DESIGN OF WATER DISTRIBUTION NETWORK FOR KUSGAON VILLAGE BY USING WATER GEM SOFTWARE

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Abstract

Water is an essential element required for the sustenance of life. Demand for drinking is increasing on a continual basis with a corresponding increasing population. This ever-increasing demand can be fulfilled by designing efficient water distribution networks based on advanced computing systems including modern hydraulic modeling and designing software. In the present study water distribution network of the Kusgaon region of Maval is designed which is located in the district Pune. State Maharashtra, India. For the design of the Kusgaon water distribution network, study of present population, population of the three decades, daily water demand, flow characteristics, and also a survey of the village is done with the help of digital GPS .The water distribution network for the villages is analyzed and designed with the help of Bentleys WATERGEMS software. Water distribution network systems are designed to deliver water from a source in the adequate quantity, quality, and at satisfactory pressure to all individual consumers. Water distribution networks are designed with the objective of minimizing the overall cost while meeting the water demand requirements at adequate pressures. The system is a pipeline network consisting of one source node and several demand nodes is considered to find its optimal geometrical layout which delivers known demands from source to consumers over a long period of time.

Keywords: Pipeline Network, Water GEM.

I. INTRODUCTION

There are numerous constraints that have limited the progress in improving rural water supply. These constraints may be categorized as administrative, financial, and technological. Although most countries regard financial problems as the primary constraint, it is most important to design a water distribution network economically. The water distribution system comprises components such as water sources and intake work, treatment works and storages, transmission mains, and networks. The main objective of the water supply system is to provide the system with the cheapest cost. The distribution network may have a cost depending on the area's layout. Either looped or branched configuration of pipes is provided which depends upon the general layout of the streets in the rural area capital cost of the network.

Water GEMS is a hydraulic modeling application for water distribution systems with advanced interoperability, geospatial model building, optimization, and asset management tools. From fire flow and constituent concentration analyses to energy consumption and capital cost management, Water GEMS provides an easy-to-use environment for engineers to analyze, design, and optimize water distribution systems. A water distribution network is an essential hydraulic infrastructure that is a part of the water supply system composed of a different set of pipes, hydraulic devices, and storage reservoirs. The water distribution network connects consumers to sources of water using hydraulic components. Water distribution system infrastructure is a major component part of a water utility. A good distribution network system is essential to improve the efficiency of the water supply. Water distribution network systems are designed to deliver water from a source in the adequate quantity, quality, and at satisfactory pressure to all individual consumers.

A distribution network may have different configurations depending on the layout of the existing area. Generally, water distribution networks have a branched and looped type of configuration of pipelines. A network is said to be an optimal network in which layout is not fixed priori but it is allowed to vary in order to obtain the optimal solution. The task to be performed in this context involves the resolution of two problems which are layout and design. Water GEMS software is developed for the design and analysis of water supply networks. The software is also used for the expansion of the existing water distribution network. The software provides a required standard and economic environment for the design, analysis, and troubleshooting of new and existing supply networks with minimum time duration. The water GEMS software algorithm is based on the Gradient method. Water GEMS software gives optimal solutions irrespective of the type of network i.e., the network may be a branched network, looped network, or a combination of branched and looped networks. In other words, Water GEMS software gives solutions to any simple or complex network. The key feature of Water GEMS software is that it can be used to accurately simulate a network before it has been built or modified. Since Water GEMS is computer-based software, while simulation of network it can easily identify potential problems and nullify them within an interactive environment so that expensive errors can be avoided. Water Distribution Networks (WDNs) serve many purposes in addition to the provision of water for human consumption, which often accounts for less than 2% of the total volume supplied. Piped water is used for washing, sanitation, irrigation, and firefighting. Networks are designed to meet peak demands. The purpose of a system of pipes is to supply water at adequate pressure and flow However, pressure is lost by the action of friction at the pipe wall. The pressure loss is also dependent on the water demand, pipe length, gradient, and diameter. Several established empirical equations describe the pressure–flow relationship these have been incorporated into network modeling software packages to facilitate their solution and use.

II. PROBLEM STATEMENT

Water is one of the most important natural resource and water scarcity is the most challenging issue at a global level. The water is most crucial for sustaining life and is required for almost all the activities of humankind, i.e., industrial use, domestic use, for irrigation; to meet the growing food and fiber needs, power generation, navigation, recreation, and also required for animal consumption.

•This project is being implemented to design the water supply system, minimize leakage, and optimize the water availability to consumers.

•It was also intended to check the capability of the water supply system components and optimize the cost of the project.

III. OBJECTIVE

Water distribution networks are designed with the objective of minimizing the overall cost of the network while meeting the water demand requirements at adequate pressures for specified maximum design discharge and also to provide the possible minimum length of the network whose operation and maintenance should be low and economical.

