Comparative analysis of Water Distribution Network system remodelled by EPANET and LOOP Program

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Abstract: *The study involves the remodeling of the existing network of Zone 20 of Gulbarga city. The existing network is old and inefficient with providing water with desired pressure to the consumersthe remodeling of the network is carried out by using EPANET and Loop Program. And both the results are subjected to a comparative analysis.*

Keywords: *Water distribution network, EPANET, LOOP Program, water supply, pressure head, remodelling.*

I. INTRODUCTION

Water is the fluid of life, a primary requirement and a major factor effecting public health, Since the beginning of life on earth and until this age of industrialization, the determination of Exact degree of the requirement and importance of water is a major issue, With the increase in demand of water and increase rates of depleting groundwater and deterioration of water quality. It is imperative to develop such a system which effectively provides water with desirable quantity, quality and meeting the demands of public. Recent developments involve the use of softwares for simulating the hydraulic and water quality simulation

The water to be served should be free from Pathogens, micro organisms and impurities and to achieve this, the water has to undergo certain purification measures. Water before being undertaken into a network system is exposed to the atmosphere containing impurities and this exposure is harmful to any living organism consuming water. Hence in order to keep the water clean , it is undergone certain purification measures taking into account the physical properties of water and as far as chemical properties are concerned chlorination is highly recommended, which is a common and a cheap disinfection method.

II. STUDY AREA

The Project area for the study is under zone 20 under the 'Water supply board' of Gulbarga city , this zone is comprised with two ward numbers namely ward number 26 and ward number 27 the area under zone 20 is Mominpura ,this area lies under the jurisdiction of Gulbarga(Kalaburagi) Municipal corporation.

Fig.1 Location of Zone 20 WDNs

III Methodology

About EPANET: EPANET is a computer based Program, performing a stretched out simulation or an extended period simulation in hydraulic and water quality performance within a network of pressurized pipes.

The conservation of energy and the continuity equation are the basic principles on which EPANET network analysis is based on, the continuity equation implies that "The algebraic sum of the flow rates in the pipes meeting at a node together with any external flows is zero. And the conservation of energy states that, the conservation of energy theory states that, "The overall energy losses obtained including the minor losses for all the closed loops minus any energy gain or head generated must be equal to zero. The

Hazen – William's equation for Head loss is one of the equations which is incorporated in the Software for the calculation of the Head loss due to friction.

$h_f = 10.69 [Q/C_{HW}]^{1.852} D^{-4.87} L$

Where C_{HW} = Hazen – Williams coefficient, L = Pipe length, Q = flow rate in the pipe (m^3/s) , h_f = head loss (m)

The flow continuity and head loss equations are solved by an algorithm incorporated in the EPANET software which is based on "Newton – Raphson iteration method" which simultaneously solves the equations derived from the flow and head loss from the network.

About LOOP Program:

The LOOP version 5.0 is a program which was developed by World Bank and is a program written in BASIC and is a menu driven program. It involves the simulation of Hydraulic behaviour of a particular water distribution network. Water distribution network. The concept on which LOOP Program is based is same as it is for EPANET .i.e. satisfying the continuity equation and conservation of energy theory, The Pipe flow rates and pressure head at the outflow points of the pipe of a looped network must satisfy the continuity equation and conservation of energy theory. In LOOP Program, the system of pipes forms a closed circuit or loop and the junctions of the loop are the outflow points of the pipe system. The whole concept is worked out by Newton Raphson iterative method.

IV: Work Carried out

The existing network is a zone 20 of the water distribution network scheme of Water Board of Gulbarga ,coming under towards namely ward number 26 and approximately half portion of ward number 27, the existing network consists of total 108 pipe links of GI material majorly 90 mm and 75 mm diameter with Roughness coefficient of 130 and 73 nodes/ junctions fed by the Mominpura Tank , the study of this zone shows uneven distribution of water due to the combination of old pipes and the new pipe material , further consultation of the residents of the zone reveals that an average water pressure was found to be around 1m and water quality found was un satisfactory.

