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# Environmental Redesigning of Sewerage System of Academic World School Bemetara (C.G.)

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**ABSTRACT:** Secure water supply and hygienic sanitation facilities are the two main basic amenities for healthy living. A proper understanding of the sewerage system is therefore necessary to look at the large percentage of domestic water perceived to be sewerage when constructing any sewerage system. The objective of this project work is to study and describe the importance of water in terms of water supply system and drainage (sewerage) system. Also analysis the major causes and sources behind water pollution, and the main work is to redesign the existing sewerage system of Academic World School Bemetara, NH12A and gives less economical and environmental friendly STP proposal. Our project location Academic world school situated at village Lolesara beside of NH12A, Bemetara (Chhattisgarh). This site is continuously facing the problem of sewer leakage, chokes, septic tank chamber was in overflow condition causing that nearby area of sewerage system became swampy and also it spread bad smell. All these problems arise due to previous worst design of sewerage system. So here our work is to redesign of existing sewerage system. A proposed STP of capacity 200KLPD out of which 90% water recycled in flushing water(108KLD), and horticulture water (55920LPD)(for irrigation purpose in side agriculture land) and remaining 10% excess water can be used other subsidiary purpose. Proposed STP will be environmental friendly. 160mm and 200mm pipe diameters of two sewer pipes of length 600m and 310m are designed respectively. Total 34 new manhole chamber of rectangular (11) and circular (24) shape is designed.

**KEYWORDS:** Water pollution, Sewerage system, Self-cleansing velocity, STP, Sewer.

## I. INTRODUCTION

Every one of us knows how precious and important water is. According to the World Health Organization, more than 3.5 million people die each year from water-related disease, of which 84% are children. The same organization reported that nearly 90% of all death cases associated with diarrheal diseases occurs in the child population of the developing world further, it is necessary that the water required for their needs must be good, compounds or bacterial in it. [1] Sewers are highly critical components of urban infrastructure that help keep the urban ecosystem protected from floods and avoid the spread of waterborne diseases by transporting waste water safely to waste water treatment facilities and by transporting rainwater from urban areas. Of course, in order to fulfill this essential position in urban infrastructure, the emphasis on sewer design and development has been on the function of sewer networks with regard to safe water transport. Owing to population increase, growing urbanization, and climate change, current sewage networks were under increasing pressure. The growing pressure on the sewers manifests itself as maintenance deficiencies leading to flooding incidents, increased loads on treatment facilities leading to low water discharge quality, and leaks due to concrete degradation related to increased structural degradation.

Therefore, in order to ensure the availability of sufficient quantity of good quality water, it becomes almost imperative in a modern society, to plan and build suitable water supply schemes and good drainage system design, which may provide potable water to the various section of community in accordance with their demands and requirements and also safely drain waste water. The provision of such a scheme shall ensure a constant and a reliable water supply to that section of the people for which it has been designed.

## II. OBJECTIVE OF THE STUDY

1. The primary purpose of this study is to understand and describe the importance of water in terms of water supply system and drainage (sewerage) system.
2. Also analysis the major causes and sources behind water pollution.
3. Redesign the existing sewerage system of Academic World School Bemetara, NH12A. and give less economical and environmental friendly STP proposal.

## III. LITERATURE REVIEW

A micro level study done by **Swapnil M. Kamble** on “Water Pollution and Public Health Issues in Kolhapur City in Maharashtra” reported that 75 to 80% of water pollution by volume is caused by domestic sewage. The remaining is industrial wastewater, which could be more toxic. Only 60% of chemical fertilizers is utilized in soils and the balance is leached into soil polluting ground water. Excess phosphate run-off is leading to eutrophication in lakes and water bodies. Adverse health outcomes are associated with ingestion of contaminated water, 4 lack of access to sanitation, contact with unsafe water, and inadequate management of water resources and systems including in agriculture. [2]

**Central Pollution Control Board (CPCB)** is monitoring the water quality of aquatic resources across the country under a three-tier programme i.e. Global Environmental Monitoring System (GEMS), Monitoring of Indian National Aquatic Resources System (MINARS) and Yamuna Action Plan (YAP). According to CPCB bulletin vol.I 2016 in river Ganga domestic waste water percentage contribution in the total quantity of wastewater and BOD load is 92 and 69 respectively and the remaining is contributed by industrial effluent. Both industrial effluent and domestic waste water contribute to the pollution in river Ganga. 6614 MLD of waste water with an organic pollution load of 426 TPD is discharged into river Ganga. The five states viz Maharashtra, Tamil Nadu, Uttar Pradesh, Delhi & Gujarat account for approximately 50% of the total sewage generated in the country. Maharashtra alone accounts for 13% of the total sewage generation in the country. No sewage treatment plant has been established in seven states/UTs viz. Arunachal Pradesh, Chhattisgarh, Daman Diu, Nagaland, Assam & Tripura. [3]