•To calculate the water demand of the Area.

•Convert irregular water supply to continuous water supply.

•Zoning of rural area on the basis of elevation and population density

•To study hydraulic parameters required for the design of water distribution system of the study area.

•To design the water distribution network.

IV. METHODOLOGIES

There are numerous constraints that have limited the progress in improving rural water supply. These constraints may be categorized as administrative, financial, and technological. Although most countries regard financial problems as the primary constraint, it is most important to design a water distribution network economically. The water distribution system comprises of components such as water sources and intake work, treatment works and storages, transmission mains, and networks. The main objective of the water supply system is to provide the system with the cheapest cost.

The distribution network may have a cost depending on the area's layout. Either looped or branched configuration of pipes is provided which depends upon the general layout of the streets in the rural area

Study Area and Data Collection:

The Kusgon village area is selected for the study area which is located in Maval Taluka of Pune district . The area of the village is 342.76 ha (847 acres) having a population of 1574

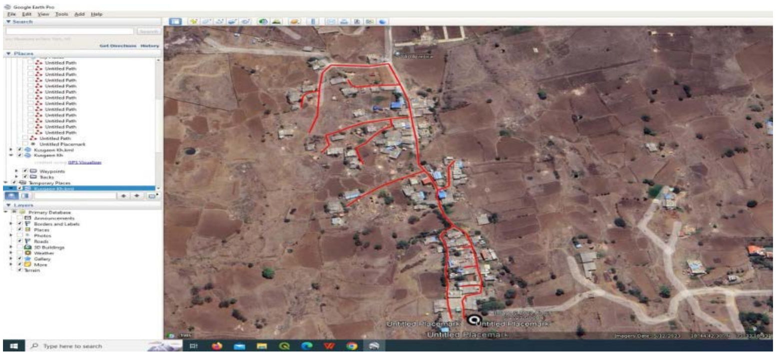
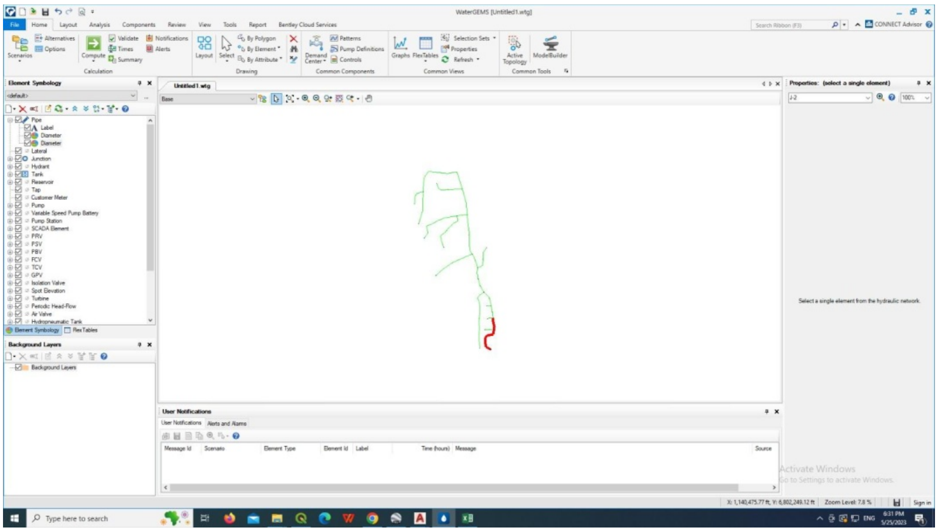


Fig. The study area of the village on Map

Watergem provides you with a comprehensive yet easy-to-use decision-supportive tool for water distribution network. Follow image is water GEMs window,



Steps for designing the Distribution Network -

1. Collected data of KUSGAON village AREA
2. Census-based GIS and elevation Zoning
3. Calculate demand method.
4. Draw the area by using Google Earth.
5. Import all data in Water GEMS.
6. By using CAD design optimized water distribution network.
7. Validate and compute the network in this study.

V. RESULTS

Kusgoan village is situated in Pune district of Maharashtra state. The source for study area of ESR is located in kusgaon village. In the area pipes are laid of various materials for the distribution system. Primarily, reservoir was a focal point from where the pipes and nodes will be drawn through Water GEMS software. Elevation and flow direction were automatically taken from the input parameters by the software.

