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DESIGN AND ANALYSIS OF WATER SUPPLY NETWORK AT RURAL AREA USING SOFTWARE JALTANTRA

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Abstract - *A water distribution system is designed with considerations of various faction including expansion of investments, future and present water demands, pipe dimensions, and reservoir locations, all withing the limits of fixed budget limitations. However, while designing the same system manually the work load becomes humongous. To mitigate this scenario, the invention of water distribution system became vital. Since many existing are either outmoded or beyond one`s means. Hence, Jaltantra, open technology platform, was created by IIT Bombay scholars, with suggestions from Maharashtra Jeevan Pradhikaran (MJP) engineers, with an intension of wide academic adoption and government utilizations. Jaltantra`s optimization algorithm considers pipe and energy costs, and future versions will inculcate GIS based demand allocation and diverse data visualizations. This review paper presents Jaltantra`s capabilities through a case study, showcasing its capacity in optimizing water distribution systems effectively.*

Key Words: Jaltantra, waster distribution system, Maharashtra Jeevan Pradhikaran, pipe diameter, cost optimization, water demand.

1.INTRODUCTION

Government bodies of Idia experience a challenge in ensuring the quality of drinking water reaching to citizens simultaneously maintaining budget guidelines. Engineers under such circumstances often approach with inadequate tools which prioritise pipe diameter selection but neglecting other important components of the water distribution system. There upon, much of the designing process relies in the impromptu methods or on engineer`s instincts perhaps. To solve this problem, Jaltantra was created to assist government engineers in determining various water network parts, including tanks, pumps, valves and pipe diameters. By introducing an integer linear program model, Jaltantra is able to produce an optimised, efficient and precise results with the help of streamlined design process.

The Maharashtra Jeevan Pradhikaran Is responsible for the development of multi village piped water schemes in Maharashtra. The engineers in MJP with a work force of over 1,500, imply complex decision-making progress which impacts the project costs. The MJP has matriculated the design of more than 11,000 rural water distribution schemes, aligning each design with government guided budgets for affordability and service quality. Generally, in gravity fed branched network are preferred over cyclic networks because of their cost effectiveness and unreliability of electricity supply. Contrary of decades of research on cost optimization, existing softwares like BRANCH, EPANET, and WaterGEMS predominantly focus pipe diameter selection, often ignoring critical components. Jaltantra mitigates this limitation by improvising cost optimization for pipes and tanks, with ongoing improvements to include pumps and valves, considering both capital and operational cost.

2.OBJECTIVES

[1] Study and analysis of data of water distribution system of selected area.

[2] Study of pipe and junction report of the system.

[3] Understanding the working and concepts of modelling and analysis of Jaltranta.

[4] Study and analyze the existing water distribution system.

[5] Optimization of existing water distribution system.

3.REVIEW OF MODELLING SOFTWARE

The Jaltantra software integrates multiple aspects of network design including important parameters like geographic data population distribution and water demand while adding constraints such as budget limitations and terrain characteristics. By using sophisticated optimization algorithms like integrated linear programming Jaltantra processes this data to find optimal solutions considering factors like pipe diameter pump locations and storage time capacities to reduce cost while aligning with the specified requirements such as budget constraints. Its significant advantage lies in the capacity to heuristically optimize cost factoring the capital and energy cost associated with infrastructure By carefully selecting the optimal design alternatives and providing the intuitive visualization and analysis tool Jaltantra helps engineers and planners in developing a very efficient water distribution network its

features help sustainability promote enhanced efficiency and offer a user friendly interfere interface contributing to improved water management practices and long term sustainability.

4. METHODOLOGY

4.1 AREA OF STUDY

The area selected for this project is Ramtek, a taluka place situated at 50km North- East of Nagpur ($21^0$23N and $79^0$19E). The town experiences maximum rainfall of 2082.50mm and has an estimated population forecast of 30863 people in total for the year 2050. The first regular water supply scheme was commissioned in the year 1973. The source of water supply scheme was considered on the right bank canal of Khindsi lake at a distance of 310m and about 30 m upstream if the existing canal gate of dam.

4.2 DATA COLLECTION

The data like, node names, water demand, elevation, head, pressure, minimum pressure in input in Jaltantra database. The below figure describes and showcases a model distribution water in the selected area. The user interface of the Jaltantra makes it easier for the user to input the date and analyse it easily.