**Ali Alnoaimi et.al** works on conceptual framework for sustainability assessment of Bahrain’s sewerage infrastructure projects. Sewerage infrastructure projects face a variety of challenges and threats to their sustained performance throughout their life cycle. These challenges lead to the enhanced risks of failure, for example, sewer leakage, overflow, and odor. Such issues can have serious impacts on the environment, public health and safety, the economy, and the service lives of assets. Limited research, if any, has been conducted on the sustainability assessment throughout the entire life cycle of a sewerage asset with consideration of all aspects of sustainability. Their study which is part of a larger research project, contributes to the literature by proposing a sewerage sustainability assessment framework that focuses on all aspects of sustainability, namely, environmental, economic, and social aspects, throughout the project life cycle. This framework is set apart from most existing frameworks, which focus more on the environmental aspect than on the social and economic aspects. [4]

**S.Manikandan and A.Nisar Ahamed** work on the designing of plumbing systems which include various parts such as water supply system, water storage system, water pumping system, waste water drainage system. Their works also deal with selection of plumbing pipes specification. Self cleansing velocity and proper gravitational flow leads to sewage treatment plant and other filter units. The integrated plumbing and drainage system design results economical and efficient service. To reduces water scarcity rainwater harvesting segment included in their work. They also gave the provision of fire fighting. [5].

## IV. PROBLEM IDENTIFICATION

Our project location Academic world school Bemetara, is situated just adjacent to NH-30, in Chhattisgarh. The school campus has green surroundings spread over more than 25 acres of a premise.at village Lolesara beside of NH12A, Bemetara (Chhattisgarh). This site is continuously facing the problem of sewer leakage, chokes, septic tank chamber was in overflow condition causing that nearby area of sewerage system became swampy and also it spread bed smell. All these problems arise due to previous worst design of sewerage system. So here our work is to redesign of existing

sewerage system. The design of a sewerage system, in general, involves selection of a suitable combination of pipe sizes and slopes so as to ensure adequate capacity for peak flows and appropriate self cleansing velocities at minimum flow. In a conventional design procedure, efforts are made to analyze several alternative systems (each meeting the physical and hydraulic requirements) and the least cost method is selected.



(source-Google Earth map)

**FIG. 1 PROJECT LOCATION**

**V. METHODOLOGY**

**5.1 Water demand**

According to NBC vol.II part 9 section 1

**Table 1:** For institutional building water requirement

S.No.	Unit	Domestic water (lpcd)	Flushing water (lpcd)	Total consumption (lpcd)
1.	Without boarding facilities	25	20	45
2.	With boarding facilities	90	45	135

**5.2 Drainage system design**

**(I) STP (Sewage treatment plant)**

- a) STP location- Depending upon various conditions such as land features etc.
- b) STP size according to designed capacity.
  - Minimum depth of STP should be more than 3meter.
  - Width of STP should be more than 3.50 meters.
  - Surface area of STP should be more than 2 times of its sewage capacity.
- c) STP technical specification should be given by STP provider specific companies.

(II) Contour plan study- For finding slope details.

(III) Hydraulic design

- a) Determination of sewer system type
- b) Shape and size of sewer
- c) Minimum size of circular sewer
- d) Flow in circular sewers
- e) Maximum Velocity
- f) Design Depth of Flow
- g) Slope of Sewer
- h) Minimum Velocity for Preventing Sedimentation
- i) Manning’s Formula for Gravity Flow-

For the hydraulic design of the pipe, Manning’s equation is used, which is given as-

$$V = (1/n) \cdot R^{2/3} \cdot S^{1/2}$$

Where, V = Design velocity in m/s

n = Manning’s roughness coefficient

R = Hydraulic radius in m

S = Hydraulic slope

j) Manhole Location - Manholes should be installed:

- 1) At the end of each sewer line. 2) At all changes in pipe size, grade or alignment, and at bends.
- 3) At all sewer pipe intersections.

