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Analysis of Water Distribution System in Limbayat Zone of Surat

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Abstract: ***This study includes selection of a specific urban pocket of Surat city and analysis of the existing water distribution system in that area and also providing remedies to cope it. The reason behind this scarcity is the pressure fluctuation. There is large variation in pressure head. The pressure supplied is not sufficient to fulfil the water demand of limbayat zone. The WATERGEMS V8i programme analyses the pressure at each node, track the flow of water in each pipe and height of the water in each tank during simulation. After simulation of existing water distribution network, results were presented in various forms and compared Water distribution networks are very important for the development of an area as they serve many purposes in addition to the provision of water for human consumption, it directly influences to the nation's development. The design of new and/or up-gradation of existing with the field actual data. This paper covers the water scarcity problems to consumer and the problem of leakage in the distribution system in particular with an explanation of its causes and its impact on various aspects of life and a clarification of the possibility of effectively using of geographic information systems to contribute in the management of this problem.***

Keywords: Hydraulic Simulation, Pipe Network, Water Demand, Water distribution system, WATERGEMS

1. Introduction

Water supply system is a system of engineered hydraulic and hydrologic components which provide water supply. Water is one of the basic necessities of every living being in the world. Water demand is increasing day by day whether it is domestic, agricultural and industrial etc. But the source of water is limited. So authorities around the world are faced with the problem to provide sufficient water from limited water source. Water distribution network are very important for development of an area as they serve many purposes in addition to the provision of water for human consumption and it's directly influences to the nation's development. Water distribution network play an important role in preserving and providing desirable life quality to the public of which reliability of supply is the major component. To solve this problem design of new or gradation of existing water distribution network is to be necessary. So such type of problem can be solved manually as well as by using different technology like, WATERGEMS. LOOP 4.0, MIKENET, STANET, BRANCH and WATERGEMS 2.0 software.

Water distribution system can be divided into two main parts: (i) Intermittent System: In this system water is supplied at regular intervals throughout the day. Water may be supplied for a few hours in the morning or in the evening. Due to some negative pressure, the quality of water is not so good compared to continuous water supply system. This system may cause serious risk to health as a result of ingress of contaminated ground water into the distribution system, (ii) Continuous system: In this system, the distribution system remains continuously pressurized so that no contaminated ground water can enter into the water pipelines even there are some small leakages in the system.

The primary task for water utilities is to deliver water of the required quantity to individual customers under sufficient pressure through a distribution network. The distribution of drinking water in distribution networks is technical challenge both in quantitative and qualitative terms. It is essential that each point of the distribution network be supplied without an invariable flow of water complying with all the qualitative and quantitative parameters. The water supply in most Indian cities is only available for a few hours per day, pressure is irregular, and the water is of questionable quality. Intermittent water supply, insufficient pressure and unpredictable service impose both financial and health costs on Indian households

The aim of this project is to suggest a framework for supporting the planning process of sustainable water supply and sanitation systems in peri-urban areas of the developing world. To analyse the existing water distribution system and to suggest some measures if present network does not fulfil the present and future demand.

2. Literature Review

Dr. G. VenkataRamana et al. (2015) published the efficient design and pipe network distribution is performed by EPANET software in Chowduru of Ptoddaturumandal in Kadapa District of Andhra Pradesh. EPANET is useful to determine the flow rates, head losses due to friction, losses from the bend and handle the demand pattern. The table of water distribution network details is carried out by EPANET tool (Dr. G. VenkataRamana, 2015).

Bentley (2014) observed that due to high head loss the minimum service level was not achieved. The solution of this problem with WaterGEMS, help to reduce the cost and also the period of identification of problem as well as repair time. In this case, the leak repair took only two days, and the cost was USD 1160 which is less than 1% of total replacement
(Bentley, 2014).

Parrod (2016) discussed SCADA and hydraulic models limitations were overcome for operators and operation engineers by integrating SCADA and hydraulic model. This paper reviews on Bentley software tools and technology with SCADA hydraulic modeling integration, which empowers operators and service engineers to improve the operation of the water supply system. By SCADA Connect@ tool concluded in Water GEMS, SCADA data will be automatically integrating with modeling software (Parrod, 2016).

