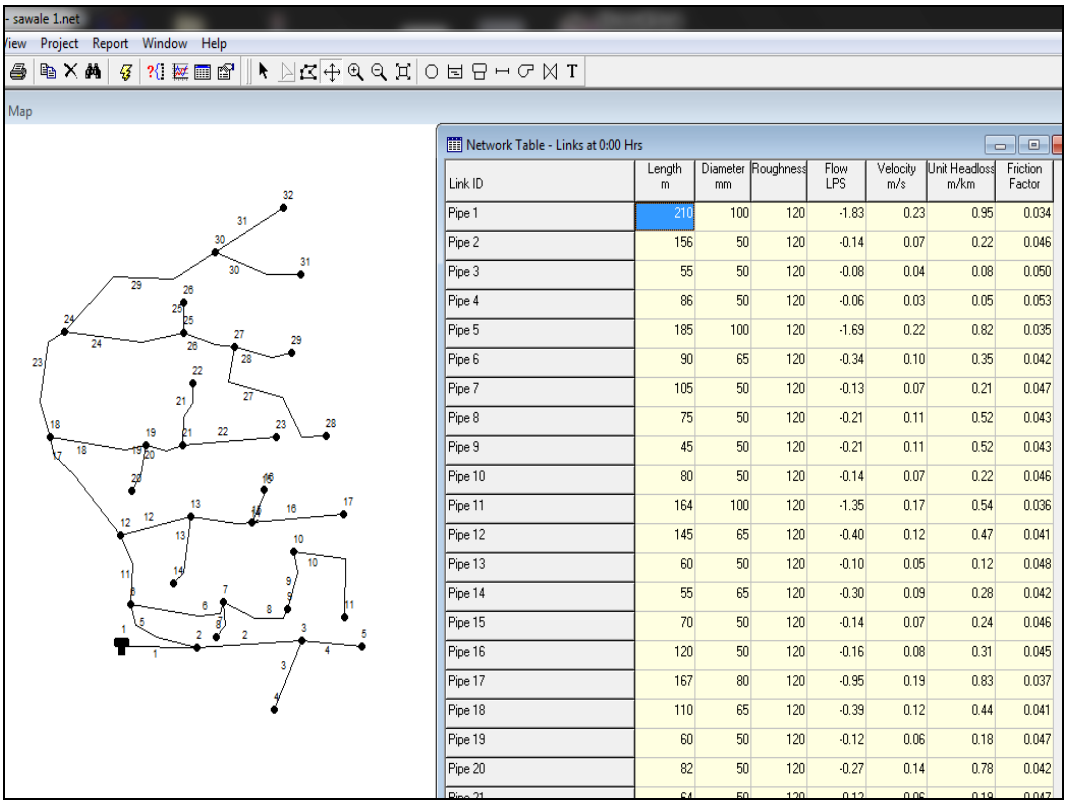


Figure 4. (a) Input File Link and (b) Input File Junction

3.3. Results and Discussions

Figure 5. Shows data report of links in pipeline network obtained in hydraulic software. This data report shows value given as input as well as some of the calculated values such as flow, velocity etc. same shows data report of nodes in pipeline network obtained in hydraulic software. This data report shows value given as input as well as some calculated values which include head, pressure etc. their result work obtain in tabulate format. Figure 6. Shows also same result but chart layouts format.



Link ID	Length m	Diameter mm	Roughness	Flow LPS	Velocity m/s	Unit Headloss m/km	Friction Factor
Pipe 1	210	100	120	-1.83	0.23	0.95	0.034
Pipe 2	156	50	120	-0.14	0.07	0.22	0.046
Pipe 3	55	50	120	-0.08	0.04	0.08	0.050
Pipe 4	86	50	120	-0.06	0.03	0.05	0.053
Pipe 5	185	100	120	-1.69	0.22	0.82	0.035
Pipe 6	90	65	120	-0.34	0.10	0.35	0.042
Pipe 7	105	50	120	-0.13	0.07	0.21	0.047
Pipe 8	75	50	120	-0.21	0.11	0.52	0.043
Pipe 9	45	50	120	-0.21	0.11	0.52	0.043
Pipe 10	80	50	120	-0.14	0.07	0.22	0.046
Pipe 11	164	100	120	-1.35	0.17	0.54	0.036
Pipe 12	145	65	120	-0.40	0.12	0.47	0.041
Pipe 13	60	50	120	-0.10	0.05	0.12	0.048
Pipe 14	55	65	120	-0.30	0.09	0.28	0.042
Pipe 15	70	50	120	-0.14	0.07	0.24	0.046
Pipe 16	120	50	120	-0.16	0.08	0.31	0.045
Pipe 17	167	80	120	-0.95	0.19	0.83	0.037
Pipe 18	110	65	120	-0.39	0.12	0.44	0.041
Pipe 19	60	50	120	-0.12	0.06	0.18	0.047
Pipe 20	82	50	120	-0.27	0.14	0.78	0.042

Figure 5. Data Report of a link (or pipe)

