

Design of Distribution System for Bambhori Village

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ABSTRACT: Today, rural as well as urban India facing serious problems of safe drinking water shortage, inadequate sanitation, and limited resources due to a rapid growth of population & unmanaged planning. Therefore, needs to pay attention towards water supply & sanitation as these affects quality of life & economy growth of the nation. Therefore, to fulfil the requirement of that purposed area sufficient design network of pipes is provided.. For this purpose the details provided by the Central public health and environmental engineering organization (CPHEEO) have been followed. The general information of the area like information about the main water source, population of the area, demand of water, pumps requirement, distribution network and water tanks are essential for efficient design of water distribution system. According to CPHEEO manual Table 2.1 the per capita consumption of water by an Individual person (for town or cities provided with supply system without sewerage system) is 70litres per day and design has been made accordingly^[9]. This work highlights the process carried out on design of water supply system for an area named **BAMBHORI**. The “EPANET” software will be used to design the distribution system in that area. The proper distribution system helps to meet the efficient water supply in that area.

KEYWORDS: EPANET(United States Environmental Protection Agency), Distribution system,CPHEEO(Central Public Health and Environmental Engineering Organisation) etc.

I. INTRODUCTION

According to the research of 2010 about 85% of the global population had accessed to the piped water supply through house connections. For the master planning of communities, countries, and municipalities water supply connections are important part of it. The planning and design requires the factors such as the location, current demand, future growth, pressure, pipe size, pressure loss, fire fighting flows, etc^[5].

Almost 68 to 70% of the population lives in the rural areas according to the census 2011. For which the Govt of India has decided to provide safe, regular and adequate water supply to the consumer through the pipe distribution system.^[14]

The use of water is increasing rapidly with the growing population. Already there is an acute shortage of both surface and underground water in many parts of the country^[12]. Careless pollution and contamination of streams, lakes, reservoirs, wells, and other underground sources has greatly impaired the quality of available water. This pollution results because of improper disposal of waste water from houses and industries. Organized community services require services of water supply as well as sewage disposal. If there is no adequate water system good sanitation will not be maintained^[9]. There will be no proper disposal then there will be nuisance, disease spread and this problem may create health hazards. The planning and designing of water distribution requires high skills and judgements.

Government as well as private agencies undertake the work of construction and maintaining the water supply. Water supply is known as the sufficient and uniform quantity of water through designated network pipes^[4]. The water supply systems should meet the requirements of all industrial, commercial and public activities. The quality requirements should also be fulfilled in the design system.

The analysis will be done using the EPANET software^[13]. This software models the water distribution system. This software is in public domain which can be freely copied and distributed.

II. MATERIALS AND METHODS

PROJECT AREA:

The Bambhori Village in the Jalgaon district in Maharashtra is selected as the study area and the data collected is as shown in the subsequent parts. The maps derived for the village is as shown below:

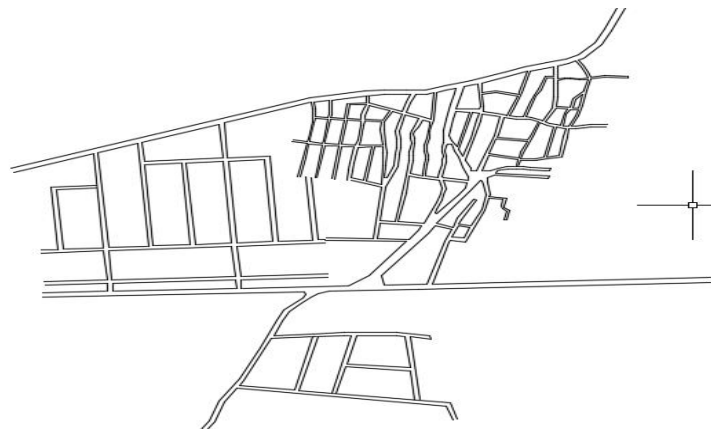


Fig-1 Layout of bambhori Village

EXISTING SYSTEM DETAILS:

Well- There is college “SSBT COET Jalgaon” whose well was used for water supply but now Bambhori village has their own well which is 25feet deep and 1.5m dia in Girna river.

Pump- 10HP centrifugal pump which is 6 to 7 years old.