Rahman et al. (2013) an attempt is made to understand the existing water demand and supply status of the study area. The study suggests various site-specific and cost-effective strategies which can be implemented with available infrastructural development (Rahman, 2013)

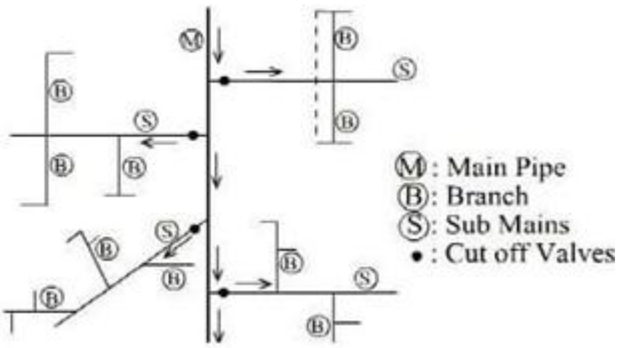
M. Günthera et al. (2015) introduced an experimental water distribution system (EWDSTUG) equipped with a smart water network comprising measurement and control devices, data collection and communication, data display and management as well as data fusion and analysis. According to them water supply system subject to continues change & development. Improving efficiency and reliability of the buried Infrastructure are expected benefits from the smart water system (M. Günthera, 2015).

3. Layouts of Distribution Systems

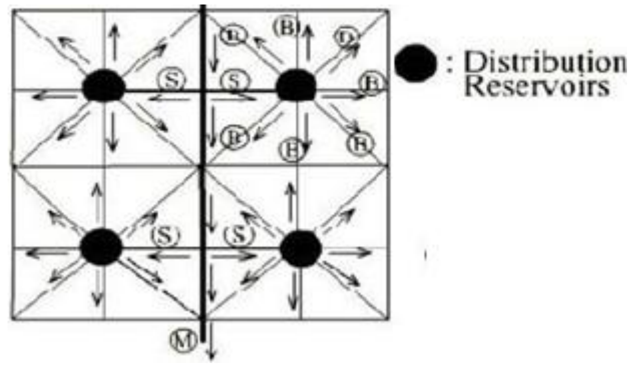
The distribution pipes are generally laid below the road pavements, and as such their Layouts generally follow the layouts of roads. There are, in general, four different Types of pipe networks; any one of which either singly or in combinations, can be Used for a particular place. They are:
Dead End System, Radial System, Grid Iron System, Ring System

3.1 Dead end system

It is suitable for old towns and cities having no definite pattern of roads



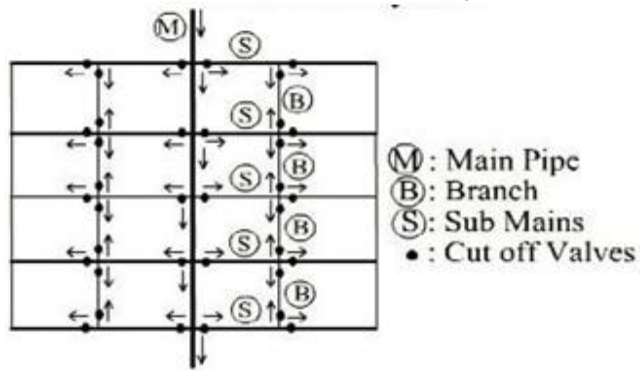
3.2 Radial system



The area is divided into different zones.The water is pumped into the distribution reservoir kept in the middle of eachZone.The supply pipes are laid radially ending towards the periphery.

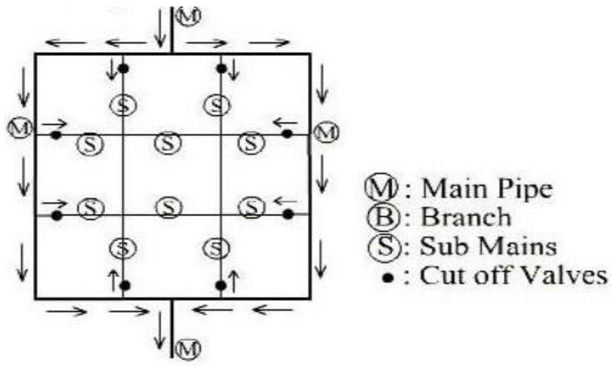
3.3 Grid iron system

It is suitable for cities with rectangular layout, where the water mains and Branches are laid in rectangles.



3.4 Ring system

The supply main is laid all along the peripheral roads and sub mains branch out from the mains. This system also follows the grid iron system with the flow pattern similar in Character to that of dead end system. So, determination of the size of pipes is easy.



