EasyChair Preprint

№ 7673

Design of Water Distribution Network for Tilgaon Village Using Epanet & Google Earth Pro

Aniket Warghat, Yash Bangera, Pratiksha Khedaskar, Davidarvinthkumar Sundararajan and Sonu Tiwari

EasyChair preprints are intended for rapid dissemination of research results and are integrated with the rest of EasyChair.

March 29, 2022

DESIGN OF WATER DISTRIBUTION NETWORK FOR TILGAON VILLAGE USING EPANET & GOOGLE EARTH PRO

Aniket Warghat [1], Yash Bangera[2], Pratiksha Khedaskar, DavidArvinthKumar.S[4], Mr. Sonu Tiwari[5]

1234UG Students, Department of Civil Engineering, St John College of Engineering & Management, Palghar
5Assistant Professor, Department of Civil Engineering, St John College of Engineering & Management, Palghar

Abstract - This study presents the use of EPANET software in the design of the water distribution network for Tilgaon village, Wada taluka. The major purpose of providing a good distribution network is to provide sufficient pressure at each point with less loss. A water distribution network consists of pipes, tanks etc. EPANET software is simulation tool which is used for efficient distribution of water supply. For the analysis of existing water distribution system various data are required like, Main water source, Population of the area, Demand for water, Requirement of the pumps, Distribution Network, and water tanks. The Google Earth Image of Tilgaon village is downloaded and the elevation of a node, length of pipe was recorded for nearly 34 junctions and 47 pipes. These data were used in EPANET software for analysis of Pressure, Head loss, and Elevation. This analysis resulted in pressure and elevation at various nodes and head loss at various pipes.

Keywords: *EPANET, Water Supply Network, Nodes, Pipes, Elevation.*

1. INTRODUCTION

Water is the major important source for all living beings for their survival. Being such an important resource, sometimes it is scarce and other time it becomes abundant, proving that its existence is nonlinear. The water is used for various activities by human beings, like domestic, drinking, power generation etc. The water shortage is the most significant and challenging situation in India. Due to the increase in population, supply of water is a major issue, with the increase in demand of water and increased rates of depleting ground water and deterioration of water quality. Managing such an important scarce water in a country like India poses a serious challenge to the engineers as well as the decision makers.

The design of water distribution system plays an important role which can overcome the water scarcity and the water demand by the users. Water distribution system is a hydraulic design leads to supply of water to the consumers, which consisting of pipes, tanks, reservoirs, pumps and valves etc. Hence, it is necessary to supply water to the consumers efficiently so that the water could be used by the users to meet their demands. It can be achieved by designing a proper water distribution network.

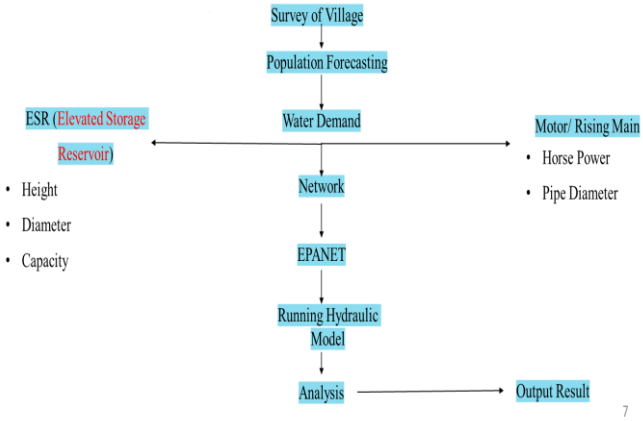
The Tilgaon is one such village in Thane district where it takes many efforts to provide and reliable services to the citizens. Water supply is major part of it. It provides sufficient quality to every citizen at optimal cost but quantity is not satisfactory. As per collected data from governmental organization quantity of water supplied to the consumers is not satisfactory as per our survey the area receives water by Hand pumps and bore wells. Although there are certain problems reported by consumer and in order to tackle these problems, we decided to design the water distribution network by EPANET Software hence it will be helpful to Gram panchayat in future to laid pipe line and all essential elements of distribution network of water supply scheme in Tilgaon village.

EPANET is a public domain, water distribution system modeling software package developed by the United States Environmental Protection Agency's (EPA) Water Supply and Water Resources Division. EPANET provides hydraulic analysis that can handle systems of any size. EPANET tracks the flow of water in each pipe, the pressure at each node and the height of water in each tank throughout the network. Running under Windows, EPANET provides an integrated environment for editing network input data, running hydraulic and water quality simulations, and viewing the results in a variety of formats. These include color-coded network maps, data tables, time series graphs, and contour plots. EPANET models a water distribution system as a collection of links connected to nodes. The links represent pipes, pumps, and control valves. The nodes represent junctions, tanks, and reservoirs. In addition to hydraulic modeling, EPANET provides many other water quality modeling capabilities.

