Design of Water Distribution Supply Network for Village Nimgaon (Madh) using Watergems Software

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Abstract **- In present study of Nimgaon (Madh) village have done and Water Distribution Network (WDN) was designed, which was located at district Nashik, State Maharashtra, India. For the design of Nimgaon (Madh) water distribution network study of present population, forecast Population for the three-decade, daily water demand, flow and also survey of village Nimgaon (Madh) was done with the help of Auto Level. From the Level survey, map was created and also elevation and length of Pipeline required for the village was calculated. The node no. and pipe no. were denoted on map of villages. Water Distribution Network of village was designed with the WaterGems/WaterCad software and compared with manually result. It was found that software result was more accurate, save time and manpower than manual result. Water is essential element required for the sustenance of life. Demand for drinking is increasing on continual basis with corresponding increasing population. This ever-increasing demand can be fulfilled by designing efficient water distribution networks based on advance computing systems include modern hydraulic modeling and designing software.**

1.INTRODUCTION OF WDN

A water distribution network is an essential hydraulic infrastructure which is a part of the water supply system composed of a different set of pipes, hydraulic devices and storage reservoirs. Water distribution network connects consumers to sources of water using hydraulic components. A distribution network may have different configurations depending upon the layout of the existing area. Generally, water distribution network has a branched and looped type of configuration of pipelines. The primary variable is flow in the network. The constraints are that demands are to be met and pressures at selected junctions in the network are to be within specified limits. The decision variables thus consist of design parameters i.e. pipe diameters, reservoir capacity, and elevation.

Google earth can be useful to visualize and model the entire cycle of water supply network from source to household. The network system must be modeled, analyzed, and its performance is evaluated under the various physical and hydraulic parameters or conditions. This process is called as "Simulation" and WaterGEMS are software that performs extended period simulation of hydraulic and water quality behavior within pressurized pipe networks. WaterGEMS tracks the flow of water in each pipe, the pressure at each junction, the height of water in each tank, and the concentration of water throughout the network during a simulation period.

1.1Components of the WDN

1. Source
2. Rising Main
3. Water Treatment Plant (WTP)
4. Master Balancing Reservoir (MBR)
5. Primary Network (Gravity Main)
6. Elevated Storage Reservoir (ESR)

1.2 Need for water distribution network

1. The purpose of distribution system is to deliver water to consumer with appropriate quality, quantity and pressure.
2. It should be capable of supplying water at all the intended places with sufficient pressure head.
3. It should be capable of supplying the requisite amount of water during fire fighting

1.3 Scope of the Work

1. Preparation of hydraulic model and extended period simulation of the same.
2. Load elevations to the hydraulic model from the 3D contour data.
3. Check the design of all the zones of the town for its adequacy.
4. Creation of the District Metering Areas (DMA)s for transformation to the 24/7 water supply.

5. Creation of scenarios as required.

2. LITERATURE SURVEY

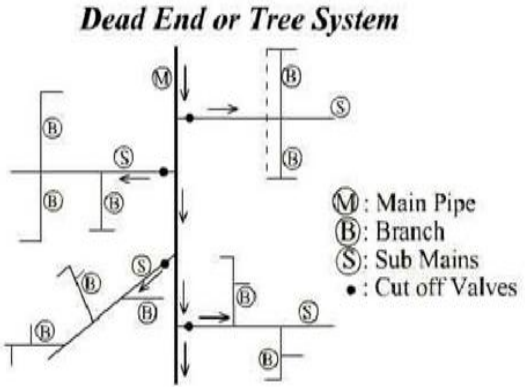
1. R Sathyanathan, 2016 done a project based on WDN throughout, using WATERGEMS/ WATERCAD/EPANET software. In the project they explain about the pressure at junctions in peak and non-peak hours and gives the clarity about the loop ends in the campus.
2. Mohammed N. Almasri PhD, 2008 done a journal paper on WATERGEMS/ WATERCAD/ EPANET software, which gives detailed explanation of the software, and also did a small WDN for the simulation. The author also explains about the branched networks, loop ends, WaterGems elements like pipes, valves, junctions, reservoirs, pumps, tanks etc.
3. Shivalingaswami.S. Halagalimath, 2016 designs a WDN for the Bagalkot city, Karnataka. The Water distribution network consists of one tank, 120 junctions, 186 pipes and only one tank which has to be serve water for 13104 people in the study region. After networking and editing the properties of pipe, nodes parameters such as length, diameter, elevation and basic demand and run the analysis, checked the results.
4. Analyzing the existing water distribution system of Surat using Bentleys Watergems:Dilip Babubhai Paneria et al (2017)In this study, the existing water distribution system is simulated through construct of a model using Bentley Water GEMS. It helped in analyzing the entire network system, visualized the effects of constituent components and parameters as well as the pressure at end node is detected low, that shows the consumer near the reservoir having more advantages of water than the one that resides away from the reservoir.
5. Review study: Experimental investigation by WaterGEMS software for redesign of water distribution system of Bhavani Mata ESR Prof. A.G.Chaudhari, et al(2017) has worked on WaterGEMS software will be used for obtaining optimal design of water supply network of a part of Nasik city. With the help of WaterGEMS software, design of optimal water supply network will be done with achieving objective of minimizing the overall cost while meeting the water demand requirements at sufficient pressures for specified maximum discharge over a long period of time. The software also gives different alternative optimal design solution considering pipe diameters, pipe material and roughness coefficient based on head dependent analysis.

