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Analysis and Redesign of 24/7 Water Distribution Network using Watergem Software

Nikita Adhav[1], Vishal Zerikunthe[2], Aishwarya Sasane[3], Arpan Deshmukh[4],
[1, 2, 3]*U.G Student Civil Department, G.H Raisoni college of Engineering and management, Pune, India*
[4]*Professor Civil Department, G.H Raisoni college of Engineering and management, Pune, India*

Abstract: ***A continuous water supply system has generated significant interest in India due to its many advantages. Also it is useful for conserving water and its quality. Now-a-days demand for drinking water is increasing day by day with corresponding increase in population. The present study shows the remodelling of existing network and also designing the water distribution network using a programming tool, which performs the extended period simulation of hydraulic and water quality behaviour within the pressurized network of pipes called watergems. This paper demonstrates the use of watergems for the hydraulic study of the distribution network. The studies present the hydraulic design and analysis of rural water distribution system (WDS) for Nighoj village of the state of Maharashtra, India. Water distribution system is designed for this study for population estimated for future 30 years watergems software have been used and the results are compare to determine the economical size of pipes for distribution system. The economical size of pipes of water display system is designed by considering the constraints; residual pressure at each node velocity of flow in pipe, head loss in pipes, material of pipes, elevated service reservoir level, peak factor and available commercial pipe diameter.***

Keywords: Water GEMS Software, Water Distribution System, Satellite Data Analysis, Water and demand Supply and System.

I. INTRODUCTION

Water is an, very important requirement in our day to day life. Providing continuous water supply i.e. 24x7 water supply to every consumer throughout the year, is one of the important emerging trend in water supply management. The provision of continuous water supply is made by the accurate design of the water distribution network with optimum design of pipes, pumps and tanks, etc. to minimize the overall cost of the project. The definition of 24x7 water supply is- "The supply of potable water to end users through system of pipes – comprising interlinked bulk transmission and/or distribution systems – which are continuously full and under positive pressure throughout their whole length, such that the end user may draw off water at any time of the day or night, 24 hours a day, every day of the year.[1] Design of water distribution network is a critical part of water supply system which contributes for the major share of overall expenditure incurred in it, hence systematic and proper design as well as modeling of distribution network becomes crucial one.With the advancement in the field of water supply, many field experts, scientists, research scholars, developers and programmers developed number of software's for design and modeling of water distribution systems.

A. Aim Of Sujal-Nirmal Abhiyaan

In Maharashtra state, population of the urban areas is rising rapidly. The State Government has embarked upon "SujalNirmal Abhiyaan". Under this program, it has been decided to give sufficient financial help to the Urban Local Bodies (ULB) which are ready to improve the Urban Water Supply Schemes, Sewerage & Sanitation, including public toilets and dry waste disposal. For Water Supply Component, Sujal-Nirmal Abhiyaan aims at achieving 24x7 water supplies as per the central government guidelines with emphasizing the focus on water conservation. It is a program to improve and sustain the performance of urban water supply by active participation of the ULBs with government support.

B. Background

Now-a-days demand for drinking water is increasing day by day with corresponding increase in population. This continuously increasing demand can be fulfilled by designing efficient water distribution networks based on advance computing systems which include modern hydraulic modelling and designing software. In order to deliver adequate service, these systems must be carefully planned, designed, operated and maintained. Design of distribution network for continuous water supply can be easily achieved with the help of software water gems, which is used for water distribution modelling and management. The present study shows the remodelling of existing network and also designing the water distribution network using a programming tool, which performs the extended period simulation of hydraulic and water quality behaviour within the pressurized network of pipes called Watergems.

C. Motivations

Government of Maharashtra (GoM) has undertaken "Sujal-Nirmal Abhiyaan" project for up gradation of water systems of small & medium towns under which government insisted various urban local bodies in the state to participate. The definition of 24x7 water supply is- "The supply of portable water to end users through system of pipes comprising interlinked bulk transmission and/or distribution systems which are continuously full and under positive pressure throughout their whole length, such that the end user may draw off water at any time of the day or night, 24 hours a day, every day of the year Design of water distribution network is a critical part of water supply system which contributes for the major share of overall expenditure incurred in it, hence systematic and proper design as well as modeling of distribution network becomes crucial one.

D. Why Watergems

Watergems can perform following functions effectively:

1) Building a network and performing a steady state analysis.
2) Extended Period Simulation (EPS).
3) Scenario management.
4) Reporting results.
5) Automated fire flow analysis.
6) Water quality analysis.
7) Darwin Designer to optimize the setup of the pipe network.
8) Darwin Designer to optimize the pipe network.
9) Scenario energy costs.
10) Pressure dependent demands.
11) Criticality and segmentation.
12) Flushing.
13) Importing SCADA data.
14) SCADA connect simulator.