As shown in figure pipe line network of selected area ,nodes , junction,

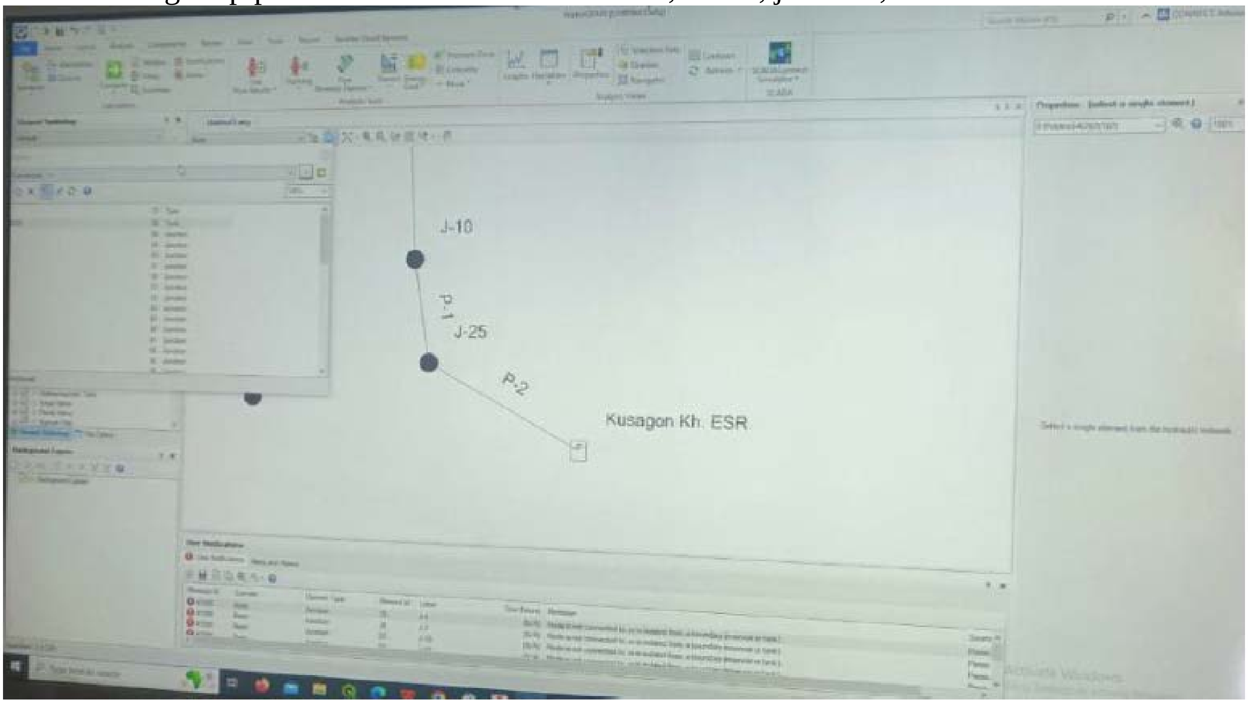


Fig. Pipe Line Network

Length, Diameter, Elevation, etc. these are inputs, and get result as shown below,