3. WATER DISTRIBUTION NETWORK

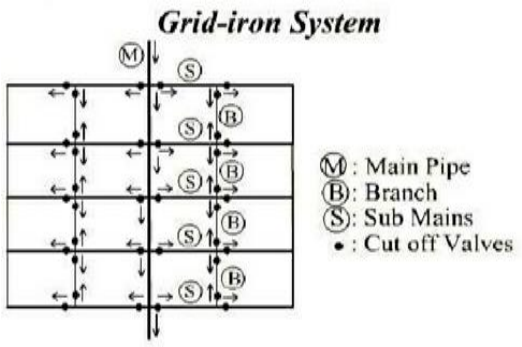
Water distribution network consist of a planar system of pipe connected together at nodes which may be at different elevation. In general, the complex will also include pumps, reservoirs and valves. A node usually has one of the two main functions; it either receives a supply for the system or it delivers the demand required by consumers. As a special case, it may satisfy neither of these requirements but merely serve as a junction between two or more pipes. The pressure head at a supply node is established by the presence of a pump or a reservoir. The effect of minor losses may be including as equivalent pipe lengths.

3.1 Layout of WDN:

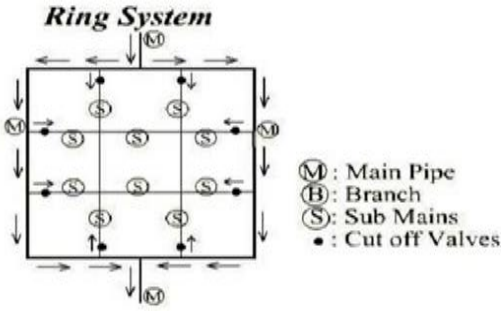
1. Dead end system: it is suitable for old towns and cities having no definite pattern of roads. Dead end system, the name itself defining that it contains dead ends in the pipe system. So, the water does not flow continuously in the dead-end system. In this system the whole pipe network is divided into several sub networks.



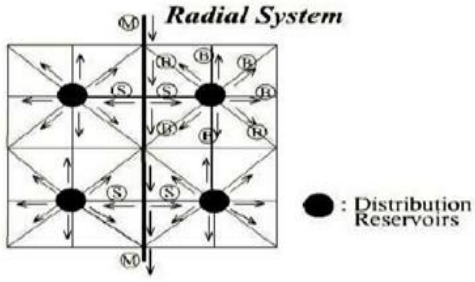
2. Grid Iron System: is one method of the layout of distribution pipes. This system is also known as interlaced system or reticulation system. In this system, the mains, sub-mains, and branches are inter-connected with each other. Thus, this system provides free circulation of water through the pipelines.



3. Ring System: Ring system, can also be called as circular system in which the main pipeline is provided around the city or area i.e., peripherally. From this main line, the branch lines are projected perpendicularly, and they are also connected with each other.



4. Radial System: Radial system is quite opposite to the ring system. In this system, whole area is divided into small distribution districts or zones and an individual distribution reservoir is provided for each distribution zone. The reservoir provided is generally of elevated type. From this reservoir the pipelines are laid radially to the surrounded streets. All distribution reservoirs are connected with main line which is passing through center of the city.



