

# **KERALA WATER AUTHORITY** *DETAILED ENGINEERING REPORT*



# **1.35 MLD CAPACITY SEWERAGE SYSTEM FOR** WADAKKANCHERY MUNICIPALITY

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#### **EXECUTIVE SUMMARY**

The detailed engineering report has been prepared for providing a Sewage Treatment Plant (STP) for Wadakkanchery Municipality in Thrissur District. As an initial part of the study, the Sewerage vertical team of Kerala Water Authority visited the Municipality and conducted several discussions with the authority and collected all basic data and information for design of the system. Detailed Discussion were done with the officials involved in the project and visited site proposed for the Sewage Treatment Plant (STP). At present there is no planned sewage treatment facility for the entire project area. Under the above circumstances it has been planned to construct a STP for the liquid waste management within the project area covering core area of the town with sewage network and other portions with septage management.

The sewage and sullage load generated for the project area was determined from the water consumption analysis and expected future requirements was also considered. It is observed that 1.35 Million Liters per Day (MLD) capacity STP is required including septage for Wadakkanchery Municipality and the unit operations, and the chemical and biological process were designed in accordance with all stipulations of accepted practice of design and Indian Standard Codes of practice. The effluent characteristics were adopted in accordance with the regulations, especially the NGT guidelines on it. The biological treatment unit consists of Moving Bed Biofilm Reactors (MBBR) with a facility for nitrification and de-nitrification also. For additional purification, clarifiers are designed as a modern plate settler. Total estimated cost is observed to be Rs. 43,28,58,000 (Forty Three Crores Twenty Eight Lakhs Fifty Eight Thousand Only) including 10 years operational expenses excluding power charges. The plant is to be equipped with sludge handling and disposal units also. It is planned to provide ecofriendly units for the system with gardens especially for the exterior portions of the units. For conserving energy and optimizing performance of the system solar energy source is also planned to be used. Also, for trouble free performance of the system, at all points of influence, sensors for measuring values of flow and required parameters are to be installed. Using Internet of Things (IoT) enabled software system, the control of the entire process can be performed effectively. It has been planned to implement the project within a short span of time.

# PROJECT AT A GLANCE

SI. No.	Item	Description	
1	Name of Project	1.35 MLD Capacity Sewage Treatment Plant and Sewerage System for Wadakkanchery Municipality	
2	Name of District	Thrissur	
3	Project area	Wadakkanchery Municipality	
4	Capacity of STP	1.35 MLD	
5	Components	Pre-treatment units, Co-treatment units for Septage, MBBR, Clarifier, Filters, Sludge handling units	
6	Project cost (including 10 years O&M cost)	Rs. 43,28,58,000	
7	10 year operational and maintenance cost	Rs. 11,09,10,000	
8	Implementation agency	Wadakkanchery Municipality	
9	Period of execution	24 Months	

# ABSTRACT OF ESTIMATE

ABSTRACT OF COST					
Sl. No.	ITEM	AMOUNT			
CIVIL IT	EMS				
1	Site Preparation-LS	₹ 5,000			
2	OG Trap, Receiving Chamber, Screen, Grit Chamber	₹ 36,79,575			
3	Equalisation Tank	₹ 38,30,105			
4	Dilution Tank for Co-treatment	₹ 12.98,720			
5	Moving Bed Biofilm Reactors	₹ 66.59.946			
9	Clarifier with Tube/Plate Settler	₹ 13.04.007			
10	Sludge Sump and Thickener	₹7.07.685			
11	Chlorine Contact Tank and Filter Feed Tank	₹9.90.224			
12	Treated Water Tank	₹7 58 410			
13	Green Belt and Landscaping	₹ 11 55 000			
14	Facility for Recycling Purposes	₹1,50,000			
15	Building with Trussed Roof and Eco-friendly walls	₹ 42 42 500			
15	Equipment Laboratory items Eurniture and Computer	₹ 42,42,500			
10	Sewer network with ninelines and chambers	₹ 10,03,16,567			
	TOTAL OF CIVIL ITEMS	₹ 21 56 97 730			
	GST Component (18%)	₹ 3 88 22 1/39			
MECHA		\$ 3,00,22,120			
	Cotes and Screens	₹ 2 25 000			
1	Dump sets and A antion system	₹ 2,23,000			
2	Pump sets and Aeration system	₹ 01,95,584			
3	PSF & ACF	₹ 35,50,000			
4	Centrifuge	₹ 4,00,000			
<u> </u>	Bypass arrangements, steel ladder and frame work	₹ 3,50,000 ₹ 65,00,700			
0	MBBR Carrier and other items	₹ 65,89,720			
/	I ube settler media	₹ 2,02,635			
8	Alum and Lime dosing systems	₹ 1,60,000			
9	Odour Control Unit	₹ 60,000			
10	GPS fitted Vacuum Trucks	₹ 90,00,000			
	IOTAL OF MECHANICAL ITEMS	₹ 2,67,32,939			
	GST Component (18%)	₹ 48,11,929			
	ICAL ITEMS	<b>T</b> 4 50 000			
1	Direct Connecting piping system	₹ 4,50,000			
2	Diesel Generator	< 8,40,000			
3	Electrical works, lo I based sensor and control units	₹ 15,25,000			
4	Electrical installations for lifting stations and collection wells	₹ 3,00,000			
5	Installation of solar units for lifting stations, wells and STP	₹ 11,60,000			
	TOTAL OF ELECTRICAL ITEMS	₹ 42,75,000			
	GST Component (18%)	₹7,69,500			
ABSTRA					
SI. No.	ITEM	AMOUNT			
	Civil Works	₹21,56,97,739			
2	Mechanical Works	₹ 2,67,32,939			
3	Electrical Works	₹ 42,75,000			
	Total Project Cost	₹ 24,67,05,678			
	GST Component (18%)	₹ 4,44,03,556			
	DPR preparation charge @ 2.5%	₹ 61,67,642			
	Centage charges@10%	₹ 2,46,70,568			
	Unforeseen	₹ 556			
	GRAND TOTAL	₹ 32,19.48.000			
	(Rs. Thirty Two Crores Nineteen Lakhs Forty Eight Thousand Only)				
	Total O&M cost for 10 years	₹ 11,09.10.000			
	TOTAL COST including 10 years O&M	₹ 43,28,58,000			
	(Rs. Forty Three Crores Twenty Eight Lakhs Fifty Eight Thousand Only)				

## **CHAPTER 1**

#### **INTRODUCTION**

#### **1.1 BACKGROUND AND PROJECT GENESIS**

Kerala Water Authority (KWA) was established on 1<sup>st</sup> April 1984 under the Kerala Water and Wastewater ordinance, 1984 by converting the erstwhile Public Health Engineering Department to provide for the development and regulation of water supply and wastewater collection and disposal in the State of Kerala and for matters connected there with. To effectively address the emerging need of wastewater management, a Sewerage Vertical wing has been created in KWA with Chief Engineer, PPD, WASCON and Sewerage as its head.

KWA as a knowledge partner, service provider and a central agency for coordinating the activities related to the planning and implementation of sewerage systems for Local Self Government Institutions (LSGIs) can contribute in many ways. In the State of Kerala, KWA is providing sewerage system partly in Thiruvananthapuram and Kochi Corporations and a Sewerage system for Guruvayur Municipality has been completed.