OHT- A RCC constructed OHT constructed in 1956 having capacity of 55000 lit .

Pipe line network- The village is divided in 5 wards.The network covered in the village is of PVC material.

POPULATION DETERMINATION:

The population data available from the statistical department according to the 2011 census was 6392^[2]. Then the same population was forecasted for the year 2041 with a 5% incremental change which came out to be 13505.Hence for the above population according to the by taking per capita as 70 lpcd including losses as per CPHEEO manual^[9].

SURVEYS AND MAPS:

The survey between the source of water supply and proposed distribution area is carried out to decide the alignment and positioning of rising main, which carry the treated water and supply it to distribution reservoir. The distribution area is also surveyed and detailed maps of are prepared showing the positions of roads, streets, lanes, residential areas, commercial locality, industrial areas, farms etc. The topographical map for the area will be prepared to get the elevation of that area.. The cross section of streets, roads, lanes is also prepared, showing the position of existing underground service lines like sewer line, Gas supply line, electric and telephone lines, existing water supply lines (if any), etc.

TENTATIVE LAYOUT:

A tentative layout of the distribution line is then prepared, showing the location of the source, treatment plant, reservoir, distribution mains, valves, hydrants, etc. The whole area is divided into various distribution zones. The population density(average number of people per hectare are) should also be marked . The pipeline length must be kept short.

USING THE EPANET TOOL

As the EPANET tool is very user friendly one should adopt the following procedure as mentioned.

1. With the available data one should prepare scheme for the design.
2. Import the layout of the map from the AUTOCAD file in to the EPANET.
3. Fixed the total demand from the tank.
4. Assign the unit of the flow also assign the formula.
5. The hydraulic properties like length , diameter, roughness are also to be assigned.
6. Run the hydraulic analysis.
- 7.

III. RESULTS AND DISCUSSION

In this paper water distribution network for Bambhori village was done.The distribution system consist of 89 junctions and 92 pipes and 1 tank as shown in the figure. The daily is considered as 70lpcd.Following figures shows the various parameters and data on the network.

Table-1 represents the length of the pipes, the pipe diameter required for the free flow coefficient of roughness, velocity between the pipe and the unit headloss. The columns (length, diameter, roughness) are the unit

parameters assigned to the network system whereas the columns (flow, velocity, headloss) are the output obtained after the simulation is run.

The demands at the nodes were also calculated by considering the rate of demand as 70 lpcd and the results obtained are mentioned in Table-2,

Table 1- Details of network from EPANET tool.

	Length	Diameter	Roughness	Flow	Velocity	Unit Headloss
Link ID	m	mm		LPS	m/s	m/km
Pipe 2	16.75	250	150	29.1	0.59	1.22
Pipe 3	47.55	250	150	29.1	0.59	1.22
Pipe 4	36.48	250	150	28.1	0.57	1.14
Pipe 5	129.80	200	150	20.77	0.66	1.93
Pipe 6	42.00	200	150	15.88	0.51	1.18
Pipe 7	147.24	160	150	10.01	0.5	1.48
Pipe 8	53.85	120	150	5.62	0.5	2.07
Pipe 9	133.98	90	150	0.67	0.11	0.16
Pipe 10	41.86	120	150	4.68	0.41	1.47
Pipe 11	182.61	120	150	0.91	0.08	0.07
Pipe 12	46.18	120	150	3.56	0.31	0.89
Pipe 13	77.34	120	150	3.25	0.29	0.75
Pipe 14	46.66	90	150	0.23	0.04	0.02
Pipe 15	33.72	90	150	0.17	0.03	0.01
Pipe 16	71.87	90	150	0.36	0.06	0.05
Pipe 17	62.96	90	150	0.31	0.05	0.04
Pipe 18	62.99	90	150	0.31	0.05	0.04
Pipe 19	17.41	90	150	0.09	0.01	0
Pipe 20	20.48	90	150	2.39	0.38	1.72
Pipe 21	19.70	90	150	1.7	0.27	0.92
Pipe 22	17.66	90	150	0.87	0.14	0.27
Pipe 23	17.57	90	150	0.09	0.01	0
Pipe 24	76.58	90	150	0.38	0.06	0.06
Pipe 25	84.58	90	150	0.42	0.07	0.07
Pipe 26	46.82	90	150	0.23	0.04	0.02
Pipe 27	30.08	90	150	2.16	0.34	1.43
Pipe 28	7.38	90	150	1.63	0.26	0.85
Pipe 29	19.90	90	150	1.26	0.2	0.53
Pipe 30	105.22	90	150	0.53	0.08	0.11
Pipe 31	125.88	90	150	0.63	0.1	0.15
Pipe 32	65.50	90	150	0.33	0.05	0.04
Pipe 33	76.26	90	150	0.38	0.06	0.06
Pipe 34	94.78	120	150	5.66	0.5	2.1
Pipe 35	30.61	90	150	0.15	0.02	0.01
Pipe 36	26.01	120	150	4.74	0.42	1.51
Pipe 37	47.62	120	150	3.83	0.34	1.02
Pipe 38	102.08	90	150	0.81	0.13	0.23
Pipe 39	96.42	90	150	0.93	0.15	0.3
Pipe 40	51.92	90	150	0.26	0.04	0.03

