OPTIMIZATION AND INNOVATIVE TECHNIQUE TO DESIGN, LAYING- SEWERAGE SYSTEM

Rupali Mannade[1], Monika Sabale[2], Neha Satav[3],Vandana Torane[4]

[1,2,3,4]Student of Final Year Degree in Civil Engineering, Dept. of civil Engineering, MIT College of Engineering, Kothrud, Pune, Maharashtra, India

---***---

Abstract - *Since last decade Infrastructure development has been taken place all over Maharashtra. Because of this migrations of people from villages to town are also increasing and reach up to 50% of world population leaving in Towns. It also predicted that about 70 % of world population will be leaving in cities by 2050. So development of the town occurs at very faster rate. Wagholi is a village located in the Pune district (altitude:-18.57930N & longitude:- 73.98230 E). As on date all the domestic waste water is either send in open drain or in open area around the houses. This is resulting in hygienic problems and to cater for; Grampanchyat of Wagholi village has come up with underground sewage collection plan. This study aim at designing collection system for Wagholi village, the work undertaken uses, SewerCAD as a tool for mapping the collection system in order to facilitate further works.*

Key Words: **Sewerage system, sewerCAD sewers, survey,sanitation, waste water.**

1. INTRODUCTION

Fig-1: WAGHOLI AREA

Wagholi has no comprehensive sewerage system. The human excreta is disposed of using on-site sanitation methods. Open defection is also not uncommon. Spent water from kitchen and bathroom is left into surface drains which lead to local depressions. Septic effluents from septic tanks are also led into the surface drains.

Contamination of drinking water sources by sewage can occur from raw sewage overflow, septic tanks, land application of sludge and partially treated waste water. Sewage itself is a complex mixture and can contain many types of contaminants.. Seepage overflow into drinking water sources can cause diseases from then ingestion of micro organisms such as E-Coli, Cryptosporidium, Hepatitis A and Helminths. The options available for disposal of excreta are either on-site or off-site sewerage systems. The proposed project aims effective abatement of pollution by providing a comprehensive waste water collection, treatment and disposal system using laterals, branches and trunk mains including sewage treatment plants. A sewerage system is composed of various sewer lines terminating at the junction of a large sewer line. The large sewer line also terminates at the junction of a still larger sewer line. Finally, the main sewer line terminates at the outfall. Thus, a sewerage system can be viewed as a set of sewer lines collecting discharges at their nodal points and emptying into another set of sewer lines.

In this paper attention is focused on the design of a sewer line and mapping of sewer network in SewerCAD tool. SewerCAD has been regarded and proven as an efficient and powerful tool in the wastewater industry.

---

2. Previous Research Works

1. A sustainable rural-waste water management technique transforming villages

- Published on : September 28-29, 2013.
- Published by : Geetika Kalha, M.P. Singh
- They have concluded that, using old natural slopes and minimum energy is the most effective method of carrying waste water. With some trial and error VLIF has found that simplified sewerage system and DEWATS system are the best means to manage waste water in villages.

2. Design and mapping of underground sewerage network in gis, case study of islampur town.

- Published on : 8 August 2014

- Published by : J. A. Patil, Dr. Mrs. S. S. Kulkarni.

- Methodology:

    1. Data collection required for design of domestic sewage collection system.

    2. Design of underground sewage collection system.

    3. Location of sewage treatment plant. (STP)

    4. Mapping sewage network using GIS.

- They have concluded that,Available population data of Islampur town from year 1951 to 2011 , the population growth rate is 0.272.Do not have proper drainage system so underground sewage system is required, due to less population and diseases.

3. Design of sewer network system for the janwad village using   sewerCAD v8i

- Published on : 7 July 2016

- Published By : Rvikiran k, Arjun S, Virupakshi.

- Methodology :

    1. Population forecasting.

    2. Survey.

    3. Design of sewer network using SewerCAD V8i.

    4. SewerCAD result.

- They have concluded that, The computer software's are usefull in avoiding the iterative process for determining the friction factor and discharge from the hydraulic heads.Well organized design software named 'SewerCAD' is given by 'Bentley systems' in collaboration with 'Haestad Methods Solution Centre'. SewerCAD can perform multiple design iterations by creating plans and profile sheets that will meet a set of constraints given by the client.

4. Design of underground drainage for anklav town.

- Published on : 2016

- Published by : Rushikumar R. Prajapati, Neha M. Joshipura, Bhavin Patel.

- Aim : To study existing underground drainage system of Anklav town, to identify the problems, to identify the causes & to design drainage network by SEWER (version 3.0) Sewer Network Design Program Software.

- Methodology :

    1. Selection of town.

    2. Collection of data.

    3. Analysis of data.

    4. Suggestions for betterment for the underground drainage system.

Irjet Template sample paragraph .Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

3. OBJECTIVES OF STUDY

The purpose of sanitation is to promote and preserve good health of the people by preventing the spread comminicable disease. This is achieved by the scientific and methodological collection, conveyance , treatment and disposal of waste matter.

i. Data collection of Wagholi town- outlets, existing system if any, disposal point

ii. Design of sewerage system manually and compare it with software.

iii. Estimation of the system.

4. MATERIALS AND METHODS

4.1 Population Forecasting

For the present work, geometric growth rate method is used for the forecasting the population of the village. The population of village is 289327 forecasted .