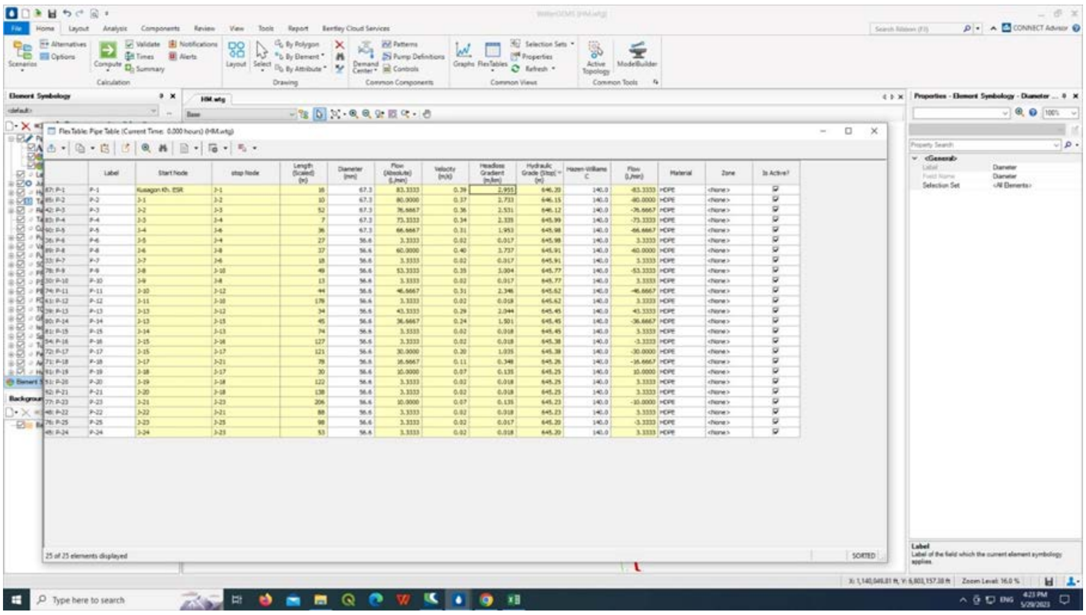


Fig. Input Table

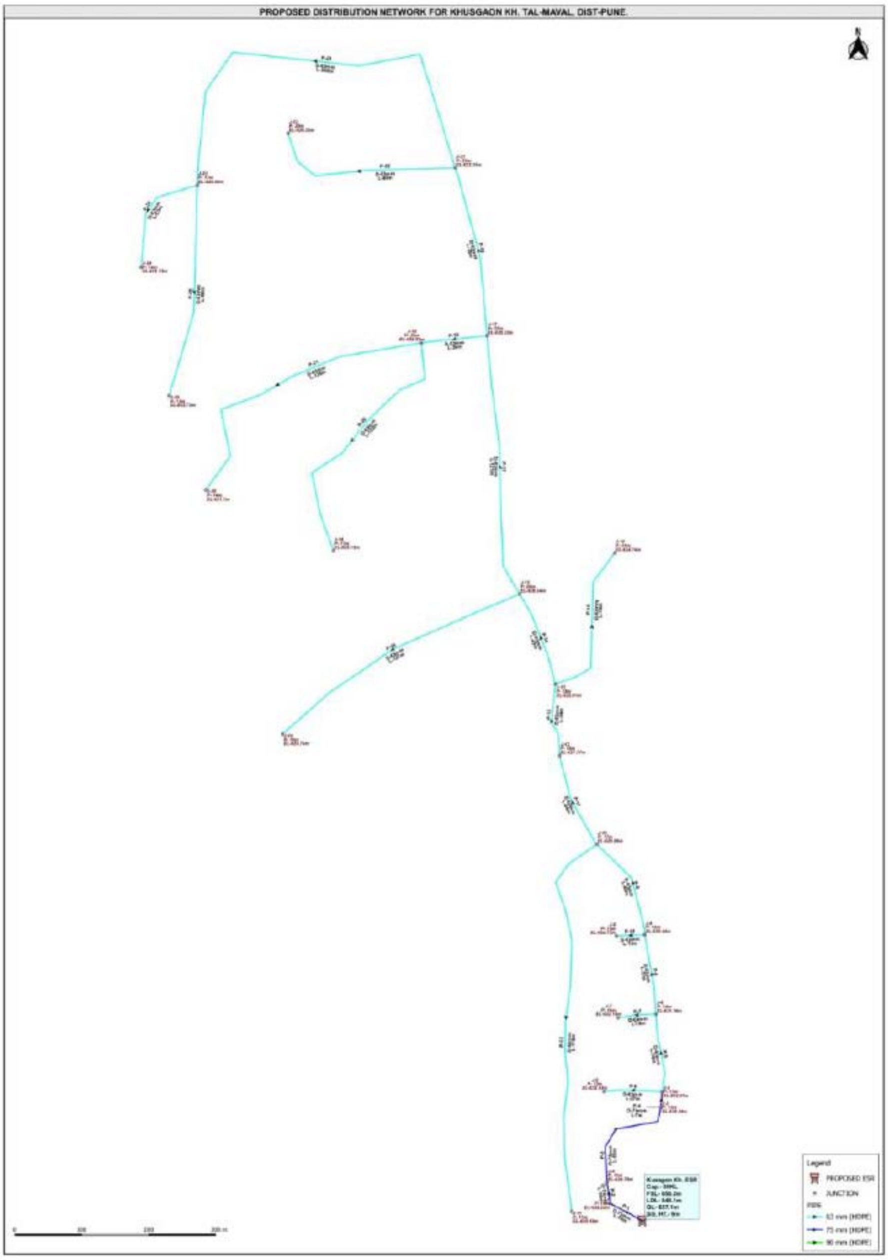


Fig. Output of Water GEM

In the given network the ductile iron pipes are used and the different colors of pipe show different diameters and for distribution of pipe the radial method is used. In the given network different diameter of pipes are shown in different colors and the details are as shown in tables.

I. Color Coding of Pipe with Diameter

Sr. No.	Diameter	Colors
1	63 mm	Blue
2	75 mm	Violet
3	90 mm	Green
4	110 mm	Red

VI. CONCLUSIONS

In this project Water GEMS software is used for obtaining optimal design of water supply network of a part of kusgaon village. The software also gives different alternative optimal design solution considering pipe diameters and pipe material. The WaterGEMS software provide required standard and economic environment for design, analysis and troubleshooting of new and existing supply network with accuracy and minimum time duration. The software is also used for solving problems in existing network and also in expansion of existing water supply network. With the help of Water GEMS software an optimal water distribution network is designed and also helps in achieving objective of minimizing the overall cost while meeting the water demand requirements at adequate pressures for specified maximum design discharge over a long period of time. In this project Water GEMS software is used for obtaining optimal design of water distribution network of a part of kusgaon village. The software provides required standard and economic environment for design, analysis and troubleshooting of new supply network with minimum time duration.

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