	Length	Diameter	Roughness	Flow	Velocity	Unit Headloss
Link ID	m	mm		LPS	m/s	m/km
Pipe 41	38.46	90	150	0.19	0.03	0.02
Pipe 42	60.17	90	150	0.3	0.05	0.04
Pipe 43	143.26	90	150	3.65	0.57	3.78
Pipe 44	153.60	90	150	0.76	0.12	0.21
Pipe 45	27.62	90	150	2.17	0.34	1.44
Pipe 46	48.11	90	150	1.67	0.26	0.89
Pipe 47	50.67	90	150	1.28	0.2	0.54
Pipe 48	25.99	90	150	0.13	0.02	0.01
Pipe 49	30.99	90	150	0.15	0.02	0.01
Pipe 50	18.16	90	150	0.9	0.14	0.28
Pipe 51	30.54	90	150	1.42	0.22	0.65
Pipe 52	31.25	90	150	0.79	0.12	0.22
Pipe 55	19.13	90	150	0.48	0.07	0.09
Pipe 56	40.85	90	150	0.37	0.06	0.05
Pipe 58	43.88	90	150	0.22	0.03	0.02
Pipe 59	9.80	90	150	-0.37	0.06	0.06
Pipe 60	57.18	90	150	0.28	0.04	0.03
Pipe 61	32.23	90	150	0.59	0.09	0.13
Pipe 63	12.92	90	150	0.01	0	0
Pipe 64	33.80	90	150	1.24	0.2	0.51
Pipe 65	40.76	90	150	0.2	0.03	0.02
Pipe 67	15.13	90	150	2.08	0.33	1.33
Pipe 68	66.34	90	150	0.33	0.05	0.04
Pipe 69	25.61	90	150	1.67	0.26	0.89
Pipe 70	62.63	90	150	0.31	0.05	0.04
Pipe 71	102.48	90	150	1.23	0.19	0.5
Pipe 72	65.10	90	150	0.32	0.05	0.04
Pipe 73	80.31	90	150	0.4	0.06	0.06
Pipe 74	87.04	90	150	0.76	0.12	0.21
Pipe 75	41.80	90	150	0.21	0.03	0.02
Pipe 76	24.57	90	150	0.12	0.02	0.01
Pipe 77	15.70	90	150	0.08	0.01	0
Pipe 91	253.50	160	150	7.15	0.36	0.8
Pipe 92	119.08	110	150	5.88	0.62	3.44
Pipe 93	174.20	90	150	0.87	0.14	0.27
Pipe 94	38.20	110	150	4.41	0.46	2.02
Pipe 95	174.91	90	150	2.69	0.42	2.15
Pipe 96	45.67	90	150	1.3	0.2	0.56
Pipe 97	98.12	90	150	0.49	0.08	0.09
Pipe 98	104.83	90	150	0.52	0.08	0.1
Pipe 99	115.35	90	150	0.58	0.09	0.13
Pipe 100	162.18	90	150	1.53	0.24	0.75

	Length	Diameter	Roughness	Flow	Velocity	Unit Headloss
Link ID	m	mm		LPS	m/s	m/km
Pipe 101	123.18	90	150	0.62	0.1	0.14
Pipe 102	20.77	90	150	0.1	0.02	0
Pipe 1	6.51	90	150	0.63	0.1	0.15
Pipe 53	62.67	90	150	0.35	0.06	0.05
Pipe 54	42.70	90	150	0.25	0.04	0.03
Pipe 57	20.54	90	150	0.1	0.02	0
Pipe 62	35.59	90	150	0.17	0.03	0.01
Valve V1	#N/A	90	#N/A	0.33	0.05	0

Table 2-Nodal demand at nodes.

