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DESIGN OF WATER DISTRIBUTION NETWORK SYSTEM BY USING BRANCH SOFTWARE

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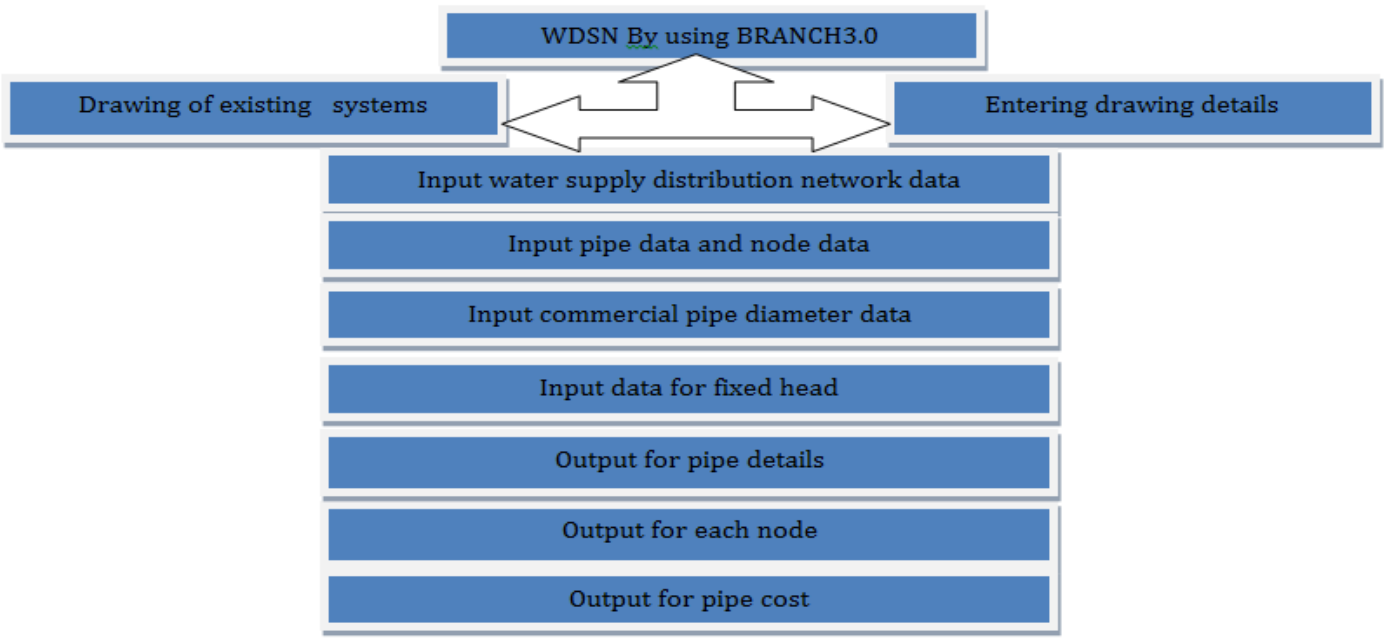
Abstract:- *In India we are facing drinking water problem in village areas. Providing sufficient water of appropriate quality and quantity has been one of the most important issues in human history so as to ensure availability of drinking water effective utilization is prime important. Hence the research is all about the analysis of the existing network and concludes about the reliability on the network for the future. For this study, water supply distribution network is designed for population estimated to future 2 decades. The heuristic software BRANCH 3 has been used for designing best economical water distribution system.*

Key words: water distribution network, BRANCH, flow, ESR (Elevated Service Reservoir)

1. INTRODUCTION:

The rapid rate of urbanization in India is resulting in many Indian. Cities facing major challenges of providing their increasing populations with adequate and sustainable water services. Most of the Indian cities are having intermittent supply with once in two days to one in week at many parts of the city. Distribution networks are an essential part of all water supply systems containing pipes, pumps and valves of different types, which are connected to each other to is an important element in WDS network, the primary aim of a water distribution system (WDS) is to deliver water from water sources to intended end points while meeting the specified requirements in terms of water quantity quality and pressure. Analysis and design of complex piping networks can be tedious, especially if the networks consists of large number of pipes and system appurtenances. Manual calculations may not be practical to obtain results simultaneous and repetitively. BRANCH 3.0Software is help to prepare and visualized the entire water supply network from source to household. The supplied water should be good in quality and sufficient in quantity. In this work, the present study area is residential ST colony of tuljapur town an existing network is old, it results in frequent breakouts and low pressure problems. Hence it is required to be optimized using BRANCH3 software for its better performance.