4. Study Area of Work

Limbayat zone is a part of Surat city. Limbayat zone occurs in the south-east zone of Surat. Limbayat zone covers the following villages under the water distribution system: Dindoli, Gamtal, Parvatgoda, Godadragamtal, Parvatgamta.

The population of study area according to 2011 census is 1,22,560. The study area covers residential area about 882.9 ha. The water distribution system of Limbayat zone i.e. WDS-1 consists of following 3 network systems: ESR-SE-1, ESR-SE-2, ESR-SE-3

5. Methodology

Following are the step has been carried out to analyze existing Water Distribution Network using WATERGEMS V8i

Step 1: Encoding of Input Data
Most of the hydraulic analysis software has common input data requirements. These data are grouped into pipe data and node data. Pipe data are the assigned pipe number, pipe diameter (mm), C-value, length (m) and diameter (mm). Node data are assigned node number, elevation (m) and water demand (lps). Pump curve data are the assigned head (m) and flow (lps).

Step 2: Hydraulic Network Simulation
This step is done by WATERGEMS. If all the data required have been input, the software could proceed with its hydraulic run. The software computes the head losses (m) in each pipe, the rate of head loss (m/km) in each pipe, the flow velocities (m/s), and the pressure in each node (m).

Step 3: Examination of Hydraulic Run Results
Usually all possible hydraulic parameters can be shown from the computer run results.

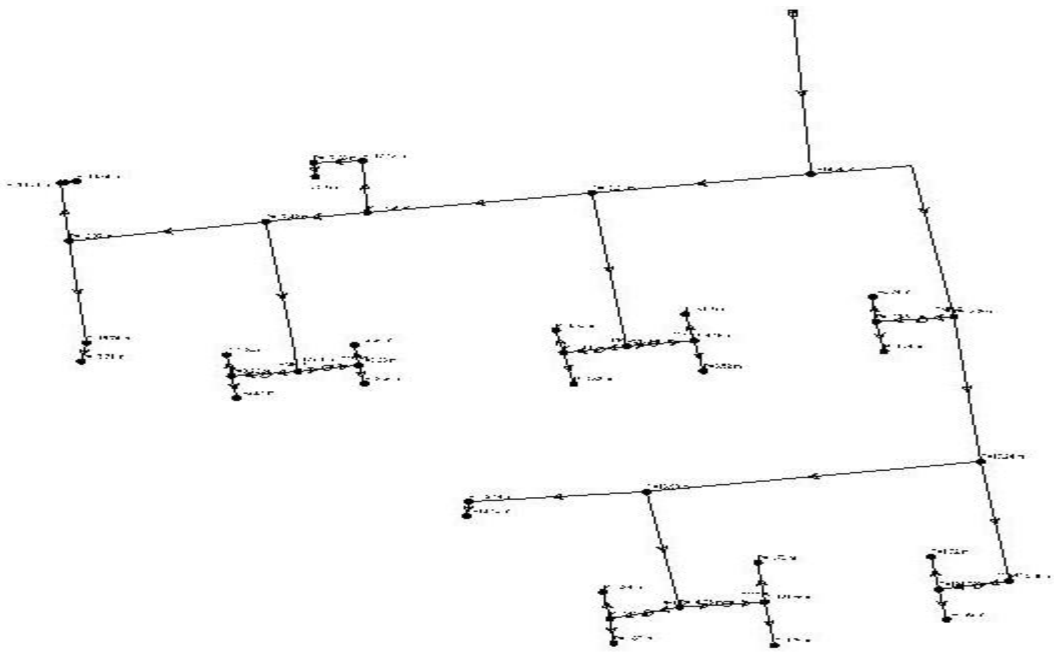
Step 4: Finalizing the Network Configuration
The model is subjected to repeated simulation and data adjustments until an acceptable network configuration is reached.

Step 5: Result and Analysis

WATERGEMS generates the results in table and graph format as shown in Figure 6. Results given by software programme in form of table and graph are displayed.