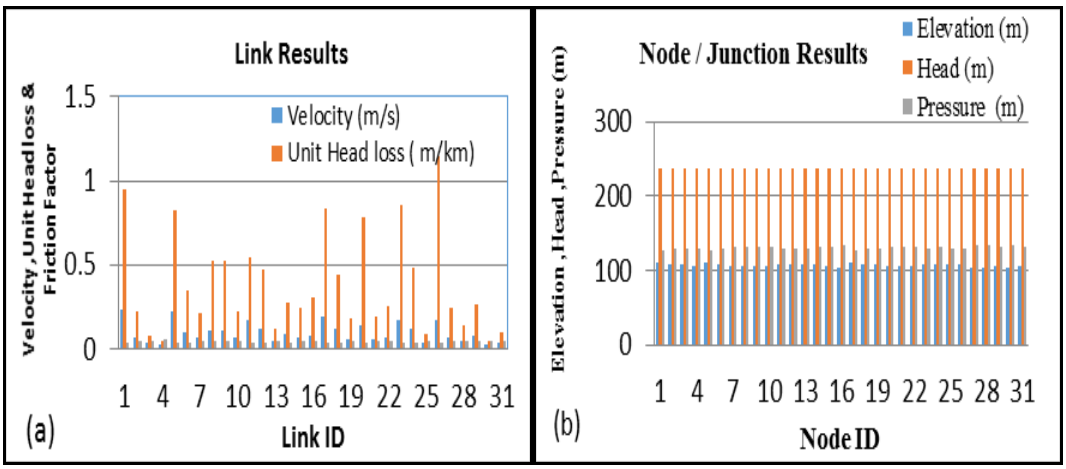


Figure 6. (a) Link Results and (b) Node Results.

Figure 7 shows a various demand pattern of each junction. It can be clearly observed from the following figure that end node has different demand. The similar Figure like Pressure, Velocity, Flow, Diameter, and Length are achieving in EPANET software.

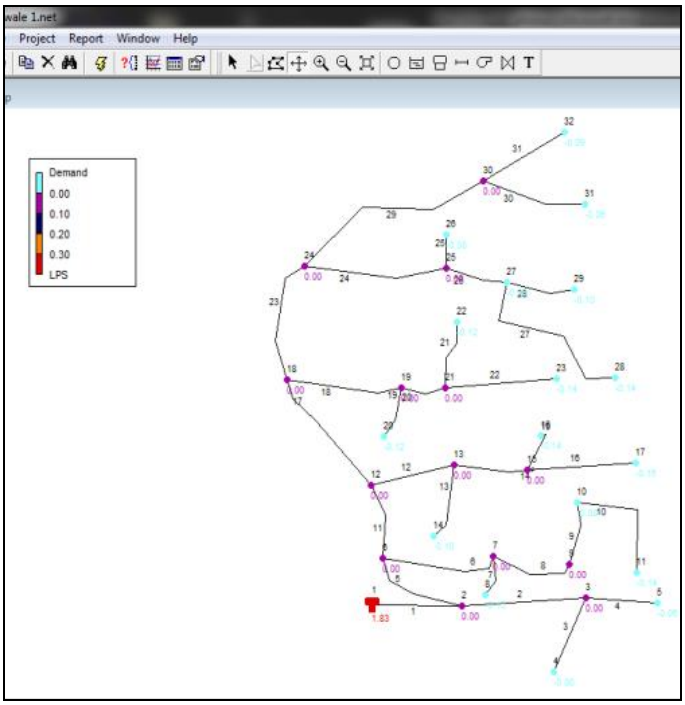


Figure 7. Demand Distribution Network Diagram

Figure 8 shows pressure versus flow distribution in the network. The similar Figure like Demand v/s flow, Pressure v/s velocity and Demand v/s Head-loss is achieving in EPANET software.

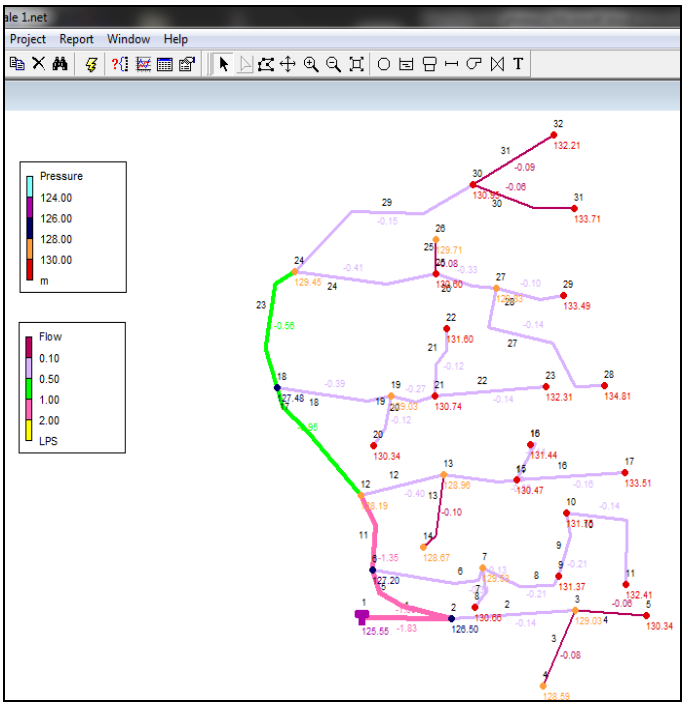


Figure 8. Pressure v/s flow and in Network Diagram

Conclusions

By the use of hydraulic software various relation are being found between elevation, velocities, flow, pressure, head, demand etc. these relations can be understood by studying the graphs plotted. Hydraulic programming estimates the flow of water in each pipe and the pressure at each junction, EPANET is intended to be an examination device for enhancing the development of drinking water inside the conveyance arranges. Results signifies that hydraulic simulation along with the application of GIS helps in providing a less time consuming, sustainable and optimized WDN.

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