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A CASE STUDY OF BANAWADI VILLAGE OPTIMUM DESIGN AND ESTIMATION OF SEWER NETWORK

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Abstract - *Residential wastewater contains perched, colloidal, and dissolved organic and inert detritus, and village infrastructure, particularly the water supply and sewerage system, is essential for rural, household, and industrial activity. In a rural setting, wastewater management is a crucial concern for gram panchayats. If gram panchayat wastewater is not properly collected, processed, and disposed of, the environmental consequences are severe. Many settlements lack adequate drainage systems. All residential wastewater is now discharged into open drains or open spaces near homes. As a result, sterility issues have emerged, prompting many villages to design a plan to collect manure underground.*

Key Words: **Wastewater, colloidal, Grampanchayat, sewer, underground, sterile, drainage, network, GIS, and GPS**.

1. INTRODUCTION

Sewerage networks, strictly speaking, keep people and civilization sane and civilized. It is made up of several sewer lines that meet at a large sewer line's intersection. As a result, it is unquestionably a crucial building for urban demands and proper sewage treatment [1]. Waste collected from the community should be transported to a discarding facility without affecting health issues.

The village sewerage system provides the necessary infrastructure for transporting wastewater to a sewage treatment plant. Individuals, commercial, and industrial establishments all generate wastewater, which is collected. The treated wastewater is eventually released back into the environment. From the source to the wastewater treatment facility, effluent can be conveyed via gravity, vacuum, or pressure sewer systems. The minimum velocity, minimum slope, diameter, and peak flow parameters are all factors to consider. For better sewerage system design, total station and remote sensing techniques such as GIS and GPS can be used [2].

Banwadi Gram Panchayat has a population of 5183 people, according to the 2011 census. Now, in the year 2022, the population is estimated to be approximately 17000 people. Water use is 1550000 litres per day. The Krishna River is the source of water, and there is a Jack well there. Waste Water Disposal There is no provision for wastewater disposal.

Hence, the objectives of this research are to design an efficient waste water collection system for the development of Banwadi village, and its implementation on a map is done with the help of ArcGIS software, and also estimate and cost the sewerage network system in order to provide a feasible budget for the village.

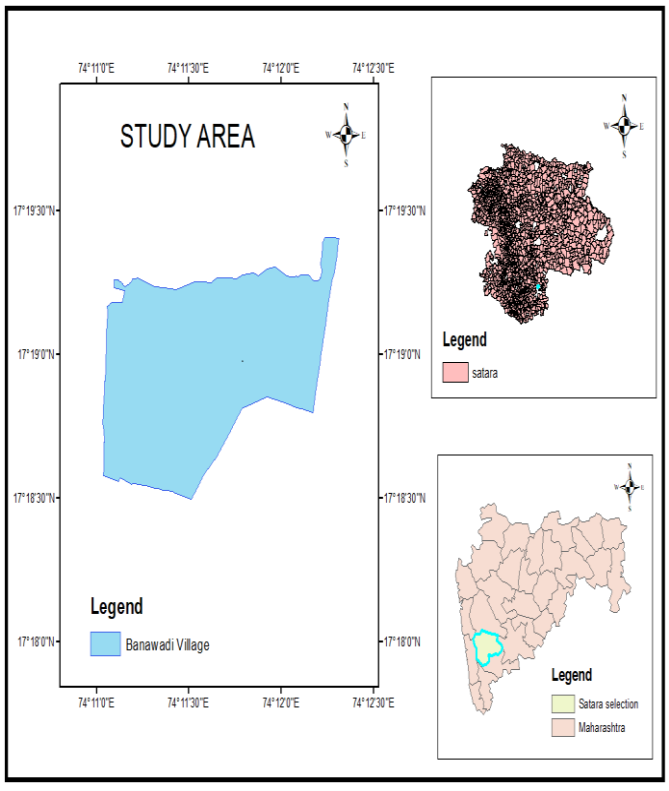
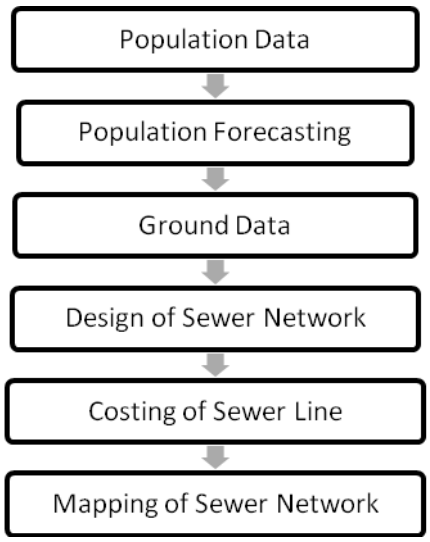


Figure 1.Study Area Map

2. METHODOLOGY



I. Population data:

To collect the population data from respective government agencies like Grampanchayat, Nagar Parishad, etc.

Table1: Population of Banawadi Village

Decade	Population
1991-2000	4115
2000-2011	5183
2011-2021	16923

II. Population forecasting:

From the collection of data, we calculate the population forecast of 4 to 5 decades of a respective village or town by using various population forecasting methods

Formula: - $Pn = Po\ (1+r)^n$

P2011 = 5183, P2021 = 17000, r = 2.27

$Pn = Po\ (1+r)^n$

$P_{2051} = 5183\ (1+2.27)^3$

$= 181227$

III. Ground data:

To find out the reduced levels of the study area by using GPS for calculating slope, excavation, quantity, etc.