1. The flow sheet shows working of BRANCH software:



2. DATA COLLECTION: The tuljapur city is divided into various VII zones for proper distribution of water. The economical water distribution system is designed in the present study for zone II for ST Colony at tuljapur city. For design a water distribution network of residential ST Colony in tuljapur town the following data were obtained from MJP (Maharashtra Jeevan Pradhikaran.).

1.	Area of Zone	: S.T. Colony
2.	Wards Included	: Ward No. 4
3.	Whether Using Existing ESR	: No
4.	Capacity of Existing ESR	: Nil
5.	Required Capacity of Zone	: 3, 50,000 Lit.
6.	Whether Proposing New ESR	: Yes
7.	Capacity of Proposed ESR	: 3, 00,000 Lit.
8.	Ground Level	: RL. 643.50 m
9.	Staging Height of ESR	: 15.0 m
10.	Top Level of Bottom Slab (HGL)	: RL. 658.50 m
11.	F.S.L.	: RL. 663.50 m
12.	Total Length of Distribution System	: 5855.0 m
13.	Total Flow for the Zone	: 16.394 LPS

3. LITERATURE REVIEW

1. Vidhi N. Mehta and Dr. G. S. Joshi (2016) this paper relates with design of rural water supply using Loop 4.0 software. The water supply distribution system is designed for population estimated for 30 years in future. This LOOP software version 4.0 has been used for designing best economical water distribution system. In this study intermittent water supply planned with considering 100 lpcd water consumption. It had studied that the simulations through BRANCH 3.0 software for the hydraulic design has provides successful solutions for economical water supply distribution system design.

2. Arati Shetkar, et. Al (2016) in this paper loop 4 software is used to provide hydraulic design of water supply network. Usually this software is being used in 11 districts of Karnataka for the design of water supply projects. And which gives solution within less time and becomes less laborious. It skips lengthy manual calculations and gives accurate results. It shows that time can be saved without compromising accurate of results in design of water distribution system.

3. Piplewar,S.K.,et.al(2013), Design of Distribution Network for Water Supply Scheme and Pindkepar Village by Branch Software has investigated, Population forecaste and optimal cot is given by software. Had studied that the design of Pindkepar village water distribution network, study of present population, population forecast for the three decades, daily water demand, and flow characteristic and also survey of the village is done.

4. S. M. Yadav et al (2012), This paper relates with the design of rural water distribution systems in developing countries. In India most of the population is staying in rural area. A LOOP version 4 software is used for designing of best economical water distribution with a case study. With minimum cost design procedure satisfied all constraints. Residual nodal pressure, velocity of flow in pipe, pipe material, reservoir level, peak factor and available commercial pipe diameters are the main constraints. It is found that water distribution network cost occupied almost 50 to 70%of the total cost of water supply system.

5.Minakshi M. Yengale, P.J. Wadhai May-(June2012),The software program for discharge analysis & cost analysis for network Karanja village is made by using VB language. Water industry due to its unique nature faces many problems. The supply of water from the limited water resources in order to fulfill the ever increasing demand of water. In order to make infrastructure improvement, a water supply system has to handle a large amount of diverse information on continuing basis. The necessary information includes the data about pipelines, valves, pressure, ESR's, Pumps. Most of the required data is generally in the paper format and is not updated regularly. It shows that to minimize the time required for analysis and to make the tedious work to easier by using computer technique and the better performance and comparison of developed computer technique with manual calculation.

4. METHODOLOGY

Input data files for BRANCH 3.0 software have been shown below.

Table-1 shows the input data file for the water distribution network of the area under study.