E. Scope of the Paper

1) Preparation of water pipe network in Bentley Water GEMS from GIS files
2) Preparation of hydraulic model and extended period simulation of the same.
3) Load elevations to the hydraulic model from the 3D contour data.
4) Check the design of all the zones of the town for its adequacy
5) Creation of the District Metering Areas (DMA) s for transformation to the 24/7 water supply system.
6) Creation of scenarios as required.
7) Preparation of final output of hydraulic design with AutoCAD drawing and report, etc. complete.

F. Necessity of Redesign Water Distribution System

In India, water availability controls population distribution. To meet the increased water demand due to growing urban population, it is necessary to provide the required water quantity through the efficient design of pipe network. The most important task in distributing desired water quantity to individual consumers is the necessary pressure through a distribution network. It is essential that each point of the distribution network be supplied with a certain quantity of water flow with all the desired parameters. The water supply in most Indian cities is only available for a few hours of a day, pressure is irregular, and the water is of questionable quality. The function of a pipe network system is to supply water at required pressure and flow.

G. Purpose and Objective

Water is an, very important requirement in our day to day life. Providing continuous water supply i.e. 24x7 water supply to every consumer throughout the year, is one of the important emerging trend in water supply management. Design of the water supply system to satisfy the functional requirement should not be the only objective but to satisfy the functional requirement at the lowest cost is most important. This paper represents the study for the design and analysis of rural water supply systems considering the aspect of economical design of the network. As per census of India of 2011, approximately 68% to 70% population of India is staying in the rural area. Indian government has decided to provide safe, regular and adequate water to the consumer at their resident through the pipe distribution system in rural area.

The key principal objectives of the study are:

1) To study hydraulic parameters of present water distribution system of study area.
2) To identify the location of critical points in the existing water distribution system.
3) To prepare GIS based water distribution network for CST.
4) To deliver water to individual consumers with appropriate quantity, quality, and pressure.
5) To supply water at convenient points and timings..
6) To re-design the water distribution network
7) 24 X 7 water supply projects in pilot area and improved water supply services.
8) Sustainable water source development.
9) Metering of 80% household connections
10) At least 80% recovery of O&M cost of water supply and sanitation
11) Achieve at least 80% collection efficiency
12) Providing safe collection and disposal of drainage and sewerage system
13) Establish system of water tariff framing
14) City wide 24 X 7 water supply system
15) 100% consumer metering

II. LITERATURE SURVEY

Dr. Sanjay[1] and V. Dahasahasra[2] Member Secretary Maharashtra Jeevan Pradhikaran Mumbai, India-In this case-study, the author presents the award winning project undertaken in Maharashtra's Badlapur city for supplying pure drinking water round the clock. It is unique not only because it is the first such attempt in India but also because of the methods adopted. Water is indispensable for life but is finite and therefore precious. Serving pure and potable water to the dense populations in developing countries, especially in India, is a daunting task.

Rutva N. Gohil[3] 1 PG Student ME-IV, Department of Civil Engineering 1S.S.E.C, Bhavnagar, Gujarat, India - The declining availability of water supplies is one of the most important environmental issues facing various countries at the present time. Climate change, affluence and population growth have resulted in vast requirements of water for use in domestic, industrial and agricultural settings. Using data from the local government body, the paper presents the status of existing water supply network condition, and comparing it with continuous water supply system of selected DMA of Bhavnagar town in Gujarat (India). Key Terms- Urban Local Bodies (ULB), District Metering Area (DMA), negative pressure.

Evaluation of Intermittent Water Supply System and Design of 24x7 for a residential area in Mysore, Karnataka, by Rakesh Beg. Al.,[4] India-Water is a basic need for life, without water life would not exist. Today in Indian scenario about one in every nine people lack access to good quality water. Although water is renewable it is finite and precious. Now-a days due to increase in water demand resulted in depleting ground water resources that in turn increased in the capital cost for water supply thus, alternative methods for conservation are to be developed one such is 24x7 which helps to prevent deliberate wasting of water in comparison to intermittent water supply system.

Design of Continuous Water Supply System by using Watergems: Dhumal, et. al.,[5] (2018) has studied continuous water distribution network i.e. 24 x7 water supply to every consumer throughout the year using with water gems software. Now a days, the concept of continues water supply has generated significant interest in India due to its advantages over intermittent system of water supply. Author suggested that water gems is very effectively design tool for design a continuous water supply system than the manual process and it required minimum time and gives accurate results within short period. Also it optimizes the distribution network on the basis of performance and cost.

Analyzing the existing water distribution system of Surat using Bentleys Watergems: DilipBabubhai Paneria et al[6] (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.

A model for transforming an intermittent into a 24x7 water supply system: Dr. Sanjay[7] and V. Dahasahasra [7](2015)-In this case-study, the author presents the award winning project undertaken in Maharashtra's Badlapur city for supplying pure drinking water round the clock. It is unique not only because it is the first such attempt in India but also because of the methods adopted. Water is indispensable for life but is finite and therefore precious. Serving pure and potable water to the dense populations in developing countries, especially in India, is a daunting task.