Table 2: Design velocities to be ensured in gravity sewers

S.no.	Criteria	Value
1.	Minimum velocity at initial peak flow	0.6m/s
2.	Minimum velocity at ultimate peak flow	0.8m/s
3.	Maximum velocity	3 m/s

(Source: WPCF, ASCE, 1982)

Table 3: slope of sanitary sewer

Sewer size (in mm)	Minimum slope	
	As percent	As 1 in
150	0.6	170
200	0.40	250
250	0.28	360
300	0.22	450
375	0.15	670
450	0.12	830
≥525	0.10	1000

(Source: CPHEEO, 1999)

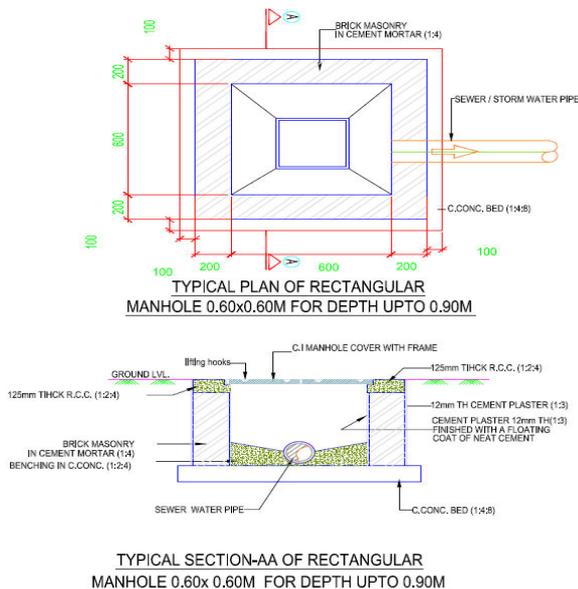


Fig -2: Rectangular manhole: plan and section

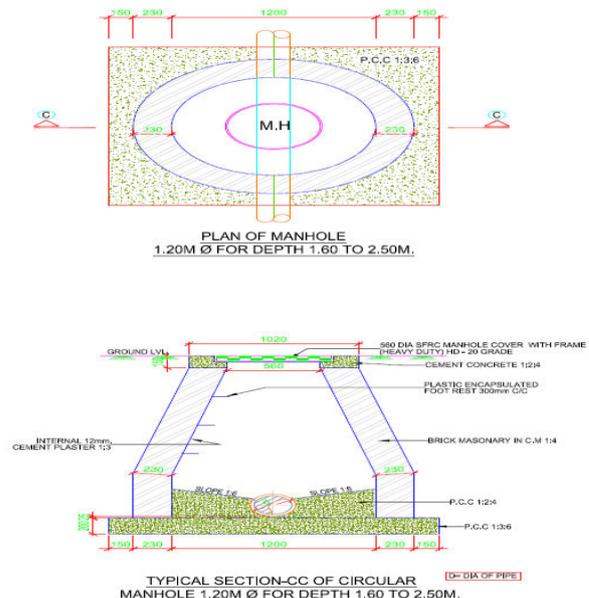


Fig 3. - Circular manhole: plan and section

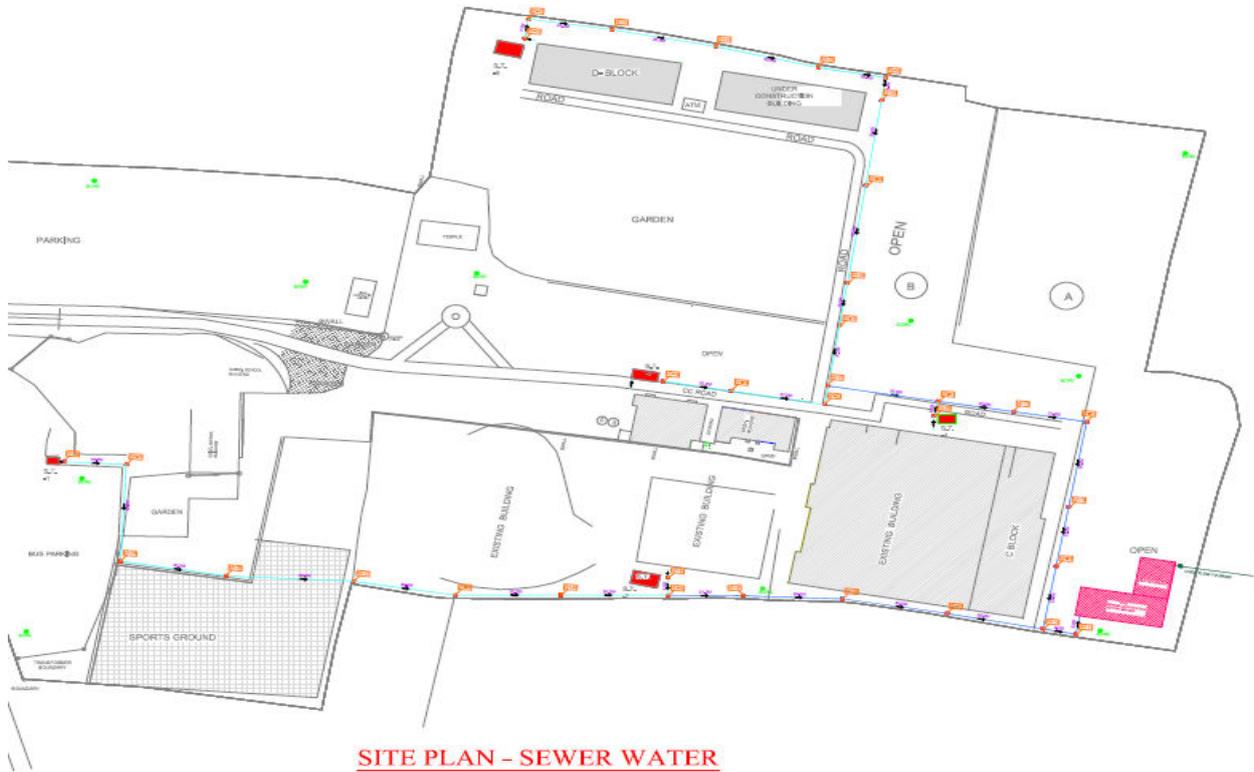


Fig -4: Sewer water site plan

VI. RESULT AND DISCUSSION

1. Total water requirement = 337170 LPD
2. Total fresh water requirement = 172500 LPD
3. Total consumption from STP = 164670 LPD
4. Total sewage generation = 235875 LPD