Node ID	LPS
Junc J2	0
Junc J3	0.24
Junc J4	0.18
Junc J5	0.65
Junc J6	0.21
Junc J7	0.74
Junc J8	0.27
Junc J9	0.67
Junc J10	0.21
Junc J11	0.91
Junc J12	0.08
Junc J13	0.23
Junc J14	0.38
Junc J15	0.42
Junc J16	0.23
Junc J17	0.09
Junc J18	0.09
Junc J19	0.1
Junc J20	0.1
Junc J21	0.07
Junc J22	0.31
Junc J23	0.31
Junc J24	0.36
Junc J25	0.23
Junc J26	0.17
Junc J27	0.53
Junc J28	0.63
Junc J29	0.1
Junc J30	0.04
Junc J31	0.33
Junc J32	0.15
Junc J33	0.47
Junc J34	0.1
Junc J35	0.24
Junc J36	0.15
Junc J37	0.1
Junc J38	0.6
Junc J39	0.35

Node ID	LPS
Junc J40	0.3
Junc J41	0.16
Junc J42	0.25
Junc J43	0.72
Junc J44	0.13
Junc J45	0.05
Junc J46	0.2
Junc J47	0.22
Junc J48	0.24
Junc J49	0.15
Junc J50	0.13
Junc J51	0.9
Junc J52	0.25
Junc J53	0.76
Junc J54	0.81
Junc J55	0.26
Junc J56	0.48
Junc J57	0.19
Junc J58	0.28
Junc J59	0.13
Junc J60	0.32
Junc J61	0.51
Junc J62	0.31
Junc J63	0.4
Junc J64	0.15
Junc J65	0.17
Junc J66	0.2
Junc J67	0.39
Junc J68	0.33
Junc J69	0.38
Junc J70	0.08
Junc J71	0.43
Junc J72	0.21
Junc J73	0.12
Junc J88	1.27
Junc J89	0.6
Junc J90	0.87
Junc J91	0.19
Junc J92	0.52
Junc J93	0.58
Junc J94	0.1
Junc J95	0.87
Junc J96	0.23
Junc J97	0.62
Junc J98	0.49
Junc J99	0.81
Junc J1	0.03
Junc J74	0.1
Junc J75	0.17
Resvr R1	-29.1