Design of Optimal Water Supply Network and Its Water Quality Analysis by using WaterGEMS Sajedkhan S. Pathan[8] and Dr. U. J. Kahalekar[9] (2013): In this paper design of water supply network duly considering optimization in addition to the cost minimization, minimum head requirement and minimum chlorine requirement is presented. A design is obtained duly considering minimum and maximum head and velocity criteria in order to determine the actual supply form each node to all consumers. In this paper a part of Aurangabad city is designed and its water quality analysis is done by WATERGEMS software.

Sumithra R.P., et. al.[10], (2013)- has carried out the feasibility analysis of water distribution system of Tirunelveli Municipal Corporation, Tamilnadu, India with the help of LOOP and WaterGEMS softwares packages for design period of 30 years. The variety of analysis has been carried out yielding wide range of results for diameter of pipes, pressure at different nodes, cost analysis, etc. Vaghela[11] and Bhagat [12](2013) :- In this paper hydraulic analysis of Water distribution network of laxminagar territory of west zone of Rajkot City is carried out. the whole analysis is based on Steady State condition. The result obtained verified that the pressure at all junction and the flows with their velocities at all pipes are feasible enough to provide adequate water to the network of study area. At the end of the analysis it was found that the resulting pressure at all nodes and the flows with their velocities are sufficient to provide to the study area.

Dilip Babubhai Paneria et al[13] (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.

Prof. A.G.Chaudhari, et al[14] (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.

Shinde Parmanand Bhaskar [15](2017), A study was undertaken to suggest measures for the improvement to the distribution system, which can easily fulfill the demand for water in the city and can lead to development of the city in near future. The paper presents results of analysis carried out using Bentley systems Water gems for basic design of distribution system which consist of reservoir, pipe network and ESR. Various materials' costs can be marked and cost estimation is not considered in this study as it depends on the authority to approve, but PVC cost is the lowest among the all materials and durable as well. Hence, PVC is suggested for adoption.

III. PROPOSED METHODOLOGY

A. Procedure

1) System Layout

By using GIS and surveying the field with the help of Council Engineers and water supply staff, we track the entire water network starting from source to line before consumer end with the help of total station and also collect relevant data.

2) Data Entry

Once collected all the data from the field, transfer the tracked network into the ArcGIS software, where we create shape files for various elements of water supply system. Then we add all the relevant information to the respective element layer.

For example:

a) In pipe attribute table, we input diameter, material, length, etc.
b) In pump attribute table, we input head, flow, power, etc.
c) In ESR attribute table, we input GL, LSL, FSL, etc.

After creating the shape files, authenticates the network with the Municipal Council and then hydraulic modeling is done.

3) Data Checking

After receiving the authenticated shape files from hydraulic modeling, checking all the data with relevant information is done like For example:

a) From Energy Audit report we check all the pumping details.
b) From scheme file, we check the transmission line and ESR details, etc.
c) From census population, we check the consumer survey data.
d) From contour plan, we check elevations.

4) Population Forecasting And Demand Calculation

We collect the census population from 1961 to 2021 and based on that with the help of census of India website library guidelines and as per service level benchmark; we forecast the population for the next 30 years from the base design period.

Now, with the help of consumer survey data, we segregate the ward wise population for respective council and based on council's development plan, we forecast the ward wise population for next 30 years.

a) Based on scheme files LPCD we calculate the demand for that particular municipal Council.

b) Now, we create the Thiessen Polygon for all the nodes of the distribution.

c) And with the help of Load Builder, we assign the demand Density Multiplier Ward Nos. No of to the respective junction/node.

5) Analysis Of Current Scenario

a) Validation

b) Zoning

c) Pattern

d) controls

e) Alternatives and Scenarios

f) Computation of scenarios

B. Design of Continuous Water Supply System on Watergems

1) Distribution Network

To initiate the modelling of distribution network, the basic network consisting of pipes, junctions, valves, tank or ESR (elevated storage reservoir), etc. Have to be drawn in Watergems. The required network can be drawn on the blank window with the provision of specified scale to it. Also we can import image, CAD and GIS files for background as a reference for drawing of desired distribution network with consideration of road network and elevation of ground terrain. We can also assign an, user defined length for every pipe, if required i.e. If drawing is not drawn to the desired scale. Also we have to fill the basic properties of every component in the drawing of water distribution network such as, junctions, valves, pipes, tanks, reservoir, pumps, etc. As water distribution systems are generally so designed, that the energy consumption in pumping and other works should be minimum and hence distribution system should supply continuous water in majority of the area through gravity (i.e. Without using pumps). The elevations should be given to every component, as it has more importance as water is continuously supplied by distribution network. In distribution network for continuous.

2) Computing Demands

For design of continuous water supply system, the population density of each zone should be accurately determined and designed for considered life span of project. For particular distribution network, the population for each branch of pipe should be known to give the sufficient design demand for end junction or node of every branch.