#### **1.2 NEED FOR A SEWAGE TREATMENT SYSTEM**

Environment protection has become the most important aspect in the present era of sustainable development. With uncontrolled urbanization, contamination of drinking water sources by sewage and septage has become a major threat to public health and safety. Direct discharge of sewage to the water courses and discharges of septic tank effluents to the stream and canals polluted the entire water course. Safe water supply and hygienic sanitation facilities are the two basic essential amenities for healthy living. In the developing world, sanitation has always been more unfortunate than its twin brother water supply. The water supply will have a measurable impact on health only if it is linked with sanitation facilities.

The objective of the present work is to prepare a Detailed Engineering Report (DER) and implementation of an STP for Wadakkanchery Municipality in Thrissur district. The major objective of establishing Sewage Treatment Plant is to treat the effluent (untreated wastewater) generated from core areas of the town and to avoid its direct release into natural environment. Wastewater may have an adverse impact on human health and environments. Therefore, proper wastewater management in this municipality is essential. Other general objectives of the present works are:

- 1. To find appropriate methods for collection, treatment and disposal of wastewater generated from the project area of Wadakkanchery Municipality.
- 2. Treat all the wastewater generated from houses, commercial establishments and public institutions etc. as per the norms laid by Pollution Control Board and other regulations.
- 3. To discuss possible options to improve management of wastewater in the project area.

#### **1.3 HUMAN DEVELOPMENT OUTCOMES FOR SEWERAGE INVESTMENTS**

Lack of access to improved sanitation costs countries up to 7% of their GDP annually. At the national and global levels, the human cost manifests in huge economic losses. These losses are mainly driven by premature deaths, health care treatment, lost time and productivity seeking treatment, and finding access to sanitation facilities in urban areas and thickly populated clusters of rural areas as well. In 2012, the World Health Organization (WHO) estimated that the global economic return on sanitation spending is US \$5.5 for every one dollar invested, more than double the economic return on water spending (US\$2.0). However, the UN 2012 Global Analysis and Assessment of Sanitation and Drinking Water indicates that only 10 out of 75 countries who participated in their survey reported to have more than 75% of the funds needed for sanitation.

Investment in safe water supply and access to improved sanitation has multiple economic returns. For every 1 US Dollar invested, there is a projected USD 3 to 34 benefits gained. The benefits range from time savings and productivity gains to budget savings on health-care. Per capita gains for the developing world population could reach at least USD 15 per capita per year. It is well established that aspects of women safety, dignity and well-being are intrinsically linked to improved availability, access and use of sanitation and drinking water facilities.



Fig.1 Human development outcomes for sewerage investments

#### **1.4 OVERVIEW OF SITUATION AND GOALS**

Wastewater disposal and treatment was a major problem in cities in Kerala. The wastewater from toilets has been disposed through septic tanks and soak pits and grey form of wastewater from kitchen and bathrooms is directly discharged into the sludge drains without any treatment. As per Census 2011, 45.455 of the urban households have "no drainage". There are 14.32% of the households connected to centralized sewerage system. Although centralized sewer system is of minor importance and disposal of sludge is a problem.

About 97.43% of the households in the urban areas of Kerala state have a toilet within their residential premises. Almost 56.69% of them are connected to septic tanks, 21.87% to pit latrines while households having connection to the centralized sewer system are about 14.32%. There are both technical and institutional dimensions to the problem of septic tanks in the state of Kerala. The septic tanks design does not comply with the national guidelines with reference to planning, design and construction. Local masons are unaware of the existing design and construction guidelines to construct and design the septic tanks. There are multiple agencies involved in operation and maintenance of water and sanitation services in Kerala. Septage management is viewed as private provision with limited role of urban local bodies.

The districts with highest percentage of households using septic tanks are Kozhikode (69.51), Wayanad (63.20), Malappuram (62.30), Kannur (60.24) and Thrissur (60.10). Together, these five districts account for 50.38 percent of the total households using septic tanks in the state of Kerala. About 50.78 percent of households in Census Towns use septic tanks for the purpose of faecal sludge management at the household level. Municipal Corporations and Municipalities have 29.40 and 19.82 percent respectively of the households having septic tanks.

The Service Level Benchmark (SLB) is to ensure that all households have access to sewerage connection to ensure that the faecal sludge is safely disposed and treated at the Sewerage Treatment Plant (STP).

Another set of reasons cited for urgency in taking up septage management is the occupational hazards for emptying the septic tanks. The Prohibition of Employment as Manual Scavengers and their Rehabilitation Act, 2013 has expanded the definition of workers engaged in such sanitation works by including the practice of septic tank emptying and manual handling of such faecal sludge. The revised Manual Scavenging Act will require states to gear up the Municipal bodies in discharging their responsibilities effectively.

In the absence of efficient water treatment systems and solid waste management systems, untreated domestic and industrial wastes, and agriculture-runoff flow into the rivers polluting the rivers in Kerala. There has been widespread bacteriological contamination of faecal origin in ground and surface water which relate to proximity of increasing numbers of leach pit latrines, leakages from septic tanks, washing, bathing and other domestic activities.

Hence the goals for setting a sewerage strategy for a district will involve multi-faceted approach to cover every habitation and other institutions and establishments. This will render adequate results in both short term and long-term development plans. If a plan has been chalked out which can provide a systematic and flexible implementation mode, stage by stage implementation and better control over the system can be achieved. A district level plan document for sewerage will create a backbone for the subsequent formation of detailed engineering reports in this regard. Hence implementation of sewerage systems at the local body level will be more effective and systematic.

#### **1.5 VISION OF SEWERAGE STRATEGY**

As per the vision of Kerala State Sanitation Strategy, all cities and towns in Kerala become totally clean, sanitized, healthy, liveable, ensuring and sustaining good public health and environmental outcomes for all citizens, with a special focus on hygienic and affordable sanitation for the urban poor and women with specific focus on the diverse topography of the state and its implications. Hence the overall vision can be defined as the achievement of an urban Kerala ensuring environmentally safe disposal of solid and liquid waste. Similarly, to formulate a vision for sewage strategy for each habitation of the State it is imperative to develop a scientific, sustainable and effective sewage system covering directly or indirectly every human settlement. Improved Institutional governance and enhanced human resource capacities for planning and maintaining the sewerage is also coming under the goal. Capacity building for adoptability to modern technologies and applications for the service providers is also another goal.

## **1.6 ORGANIZATION OF DETAILED ENGINEERING REPORT**

The Detailed Engineering Report (DER) for the Sewage Treatment Plant and Sewer Network for Wadakkanchery Municipality in Thrissur District has been prepared by KWA and presented in 7 chapters, describing different project concepts and activities.

Chapter 1 deals with a general introduction to the subject. Vision and goals of the sewerage for entire project area and its social implications are described.

Chapter 2 consists of various aspects of the sewerage strategy for the project area. Plan for the sewerage treatment and the technology adopted are described.

Chapter 3 describes sewer network in details. Planning of sewer network in core areas and its design is illustrated in detail.

Chapter 4 deals with the unit operations and treatment process in details. Various components of the sewerage system and its design aspects are also described in detail.

In Chapter 5, detailed estimates for all components of the sewerage project are illustrated.

Chapter 6 deals with various aspects of operation and maintenance of the sewage treatment plant in detail. Since it is decided to impart optimum cost and functional aspects of operation, applications of modern technologies for control of the process are also dealt with.