2. STUDY AREA

Tilgaon is a Village in Wada Taluka in Palghar District of Maharashtra State, India It is located 50 KM towards South from District headquarters Palghar. 10 KM from Wada. 79 KM from State capital Mumbai. This village is located at the bank of river Tanasa river. The latitude and longitude of the village corresponding 19.563672265168275 N, 73.15504619393391 E respectively. As we calculated the population for the given year 2041 will be 1722. Our goal is to design water distribution network for this village for 20 years period.

3. METHODOLOGY



4. POPULATION FORCASTING

The primary aim of developing the water distribution network is to cater the water demand in an efficient manner for future desired period of the Tilgaon village. In this regard, the network was designed for design period of 20 years considering the futuristic growth of the population. Various methods have been employed to project the growth of population based on the precious years records and finally we concluded that, the incremental increase method because of high population estimate which is being shown in the below table 1 & 2

Sr No	Year	Population	Increase in Population	% Increase in Population	Incremental Increase	Decrease in % increase
1	1981	596	-	-	-	-
2	1991	786	190	31.88	-	-
3	2001	703	-83	-10.56	107	21.32
4	2011	944	241	34.28	158	-23.72
5	2021	1176	232	24.57	-9	9.71
			580	80.17	256	7.31

Table 1

Sr No	Method	Population (2041)
1	Population by Incremental Increase Method @ 2041	=P+nd+(n(n+1) *t/2) = 1722
2	Population by Arithmetic Method @ 2041	= P+nd = 1466
3	Population by Geometric increase Method @ 2041	= P*(1+r/100) ^n = 1695
4	Population by Decrease Rate of growth Method @ 2041	$P_{n-1} + (r_{n-1} - t/100)*P_{n-1}$ =1718

Table 2

Population @ 2041 = 1722 people

5. WATER DEMAND

Water demand was calculated for the period of 20 years (2041). The result was described has

Population	LPCD	Demand	Q Demand
1722	70	128000	3 l/s

6. DESIGN OF WATER DISTRIBUTION NETWORK

Distribution network of water at Tilgaon village, Palghar district Had some components such as source, pumps, storage tank, 34 junction, 47 pipes. Design of distribution network given below fig.1

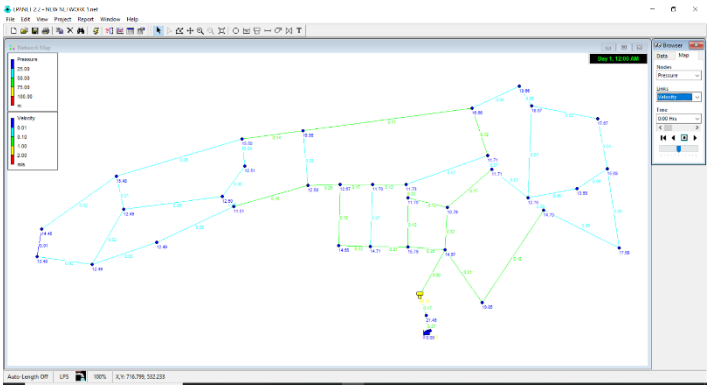


Fig 1

7. EPANET ANALIYS

A. Pressure

As per CPHEEO Manuel for residential area distribution system should be design so that, the pressure should be maximum 22meters of water. Pressure at all junction was described table 3

Label	Elevation (m)	Demand (L/s)	Pressure (MPa)
J-1	67	0.051	0.211
J-2	72	0.1229	0.161
J-3	67	0.0962	0.21
J-4	72	0.1191	0.16
J-5	69	0.0902	0.19
J-6	71	0.0935	0.17
J-7	69	0.0671	0.19
J-8	68	0.1009	0.199
J-9	74	0.1139	0.141
J-10	73	0.0491	0.15
J-11	75	0.0681	0.131
J-12	70	0.1542	0.18
J-13	67	0.0437	0.209
J-14	76	0.0797	0.121
J-15	71	0.069	0.17
J-16	75	0.0575	0.131
J-17	75	0.0853	0.131
J-18	75	0.0758	0.131
J-19	74	0.0687	0.141
J-20	72	0.0506	0.16
J-21	74	0.0918	0.14
J-22	70	0.1622	0.179
J-23	71	0.1238	0.169
J-24	74	0.0365	0.14
J-25	74	0.0842	0.14
J-26	75	0.0973	0.13
J-27	74	0.083	0.14
J-28	74	0.1027	0.14
J-29	73	0.0459	0.15
J-30	72	0.065	0.16
J-31	74	0.1088	0.14
J-32	71	0.1431	0.169
J-33	75	0.0706	0.131
J-34	72	0.072	0.16

Table 3

B. Velocity

For peak time design criteria in the range of 0.01 – 2m/s.
The simulation result of velocity using EPANET was described as Table 4.