Design demand for each branch design population at that branch x rate of water supply (lpcd) Each branch of network is considered separately for calculation of daily water demand, which would have to be given at the end node or end junction of that branch. There are various methods of population forecasting such as arithmetical increase method, geometrical increase method, geographical increase method, etc. And based on this population forecasting water requirement is calculated. In addition to it, some losses are taken into account to find out gross water demand. Generally, the probable life span of water supply system is taken as 20 to 30 years.

3) Defining Demand Pattern

The modeling of distribution network for continuous water supply in Watergems should be done with 'EPS (Extended Period Simulation)' instead of 'steady state' of time analysis type. For EPS analysis it is required to give specific pattern for given demands with respect to hourly, daily or monthly variation in water demands. As the distribution network is designed for continuous water supply system, the hourly varying demand pattern plays an important role in it. Watergems estimates the network with respect to peak factor (maximum factor from hourly varying demand pattern).Also we can give patterns to pumps, valve settings and power usage also.

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4) Computation Of ESR

Capacity of ESR is mainly depends upon population and rate of water supply for a day. In continuous water supply, tank capacity is designed for maximum multiplier given in hourly varying demand pattern i.e. Peak factor. Daily Demand =Population x rate of water supply (lpcd) x Peak factor In addition to this there is losses in pumping and rising main also taken in consideration for total daily demand. Capacity of ESR is depends upon daily demand and pumping system provided.

5) Analysis Of Network

For continuous water supply, distribution network is analyzed for EPS. The pumps are provided to fill the ESR with consideration of ESR emptying time and the time at which ESR runs full. By analyzing network, the software gives results which includes velocity of water in pipe, pressure at each junction, headless gradient of pipes, hydraulic grade of junctions, flow, etc. And much more. The results, reports and graphs can be exported to MS Excel, MS Word, or CAD format effectively

6) Optimization

The software water gems has an extraordinary feature named as 'Darwin Designer', which gives optimum results to maximize benefit or to minimize capital cost of the project. Darwin designer is a generic algorithm. It provides multi criteria optimization. The criteria being performance and cost. The solutions provided by the software are ranked. This allows the user to choose the best solution which suits to his requirements of pressure and availability of money. It optimizes the network, on the basis of pressure and velocity constraints given. Darwin designer gives the optimum solution for network which may consist variety of diameter pipes. Hence, from practical point of view, these diameters maybe efficiently arranged

IV. DESIGN CRITERIA

A. Design Year

Water supply project is normally designed for the period of 30 years. Therefore, the project is designed for implementation in two phases. Phase-I will be from year 2022 to year 2037 and Phase-II from year 2037 to year 2052.

Table: 1 Stage wise years of the project

Sr No	Stage	Year
1	Immediate Stage	2022
2	Intermediate Stage	2037
3	Ultimate Stage	2052

B. Population

The population analysis is based on 2011 census and the trend value during 1961-2021. Among the various mathematical models usually adopted for population projections, the adopted methods are as described below and the mean of arithmetic and incremental increase method is adopted for calculating the water demand.

1) Arithmetic Increase Method
2) Geometric Increase Method
3) Incremental Increase Method

Table: 2 Population increase by incremental increase method

POPULATION PROJECTION					
SR NO	YEAR	TOTAL POPULATION	INCREASE IN POPULATION	INCREMENTAL INCREASE IN POPULATION	PERCENTAGE INCREASE IN POPULATION
1	1971	0	0	0	0.00%
2	1981	0	0	0	0.00%
3	1991	5142	0	0	0.00%
4	2001	8524	3382	0	29.02%
5	2011	10385	1861	-1521	13.69%
TOTAL			5243		42.71%
	AVERAGE		2621.5		21.36%
	SAY		996	capita/decade	

Table: 3 forecasting of population

POPULATION ADOPTED			
YEAR	2022	2037	2052
POPULATION	11381	14002.5	16624
SAY	11381	14003	16624

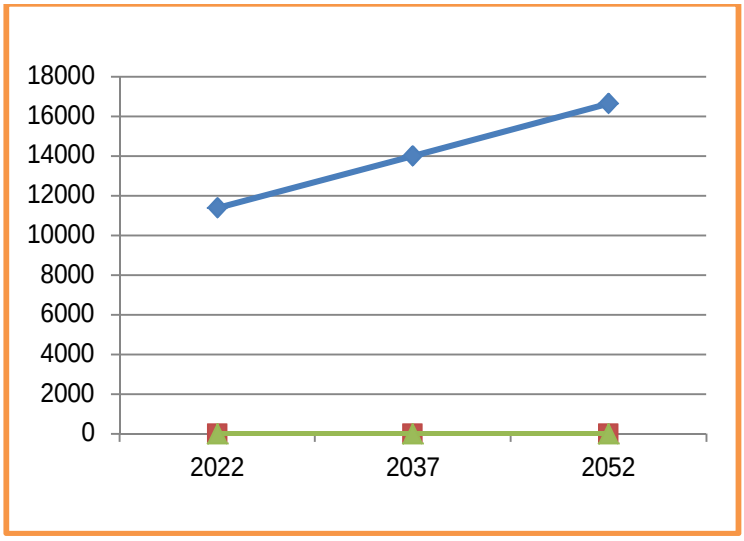


Fig: 1 Statistics of population increase

C. Density And Ward Wise Details

Table: 4 ward wise density of population

Density	Multiplier	Wards No's	No of ward
Low Density	1.10	1.2.3.4.5.6.7.8.9.10.11.12.17.18.21.22.23.29.30	19
Medium Density	1.14	13.15.20.24.25	05
High Density	1.24	16.27	02
Very High Density	1.31	19.26.28	03
		Total	29