4. EXISTING WDN INFORMATION

Nimgaon Madh is a Village in Yeola Taluka in Nashik District of Maharashtra State, India. It belongs to Khandesh and Northern Maharashtra region. It belongs to Nashik Division. It is located 76 KM towards East from District headquarters Nashik. 12 KM from Yeola. 229 KM from State capital Mumbai.Nimgaon Madh Pin code is 423401 and postal head office is Yeola. Nimgaon Madh is surrounded by Kopargaon Taluka towards South, Rahata Taluka towards South, Niphad Taluka towards west, Chandwad Taluka towards North. Yevla , Shirdi, Manmad , Vaijapur are the nearby Cities to Nimgaon Madh.This Place is in the border of the Nashik District and Ahmednagar District. Ahmednagar District Kopargaon is South towards this place.

4.1 Nashik: 41-Villages regional water scheme NASHIK: The water supply department has decided to include the 41-village regional drinking water supply scheme in the National Rural Drinking Water Supply Programme to ensure the villagers of the drought prone Yeola taluka get drinking water.According to the water supply department the 41-village water supply scheme will provide drinking water to Rajapur, Mamdapur, Rendale, Angulgaon and others.The scheme will be based on the existing 38-village regional water supply scheme.The 41-village water supply scheme will include maximum numbers of villages in the drought prone taluka of Yeola. When the scheme comes effective, it will be another step towards being a tanker-free taluka.The scheme will ensure assured drinking water to the villagers and will be a major relief for them.The 38-village regional water supply scheme currently draws water from Palkhed Dam, but the new scheme is expected to draw water from Nandumadhmeshwar Dam. Pre-feasibility report for the project was presented by the Maharashtra Jeevan Pradhikaran in the month of September 2017. Separate storage water tank will be created by reserving water on Express Canal at Nandurmadhmeshwar. This water will be pumped for the scheme.The reservation of drinking water on Nandurmadhmeshwar is much beneficial considering the shorter distance required for the water to reach the beneficiary villages as against the 38-regional water scheme where the water has to travel 94 km from Palkhed Dam through open channel leading to loss of water and even water thefts on the way.

5. METHODOLOGY

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Typically, it encompasses concepts such as paradigm, theoretical model, phases and quantitative or qualitative techniques methodology does not set out to provide solutions – it is, therefore, not the same as a method. Instead, a methodology offers the theoretical underpinning for understanding which method, set of methods, or best practices can be applied to specific case, for example, to calculate a specific result. WaterGEMS provides you with a comprehensive yet easy-to-use decision-support tool for water distribution networks.

5.1 Methodology Flow Chart consist of following steps

1. Take Road map of the study area from Google earth map.
2. Draw water distribution network in WaterGEMS software.
3. Put the value of design constraints
4. Specify population based peak factor as per Standards
5. Validate and compute the network.

6. ANALYSIS USING WATERGEMS.

A Node number and pipe marking of Nimgaon village is calculated as below. The presented results of the WaterGems Software.

TABLE 6.1: RESULTS USING WATERGEMS

NIMGAON VILLAGE						
Pipe No.	From Node	To Node	L (m)	Dia. (mm)	Flow (lps)	HGL (m)
1	1	2	30	133	.048	117.10
2	2	3	114	133	.189	116.10
3	3	4	75	71	.123	116.77
4	3	5	36	133	.06	116.77
5	5	6	37	71	.069	116.67
6	6	7	42	71	.066	116.66
7	6	8	40	71	.084	116.66
8	8	9	50	71	.0183	116.66
9	8	10	110	71	.093	116.66
10	5	11	56	133	.141	116.65
11	11	12	86	71	.060	116.54
12	11	13	37	133	.090	116.54
13	13	14	54	71	.228	116.46
14	14	15	138	71	.090	116.54
15	14	16	54	71	.012	116.45
16	13	17	7	133	.129	116.43
17	17	18	77	71	.048	116.44
18	17	19	30	133	.117	\116.44
19	19	20	70	71	.0132	116.44
20	19	21	80	71	.096	116.39
21	21	22	59	71	.147	116.39

7. RESULTS AND DISCUSSION

7.1 Results.

1. This project is being implemented to improve the water supply system to minimize the leakage and optimize the water availability to consumer
2. The existing system of water supply is facing problems like A higher rate of leakage, poor maintanance, poor customer service and poor quality of water with differ.

From the above papers and data we came to know about the basic knowledge of how to use WATERGEMS/ WATERCAD/ EPANET software and how it works. Almost all the authors who worked on this software gives the output as comparison between already existing WDN and virtual WDN. If we are careful at giving the input data i.e. diameter, length, elevation, demand to the WDN in the software and simulation will be successful and errors can be avoided as much as possible. Loop ends also want to kept in mind while designing the network. According to the location of loop ends only the network should be manipulated.

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