In the concluding Chapter 7, observations gathered from the pre-feasibility studies for the planning, design and implementation of the sewerage system for the institution is presented. Action plan for the implementation of the project and recommendations for future additions are also dealt with.

#### **CHAPTER 2**

#### PLAN OF SEWAGE TREATMENT

#### **2.1 GENERAL**

In this Chapter general aspects of sewage collection, treatment and disposal for the Wadakkanchery Municipality is described. For core area of the Municipality, sewer network consisting of pipeline network is planned to be laid underground to collect sewage load from various nodes in the system across the project area. The sewage network system also consisting of manholes at the interval of 30 m in normal cases and at every bends in vertical and horizontal planes. Whenever there is a variation in diameter, manholes are also provided. To reduce depth cutting, lifting manholes are provided with sewage lifting pumps of smaller capacities. Solar power and diesel generator backup power is also provided to get uninterrupted working of the system. IoT enabled monitoring of the sewerage system is envisaged with a control station inside the Sewage Treatment Plant (STP).

The locations in the project area without having sewer network are included in the septage management plan. Using septage transportation system, sludge from various points is collected and diluted using cotreatment facility at STP area and treated along with sewage.

Sewage Treatment Plant is designed for primary treatment and subsequent bacteriological and chemical treatment process. Finally, sludge handling units are planned to be provided. The recycled water can be taken for agricultural and other commercial and industrial purposes and for recharging water bodies and to alleviate any pollution loads.

## **2.2 PROJECT AREA**

Thrissur District is situated in south-western India (10.52°N 76.21°E) and is in the central part of Kerala. Thrissur is at sea level and spans an area of about 3,032 sq.km. It is bounded on the north by small parts of Malappuram district, on the east and north by Palakkad district, on the east by small parts of Coimbatore district of Tamil Nadu, on the south by Ernakulum district, and on the west by the Arabian Sea (54 km). Descending from the heights of the Western Ghats in the east, the land slopes towards the west forming three distinct natural divisions – the highlands, the plains and the seaboard.

**Wadakkanchery** is a major town in Thrissur, Kerala and lies between 10°39'34"N 76°14'58"E and10°39'34"N 76°14'58"E. Up until 1860, this area was part of Chelakkara Taluk. Now, it is the headquarters of Thalappilly Taluk with an area extend 51.56 sq.m. As per Census 2011 Wadakkanchery Municipality has a population of 61341 with 29369 Men, and 31972 Women Wadakkanchery obtained municipality status from the government by merging with the Mundathikode panchayath in 2015 and it is the only town in Thrissur District to be raised as municipality recently.

Wadakkanchery is situated on the Thrissur–Shornur State Highway 22 and is directly connected to Kunnamkulam (another major town in the Thrissur district). Ottupara Bus Stand is a main stop on the Thrissur–Ottapalam/Chelakkara bus route. Railway Station is in Wadakkanchery and is managed by Southern Railways. Being one status of Adarsh station by the government of India, it is the main station after Thrissur Railway station.

Wadakkanchery is an important cultural centre. The Kerala Kalamandalam is located at Cheruthuruthy, not far from Wadakkanchery. This place is home to many artists, literary and cinema figures. Government Boys' High School, Government Girls' High School, St. Pius, and Bharathiya Vidya Bhavan are the premier schools located at Wadakkanchery. Sri Vyasa NSS College, managed by the Nair Service Society, at Parlikkad is a noted educational institution near Wadakkanchery. Parlikkad also hosts a major religious congregation of Hindus during December of every year.

The Vazhani Dam, approximately 8 km from Wadakkanchery, made entirely of mud is the major tourist attraction nearby. Wadakkanchery is situated in the heart of the "Pooram belt". Poorams are the annual festivals in temples of central Kerala, especially the "Uthraalikkaavu Pooram" and "Machad Thiruvanikaavu Vela" which are well known for their firework extravaganzas and rituals respectively, during the festivals. The "Pathinettara (eighteen and half) Kavu Vela" is famous which takes place on the first day of Kumbha masam at different temples in and around Wadakkanchery. The most famous fireworks are during the festival at Sree Rudhira Mahakali (shortened to Uthrali) Kavu. This takes place in the month of Kumbham (February–March). The pomp and gaiety of this occasion is matched only by the fireworks of the Thrissur pooram. It falls on the very next Tuesday of Machad Mamankam during the month of Kumbham. The Para Purappad here is on the same day of Machad Mamankam.

Unlike other temple festivals in Kerala where caparisoned elephants are the main attraction, the 'Machad Mamankam' or 'Machattu Vela' is celebrated on the Tuesday coming after the first Friday of the Malayalam month Kumbha, with huge models of caparisoned horses. Villages in the nearby area of the temple participate in the festival in a competitive but spiritual way. These huge horses are carried by the youth of their respective villages to the temple.

Many important places of worship are in the town. These include Uthraalikkaavu temple, Machad thiruvaanikkavu, Akamala Sastha temple and Maari Amman Kovil, St. Francis Xaviers Forane Church, St. George Malankara Orthodox Syrian Church, India Pentecostal Church of God, Assemblies of God Church, Ottupara Town Masjid, and Juma Masjid. The Dhanwanthari Temple at Nelluvay near Erumapetty (on Wadakkanchery–Kunnamkulam Road, approximately 8 km from Wadakkanchery) is another place of religious interest. The Siva temple at this place is considered an archaeological monument by the Archaeological Survey of India. The Pallimanna Siva Temple at Kumblangad at 3 km from Wadakkanchery is another archaeological monument by the Archaeological Survey of India. The St. Jude Thaddeus Church is located at Kumbalangadu, 3 km away from Wadakkanchery. The Carmalmatha church is another famous church nearby, located at Kundannur, 5 km away from Wadakkanchery. Hospitals in the town are Wadakkanchery district

hospital, Divine Hospital and Holly medical centre nearby Ottupara–Vazhani road. A part of Thrissur Medical College and its premises in the Wadakkanchery Municipality. Wadakkanchery assembly constituency is part of Alathur Lok Sabha constituency.



Fig.2 Wadakkanchery Municipality located in Thrissur District Map

## \* Important Landmarks

- Uthraalikkaavu Temple, Wadakkanchery
- Nelluvai Dhanwathari Temple, Nelluvai
- Machad Tiruvaanikkavu Temple, Thekkumkara
- ✤ Akamala Temple, Wadakkanchery
- Kerala Kalamandalam Cheruthuruthy
- ✤ Kozhimamparambu temple, Cheruthuruthy
- \* Kulasekharanellur siva Temple, Cheruthuruthy
- Vazhani Dam
- Asuramkundu Dam, Attoor, Chelakkara
- Vallathole Musium, Cheruthuruthy
- Bharathapuzha
- Poomala Dam and Cheppara
- Pathirikkotukavu temple.
- Kodassery mala shivaparvathi temple
- Periyammakkavu temple
- Kuttiyankkavu Temple, Minalur
- Cheru chakki chola check dam, Wadakkanchery
- Thoomanam waterfall Wadakkanchery



Fig.3 Map of Wadakkanchery Municipality 2.3 PRESENT CONDITION OF SEWAGE COLLECTION AND DISPOSAL

Wadakkanchery Municipality is located about 20 Kilometres to the North of Thrissur Town. As per Honourable NGT report The Aloor- Kecheri River which passes through Wadakkanchery municipality is included under Class-4 Category and the polluted stretch is identified at Challipadam Thodu. At present there is no centralised sewerage system working in the project area. However onsite sanitation facilities available for majority of the portions under the project area. Hence it is imperative that a comprehensive sewerage masterplan for the Wadakkanchery Municipality is inevitable to meet the future demand considering the urbanisation and growth.



