Smart Water Distribution System of Pressurised Water to Nigdi Pradhikaran Area (Sector 23-28): A Case Study

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Abstract- *Water utility is the basic requirement to meet the needs of the growing population of a developing city. For this water supply system should work efficiently and effectively so that people of the city receive water with adequate pressure and quality. Pimpri Chinchwad city is developing as a smart city and its population is rapidly increasing day by day. To achieve smart city aspirations, Pimpri Chinchwad Municipal Corporation (PCMC) is looking forward to implementing 24 X 7 water supply in the city. However, this immensely large-scale water supply system is an intricate structure with vigorous random city and multiple operation controls. To ensure the reliability of the water distribution network, hydraulic modeling and simulation through various specialized softwares plays a significant role.*

This paper presents the study of the water supply network from Water Treatment Plant (WTP), to the study area. WaterGEMS V8i software is used to build the hydraulic model for its analysis. The model provides information about probable locations of nodes with inadequate pressure and necessary improvements are made in network to make it adequate.

Keywords- WaterGEMS, Hydraulic Model, Water Distribution Network

I. INTRODUCTION

Water conveyance system is a vital piece of city's framework that passes on treated water from Water Treatment Plant to the consumer end. It involves pipes, siphons, valves, supplies and is the expensive resource of the generally supply framework. Water conveyance framework can be comprehensively grouped into two kinds as irregular and persistent framework. In irregular water supply framework, water is provided to the clients for under 24 hours for a indicated period. By and large, water is provided at pinnacle hours for example in morning 6 A.M to 9 A.M and night 5 P.M to 8 P.M. In India, this framework is commonly trailed by numerous urban areas and customer needs to store water amid supply hours. In persistent water supply framework, water is provided to the client's 24 hours per day and 7 days seven days. The water is satisfactorily pressurized to achieve purchasers end and purchaser need not store the water, evading wastage of water. In 24 x 7 water supply plot, water won't remain dormant in channels at any moment. Along these lines, there is dependably accessibility of new water which will likewise help in improving the general wellbeing of city. So as to keep up the quality,weight and stream parameters at every hub in the water conveyance framework, calculation of water driven parameters what's more, water quality at every hub is fundamental. Pressure driven displaying rearranges the investigation of water dissemination framework. With its assistance, the vulnerabilities in present and future requests can be anticipated. Henceforth the unwavering quality of water circulation framework can be processed and extraordinary measures to improve the framework can be proposed.

1.1 Significance of work

With the help of hydraulic modelling the pressure variations in the pipe network can be monitored. It helps to check the adequacy of pipe network i.e. their diameters and number of pipes. If the pipe network is not adequate necessary modifications can be made such that water is conveyed to the users with adequate pressure.

1.2 Objectives

1. To study hydraulic parameters of present water distribution system of study area.
2. To simulate hydraulic model for the study area.
3. To monitor water quality parameters.

II. STUDY AREA

Pimpri Chinchwad is located to the north-west of Pune city in Maharashtra, India. The coordinates of the city are 18˚37'07.04''N 73˚48'13.43" E. Pawana dam is the main source of water for the city which is 35 km away from the city. The water distribution network from Water Treatment Plant, Nigdi to Sector 23-28 is identified as the study area out of the whole PCMC region. The main reason for the selection

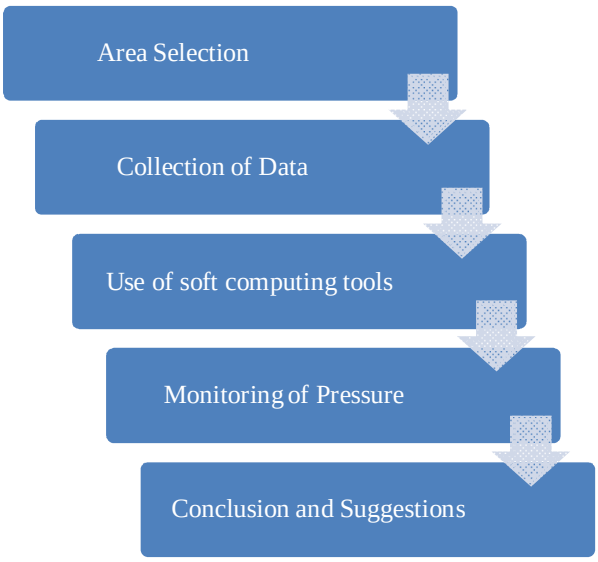
of the above study area is uneven pressures and tremendous fluctuations observed in the flow rate.

III. INTRODUCTION TO WATERGEMS

Bentley WaterGEMS V8i is user-friendly software which can be utilized as a decision support tool for water distribution network. This soft computing tool is useful to understand the behaviour of infrastructure as a system and its responses to operational strategies. A water supply system should develop as population and demand increases and this software simulates the same. WaterGEMS V8i is hydraulic modeling software for water distribution systems with advanced interoperability, geospatial model building, optimization and asset management tools. It provides an easy to use environment for engineers to analyze, design and optimize water distribution network from fire flow, water quality simulation and constituent concentration analysis to criticality, energy consumption and capital cost management.

IV. METHODOLOGY

Following steps have been carried out to analyze existing water distribution network using WaterGEMS V8i



Step 1: Selection of Study Area.

As discussed in the section no.2 study area is selected to fulfill the objectives.

Step 2: Collection of data.