6. Result

After collecting data of three distribution networks of Limbayat zone Campus pressure, flow and velocity have been computed using WATERGEMS and by following the methodology described in Chapter 4 results by WATERGEMS are obtained. Analysis of results has been carried out and error between computed results and actual results are shown in table



Sr no	Description	Persons	Water requirement per person	Water requirement	Building Water Demand	Tank on Each Building	End Node demand	Building height+ Plinth+TankHeight
			LPCD	Lits	LPM	No's	LPM	M
1	Building 1	220	135	29700	495	2	247.5	20.1
2	Building 2	220	135	29700	495	2	247.5	20.1
3	Building 3	220	135	29700	495	2	247.5	20.1
4	Building 4	220	135	29700	495	2	247.5	20.1
5	Building 5	220	135	29700	495	2	247.5	20.1
6	Building 6	220	135	29700	495	2	247.5	20.1
7	Building 7	220	135	29700	495	2	247.5	20.1
8	Building 8	220	135	29700	495	2	247.5	20.1
9	Building 9	220	135	29700	495	2	247.5	20.1
			Total =	267300				

6.1 Pipe Report

Label	Length (Scaled) (m)	Start Node	Stop Node	Diameter (mm)	Material	Hazen-Williams C
P-65	49	J-48	J-35	150	GI	120
P-75	42	J-53	J-48	200	GI	120
P-89	7	J-32	J-64	60	HDPE	140
P-90	7	J-32	J-65	60	HDPE	140
P-91	6	J-54	J-66	60	HDPE	140
P-92	6	J-54	J-67	60	HDPE	140
P-93	7	J-36	J-68	60	HDPE	140
P-94	10	J-36	J-69	60	HDPE	140
P-95	10	J-47	J-70	60	HDPE	140
P-96	9	J-47	J-71	60	HDPE	140

6.2 Junction Report

ID	Label	Elevation (m)	Demand (m^3/h)	Hydraulic Grade (m)	Pressure (m H2O)
473	J-31	100	0	117	17
474	J-32	119.15	0	122.41	3
479	J-35	100	0	117.88	18
480	J-36	119.13	0	123.28	4
482	J-37	100	0	116.25	16
483	J-38	118.9	0	121.66	3
498	J-47	119.13	0	123.28	4
500	J-48	100	0	118.31	18

Following are some of the findings of above study:

Total numbers of pipes are 53.
The flow computed using WATERGEMS is nearly equal to the actual flow.
The velocity computed using WATERGEMS is nearly equal to the actual velocity.
The head loss computed using WATERGEMS is nearly equal to the actual head loss

7. Conclusion

Based on the above study, 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 as per the consumer needs. There may be leakages in the pipes which results in the pressure difference which consequently results into the scarcity of water. Comparison of these results indicates that the simulated model seems to be reasonably close to actual network. With the use of this software one can indeed analyze the network at the desk and can foresee the error, if any, in the design and consequently the changes required to be done in such designs for its successful execution at site. The result reveal that the software used for the design has the capability to handle various pipe network problems without changing in model of or mathematical formulation. The software used was viable alternative to other methods particularly in view of accuracy and its results in a simpler algorithm, without any iterative process.

References

[1] Dr. G. VenkataRamana, C. V. (2015). Network analysis of water distribution system rural areas using EPANET. Procedia Engineering.
[2] Bentley. (2014). Cost-effective leak detection using WaterGEMS.
[3] Parrod, P. (2016). Water System Operations Made Easier Enriching SCADA Data Through Hydraulic Modeling A Bentley Technical Paper Water System Operations Made Easier.
[4] Rahman, M. A. (2013). Urban water supply network analysis: A case study on Pabna municipality, Bangladesh. International Journal of Advanced Research.
[5] M. Günthera, D. C.-H. (2015). Showcasing a smart water network based on an experimental water distribution system. Procedia Engineering.
[6] DIXIT, M. RAO, B.V. A simple method in design of water distribution networks, Proceedings of Afro-Asian Conference on Integrated Water Management in Urban Areas, Bombay.
[7] C. Bragalli, C. D'Ambrosio, J. Lee, A. Lodi, and P. Toth. On the optimal design of water distribution networks: a practical MINLP approach Optimization and Engineering.
[8] M. Van Den Boomen, A. Van Mazijk, and R.H.S. Beuken. First evaluation of new design concepts for self-cleaning distribution networks. Journal of Water Supply: Research and Technology.
[9] T. Chuenchom, S. Limanond, U. Makmaitree, S. Tavaorntaveevong, J. Pingclasai, R.S. Mckenzie, "Experiences wWith Enterprise Water Loss Management System Deployment At Bangkok's Metropolitan Waterwoks Authority", 2009.
[10] Bently Systems, "Water leakage detection and reduction with WaterCAD&WaterGEMS V8 XM's Darwin Calibrator", 2008.