

# Design of sewer network system for the Janwad village using SewerCAD V8i

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**Abstract** - The present study includes the use of SewerCAD V8i software for the design and analysis of the sewage system for the Janwad village situated in chikodi taluka, Karnataka. SewerCAD V8i is computer software specifically developed for the purpose of design and analysis of the sewer networks. Bentley SewerCAD V8i is the first and only fully-dynamic, multi-platform (GIS, CAD and Stand-alone) sanitary and combined sewer modelling solution. With Bentley SewerCAD V8i, we will analyze all sanitary and combined sewer system elements in one package. The hydraulic design consists in the computation of the transit and total flow and hydraulic modelling for network pipes diameters or slopes. The network consists of pipes of varying diameters, manholes and outfall. The application provides reports, layouts, longitudinal or transversal cross sections of the pipe network, displayed in an advanced graphic system based on AutoCAD technology. With specific tools and features included, SewerGEMS V8i offers a full range of possibilities for the designer to draw, label, dimension and plotting the drawings of the sewage networks. In this work the sewerage networks were designed considering the regulations put forth by governing bodies and using commercially available materials and the results obtained are well within the range.

**Key Words:** arithmetic progression, janwad, sewerage system, SewerCAD, sewer network design.

## 1. INTRODUCTION

Water is one of the most important factors for the sustainability of life. Water covers about 70% of earth's surface and the fresh water available is about 1.7% as surface and ground water sources. The supplied water is used for domestic, industrial, recreational purposes. This water is likely to be generated as waste water. In practice around 80% of the water supplied is likely to be converted in to wastewater [1]. Hence, there is a need for the sewerage systems to carry the generated wastewater to a specific point for treatment and disposal purposes. A sewerage network is just a reverse action of water supply network. In

term of cost involved, laying a sewerage system is appreciably high compared to the water supply system. It involves a huge investment with need for daily maintenance, and the operational cost is one of the major expenditures [2]. Sewerage system is a network of pipes, pumps and force mains for the collection of waste water from a community. The immediate and nuisance-free removal of sewage from the sources of its generation, followed by treatment, or dispersal into the environment in an eco-friendly manner is necessary to protect public health and environment. Hence, a proper network has to be provided to avoid the above said conditions. The sewer networks are also have to be ensured so that they are not leaking which may lead to ground water contamination and soil pollution [3]. In this paper, 'SewerCAD' software is adopted for the design & analysis of underground drainage system. [4]

The sewer network is designed by considering regulations of the local governing bodies and with the use of commercially available materials. Utilizing these data, analysis has to be performed to simulate hydraulic conditions of sewers [5].

### 1.1 Study Area

Janwad village of chikkodi taluka, Belagavi, Karnataka was the area taken up for the study. The area is about 0.087sq.km. The latitude and longitude of the place is 16°34'3" and 74°34'21" respectively. Fig 1.1 shows the map of the study area.



**Fig-1:** Google earth map of Janwad village, Belagavi, Karnataka

### 1.2 Background

The village has open drain system for the flow domestic sewage which is not aesthetic and may cause ill effects on health. The existing open drain system is poorly constructed and doesn't carry sewage to the outfall. Hence, there is a need for a systematic water distribution system and sewerage system.

## 2. MATERIALS AND METHODS

### 2.1 Population Forecasting

The number of people occupying a given area (i.e., the population) was obtained by official survey conducted by the government agencies at intervals of 10 years which is known as 'decennial censuses. Thus obtained data was useful for forecasting the population for the village towards the end of the design period. Village planning authorities and other appropriate authorities will have the records of population development rates which can be incorporated for the design purposes. The population was forecasted using arithmetic progression method [6].

### 2.2 Survey

As the first step of data collection, survey was conducted on February 2016 in Janwad village, Belagavi, Karnataka. The latitude and longitude of the place is 16° 34'3" and 74° 34'21" respectively and having an area of around 0.087 sq. km. 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.