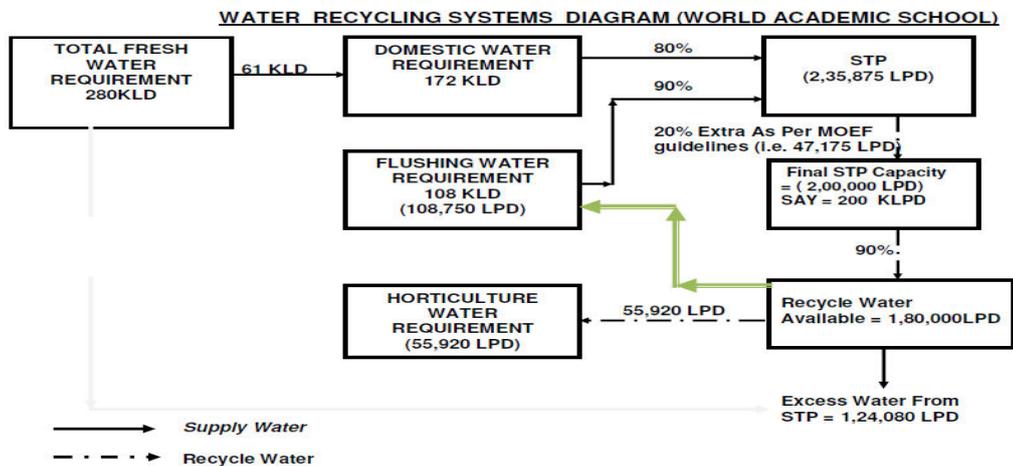


Fig -5: Flow diagram of water recycling through STP



TABLE 4: SEWER MANHOLE SIZE, DEPTH & PIPE INVERT LEVELS OF WORLD ACADEMIC SCHOOL BEMETARA

SEWER MANHOLE SIZE, DEPTH & PIPE INVERT LEVELS OF WORLD ACADEMIC SCHOOL , BEMETARA (R2)										
SR. No	Manhole		Length of Pipe	Length of Pipe	Manhole Finish Level (MHFL)	PIPE SIZE	GRADIENT	START INVERT LVL OF PIPE	MANHOLE DEPTH	MANHOLE SIZE
	From	To	MTR.	Ft	LVL	MM		MTR	MTR.	MM
1	MH-01	MH-01	0.00	0.00	99.530	160	100	98.93	0.60	600X600
2	MH-01	MH-02	7.00	22.96	99.530	160	100	98.86	0.67	600X600
3	MH-02	MH-03	24.00	78.72	99.230	160	100	98.62	0.61	600X600
4	MH-03	MH-04	30.00	98.40	98.780	160	100	98.32	0.46	600X600
5	MH-04	MH-05	30.00	98.40	98.780	160	100	98.02	0.76	600X600
6	MH-05	MH-06	30.00	98.40	98.460	160	100	97.72	0.74	600X600
7	MH-06	MH-07	9.00	29.52	98.460	160	200	97.68	0.78	600X600
8	MH-07	MH-08	30.00	98.40	99.210	160	200	97.53	1.68	900 DIA.
9	MH-08	MH-09	30.00	98.40	99.180	160	200	97.38	1.80	900 DIA.
10	MH-09	MH-10	15.00	49.20	99.180	160	200	97.30	1.88	900 DIA.
11	MH-10	MH-21	21.00	68.88	99.510	160	200	97.20	2.32	1200 DIA.
12	MH-21	MH-11	27.00	88.56	99.540	200	200	97.06	2.48	1200 DIA.
13	MH-11	MH-12	22.00	72.16	99.510	200	200	96.95	2.56	1200 DIA.
14	MH-12	MH-13	21.00	68.88	99.510	200	200	96.85	2.67	1200 DIA.
15	MH-13	MH-14	30.00	98.40	99.580	200	200	96.70	2.89	1200 DIA.
16	MH-14	MH-15	21.00	68.88	99.410	200	200	96.59	2.82	1200 DIA.
17	MH-15	MH-16	22.00	72.16	98.230	200	200	96.48	1.75	1200 DIA.
18	MH-16	MH-17	9.00	29.52	97.750	200	200	96.44	1.32	1200 DIA.
19	MH-17	STP	6.00	19.68	97.750	200	200	96.41	1.35	-
19	MH-18	MH-18	0.00	0.00	99.690	160	200	98.93	0.76	600X600