Table-1: Input Data for Water supply system

Item	Details
Title of the Project	DIST SYSTEM OF TULJAPUR ZONE2
Name of the User	RAKHI KURE
Number of Pipes in the network	66
Number of Nodes in the network	67
Number of Commercial Diameters	11
Peak Design Factor	3.16
Minimum head loss (m/km)	0.0001
Maximum head loss (m/km)	12
Minimum Residual Pressure (m)	7
Type of Formula'	Hazen

In the above Table-1, the peak design factor is taken as 3.0 i.e. as per Central Public Health maximum head loss, pressure m/km is taken 0.001 i.e. as per the rural water supply manual The Pipe input data and Node input data sample calculations up to 10 node is shown in Table-2 and Table-3

Table-2: Pipe input data

Pipe. No	From Node	To Node	Length(m)	Hazen constant
1	100	1	40.00	140
2	1	2	143.00	140
3	2	3	114.00	140
4	3	4	100.00	140
5	4	5	165.00	140
6	5	6	113.00	140
7	6	7	268.00	140
8	7	8	199.00	140
9	8	9	248.00	140
10	9	10	73.00	140

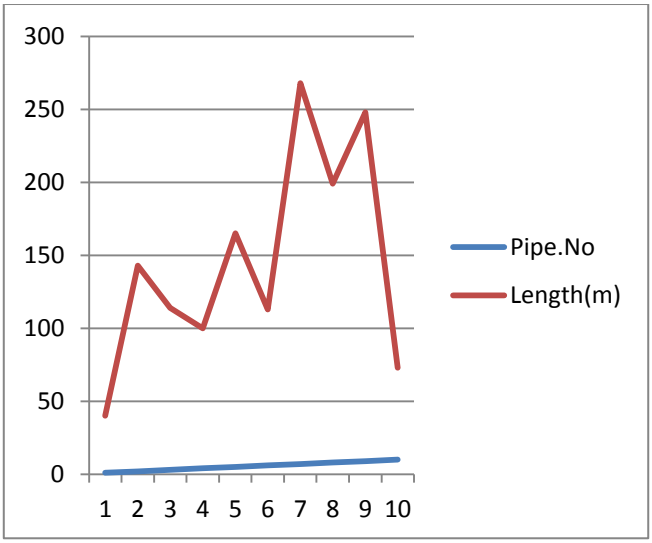


Chart-1 Pipe data of distribution network

The analysis of above chart 1. Includes source nodes and junction nodes that are shown in Chart-1.

Table-3: Node input data

Node No.	Peak Factor	Flow (lps)	Reduce level(m)	Minimum. Pressure(m)
100	3.16	0.000	643.50	7.00
1	3.16	-0.055	643.78	7.00
2	3.16	-0.197	642.68	7.00
3	3.16	-0.157	641.02	7.00
4	3.16	-0.138	639.78	7.00
5	3.16	-0.228	641.36	7.00
6	3.16	-0.156	642.50	7.00
7	3.16	-0.370	641.54	7.00
8	3.16	-0.275	641.54	7.00
9	3.16	-0.343	637.02	7.00
10	3.16	-0.101	636.09	7.00

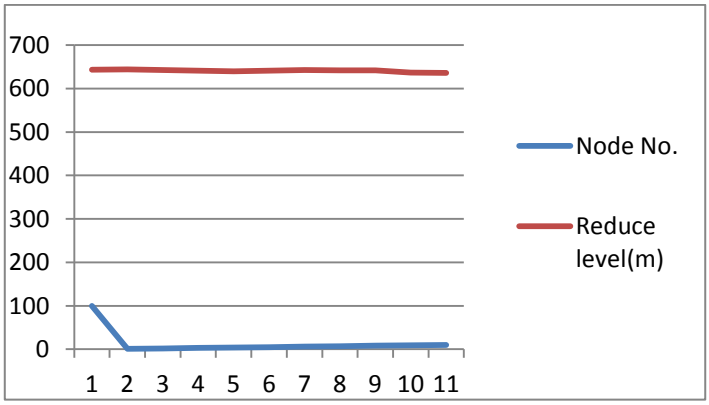


Chart-2 Node data of distribution network

The analysis of above chart 2 which includes the ground elevation and mini pressure (m) at each node of the network could be determined.

Table-4: Data for fixed head

Node no	Grade Line m
100	658.50

In the above Table 4, head 658.50m has been obtained from the summation of base elevation plus staging height of tank. In this study, the possibility is also explored for the staging height of the tank 15.0 m.

5. RESULT AND DISCUSSION

BRANCH3.0 Software depicts the results for input data files as discussed earlier. After studying the output results are obtained are as shown below. Table 5 shows the output for pipe i.e. available flow (lps) in each pipe, economical diameter (mm), head loss (m), head loss (m/km). Table 6 shows the output for each of nodes i.e. the available flow (lps) at the node, hydraulic gradient line (m) and pressure (m). Table 7shows the output for cost of PVC pipe i.e. Diameter (mm), length (m), cost (1000 Rs.) and cumulative cost (1000 Rs.).