For hydraulic analysis in the software all the required input data was collected from Water Treatment Plant, Nigdi. Pipe data such as pipe diameter (mm), C-value and length (m) are assigned to the network. Input for nodes are elevation (m), water demand (lps) and time pattern.

Table -1:- DATA OF ESR's

Details	ESR 1	ESR 2	ESR 3	ESR 2+ ESR 3
Capacity	2.5 ML	2.5 ML	1.0 ML	3.5 ML
Population	23416 Person	-	-	43279 Person
Demand	4,53 MLD	-	-	8.43 MLD
Water Supply Timings	4:30 am to 10:00 am 4:30 pm to 10:00 pm	4:30 am to 10:00 am 4:30 pm to 10:00 pm	4:30 am to 10:00 am 4:30 pm to 10:00 pm	-

NOTE: - Alternate day water supply is done during Summer Season and supply timings may vary according to it.

Fig: - INPUT DATA OF PIPE DIMENSIONS

A1 ZONE PIPE SUMMARY

Diameter (mm)		Material	Length (m)			
Outer	Inner		Existing	Additional Proposed	Replaced	Total
110.00	92.70	HDPE	0.00	11618.43	5023.75	16642.18
160.00	135.00	HDPE	0.00	2080.59	344.93	2425.52
180.00	151.80	HDPE	0.00	83.73	0.00	83.73
225.00	189.90	HDPE	0.00	134.95	1022.22	1157.17
280.00	236.50	HDPE	0.00	29.14	0.00	29.14
	200.00	DI New	0.00	0.00	7.96	7.96
	300.00	DI New	0.00	124.67	0.00	124.67
	100.00	DI	11745.71	0.00	0.00	11745.71
	150.00	DI	5920.72	0.00	0.00	5920.72
	200.00	DI	3541.57	0.00	0.00	3541.57
	250.00	DI	764.91	0.00	0.00	764.91
	300.00	DI	3476.50	0.00	0.00	3476.50
	400.00	DI	50.04	0.00	0.00	50.04
	100.00	CI	31429.94	0.00	0.00	31429.94
	150.00	CI	6660.03	0.00	0.00	6660.03
	200.00	CI	8550.43	0.00	0.00	8550.43
	250.00	CI	2154.61	0.00	0.00	2154.61
	300.00	CI	5112.03	0.00	0.00	5112.03
	350.00	CI	63.63	0.00	0.00	63.63
	400.00	CI	139.58	0.00	0.00	139.58
	450.00	CI	7.20	0.00	0.00	7.20
	200.00	MS	31.75	0.00	0.00	31.75
	600.00	MS	541.44	0.00	0.00	541.44
	700.00	MS	1304.55	0.00	0.00	1304.55
	900.00	MS	0.00	0.00	0.00	0.00
	1200.00	MS	4.23	0.00	0.00	4.23
Total			81498.87	14071.51	6398.86	101969.24

Step 3: Use of Soft Computing Tools

The use of soft computing tools allows us an upper hand for getting proper results. The tools or software helps us to analysis the distribution network and to suggest some suggestions by sitting on our workplace rather than going on field and monitoring it. The tools like WaterGEMS (which is preferred over EPANET) is used to analysis the distribution network and suggest some required changes if required.

Step 4: Monitoring of Pressure

Pressure monitoring is important aspect to know as this will be the end result of our project. The end result is that equalized water pressure is distributed to each and every house. To achieve this end result we conducted the following test and according to it we decided that the project is feasible. The tests were conducted in following manner.

1. Pressure Zero Test (PZT)
2. Leakage Detection Test
3. Hydro Test

1) Pressure Zero Test:

A method of determining non revenue water in a district metering area.
This is a test that checks whether a particular area in a water system is watertight. The valves around the area are closed and the pressure is monitored, if there is zero water pressure through the area, it means boundaries of that area are watertight.

2) Leakage detection test :(Acoustic testing)

The most effective way to find leaks in underground water pipes is with acoustic water leak detection equipment. It is based on the principal that water escapes through the leak a mechanical vibration is generated. This test is carried out at night where minimum disturbance is observed. It is monitored using listening stick or leak noise loggers. The path of the pipe should be marked on the ground and acoustic microphones are used to pin point the leak by identifying the point with highest acoustic signal.

3) Hydro testing:

In this test the pipe dimensions are known and are carried out to know if there is any pressure difference in the pipe or if the joint of pipe are having any leakages. The leakage can be identified by physical inspection of the area where pipe has been layout. Hydro test is carried out to know if the end users are getting water of equal pressure which is our aim of our project.

V. RESULTS:

1) PRESSURE ZERO TEST:

Fig: Meter gauge showing zero pressure

2) LEAKAGE DETECTION TEST:

Fig: Identification of point showing Leakage

3) HYDRO TESTING:

PROJECT	AMRUT PCK III
DATE	03/06/2019
ZONE	SECTOR 27
PIPE DIAMETER	200 mm
PIPE LENGTH	645m
REQUIRED PRESSURE	5.50 kg/cm^2
BUILD PRESSURE	**5.70 kg/cm^2**
START TIME	11:45 am
END TIME	12:15 pm

VI. CONCLUSION

It is observed that insufficient pressures in some of the junctions in the distribution network occur due to inadequacy of pipe. Adequate pressures can be obtained by adding parallel pipes of equivalent diameters or replacing the pipe with higher diameters. Adding parallel pipes can be more feasible as the older pipes can be retained in the network and the network can be improved with new pipes.

Replacing the older pipes can cause difficulties for the users as water supply is cut off and higher costs are likely to incur.

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