IV. Design of sewer network:

With the help of population forecasting data and ground data designing of sewer network will be done.

a. Hydraulic design equation

For the design of sewer lines and the determination of sewer diameter.

We are using Manning's equation which is given

$$V = 1/n.\ R^{2/3}.\ S^{1/2}$$

b. Design of storm drain

The quantity of storm water runoff is calculated using the Rational Formula given

$Q = 10\ C\ i\ A$

c. Calculation

Calculations for main sewer line

Table 2: Description of values

Description	Values
Design life	30 years
Per capita sewage flow	80% of the water supply rate
Peak factor	2.25
Manning's coefficient	0.013
Shape of sewer	Circular

Design calculation of the sewer network

Water supply = 18122.7 m^3 /day

Waste water = 0.1119 m^3/sec

Total Discharge = 0.1129 m^3/sec

Main line:

Peak discharge = 0.2528 m^3/sec

Q = 0.2612 m^3/sec

By using Manning's equation

v = 1.1276 m/s < 3m/s (scouring velocity) Hence OKAY

v_{min} = 0.6924 m/s

0.6924 m/s > 0.6 m/s (self-cleansing velocity)

Hence OK.

d. Storm drain calculation

Main line:

q = 10.c.i.A = 0.021 m^3/s

v_{min} = 1.05 m/s >0.6 m/s

V. Estimation of sewer line:

Estimate of the total cost of the sewer line network. We calculated RL by using GPS essential software and by using this we found out the ordinates of points and used them to find out earthwork by using Simpson's 1/3 rd rule.

The ordinates are as follows,

$O_0 = 3$, $O_1 = 3$, $O_2 = 2.79$, $O_3 = 3$.

$O_4 = 3.3$, $O_5 = 1.12$, $O_6 = 1.67$

$O_7 = 1.45$, $O_8 = 0.22$, $O_9 = 2$

Area = 1953 m^2

VI. Mapping of sewerage network

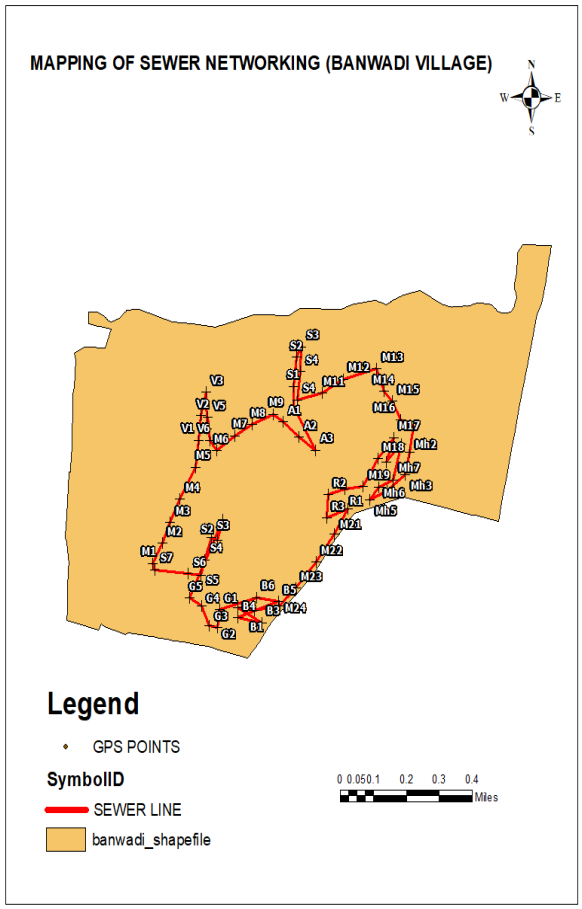


Figure 2. Mapping of Banawadi village

A GPS essential app is used to create way points. Each point was taken at a 100 m interval and every change in connection point. By using ArcGIS 10.3 for mapping and also to help with the drawing of contour maps.

3. Result and Discussion

According to the data collected from Grampanchayat the current population of the Banawadi Village is 16923. As Banawadi is a Young and developing area the method which is most suitable for forecasting the population is Geometrical Increase Method, this method also gives the highest value of the population. The forecasted population for the next 30 years is 181227.

The factor used for calculation of design discharge is 2.25 and the calculated design discharge is 19572.5m^3/day. Diameter range is 230mm to 600m.

Table 3: Flow of Sewer Line

Line	Discharge (cu.m/sec)	Peak Disch--arge (cu.m/sec)	Veloci--ty (m/s)	Qmin (m/s)	Vmin (m/s)
Main	0.1129	0.2528	-	-	-
Main line1	0.2612	0.2528	1.1276	0.1441	0.6924

Table 4: Storm Drainage

Line	Q(cu.m/sec)	Qmin(m/s)	Vmin(m/s)
Main line	0.021	0.333	1.05

Table 5: Costing of Sewer Drainage Network

Sr. No	Line	Cost
I	Main Line	Rs.3454610

4. CONCLUSIONS

The design diameter range for the town is between 230 mm to 600 mm.There has been an increase in the population and a corresponding increase in the panchayats limits. The area under the development has been considered in this study for catering to the need of providing safe sanitation to the present and the projected population. The design discharge for the design of the sewer line is taken as 19572.51 m^3 / day.

There are 4 wards in the village and the estimated cost for each ward is around 7 lakhs and the estimated cost for the main sewer line is around 30 lakhs.

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