D. Water Demand

Domestic demand for resident population - 135 v) Alternatives and Scenarios LPCD

Table: 5 demand of water for supply

The water demand has been calculated on the basis of 55 liters per head per day and 15% water losses have been considered. Water requirement for different stages of the scheme is details below…		
DEMAND ADOPTED		
VILLAGE NAME	YEARS/STAGE	DEMAND (KLD)
NIGHOJ	INITIAL STAGE YEAR 2022	736.3507
	INTERMEDIATE STAGE YEAR 2037	905.9941
	ULTIMATE STAGE YEAR 2052	1075.5728

DESIGN WATER DEMAND	1080 KLD

E. Losses In The System

The losses in the transmission and distribution are taken as 15%.

F. Demand Pattern

The supply of water is targeted for continuous 24x7 module, with peak factor of 3.0

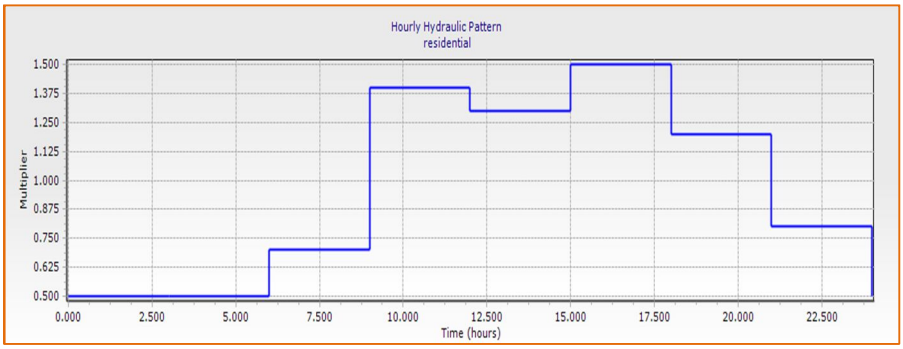


Fig: 2 Static variations in water flow of distribution system

G. Pumping Main

1) Design Hours - 20 hours

2) Pipe size – DI-K9 pipes up to and including 600 mm diameter.

3) Velocity - The design velocity in the transmission mains and feeder mains should preferably be not less than 0.8 m/s and in no case greater than 1.8 m/s.

4) Terminal pressure - The terminal pressure in the transmission mains at the point of discharge into various OHT reservoirs will be 2 m.

H. Sluice Valves

Table: 6 Types of sluice valve used

Sr No	Criteria	Diameter of Valve
1	For pipe size up to 300 mm	Same size as pipe
2	For pipe size Greater than 300 mm	Above 2/3rd of pipe size but minimum of 300 mm diameter

I. Air Valves

Air valves shall be provided at the high points in the pipeline. Size of air valve shall be D/4th to D/6th of pipe diameter, where D is diameter of pipe.

J. Data Analysis

1) Satellite Data Analysis

The IRS LISS-IV digital data covering study area was analysed and it broadly consists of following steps

a) Image processing and geo-referencing using GCP library.
b) Administrative boundary superposition on satellite data
c) Satellite data extraction covering study area using district boundaries.
d) Digital Elevation Models (DEM) generation using CARTOSAT data and LISS-IV data.

2) GIS Data

The GIS layers like roads transport network, water bodies, district boundaries, etc. were used in this study.

3) Google Image

The Google Earth Image of city was downloaded and the elevation of nodes, length of pipe was recorded for nearly 285 nodes and equal number of pipes. These data was used in WATERGEMS Software for analysis of pressure, head loss and elevation.

K. Equations Used In Watergems Software

Following are the equations with the help of which flow of water is calculated. Darcy-Weisbach equation is viewed by many engineers as the most accurate method for designing water distribution network their head losses in pipes.

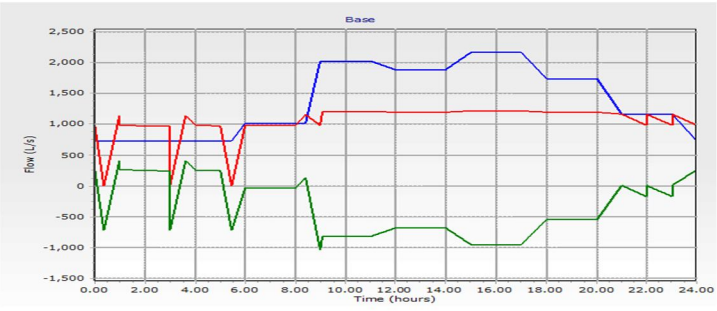
The Hazen-Williams Formula is frequently used in the analysis of pressure pipe systems.