Label	Diameter (mm)	Velocity (m/s)
P-1	120	0.228
P-2	120	0.228
P-3	120	0.224
P-4	120	0.256
P-5	75	0.15
P-6	75	0.128
P-7	75	0.042
P-8	75	0.022
P-9	75	0.029
P-10	75	0.014
P-11	75	0.047
P-12	75	0.059
P-13	75	0.029
P-14	75	0.04
P-15	75	0.053
P-17	75	0.028
P-18	75	0.038
P-19	75	0.122
P-20	75	0.226
P-21	75	0.251
P-22	75	0.083
P-23	75	0.086
P-16(1)	75	0.053
P-16(2)	75	0.087
P-24	75	0.053
P-25	75	0.156
P-27	75	0.075
P-29	75	0.179
P-30	75	0.055
P-31	75	0.08
P-32	75	0.098
P-33	75	0.03
P-34	75	0.022
P-35	75	0.038
P-36	75	0.103
P-37	75	0.043
P-38	75	0.025
P-39	75	0.012
P-40	65	0.002
P-42	75	0.005
P-43	75	0.04
P-44	75	0.041
P-45	75	0.011
P-26(1)	75	0.086
P-26(2)	75	0.119
P-28(1)	75	0.086
P-28(2)	75	0.152
P-46	75	0.049
P-47	75	0.013

Table 4

C. Head Loss Gradient

Head loss Gradient at each pipe was described as table 5.

Label	Diameter (mm)	Flow (L/s)	Head loss Gradient (m/km)
P-1	120	2.5805	0.556
P-2	120	2.5805	0.556
P-3	120	2.5294	0.536
P-4	120	2.8924	0.687
P-5	75	0.6625	0.442
P-6	75	0.5663	0.331
P-7	75	0.1867	0.042
P-8	75	0.0965	0.012
P-9	75	0.1294	0.022
P-10	75	0.0623	0.006
P-11	75	0.2066	0.051
P-12	75	0.2605	0.079
P-13	75	0.1264	0.021
P-14	75	0.1755	0.038
P-15	75	0.2354	0.065
P-17	75	0.1243	0.02
P-18	75	0.168	0.035
P-19	75	0.5377	0.301
P-20	75	0.9988	0.946
P-21	75	1.1081	1.147
P-22	75	0.367	0.148
P-23	75	0.3814	0.159
P-16(1)	75	0.2342	0.064
P-16(2)	75	0.3841	0.161
P-24	75	0.2352	0.065
P-25	75	0.6909	0.478
P-27	75	0.3315	0.123
P-29	75	0.79	0.613
P-30	75	0.2415	0.068
P-31	75	0.3542	0.139
P-32	75	0.4336	0.202
P-33	75	0.1338	0.023
P-34	75	0.0974	0.013
P-35	75	0.1672	0.035
P-36	75	0.4567	0.222
P-37	75	0.1922	0.045
P-38	75	0.1092	0.016
P-39	75	0.054	0.004
P-40	65	0.0081	0
P-42	75	0.024	0.001
P-43	75	0.1759	0.038
P-44	75	0.1803	0.04
P-45	75	0.0475	0.003
P-26(1)	75	0.3799	0.158
P-26(2)	75	0.5272	0.29
P-28(1)	75	0.3821	0.16
P-28(2)	75	0.6721	0.454
P-46	75	0.2179	0.056
P-47	75	0.0569	0.005

Table 5

8. CONCLUSION

Based on the analysis as above, it was concluded

a. Current population of Tilgaon village was 944 people and the forecasted population in year 2041 is 1722 people.
b. Water demand for village 128000 liter for supplying 1722 people per day.
c. For distribution network components are source, pumps, storage tank, 34 junction, 47 pipes.
d. The pipes used in distribution network are HDPE pipe with roughness 140 and diameter less than 120mm.
e. Current water supply network is designed with CPHEEO Manuel, as per Jal Jeevan Mission per capita demand should be 70 lpcd for area where no sewer system is provided.
f. As village is growing at a slow rate, the current distribution network will be sufficient in future.
g. We are not using dead end system which causes insufficient pressure at nodes. In place we are using looped network to overcome this problem and getting adequate pressure at nodes.
h. The hydraulic simulation result using EPANET 2.2 was shown above. The whole distribution network could be a success because design criteria result for main parameters such as pressure, velocity and head loss gradient is in given range.

9. REFERRENCE

[1]**. Stratton**, Anna T; Jackson, Sue; Marinoni, Aswadd; Proctor, Wendy; and Woodward, Emma. 2011. Exploring and Evaluating Scenario for a River Catchment in Northern Australia Using Scenario Development, Multi-criteria Analysis and a Deliberative Process as a Tool for Water Planning. Journal of Water Resource Manage (25): 141-164.

[2] CPHEEO Manual

[3] Water Supply Engineering book by Santosh Kumar Gar

[4] The report on Physico-Chemical Analysis of Drinking Ground Water in Varangaon Region, Dist Jalgaon, Maharashtra, India

10. AUTHORS

Correspondence Author –Aniket.M.Warghat , BE Civil Engineering, Department of Civil Engineering, St John College of Engineering & Management, Palghar, aniketwargat96@gmail.com