Fig.4 Polluted strech in Aloor - Kecheri Puzha

## 2.4 EXPECTED SEWER LOAD FROM PROJECT AREA

For computation of sewage load, population forecast has been performed in the geometrical progression method. For the local body, the decadal population variation has been taken as the mean value of the last decadal variation value for it and for the District. Form this value expected population in 2052 has been determined from the base year of 2011, since the latest Census data is available for the year 2011. For computing the sewage load, return ratio of 80% has been adopted. In addition to this, for the non-domestic and floating demand, a value of 20 percentage is taken and for unaccounted water and infiltration, another 20 percentage is taken. In addition, social survey was also conducted to determine the number of houses, shops etc. and other buildings in the project area.

SI.NO	Description	Number	Expected Sewerage Load in
			MLD
1	Houses	832	0.4
2	Small Shops	534	0.03
3	2 Floor Complex	264	0.11
4	3 Floor Complex	329	0.18
5	4 Floor Complex	54	0.04
6	Flats	12	0.01
7	Cinema Theatre	2	0.02
8	Govt. Offices	18	0.03
9	Hotel Rooms	60	0.01
10	Restaurants	12	0.01
11	Schools	2	0.03
12	Hospitals	2	0.04
		Total	0.91 MLD

\*In addition to the above sewerage load the septage for the remaining area is also calculated.

Table 1 Expected sewer load from project area

### 2.5 SEWERAGE TECHNOLOGY

Decentralized wastewater management system (DWMS) may be designed as the collection, treatment, and disposal/reuse of sewage from individual houses, cluster of houses, isolated communities, industries or institutional facilities as well as from portion of existing communities at or near the point of generation of sewage. Decentralized systems maintain both the solids and liquid fraction, although the liquid portion and any residual solids can be transported to a centralized point for further treatment and reuse.

Recognizing the many applications and benefits of sewage reuse, some important points may be kept in view such as (i) review of the impact of the population growth rate (ii) review of potential water reuse applications and water quality requirements (iii) review of appropriate technologies for sewage treatment and reuse (iv) considering the type of management structure that will be required in the future and (v) identification of issues that must be solved to bring about water reuse for sustainable development on a broad scale. It has been emphasized that if the sewage from the urban and semi urban areas were reused for a variety of non-potable uses, the demand on the potable water supply would be reduced.

The choice of appropriate technology will also depend on several factors such as composition of sewage, availability of land, availability of funds and expertise. Different operation and maintenance options will have to be considered with respect to sustainable plant operation, the use of local resources, knowledge, and manpower.

## 2.6 STRATEGY FOR SEWERAGE SYSTEMS

For formulating a strategy for planning, designing and implementing sewerage systems for a project area it is imperative to closely examine the factors contributing to the generation of sewage load and its effective treatment, recycling and disposal arrangements. For this purpose, each location in the project area concerned has been analysed thoroughly using available data on the following parameters and features:



Fig.5 Parameters for analysing LSGI's for sewerage/FSSM system

Since another important feature influencing the sewage load generation and its subsequent management task is the scatter of population density, an analysis was performed in this regard. Population forecast

for the project area was carried out using geometrical progression method with the increment percent as the mean value of last decade increment and the district average value.

## 2.7 PLAN FOR AREAS DIRECTLY CONNECTED TO POLLUTION OF WATER BODIES

The management of onsite sanitation systems such as septic tanks remains a neglected component of urban sanitation and wastewater management. Sullage, which is a fluid mixture of untreated and partially treated sewage solids, liquids and sludge of human or domestic origin, flows out of septic tanks and enters waterways or is generally disposed into nearest water body or nearest drain or low-lying areas. Solids accumulating in the septic tank that is defined as septage is periodically taken out and disposed of without treatment. This leads to serious health and environmental implications. In the absence of efficient water treatment systems and solid waste management systems, untreated domestic and industrial wastes, and agriculture-runoff flow into the rivers polluting the rivers in the locality. There has been widespread bacteriological contamination of faecal origin in ground and surface water which relate to proximity of increasing numbers of leach pit latrines, leakages from septic tanks, washing, bathing and other domestic activities. This scenario demands a planned sewerage system for the areas which are in proximity to the rivers.

Sl. No.	LSG	Water body in River Rejuvenation Program as per Order dated 22.06.2020 in the matter of OA No. 673 of 2018	Details of action plan as a part of abatement of pollution
1	Wadakkanchery Municipality	Kechery River Polluted stretch identified (Puliyannor to Kechery).	Polluted stretch identified (Puliyannor to Kechery).

Table 2 Polluted stretch of Kechery River

## 2.8 PROGRAMME FOR ABATEMENT OF POLLUTION TO ENVIRONMENT

In the river rejuvenation programs several departments of Kerala State Government has been jointly chalked out short term and long-term plans for the abatement of pollution to the rivers. Local Self Government Institutions (LSGI's), Irrigation department, Kerala State Pollution Control Board, Ground Water Department and KWA etc. are among these participants. In the short term plans, identification of polluted stretches, surveillance to restrict dumping of wastes into river and its branches, cleaning and desilting of canals, closing of all unauthorized outlets leading to the river, boards to display slogans against littering waste in various places other activities like posters, notices and awareness classes, river water quality monitoring, inspection and effluent quality monitoring of the flats, industrial units, service stations, hospitals, hotels etc. are envisioned. In the long-term action plan, planning, design and operation of STPs and FSSM units are envisaged. These treatment facilities are to be so designed that safe disposal and recycling of the wastewater can be materialised. If decentralised units are planned, management of operation is observed to be optimised. Ground water recharging / rainwater harvesting

etc. are also to be planned in the long-term action sequence. The strategy for abatement of pollution to environment can be summarised as follows:



Fig.6 The strategy for abatement of pollution to environment

## 2.9 OUTLINE OF SEWERAGE IMPLEMENTATION

In the implementation procedure for sewerage schemes, multi-faceted approach is essential to achieve its goals. Since the primary goal of sewerage system is providing hundred complete and scientific sanitation facilities for every household, grass route level planning is necessary. Every local body must be able to prepare a sanitation plan which can be implemented along with the development document for the LSGI.

Since the State is heading for a rapid expansion in drinking water production and distribution sector KWA, especially on materialising a 24 X 7 drinking water concept in urban areas, and to ensure the households have 100% access to piped water supply, mostly through individual connections, the sanitation facilities will generally improve. However, the production of sewage will also increase and hence this will demand sewerage facility for every household unit. Additionally recycling of grey water is also to be planned and implemented for non-drinking water usage.

For effective implementation of the sewerage there should also an Integrated Management Information System (IMIS) which is continuously updated.