The remodeling of the entire network of the zone 20 is done on EPANET and LOOP Program , by using the survey elevation data , determining the pipe lengths of the entire network , nodal demands or the average demand for the Projected population for 30 years i.e. for 2041 , selecting HDPE pipes and Roughness factor as 145 , Hazen – Williams equation for Determining pressure head loss , the softwares are run and the network is remodeled by choosing pipe diameters on the basis of minimal residual pressure ,i.e. pressure at all the junctions of the pipes should not be less than 7 m , optimizing the network by using pressure as the parameter. Population considering unaccounted water for 10%.and 1.10 as multiplier

The results for pipes and nodes for EPANET and LOOP Program were obtained. At the end of the analysis it was found that the resulting pressures at all the junctions and the flows with their velocities at all pipes are adequate enough to provide water to the study area. Further the analysis was carried out to determine the difference in the design of the softwares and to know which remodeled design is more efficient with respect to hydraulic characteristics of the network and most economical with respect to the overall cost of the project. The Table1 show the difference in diameters of pipes of EPANET AND LOOP Program. Further it can be noted that the pressure head at the nodes of the critical pipes mentioned in the Table2 and Fig1 by EPANET and LOOP Program are well within the prescribed limitations as per CPHEEO.

Table1. Comparison of diameters obtained from EPANET and LOOP Program.

Pip-e ID	Pipe Diameters for EPANET(mm)	Pipe Diameters LOOP Program(mm)
1	225	280
2	225	280
3	200	250
5	110	125
7	140	160
8	125	140
9	140	160
11	180	200
13	180	200
14	180	200
15	180	200
16	125	140
24	125	140
25	125	140
43	110	125
49	110	125
52	110	125
53	110	125

55	125	140
57	140	160
63	125	140
65	160	180
78	110	125
80	125	140
85	110	125
104	180	200
105	140	160
106	125	140
108	160	180
109	140	160
103	110	125
89	110	125

Table2. Comparison of pressure heads

Junctions	Pressure head (EPANET)	Pressure head (LOOP Program)
Node ID	m	m
Junc 2	12.16	11.04
Junc 3	11.41	11.44
Junc 4	12.21	11.92
Junc 5	13.81	13.65
Junc 6	14.03	13.93
Junc 7	14.75	14.68
Junc 8	15.70	15.81
Junc 9	17.07	17.24
Junc 11	12.90	12.61
Junc 12	13.87	13.32
Junc 14	13.26	13.08
Junc 15	13.30	13.12
Junc 16	15.97	16.10
Junc 29	16.42	16.53
Junc 30	17.11	17.19
Junc 31	16.93	17.04
Junc 34	16.46	16.55
Junc 35	16.07	16.07
Junc 36	12.20	11.88
Junc 37	14.90	14.84
Junc 38	14.80	14.74
Junc 42	14.09	14.12
Junc 44	12.25	12.19
Junc 45	11.96	11.90
Junc 46	11.96	11.91
Junc 47	13.99	13.97
Junc 48	13.54	13.73
Junc 50	12.12	12.21
Junc 51	12.09	12.19
Junc 52	16.03	16.08
Junc 54	14.43	14.42
Junc 69	10.61	10.61
Junc 70	12.09	11.98
Junc 74	11.92	11.71

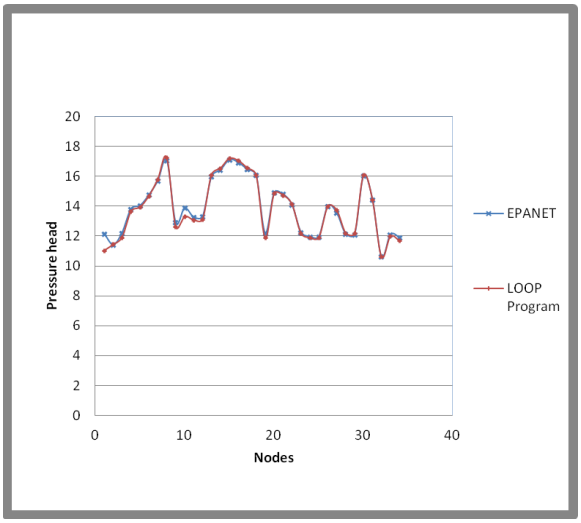

Fig1. Comparison of EPANET and LOOP Program with respect to pressure heads

V: CONCLUSION

The existing network is remodeled by using EPANET and LOOP Program, the remodeling was successful fulfilling all the hydraulic needs of the network, further the remodeled design of both the softwares were compared and analysed and was found that EPANET was more efficient in designing and more cost effective comparatively. The cost estimated by EPANET is Rs 21, 27,087 and by LOOP Program is Rs 23, 87,726.

VI: REFERENCES

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