1) Hazen-Williams Equation:- Q= k.C.A.R0.63.S0.54 Manning's equation is used for analysis of the roughness coefficient.
2) Manning's Equation:- Q= k/n. A. R2/3. S1/2
3) Darcy-Weisbach Equation:-hL= f LV2 / 2gd

V. RESULTS & DISCUSSION

Analysis Using Geo-informatics Technology and Water GEMS in Nighoj village" was carried out with the basic objective of analysing present water distribution system and method to improve it.

The population for city was estimated using Arithmetic Increase method, Geometric Increase method and Incremental Increase method. From that Incremental Increase method was used for next three decade estimation and for that population the water demand was estimated. The present pipeline network was analyzed using Water GEMS software, so that the idea of continuous water supply system can be implemented with proper pressure and without more head loss. The Google Earth image for city was downloaded and elevation of nodes and length of pipes was recorded for nearly 285 nodes and equal number of pipes. And these data was used in Water GEMS software for the analysis of pressure, head loss, etc. The Indian Remote Sensing (IRS) LISS-IV data covering city was analysed for understanding the road transport network, study area and various infrastructure in the city. This study indicated that the outcome result from Water GEMS software i.e.; pressure, head loss, etc. were checked with hydraulic equation and found. Velocity and flow in the buildings are also improved, owing to the increment of the pipe diameter in the mains, and also because of the continuity of the flow maintained. Following results shows the velocity in the **Nighoj village** after the dead ends are being connected and also after the pipe diameter is being increased.



A. Analysis of Project

Following steps are carried out to analyse the existing water distribution network using WATERGEMS

Step 1: Selection of study area as discussed in Study area is selected to fulfill the objectives. By using GIS and surveying the field with the help of Council Engineers and water supply staff, we track the entire water network starting from source to line before consumer end with the help of total station and also collect relevant data.

Step 2: Collection of data For hydraulic analysis in the WATERGEMS software, all the required data input data was collected from the grampanchayat Nighoj and tahsil office of Parner Taluka. Pipe data such as pipe diameter (mm), C-value, and length (m) are assigned to the network. ESRs details such as capacity, elevation, demand, etc. Are assigned. input data for ESRs, the existing network of water distribution network system of Rivet the description of pipes used in network.

Step 3: Construction of Model and its run Model is constructed using water gems software by giving all the necessary inputs as mentioned in step no.2 the constructed network of the water distribution system in the junction table pressure, demand, and hydraulic grade at the different junction.

Step4: Suggestion Additional storage will be required. Due to infrastructure development. A designed network that fulfils future demands.

