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REVIEW STUDY: EXPERIMENTAL INVESTIGATION BY WATERGEMS SOFTWARE FOR REDESIGN OF WATER DISTRIBUTION SYSTEM OF BHAVANI MATA ESR

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ABSTRACT

Water is an essential element required for the sustenance of life. Demand for drinking water is increasing on continual basis with corresponding increase in population. This ever increasing demand can be fulfilled by designing efficient water distribution networks based on advance computing systems include modern hydraulic modelling and designing softwares.

Decision variables involves are pipe diameter, reservoir elevations and reservoir capacity etc. with flow as primary variable. 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 NASHIK city is designed by WaterGEMS software.In this paper design of water supply network duly considering optimization in addition to the cost minimization, minimum head requirement is presented. Gradient method is one in which the pipe discharges and nodal heads are taken as the basic unknowns in formulating the Q-H equations. The non linear Q-H equations for the pipe head loss are linearized and solved by Gradient method. WaterGEMS software algorithm is based on Gradient method gives optimal solution for the design of new as well as expansion of existing water supply network.

Keywords: Watergems Software, Gradient Method, Water Supply Network, Optimization, Water Quality Analysis

I. INTRODUCTION

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 (Webber, 1971) and

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these have been incorporated into network modeling software packages to facilitate their solution and use. There is still not a convenient evaluation for the reliability of water distribution systems. Traditionally, a water distribution network design is based on the proposed street plan and the topography. Using commercial software, the modeler simulates flows and pressures in the network and flows in and out to/from the tank for essential loadings.

Water distribution networks play an important role in modern societies being its proper operation directly related to the population's well-being. However, water supply activities tend to be natural monopolies, so to guarantee good service levels in a sustainable way the water supply systems performance must be evaluated. The incorporation of performance assessment methodologies in the management practices creates competitiveness mechanisms that lead to the culture of efficiency and the pursuit of continuous improvement.

The primary task for water utilities is to deliver water of the required quantity to individual customers under sufficient pressure through a distribution network. The distribution of drinking water in distribution networks is technical challenge both in quantitative and qualitative terms. It is essential that each point of the distribution network be supplied without an invariable flow of water complying with all the qualitative and quantitative parameters. The water supply in most Indian cities is only available for a few hours per day, pressure is irregular, and the water is of questionable quality. Intermittent water supply, insufficient pressure and unpredictable service impose both financial and health costs on Indian households. Leakage hotspots are assumed to exist at the model nodes identified. For this study area Bhavani Mata E.S.R. zone of Nasik City has been identified and the network model for the area under consideration will be prepared and studied for water losses.

II. LITERATURE REVIEW`

Thomas M. Walski, Water Distribution System Analysis before Digital Computers,(August 27-30, 2006): *This paper traces the development of analysis from Archimedes and the Roman aqueducts, through the development of principles of fluid flow by Newton, Bernoulli and Euler to the development of head loss equations by Chezy, Darcy, Weisbach, Hazen, Williams and Moody. It then looks at how principles developed for individual elements where combined to solve network problems by Cross and the subsequent development of analogy computer methods. With the coming of digital computers, water distribution system analysis has become significantly more powerful because of the ability of modern computers to handle computations much more quickly than could be handled with manual calculations.*

P. Romero-Gomez, C. Y. Choi, B. van Bloemen Waanders, and S. McKenna, Transport Phenomena at Intersections of Pressurized Pipe Systems (August 27-30, 2006): *The present parametric study focuses particularly on pipe intersections to characterize complex mixing phenomena in pressurized water distribution pipe networks. Selected computational results are compared with experimental results. The present study addressed complex transport phenomena at four-pipe cross junctions, which are commonly found in municipal drinking water systems. Simulations using computational fluid dynamics (CFD & a series of experiments were employed to address (i) existing problems based on the perfect mixing assumption in network water quality models and (ii) potential approaches for its revision. The analysis presented in this paper is part of the efforts for an accurate modelling of water quality. As utilities change from having a single mission of supplying water*

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to consumers to also having a security mission, the computer modelling tools used for network analysis will have to evolve to better simulate solute transport.

Shriram Vaijapurkar, Siddharth Vaijapurkar. Study of Ancient Water Storage System on Forts in Nashik District of Maharashtra (25-27 JUNE 2007): *The presented paper is an attempt to explore these springs and water bodies along with their technical facts. Our culture, tradition and a rich heritage teach us lot many new techniques of water conservation and harvesting of rainwater. The need of hour is to have the deep sense of responsibility, a searching vision and an erg to explore these facts. Traditional systems doesn't mean that they are old and not useful. These are different than that of constructed and maintained by the government agencies. The modern systems are costly and some time may cause harm to environment. The water available from those systems is used for farming and other commercial works. Modern techniques do possess negative image in the mind of common man and society. It is also the truth that these systems have made the farmers and other society, a dependents on Government*