4.2 Survey

As the first step of data collection, survey was conducted on June 2018 in Wagholi village,pune,Maharashtra. The survey provided the data regarding the ground levels, road alignment and the location of the houses in the village. Simple chain survey and plain table provided detailed information of the terrain and road alignments along with dumpy level was used to get the elevations details. Detailed study of topography, future extensions, location of treatment plants were carried out. The following data were collected.

a) Details about contour, land use, population, source of water, sewage generation and population variation were collected.

b) Data of existing open drain system were collected.

c) Location of roads and adjacent areas were recorded.

d) Problems regarding existing water distribution system and disposal through open drains were determined.

4.3 Design of sewer network using SewerCAD v8i

The results of sewer network were derived from SewerCAD and was analyzed as per standard design constraints and guidelines prescribed by CPHEEO. The results derived were well within the design parameters and they were in acceptable manner so as to implement on the field without much difficulty. The summary of the results are narrated in table.

The typical analysis of sewer network for the village was represented in the form of graphs with respect to elevation invert level versus length as shown in figure.

4.4 SewerCAD results

The result of network was derived from the 'SewerCAD' according to the parameters prescribed by CPHEEO. The d/D ratio of 80% is fixed for the present study as recommended by CPHEEO guidelines. The results obtained are within the parameters. The summary of the results are narrated in Table-1.

Table -1: Summary of sewer network of the village

Sr. No.	Parameters	Total	Units
1	Area	33.67	Km2
2	Manholes	329	Numbers
3	Sewer length of Bhavadi road	244.6	Meter
4	Sewer length of Bhawadi road	90.6	Meter
5	Sewer length of lohgaon wagholi road	100.3	Meter
6	Sewer length of ubale nagar road	124.8	Meter
7	Sewer length of wagholi to awhalwadi road	116.1	Meter
8	Sewer length of kesnand road	193.6	Meter

Fig-2: shows the pictorial representation of the sewerage network designed for the village. The numbers in the map represents the corresponding roads.

Fig-2: Map representing the sewerage network for the village.

Table-2: Details of diameter along with length of sewer lines

Sr. no.	Diameter (mm)	Length (m)	Percentage (%)
1	1648	244.6	28.11
2	1198	90.6	10.41

3	998	100.3	11.53
4	1048	124.8	14.34
5	1448	116.1	13.34
6	1088	193.6	22.25
		Total =870	

From the design outcomes it is seen that about 28.11% of the pipes were of 1648 mm diameter, and remaining was of 1198 mm, 998 mm, 1048 mm, 1448 mm, 1088 mm diameter. Due to less load generated per manhole above diameter pipes were sufficient for the design as represented in Table-2.

- Details of velocity in the sewer lines :

    1. For Bhavadi Road :

Sr. no.	Velocity (m/s)	Number of MH	Percentage (%)
1	< 2	-	-
2	2 – 4	16	23.53
3	>4	52	76.47
		Total = 68	

    2. For Bhawadi Road :

Sr. no.	Velocity (m/s)	Number of MH	Percentage (%)
1	< 2	4	6.06
2	2 – 4	38	57.58
3	>4	24	36.36
		Total = 66	

    3. For Lohgoan Wagholi Road:

Sr. no.	Velocity (m/s)	Number of MH	Percentage (%)
1	< 2	2	7.14
2	2 – 4	25	89.28
3	>4	1	3.57
		Total = 28	

4. For Ubale Nagar Road:

Sr. no.	Velocity (m/s)	Number of MH	Percentage (%)
1	< 2	2	5.56
2	2 – 4	31	86.11
3	>4	3	8.33
		Total = 36	

5. For Wagholi To Awhalwadi Road:

Sr. no.	Velocity (m/s)	Number of MH	Percentage (%)
1	< 2	2	7.14
2	2 – 4	23	82.14
3	>4	3	10.71
		Total = 28	

6. For kesnand road :

Sr. no.	Velocity (m/s)	Number of MH	Percentage (%)
1	< 2	1	4.17
2	2 – 4	22	91.67
3	>4	1	4.17
		Total = 24	

4.5. Innovative Techniques:

1 . Use of ferrocement in sewer:

Ferrocement can be successively used for casting sewers. Ferrocement construction is an innovative and advance technique, its readily available materials and ease of construction makes it suitable in developing countries for housing, water and food storage structures.

Properties :

- Thickness : 10 – 60 mm
- Steel : 5 – 8%
- Ultimate tensile strength : 34.5 N/mm^2
- Compressive strength : 27.5 – 30 N/mm^2
- Allowable tensile strength : 10 N/mm^2

2. Use of sensors:

      To equip manholes with sensors that can measure water levels in order to accurately detect early signs of overflow.

5. Conclusions

- The available population data of wagholi village from year 2011 to 2041, the population growth rate is 0.272.
- Do not have proper drainage system, so underground sewerage system is required due to less pollution and Diseases.
- The computer software's are useful in avoiding the iterative process for determining the friction factor and discharge from the hydraulic heads.
- The software used was viable alternative to other methods particularly in view of accuracy and it results in a simpler algorithm, without any iterative process.

6. References

1. Sanitary engineering and disposal by S.K. GARG

2. Sanitary engineering by R.S.DESHPANDE

3. Environmental engineering by A. KAMALA

4. Bentley systems (2007). "Sanitary sewer design and modeling- applying sewerCAD version V8 X M", incorporated 'Haestad methods solution center', watertown, CT 06795.

5. Garg, S. K. (2005), Sewage Disposal and Air Pollution Engineering, Khanna Publisher, Delhi.

6. Gopal S. and Sarkar R. (2009), "Study of Water Supply & Sanitation Practices in India using Geographic Information Systems: Some Design & Other Considerations in a Village Setting". Indian J Med Res, (129), 233-241.