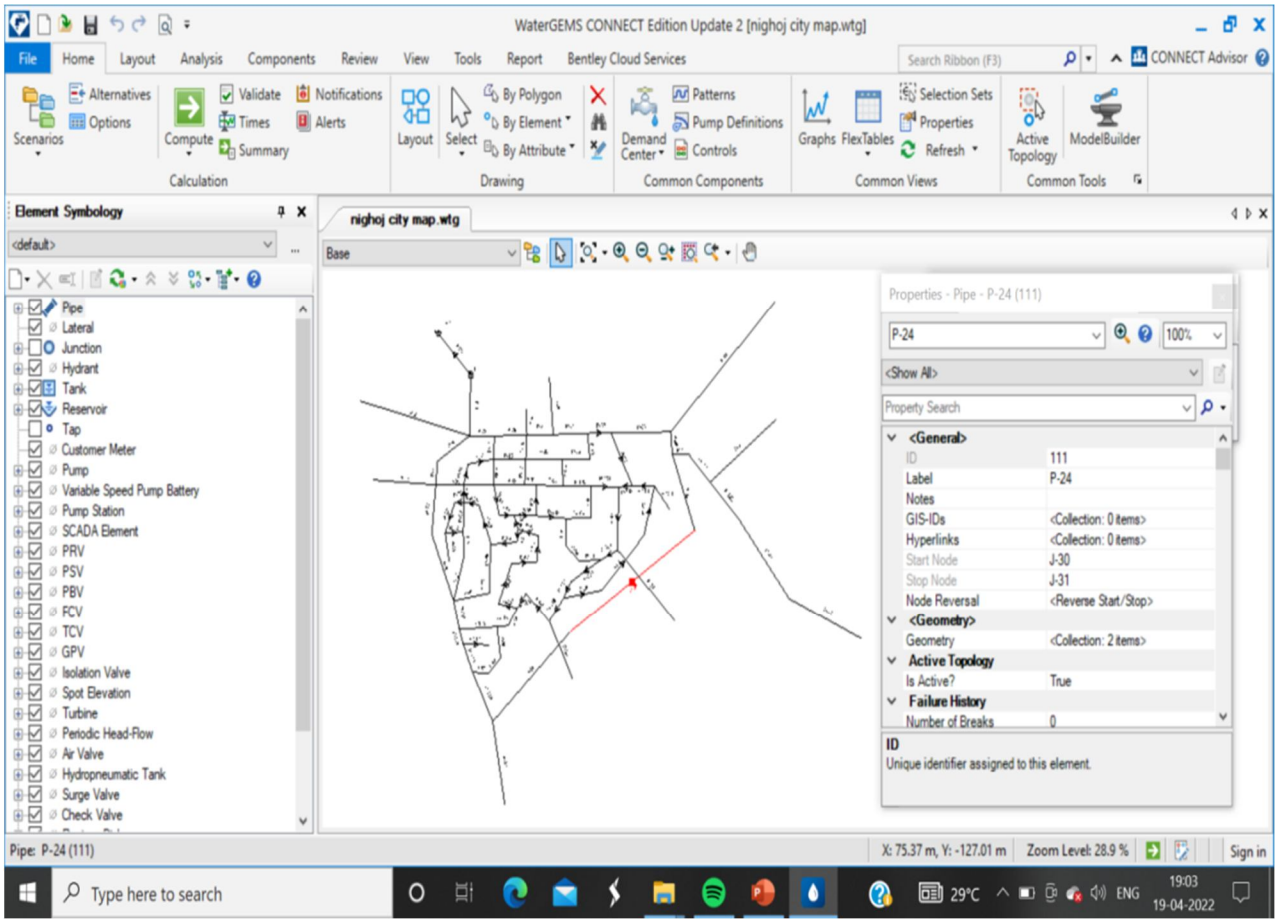


Figure 5.1 Showing the software interference of water gems

Further the nodes, from the main tank, lesser are the pressure. Also when there is more number of branches from the main pipeline, the pressure and other flow parameters get reduced. For building structures such as LT 2 and 3, Class IV staff quarter, and NK have lower pressure of 22.98m with velocity ranging from 0-0.03 m/s, as these buildings are far away from the overhead tank. The cause of pressure drop is also noticed to happen due to reduction of pipe diameters, which gets reduced from 65mm mains to 40mm and below in service lines inside the buildings and also because of lots of connections inside the building for which the pressure gets distributed. The negative sign in the flow values are shown in some of the pipes indicating the reverse direction of flow with respect to the ID numbering of the nodes. New pipe line network of selected area, nodes, junctions, tank, pump etc.

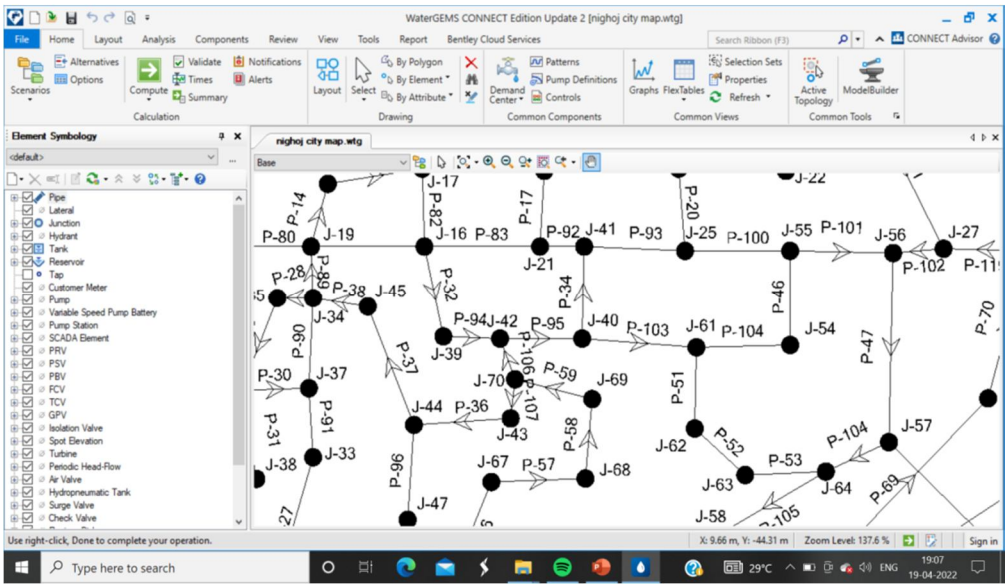


Figure 5.2. Connections of pipes, joints, flow direction, tank, pump.