## 2.10 PLAN FOR REUSE OF RECYCLED SEWAGE

In the planning and implementation of water reclamation and reuse, the reclaimed water application will usually govern the wastewater treatment needed to protect public health and the environment, and the degree of reliability required for the treatment processes and operation (Metcalf and Eddy). The major wastewater re use categories are as follows:

a] agricultural irrigation, crop irrigation and commercial nurseries

b] landscape irrigation

c] industrial recycling and reuse

- d] groundwater recharge, groundwater replenishment and saltwater intrusion control
- e] recreational/environmental uses
- f] non-potable urban uses

e] potable reuse

In the present project, the dewatered sludge can be used as a manure for cultivating vegetables and other plant life.

## 2.11 INTEGRATION WITH OTHER PROJECTS

Planning and design of sewerage schemes can be combined with other water resources projects also. This is since most of these projects are inter-related and environment sensitive. Hence the location of an STP, collection wells and coverage of sewage networks in an area depends upon the water supply system existing in that area, proximity of irrigation canals, water bodies and flood routing structures if any. The integration of different projects related to the water resources and conservation schemes greatly influence the successful establishment and operation of the sewerage schemes in an area. As shown below and integrated planning of the projects associated with water resources will contribute effectively for a successful sewerage system.

#### **CHAPTER 3**

#### PLANNING, DESIGNING AND LAYING OF SEWAGE NETWORK

## **3.1 GENERAL**

The most common type of sewer construction practice involves the use of open trenches and prefabricated pipes. In the present project also, open trenches are planned in most of the areas for laying of sewer load carrying pipe network. Sewer loads generated from individual households, commercial establishments, public institutions etc. in the core area of the Wadakkanchery town is collected from the source nodes and carried through pipes and concrete chambers to the nearest manholes. From there it is transported through a network of pipes towards the Sewage Treatment Plant (STP). Care has been taken to limit the depth of cutting below 4 meters in most of the cases to avoid construction and operation difficulties. For septage management, de-sludging from sources are performed annually using special equipment and septage is carried to the STP for co-treatment after desirable dilution.



Fig.7 Sewerage and Septage zones in Wadakkanchery Municipality

In Wadakkanchery municipality the densest area is in Wadakkanchery town and in the nearby area. As per the discussion done with municipal authorities it is decided to propose a sewage network system in the main town area and to propose septage for the remaining area as most of areas in Wadakkanchery municipality still have rural nature. Co-treatment facility is also provided here to treat the septage waste in the same STP.

In the Sewerage zone it is proposed to lay sewers for about 14 Kilometres with pipe size ranging from 225 mm to 355mm outer diameter. Manholes are proposed at every 30 m interval and in every bends and road junctions. Two wells are proposed on two sides of Aloor- Kecheri river and from there pumping of sewerage to the STP site which is about 900 meters from the Wells. As the Municipality doesn't own land here, private land which are suitable is proposed for well and STP.

## **3.2 COMPONENTS OF SEWAGE NETWORK**

Sl. No.	Type of element	Material	Function
1		Reinforced concrete	Collection of sewage from individual units for transferring to manholes
2	Sewer pipelines	High Density Polyethylene (HDPE)	Transfer of sewage by gravity flow from one point to other
3	Manholes	Reinforced concrete	Sewage collection points and inspection areas for removing blocks and cleaning of lines
4	Lift manholes	Reinforced concrete	Sewage collection points and inspection areas for removing blocks and cleaning of lines and lifting of sewer load to the next manhole. Submersible pump sets are installed inside in such manholes.
5	Collection well	Reinforced concrete	Centralised collection point for sewer load from a sub- zone in the project area.
6	Pumping station	Reinforced concrete	Centralised collection point for sewer load from a sub- zone in the project area and pumping of sewage to the next well or STP.

The components of the sewage collection and carriage network consists of the following elements:

#### Table 3 Components of sewage network

#### **3.3 DESIGN OF SEWAGE NETWORK**

For the design of sewage network, hydraulic analysis was performed for the initially planned network and refined for a set of constraints and inflow values. The pipelines are designed for gravity flow conditions except for lifting and collection points. Minimum outer diameter of the pipeline was taken as 225 mm for main lines along the roads and for carriage from chambers to manholes, it is taken as 180 mm with material as HDPE. The slope was taken as a minimum value of 1 in 170 in general and care has been taken to provide sufficient slopes to generate self-cleansing velocities during peak flow conditions when the pipe is near to full in load. All stipulations given by the relevant Indian Standard Codes of practice and CPHEEO Manual has been adopted in design.

# **3.3.1. CREATING PRIMARY MODEL FROM GEOGRAPHIC INFORMATION SYSTEMS** (GIS)

Using GIS data available, the project area was examined thoroughly, and a primary model of sewer flow was generated. This model was later refined using reduced elevations obtained from Differential Global Positioning System (DGPS) Real Time Kinematic Survey (RTK) values at the control points established in the primary model. The GIS provides information of population density scatter, presence of water bodies, road network and topographical features as a quick reference for planning an optimum site for the STP as well as the routing of sewer load.



Fig.8 Wadakkanchery Sewage Network Zone in Google Map Backdrop



Fig.9 Satellite imaginary of proposed collection wells and STP

# **3.3.2 TOPOGRAPHICAL SURVEY USING DGPS**

For ascertaining accurate reduced levels of all control points in the primary model, Real Time Kinematic Survey (RTK) using DGPS was performed. DGPS is an improved autonomous Global Positioning which reduces the effect of correlated errors from two or more receivers only if they are all observing the same satellites. The DGPS data was retrieved in a computer system and subsequently used for hydraulic simulation of the network.





## **3.3.3 SOCIAL SURVEY**

Social aspects of the sewage load generation have been examined in detail by performing social survey for the project area. Various teams comprising of people intended to gather information regarding presence of houses, commercial establishments and other public institutions were set up and extensive field survey was conducted. The variations of sewage flow and expected abnormalities were also studied and incorporated in the sewer network design. Expected sewer load in the core area is shown as follows:

SI. No.	Description	Number	Expected Sewerage Load in MLD
1	Houses	832	0.4
2	Small Shops	534	0.03
3	2 Floor Complex	264	0.11
4	3 Floor Complex	329	0.18
5	4 Floor Complex	54	0.04
6	Flats	12	0.01
7	Cinema Theatre	2	0.02
8	Govt. Offices	18	0.03
9	Hotel Rooms	60	0.01
10	Restaurants	12	0.01
11	Schools	2	0.03
12	Hospitals	2	0.04
		Total	0.91 MLD

Table 4 Social survey details

## **3.3.4 HYDRAULIC SIMULATION OF SEWAGE NETWORK**

Hydraulic simulation of sewage network was performed after collection of all basic input data like sewage inflow at all points, expected routing plan for easy carriage of sewer load towards a common collection point and location of STP. A suitable peak factor to accommodate sewage flow variations are provided in the hydraulic analysis. The sewer flow is expected to be carried out in gravity conditions through a network of pipelines, manholes and lifting stations. The maximum depth of cutting is limited below 4.0 m and hence sewage lifting stations are provided making use of the manholes itself. For all pipelines minimum slopes to generate gravity flow is given as per the recommendations of CPHEEO Manual of Sewage Treatment Systems.

For hydraulic simulation of the sewage network comprising of pipelines, manholes and lifting stations, US Environmental Protection Agencies' Storm Water Management Model (SWMM) is adopted considering its versatility in hydraulic modelling using dynamic flow routing conditions. US EPA's Storm Water Management Model (SWMM) is used throughout the world for planning, analysis, and design related to stormwater runoff, combined and sanitary sewers, and other drainage systems.