Table-5: Output for pipe details

Pipe No.	From Node	To Node	Peak flow(lps)	Dia(mm)	Hazens constant	HL(m)	HL/1000(m)	Length
1	100	1	25.508	171.0	140	0.28	7.00	40.00
2	1	2	25.334	152.8	140	1.71	11.96	143.00
3	2	3	23.179	152.8	140	1.15	10.09	114.00

4	3	4	16.647	133.6	140	1.06	10.60	100.00
5	4	5	15.329	133.6	140	1.50	9.09	165.00
6	5	6	9.745	133.6	140	0.44	3.89	113.00
7	6	7	7.167	105.0	140	1.92	7.16	268.00
8	7	8	5.998	105.0	140	1.03	5.18	199.00
9	8	9	4.509	85.8	140	2.02	8.15	248.00
10	9	10	2.841	71.4	140	0.62	8.49	73.00

Table-6: Output for each node

Node No.	Peak flow(lps)	Elevation(m)	HGL(m)	Cal Pressure(m)	Spec Pressure(m)
100	25.508	643.50	658.50	15.00	7.00
1	-0.174	643.78	658.22	14.44	7.00
2	-0.623	642.68	656.51	13.83	7.00
3	-0.496	641.02	655.36	14.34	7.00
4	-0.436	639.78	654.30	14.52	7.00
5	-0.720	641.36	652.81	11.45	7.00
6	-0.493	642.50	652.36	9.46	7.00
7	-1.169	641.54	650.44	8.90	7.00
8	-0.869	641.54	649.41	7.87	7.00
9	-1.084	637.02	647.39	10.37	7.00
10	-0.319	636.09	646.78	10.69	7.00

Table-7: Output for pipe cost

Outer diameter	Pipe material	Length(m)	Cost (1000 Rs.)	Cumulative cost (1000 Rs.)
71.4	PVC	4095.00	319.41	319.41
85.8	PVC	618.00	66.74	386.15
105.0	PVC	467.00	69.12	455.27
133.6	PVC	378.00	93.37	548.64
152.8	PVC	257.00	83.53	632.16
171.0	PVC	40.00	17.80	649.96

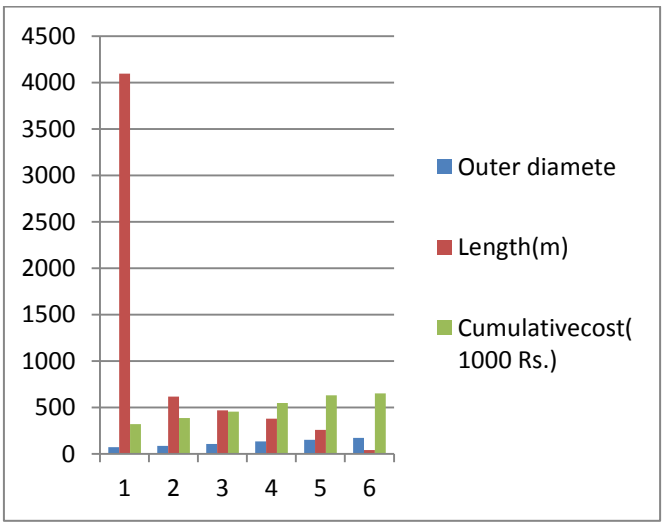


Chart-3 Cost summary of distribution network

With the use of available data BRANCH3.0 is used for estimation of output variables which is shown in table7and Chart 3. Shows cost summary of distribution network.

6. DISCUSSION

The output of distribution network are as follows-74.4mm dia to 174.0mm dia.distribution pipe, it is requires with 6.49laks rupee. With length of 5855m require for complete network, In the chart analysis the length, ground elevation and HGL at each node of the network could be determined; which; includes source nodes and junction nodes that are shown in chart-1 and chart-2.With the use of available data for BRANCH3.0. is used for estimation of output variables which is shown in table-7 and chart-3 shows cost summary of distribution network.

7. CONCLUSION

On the basis of result it can be concluded that successful solution for economical water supply distribution system design by using BRANCH.3.0 is one of the best linear programming method for design calculations. So at the end of the analysis it was found that the resulting pressure at all the nodes and flows with their velocities at all links are sufficient enough to provide water to the study area economically.

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