### 2.3 Sewer V8i

SewerCAD V8i is simulation software which is used for the design and analysis of sewerage system of a specified area with considerable population. 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.

## 3. RESULTS AND DISCUSSIONS

### 3.1 Population forecasting

For the present work, arithmetic progression method was adopted for the forecast of the population of the village, since; the exponential growth rate was not available from the collected data. The population was forecasted and a population of 4436 was forecasted at the end of 3 decades.

### 3.2 Survey

The detailed topographical survey was carried out for the village using dumpy level. The roads were identified and represented in AutoCAD.

### 3.3 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-2.

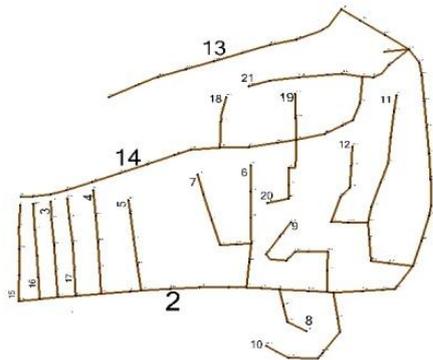
### 3.4 SewerCAD results

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 the village

Sl.no	Parameters	Total	Units
1.	Area	83075	m <sup>2</sup>
2.	Manholes	142	numbers
3.	Sewer line length	3474	m

The 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.

The results obtained from the software were represented in terms of percentages of design parameters with respect to their manholes as shown in table.

**Table-2:** Details of depth wise manhole

Sl No.	Depth of MH	Number of MH	Percentage
1.	< 1.0 m	27	19.1%
2.	1 m – 2 m	75	52.8%
3.	2 m – 3 m	40	28.1%

From the above table, obtained from design simulation shows that 19.1% manholes have a depth less than 1m, 52.8% of the manholes have a depth between 2 to 3 m and remaining 28.1% of the manholes have a depth between 2 to 3 m. The results were compared with diameter and depending length as shown in Table-2.

**Table-3:** Details of diameter along with length of sewer lines

Sl no.	Diameter (mm)	Length (m)	Percentage
1.	150	3242	92.8%
2.	200	250	7.2%
3.	<b>Total</b>	<b>3492</b>	

From the design outcomes it is seen that about 92.8% of the pipes were of 150 mm diameter, and remaining was of 200mm diameter. Due to less load generated per manhole 150 mm and 200 mm diameter pipes were sufficient for the design as represented in Table-3.

**Table-4:** Details of velocity in the sewer lines

Sl no.	Velocity (m/s)	Number of MH	Percentage
1.	< 0.3	51	36.4%
2.	0.3 – 0.6	57	40.7%
3.	> 0.6	32	22.9%

The outcome from the design simulation results from Table-4, shows that 36.4% of the manholes had a velocity <0.3m/s, about 40.7% of the manhole fell between 0.3-0.6m/s and 22.9% of the manhole has a velocity >0.3%. The lower velocity of less than 0.3m/s is caused due to lack of load generated at the starting of the branches and less load contributed for the successive manholes. Around 64% of the manholes have velocities more than 0.3m/s which are acceptable by the departments.

#### 4. CONCLUSIONS

The following conclusions were drawn based on the work carried out on network design for sewerage system for Janwad village.

- 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.
- Most of the manholes fall under 1-3 m depth as suggested by the department and the execution of such depth no much difficulty.
- 92.8% pipelines were of 150mm diameter, rest was of 200mm diameter pipes. Since CPHEEO prescribes 150mm minimum diameter and area consists of more number of initial branches of sewer lines, the minimum of 150mm diameter was considered in the design.
- For the initial branches with velocities below 0.60 m/s, flushing manholes can be adopted to increase the self cleansing capacity.
- Thus the results obtained were within the design criteria and they are acceptable for easy and smooth on the field implication without much difficulty.

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