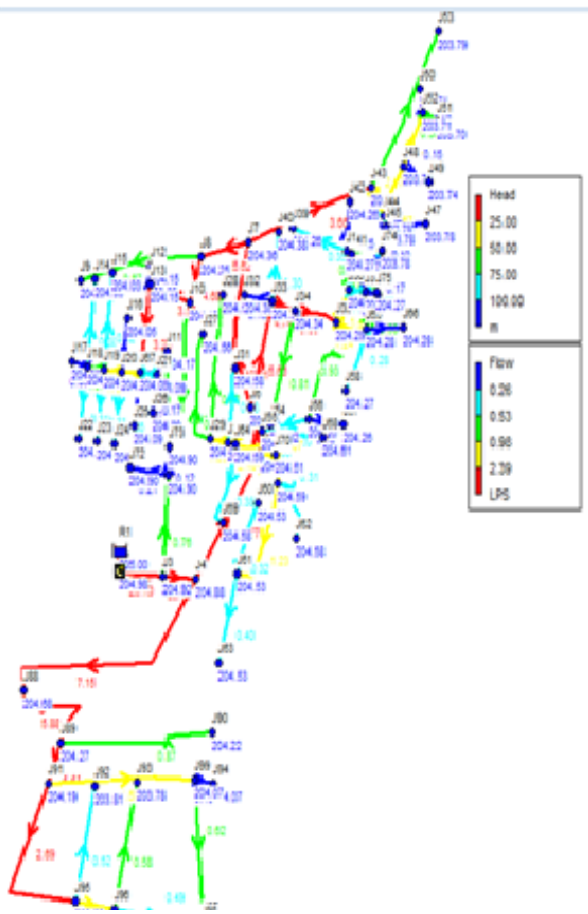


Fig-2 Head vs Flow

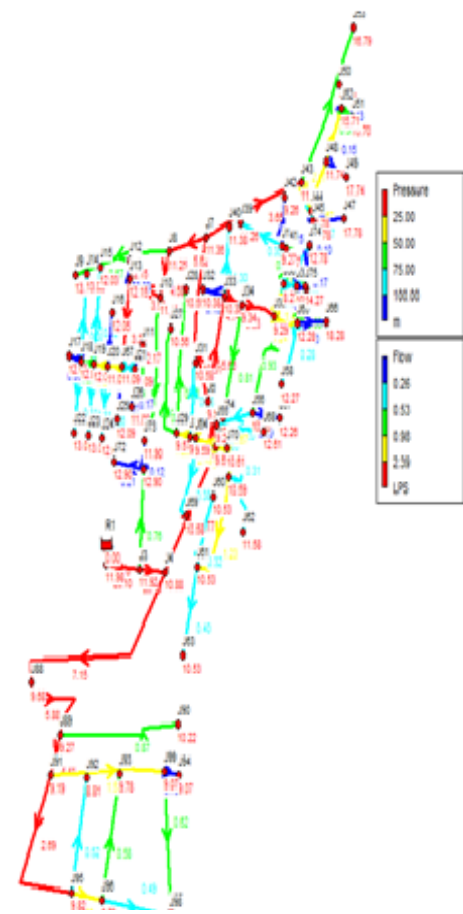


Fig-3 Pressure vs Flow

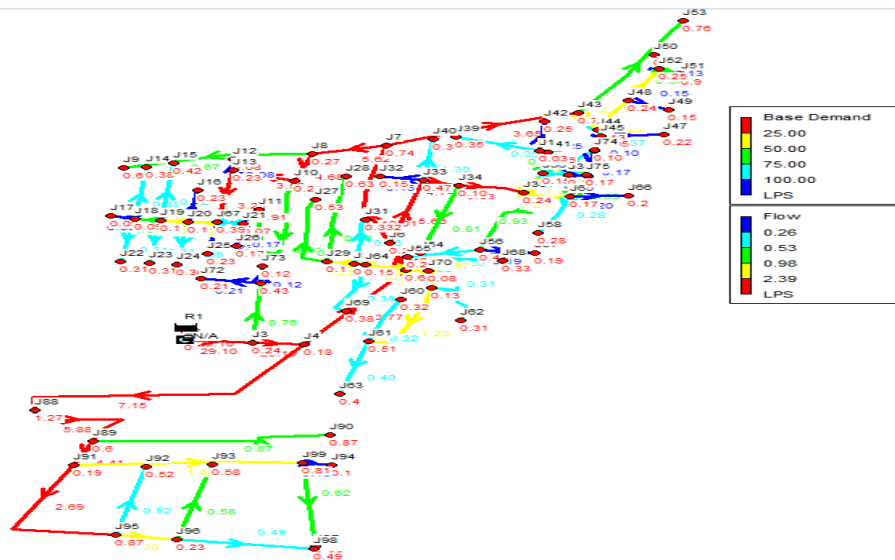


Fig-4-Base Demand vs Flow

Fig 2 shows the representation of distribution network between residual pressure at all nodes and the corresponding flow in the pipes. by knowing these parameters the diameter of the pipe is usually fixed by using trial and error method. The parameters like pressure vs flow & base demand vs flow are shown in Fig-3 & Fig-4 respectively.

IV. CONCLUSION

1. The pressure at all the nodes in the distribution network was found to be greater than 7 m.. The flow can be taken easily.

2. The assumed diameter 250mm, 160mm,120mm,90mm are sufficient to withstand the pressure of the entire distribution network.
3. The design network can easily withstand for 5 % increase in population .
4. At some nodes like J88 & J11 the demand is more due to the elevation.
5. The method of distribution used here in this model is combined gravity system.
6. One over head tank is needed for the entire bambhori village.
7. The Bambhori village was initially divided in 5 wards but now it will be divided in 7 wards for the future demands.
8. New OHT is needed in the village to meet the future demand of the Bambhori Village.

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