20	MH-18	MH-19	20.00	65.60	99.690	160	200	98.83	0.86	600X600
21	MH-19	MH-20	27.00	88.56	99.510	160	200	98.70	0.82	600X600
22	MH-20	MH-21	7.00	22.96	99.510	160	200	98.66	0.85	1200 DIA.
23	MH-22	MH-22	0.00	0.00	99.540	160	200	98.78	0.76	600X600
24	MH-22	MH-11	5.00	16.40	99.540	160	200	98.76	0.79	1200 DIA.
25	MH-23	MH-23	0.00	0.00	99.390	160	200	98.48	0.91	900 DIA.
26	MH-23	MH-24	18.00	59.04	99.450	160	200	98.39	1.06	900 DIA.
27	MH-24	MH-25	32.00	104.96	99.120	160	200	98.23	0.89	900 DIA.
28	MH-25	MH-26	30.00	98.40	99.120	160	200	98.08	1.04	900 DIA.
29	MH-26	MH-27	36.00	118.08	99.170	160	200	97.90	1.27	900 DIA.
30	MH-27	MH-28	30.00	98.40	99.170	160	200	97.75	1.42	900 DIA.
31	MH-28	MH-29	30.00	98.40	99.680	160	200	97.60	2.08	1200 DIA.
32	MH-29	MH-30	30.00	98.40	99.680	160	200	97.45	2.23	1200 DIA.
33	MH-30	MH-31	21.00	68.88	99.230	200	200	97.34	1.89	1200 DIA.
34	MH-31	MH-32	29.00	95.12	99.230	200	200	97.20	2.03	1200 DIA.
35	MH-32	MH-33	30.00	98.40	98.230	200	200	97.05	1.18	1200 DIA.
36	MH-33	MH-16	28.00	91.84	98.230	200	200	96.91	1.32	1200 DIA.
37	MH-34	MH-34	0.00	0.00	99.680	160	200	98.08	1.60	900 DIA.
38	MH-34	MH-30	6.00	19.68	99.680	160	200	98.05	1.63	1200 DIA.

VI. CONCLUSIONS

The main aim of this work is to redesign the sewerage system which includes slope or gradient analysis of project site, new position of manhole and septic tank chamber, and diameter of sewer pipe line, length of sewer line and depth of manhole chamber. Environmental design is the process of discussing surrounding environmental parameters. It aims to produce environments that improve the natural, social, educational, and physical environments of specific regions.

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