Fig.11 Map area in SWMM model with invert levels of nodes in gradation



Fig.12 Map area in SWMM model with flow routing in gradation towards outfalls



Fig.13 Map area in SWMM with capacities of pipelines during peak flow in gradation



Fig.14 Map area in SWMM model with lifting stations and pumps



Fig.15 Map area in SWMM model with velocity profile in gradation



Fig.16 Water elevation profile plotted in SWMM model of sewage network



Fig.17 Water elevation profile plotted in SWMM model of sewage network with lifting in between



Fig.18 Water elevation profile plotted in SWMM model of sewage network



## Fig.19 Water elevation profile plotted in SWMM model of sewage network for a small reach

SI. No.	Type of pipe	Internal diameter (mm)	Outer diameter (mm)	Pressure rating	Total length (m)
1		135.55	180	PN 8	6756.00
2	High density	169.50	225	PN 8	12668.40
3	polyethylene (HDPE)	211.05	280	PN 8	578.30
4		267.60	355	PN 8	421.00

Table 5 Pipes proposed for sewage network-gravity flow

SI. No.	Type of pipe	Internal diameter (mm)	Outer diameter (mm)	Pressure rating	Total length (m)
1	High density polyethylene (HDPE)	169.50	225	PN 10	230
2	polyculytene (HDFE)	211.05	280	PN 10	900

Table 6 Pipes proposed for sewage network-pressurised flow

## **3.4 DESIGN OF MANHOLES AND LIFTING STATIONS**

A manhole is an opening by which a man may enter a sewer for inspection, cleaning and other maintenance and fitted with a removable cover to withstand traffic loads in sewers. Having designed the sewer system, the manholes are first constructed in identified reaches before the sewers are laid. The diameters of circular manholes for stated depths of sewers are in Table as shown below:

SI. No.	Range of depths, in m	Internal diameter in m
1	Above 0.90 m and up to 1.65 m	0.90
2	Above 1.65 m and up to 2.30 m	1.20
3	Above 2.30 m and up to 4.5 m	1.50

#### Table 7 Details of manholes

Manholes are primarily designed as reinforced cement concrete manholes with special treatment to resist corrosive and adverse environments. Manholes should be built to cause minimum head loss and interference with the hydraulics of the sewer line. One way to maintain a relatively smooth flow transition through the manhole, when a small sewer joins one of a larger diameter, is to match the pipe crown elevations at the manhole. Precast rings for shaft can be done to manage inlet and out portions and house sewer connections through chambers. The structural design of the manholes is performed to withstand traffic loads also with controlled cracking under severe exposure conditions.

SI. No.	Type of manhole	Internal diameter (m)	External diameter (m)	Average depth (m)	Average volume (m <sup>3</sup> )	Total number	% of total number
1	Class – 1	0.90	1.40	1.06	0.96	459	81.53
2	Class - 2	1.20	1.80	1.95	2.76	43	7.64
3	Class – 3	1.50	2.20	2.93	5.97	61	10.83

Situations restricting depth of cutting can be easily got over by restricting the depth of sewers to a practicable limit and diverting the flow into a pavement submersible pump station with a lockable control panel there itself like the pillar boxes of the electricity board and the delivery main can lift the flow to the downstream manhole at the conventional 0.9 m depth to invert. There are called lifting manholes and during the analysis stage itself the number of such manholes are designed to be minimum.

These submersible pump stations of lifting manholes can be operated by mercury float switches and powered by dedicated feeder lines from the local electrical authority like the lines given to the hospitals, etc. These pump sets can also be connected to solar panels. The pump pit can be covered with pedestrian grade walkway slabs which are of reinforced cement concrete and with adequate lifting arrangements to permit the lowering and lifting the submersible pump sets. With the advancement in technology, the IoT enabled sensors can be installed in these lift manholes and connected to a remote-control station using cloud data transfer.

Sl. No.	Description of lift manholes	Discharge in LPS	Head in m	Power in HP
1	LF-1	0.69	6	0.10 HP
2	LF-2	3.05	6	0.30 HP
3	LF-3	0.20	6	0.10 HP
4	LF-4	0.40	6	0.10 HP
5	LF-5	7.98	6	0.90 HP
6	LF-6	0.06	6	0.10 HP

The details of lift manholes are outline below:

Table 9 Details of lifting stations

## **3.5 DESIGN OF COLLECTION WELLS**

There are two collection wells as per the design for the project area. The details of the collection wells are outlined as follows:

SI.No.	Description	Peak flow in LPS from network	Average flow in LPS from network
1	Collection well-1	10.37	4.15
2	Collection well-2	18.44	7.18

## Table 10 Details of collection wells



Fig.20 Sewerage zones with lifting station, collection wells and proposed STP



Fig.21 Proposed site for Well 1 & Well 2 on sides of Aloor- Kecheri river

It is planned to collect sewage flow from well-2 to well-1 and sewage load is transported from well-1 to the STP. Each collection well is designed to have adequate storage during peak hours of flow. Two submersible centrifugal pumps are provided to work in parallel during peak hours flow or whenever the situation demands for it. The detailed design of the collection wells is presented below:

DESIGN OF COLLECTION WELL No.2				
Average inflow into well from network	7.38	LPS		
Peak inflow into well from network	18.44	LPS	PF	2.50
Average flow into well from other well	0	LPS		
Peak flow into well from other well	0	LPS		
Total average inflow into well from network+other	7.38	LPS		
well				
Total peak inflow into well from network+other	18.44	LPS		
Well Deak hours	1			
Number of numps operated in neak hours	+ 2			
Rated outflow during neak hours/numn in parallel	2 7 38	IPS		
Total rated outflow in peak hours	14 76			
Inflow converted into storage during neak hours	3.68			
Volume of sewage to be stored in well	52.99	$m^3$		
Dispersion of collection multiment	52.99			
Drath of collection well for store as	5.1 2.6	111 m		
Volume of concerned in mell	2.0 52.11	m m <sup>3</sup>	alt	
	33.11	m-	OK	
Wall thickness of collection well	0.45	m		
Base slab thickness	0.45	m		
Offset to base slab	0.45	m		
Outer dia of collection well	6	m		
Freeboard of collection well	0.5	m		
Distance of travel in pumping to next station	50	m		
Velocity of travel adopted	0.9	m/sec		
Diameter of pumping line required	102.18	mm	fix OD	180
		pressure r	pressure rating	
Total head for the pump set		100		
	12	m		
Discharge for the pump set	12 7.38	LPS	efficienc y	0.5
Discharge for the pump set Power required for pump set/number	12 7.38 2.36	HP	efficienc y fix HP	0.5 2.5
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1	12 7.38 2.36	III LPS HP	efficienc y fix HP	0.5 2.5
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network	12 7.38 2.36 4.15	III LPS HP LPS	efficienc y fix HP	0.5 2.5
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network	12 7.38 2.36 4.15 10.37	III LPS HP LPS LPS	efficienc y fix HP PF	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well	12 7.38 2.36 4.15 10.37 7.38	m LPS HP LPS LPS LPS	efficienc y fix HP PF	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well	12         7.38         2.36         4.15         10.37         7.38         14.76	m LPS HP LPS LPS LPS LPS	efficienc y fix HP PF	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53	m LPS LPS LPS LPS LPS LPS LPS	efficienc y fix HP PF	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13	III ILPS ILPS ILPS ILPS ILPS ILPS ILPS	efficienc y fix HP PF	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well Peak hours	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13         4	III ILPS ILPS ILPS ILPS ILPS ILPS ILPS	efficienc y fix HP PF	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well Peak hours Number of pumps operated in peak hours	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13         4         2	III LPS LPS LPS LPS LPS LPS LPS LPS	efficienc y fix HP PF	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well Peak hours Number of pumps operated in peak hours Rated outflow during peak hours/pump in parallel	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13         4         2         11.53	m LPS HP LPS LPS LPS LPS LPS LPS LPS	efficienc y fix HP	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from other well Peak flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well Peak hours Number of pumps operated in peak hours Rated outflow during peak hours/pump in parallel Total rated outflow in peak hours	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13         4         2         11.53         23.06	m LPS HP LPS LPS LPS LPS LPS LPS LPS LPS LPS	efficienc y fix HP	0.5 2.5 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well Peak hours Number of pumps operated in peak hours Rated outflow during peak hours/pump in parallel Total rated outflow in peak hours	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13         4         2         11.53         23.06         2.07	m LPS HP LPS LPS LPS LPS LPS LPS LPS LPS LPS LP	efficienc y fix HP	0.5 2.50 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well Peak hours Number of pumps operated in peak hours Rated outflow during peak hours/pump in parallel Total rated outflow in peak hours Inflow converted into storage during peak hours Volume of sewage to be stored in well	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13         4         2         11.53         23.06         2.07         29.81	m LPS HP LPS LPS LPS LPS LPS LPS LPS LPS LPS LP	efficienc y fix HP	0.5 2.50 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well Peak hours Number of pumps operated in peak hours Rated outflow during peak hours/pump in parallel Total rated outflow in peak hours Inflow converted into storage during peak hours Volume of sewage to be stored in well Diameter of collection well-inner	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13         4         2         11.53         23.06         2.07         29.81         5.1	m LPS HP LPS LPS LPS LPS LPS LPS LPS LPS LPS LP	efficienc y fix HP	0.5 2.50 2.50
Discharge for the pump set Power required for pump set/number DESIGN OF COLLECTION WELL No.1 Average inflow into well from network Peak inflow into well from network Average flow into well from other well Peak flow into well from other well Total average inflow into well from network+other well Total peak inflow into well from network+other well Peak hours Number of pumps operated in peak hours Rated outflow during peak hours/pump in parallel Total rated outflow in peak hours Inflow converted into storage during peak hours Volume of sewage to be stored in well Diameter of collection well-inner Depth of collection well for storage	12         7.38         2.36         4.15         10.37         7.38         14.76         11.53         25.13         4         2         11.53         23.06         2.07         29.81         5.1         2.6	m LPS LPS LPS LPS LPS LPS LPS LPS LPS LPS	efficienc y fix HP	0.5 2.50 2.50

Volume of sewage stored in well	53.11	m <sup>3</sup>	ok	
Wall thickness of collection well	0.45	m		
Base slab thickness	0.45	m		
Offset to base slab	0.45	m		
Outer dia of collection well	6	m		
Freeboard of collection well	0.5	m		
Distance of travel in pumping to next station	900	m		
Velocity of travel adopted	0.9	m/sec		
Diameter of pumping line required	127.72	mm	fix OD	225
		pressure r	ating	PN 10
Total head for the pump set	18	m		
Discharge for the pump set	11.53	LPS	efficienc y	0.5
Power required for pump set/number	5.53	HP	fix HP	6





Fig.22 Computer simulation using EPANET for pumping from collection wells

### **3.6 LAYING OF SEWER NETWORK**

In the following sections, important matters in connection with the laying of sewer network and making the system efficient is illustrated in detail.

## **3.6.1 EXCAVATION AND LAYING**

 On all excavation work, safety precautions for the protection of life and property are essential; and measures to avoid too great inconveniences to the public are desirable. Such measures and precautions include the erection and maintenance of signs (to forewarn public), barricades, bridges and detours; placing and maintenance of lights both for illumination and as danger
signals; provision of watchmen to exclude unauthorized persons, particularly children from trespassing on the work.

- 2. Computation of the safe load carrying capacity of the pipe when installed and bedded in the manner to be specified using a suitable factor of safety and making certain the design supporting strength thus obtained is greater than the maximum load to be applied.
- 3. Sewers may be laid in trenches or under embankment in areas which may be temporarily or permanently submerged in water. The fill load in such cases will be reduced and will correspond to the buoyant weight of the fill material. However, effect of submergence could be ignored which provides an additional factor of safety, but it may be necessary to check whether a pipe is subject to flotation. Under submergence, the minimum height of the fill material that will be required to prevent flotation ignoring the frictional forces in the fill can be determined. Wherever sufficient height of fill material is not available, anti-flotation blocks should be provided.
- 4. All rigid pipes may be tested for strength in the laboratory by the three-edge bearing test (ultimate load).
- 5. Width of the trench specified for a particular job should be minimum in consonance with the requirements of adequate working space to allow access to all parts and joints of pipe.
- 6. The Field Engineer should keep in touch with the Design Engineer throughout the duration of the Project and any deviation from the design assumptions due to the exigencies of work, should be immediately investigated and corrective measures taken in time.
- 7. All pipes used on the work should be tested as per the IS specifications and test certificates of the manufacturers should be furnished for every consignment brought to the site.
- 8. Whenever shoring is used, the pulling out of planks on completion of work, should be carried out in stages and this should be properly supervised to ensure that the space occupied by the planks is properly backfilled.
- 9. Proper backfilling methods both as regards to selection of materials, methods of placing and proper compaction should be in general agreement with the design assumptions.
- 10. In quicksand conditions, it is necessary to anchor the sewer to the ground and hold it at the grade as laid in the face of soil sinkage.
- 11. The type of bedding (granular, concrete cradle, full concrete encasement etc.) would depend on the soil strata and depth at which sewer is laid.
- 12. It is understood that the line (horizontal alignment) and grade layout of a sewer line as per design must be carried out meticulously. The horizontal layout determines the location as well as direction of the sewer line, while slope (grade) of the line provides the necessary hydraulic carrying capacity of the sewerage system.
- 13. The location of the trench is generally laid out first as an offset line running parallel to the proposed sewer centre line. This offset line is demarcated by wooden stakes driven into the ground surface at intervals of, say, 15 m. The offset line, as is clear, is quite away from the sewer centre line with a view not to allow it being disturbed during construction; however, it

must be proximate enough so that the transfer of measurements to the actual trench can readily be done.