Sajedkhan S. Pathan, Dr. U. J. Kahalekar, Design of Optimal Water Supply Network and Its Water Quality Analysis by using WATERGEMS, (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. In this paper WATERGEMS software is used for obtaining optimal design of water supply network of a part of Aurangabad city. With the help of WATERGEMS software design of optimal water supply network and its water quality analysis is 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 is also used for solving problems in existing network and also in expansion of existing water supply network.*

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III. METHODOLOGY

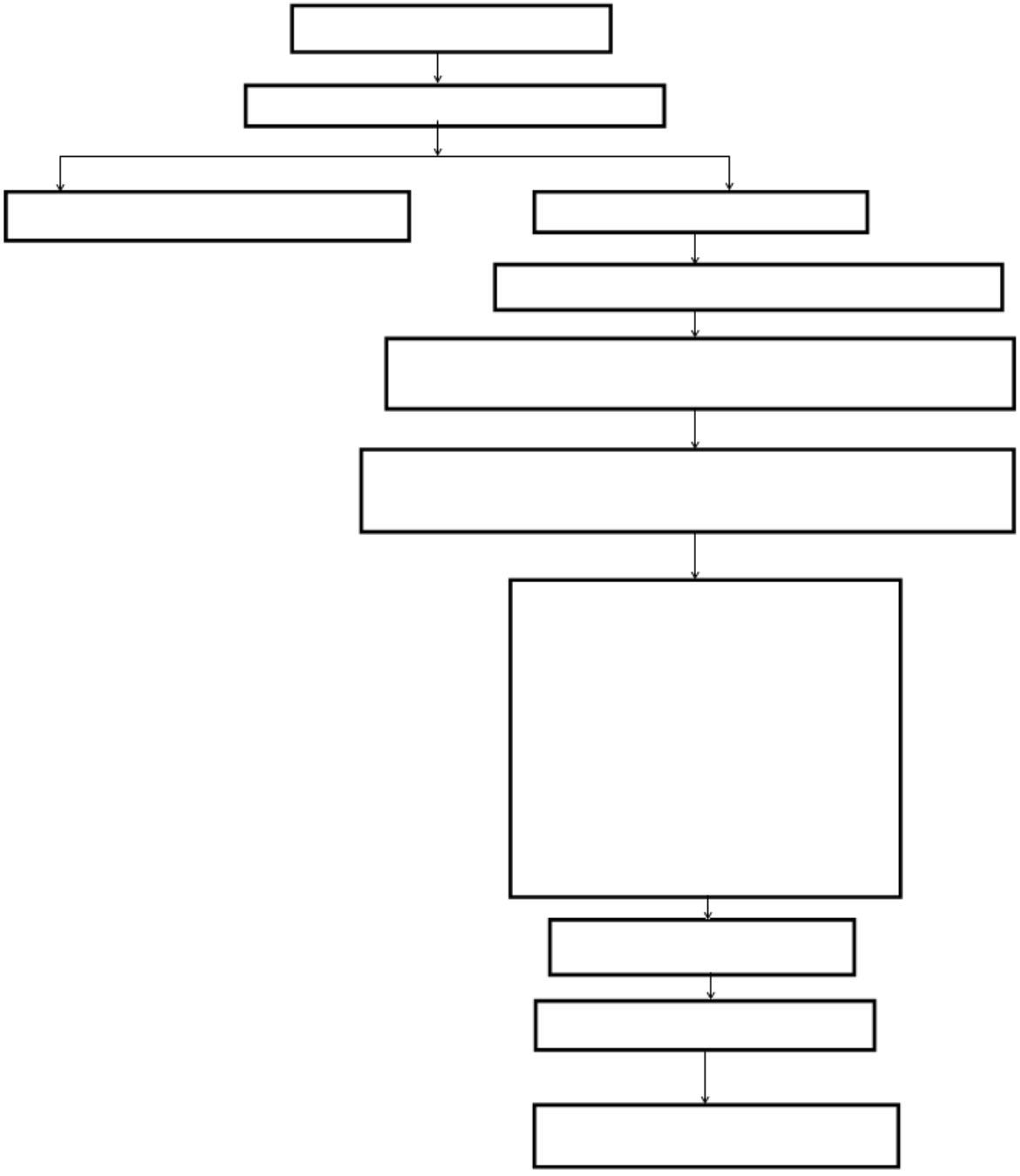

Fig.1. Flowchart for Methodology

WATERGEMS *software algorithm is based on Gradient method gives optimal solution. The software creates the network and by use of Model Builder transfers existing data on network then applies elevation data with Terex and take the demand using Load Builder and lastly goes for simulation of network for giving optimal design of water supply network.*

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IV. EXPECTED RESULTS

The proposed optimized design done will give an output or result with minimum head loss and economical diameter. In accordance with these appropriate head will be achieved with passage of desired flow at sufficient velocity through the pipe system. Overall about 70% of uniform pressure will be obtained for larger portion of command area. Variations in head, velocity and unit head loss during peak hours will be observed within standard criteria.

In this project 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.

The WATERGEMS software will provide required standard and economical 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.

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