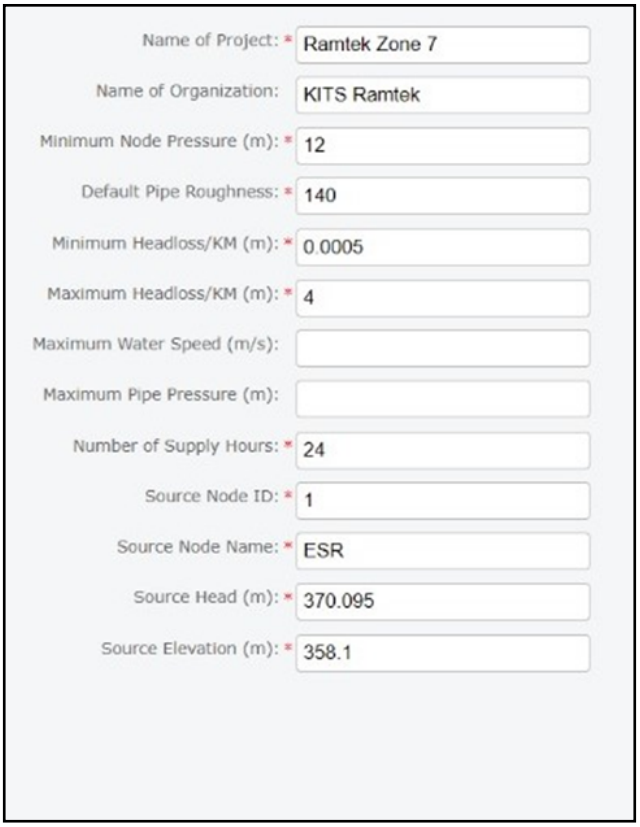

Fig -1: Data input interface

4.3 DATA ANALYSIS

After the data has input , Jaltantra simulates the date and using Hazen William`s equation it calculates the cost of pipe at each node.. Jaltantra after analysing the data it shows the data in various forms like graphs showing head loss and nodes with their pressure head.The below pictures represents the simulated data analyzed by the Jaltantra.

Fig -2: Analyzed data

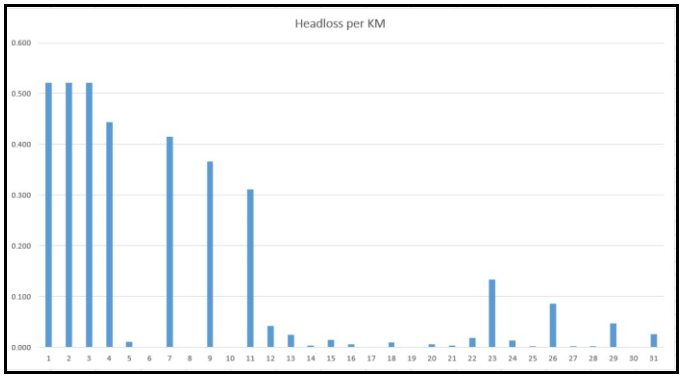

Fig- 3: Headloss per KM

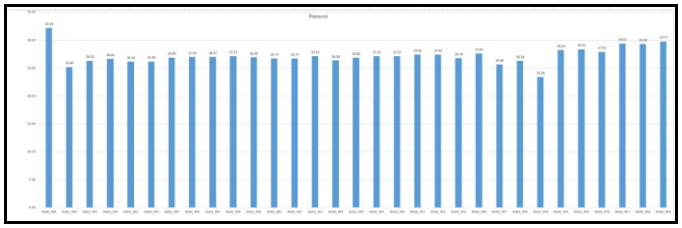

Fig- 4: Nodes and Pressure head

4.4 CALCULATING THE COST OF WATER SYSTEM MANUALLY

The cost of the existing water distribution system is calculated in the excel format with all the required data such as water demand, pressure, elevation, etc. The cost of pipe and discharge is also calculated using cost parameters of pipe.

$$C_m = K_m L_i D_i^m ,$$

Where,

K_m and m = Cost parameter for pipe,

L_i = Length of i^{th} pipe,

D_i = Diameter of the i^{th} pipe.

4.5 COMPARING THE RESULTS

After having calculated the cost of the water distribution system by both means, manually and with the help of Jaltantra, a comparative study is done to understand the optimization in results.

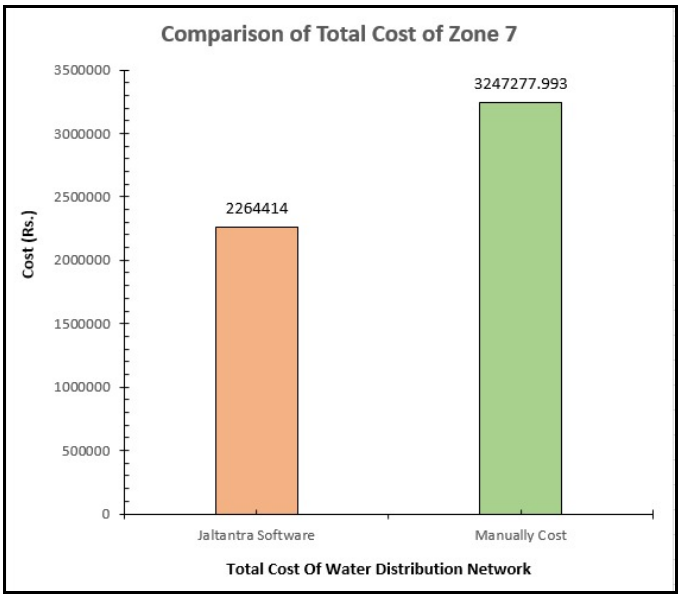

Fig- 5: Comparison of total cost

5. CONCLUSIONS

[1] After conducting this extensive comparative study, it became evident that various factors are responsible for the selection of an effective water distribution system software, such as availability of the software, compatibility and user-friendly description, application of optimal methods.

[2] As accuracy and precision is of prime importance the sped in calculating the results are also of same importance, there an application with such capabilities is in demand.

[3] Though most of the software have almost every feature which is required to design an optimal waster distribution network the free public domain availability is what that makes Jaltantra an inevitable choice.

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