VI. CONCLUSION

Now days, the concept of continuous water supply has generated significant interest in India due to its number of advantages over intermittent system of water supply. Presently there are number of continuous water supply systems designed and developed by using water gems software effectively. In Maharashtra state Malapert continuous water supply scheme effectively implemented which is designed in water gems. Design of continuous water supply system by using water gems becomes much more advantageous than manual process, as it minimizes the required time and gives accurate results within short period. Also it optimizes the distribution network on the basis of performance and cost. This study indicated that the outcome result from Water GEMS software i.e.; pressure, head loss, etc. were checked with hydraulic equation and found. Velocity and flow in the buildings are also improved, owing to the increment of the pipe diameter in the mains, and also because of the continuity of the flow maintained. The results show that the velocity in the **Nighoj village** after the dead ends are being connected and also after the pipe diameter is being increased. Further the nodes, from the main tank, lesser are the pressure. Also when there is more number of branches from the main pipeline, the pressure and other flow parameters get reduced. For building structures such as LT 2 and 3, Class IV staff quarter, and NK have lower pressure of 22.98m with velocity ranging from 0-0.03 m/s, as these buildings are far away from the overhead tank. The cause of pressure drop is also noticed to happen due to reduction of pipe diameters, which gets reduced from 65mm mains to 40mm and below in service lines inside the buildings and also because of lots of connections inside the building for which the pressure gets distributed. The negative sign in the flow values are shown in some of the pipes indicating the reverse direction of flow with respect to the ID numbering of the nodes. New pipe line network of selected area, nodes, junctions, tank, pump.

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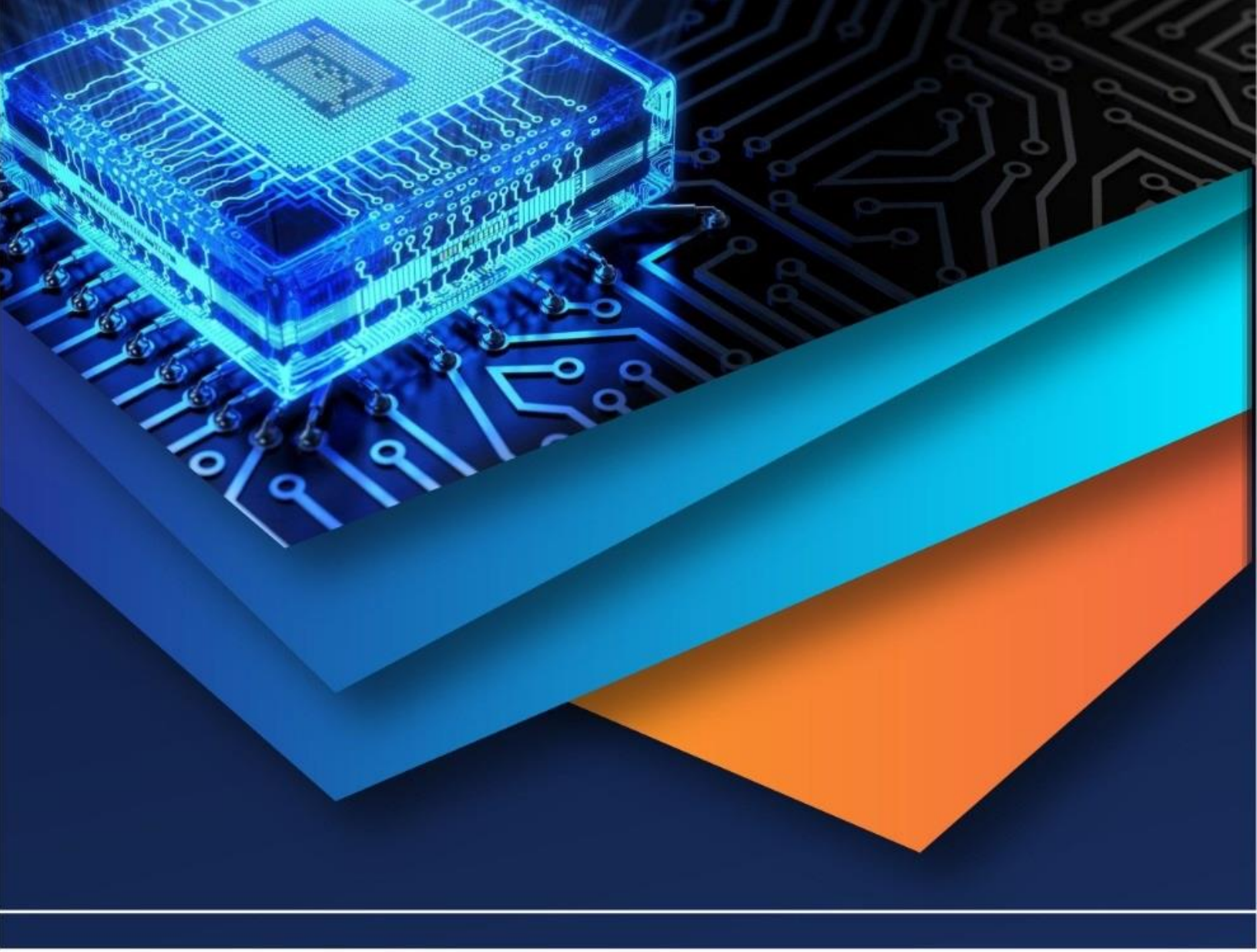

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