- 14. Two procedures are available to lay pipe sections in the open trench, namely, by batter boards, and by laser beams. Better boards are placed across the trench at uniform intervals. The tops of these boards can be set at some even height above the designed sewer invert elevation. The centre line of the sewer is traced on the boards by extending a line of sight with a transit level or a theodolite and a string is stretched from board to board along this very line. Later on this Line is transferred onto the trench bed by means of a plumb bob. Invert levels and action line is transferred onto the trench bed by means of a plumb bob. Invert levels and characteristics indicated by vertical rods are marked off in even increments -the lower end of each rod is placed on the pipe invert, and the string over the batter boards helps to check if it matches with the proper elevation mark on the rod, by appropriate adjustment of the pipe placement centreline transferred. In the laser method, advantage is taken of an intense, narrow beam of light that is projected by the laser instrument, over a long distance. This beam is aligned through a sewer pipe to strike a target held at the other end of the pipe. A transit that is placed above a manhole helps establish the alignment of the sewer with reference to field survey points and transfer it down to the laser instrument that is mounted inside the manhole. Lasers can achieve an accuracy of 0.01 per cent over up to 300 m
- 15. Cross drainage works arise when a sewer must cross another service like electricity, water line, gas piping, telecommunication cable, river courses, nalas, etc.
- 16. Regarding power cables, the sewer shall be above and apart from the power cable by at least 30 cm as per IS: 1255. Regarding water lines, the sewer shall always travel below the water line. Regarding gas lines, the sewer must travel above the gas line so that sewer gases if they escape need not accidentally set off an ignition of the gas line. Regarding telecommunication cables, lateral separation of at least 30 cm shall be followed. In cases of river crossings and nala crossings each situation shall be decided on its site conditions and gravity sewers may be converted to pumped sewer lines by a low lift dedicated pumping station before the crossing discharging into the gravity section after crossing the water course and this will help in always keeping the pumped sewer visible or close to the ground.
- 17. A cross connection between water main and sewer main seldom occurs because of the sizes of these mains. However, where the location is complicated, the water mains shall be either blue coloured pipes or painted with blue florescent coloured paint.
- 18. A minimum offset of equal to half the width of the manhole plus 30 cm shall be the lateral offset between water mains and sewer lines. It is advisable to encase the sewer than the water main.
- 19. Gravity sewers shall not be laid closer to water retaining structures and the effort should be to detour as far as possible. In case of leakages in sewer joints, the leakage may gain access to the sidewalls of the water retaining structures.

- 20. The width of trench at and below the top of a sewer should be the minimum necessary for its proper installation with the due consideration to its bedding. The width of a sewer trench depends on the type of shoring (single stage or two stage), working space required in the lower part of the trench and the type of ground below the surface.
- 21. Excavation for sewer trenches for laying sewers shall be in straight lines and to the correct depths and gradients required for the pipes as specified in the drawings. The material excavated from the trench shall not be deposited very close to the trench to prevent the weight of the materials from causing the sides of the trench to slip or fail. The sides of the trench shall, however, be supported by shoring where necessary to ensure proper and speedy excavation. In case, the width of the road or lane where the work of excavation is to be carried out is so narrow as to warrant the stacking of materials near the trench, the same shall be taken away to a place to be decided by the Engineer-in-Charge. This excavated material shall be brought back to the site of work for filling the trench.
- 22. In case the presence of water is likely to create unstable soil conditions, a well point system shall be employed to drain the immediate area of the sewer trench prior to excavation operation. A well point system consists of a series of perforated pipes driven or jetted into the water bearing strata on either side of a sewer trench and connected with a header pipe leading to a pump, In the event of excavation being made deeper than necessary, the same shall be filled and stabilized.
- 23. The shoring shall be adequate to prevent caving in of the trench walls of subsidence of areas adjacent to the trench. In narrow trenches of limited depth, a simple form of shoring shall consist of a pair of 40 to 50 mm thick, and 30 cm wide planks set vertically at intervals and firmly strutted. For wider and deeper trenches, a system of wall plates (Wales) and struts of heavy timber section is commonly used. Continuous sheeting shall be provided outside the wall plates to maintain the stability of the trench walls. The number and the size of the wall plates shall be fixed considering the depth of trench and type of soil.
- 24. In non-cohesive soils combined with considerable ground water, it may be necessary to use continuous interlocking steel sheet piling to prevent excessive soil movements due to ground water percolation. Such sheet piling shall extend at least 1.5 m below the bottom of the trench unless the lower part of the trench is in fine material. In case of deep trenches, if conditions demand, excavation and shoring may be done in stages.
- 25. All pipes, ducts, cables, mains and other services exposed due to the excavation shall be effectively supported.
- 26. Trenches for sewer construction shall be dewatered for the placement of concrete and laying of pipe sewer or construction of concrete or brick sewer and kept dewatered until the concrete foundations, pipe joints or brick work or concrete have cured.
- 27. Where a sewer must be laid in a soft underground stratum or in a reclaimed land, the trench shall be excavated deeper than what is ordinarily required. The trench bottom shall be stabilized

by the addition of coarse gravel or rock. In case of very bad soil the trench bottom shall be filled in with cement concrete of appropriate grade.

28. In the areas subject to subsidence, the pipe sewer should be laid on suitable supports or concrete cradle supported on piles.

# 3.6.2 SEWER CARRIAGE SYSTEM WITH PIPELINES AND CONNECTIONS TO HOUSES/OTHER UNITS

- Unlike in the case of CI, DI, UPVC pipe sewers, the HDPE sewers are normally butt welded and pre-assembled on ground and then only laid inside the trench spanning manhole to manhole. The butt welding shall follow the manufacturer's recommendations. Where flanged joints are needed for attaching or inserting fittings and specials like valves, the free end of the HDPE pipe shall be butt welded with a standard flange and thereafter the flanged jointing can be made. However, in the case of such pipes, the uplift during high groundwater conditions above the pipe level is a problem specifically in high ground water and coastal areas.
- 2. Other than the metallic and concrete pipe sewers, the uplift during high groundwater conditions above the pipe level is a problem specifically in high ground water locations, waterlogged locations and coastal areas. The concrete surrounds or venteak piles shall be used to hold these in place in such conditions, where ground water can rise above the sewer.
- 3. Each section of sewer shall be tested for water tightness preferably between manholes. To prevent change in alignment and disturbance after the pipes have been laid, it is desirable to backfill the pipes up to the top keeping at least 90 cm length of the pipe open at the joints. However, this may not be feasible in the case of pipes of shorter length, such as stoneware and RCC pipes. With concrete encasement or concrete grade, partial covering of the pipe is not necessary.
- 4. As soon as a stretch of sewer is laid and tested, a double disc or solid or closed cylinder, 75 mm less in dimension than the internal dimension of the sewer shall be run through the stretch of the sewer to ensure that it is free from any obstruction.
- 5. Backfilling of the sewer trench is a very important consideration in sewer construction. The method of backfilling to be used varies with the width of the trench, the character of the material excavated, the method of excavation and the degree of compaction required.
- 6. No trench shall be filled in unless the sewer stretches have been tested and approved for water tightness of joints. However, partial filling may be done keeping the joints open to avoid disturbance.
- 7. In the design of sewer systems, consideration should be given to the desirability of maintaining velocities sufficient to avoid sulphide build up and of minimizing pressure lines and points of high turbulence. The designer should take into consideration topography, grades of sewers, ventilation, materials of construction, sewage temperature and strength, etc.

- 8. Any protective coating used should possess the following qualities: (i) it should be resistant to acid attack, (ii) it should bond securely to the concrete, (iii) it should be economical and durable, (iv) it should be resistant to abrasive action by flow of sewage, and (v) when applied, it should be thin enough to fill all pores and irregularities in the surface. The coating should be continuous with no pin holes or other breaks.
- 9. The house service sewer connections shall be effected only in manholes. In case of old sewers, a new manhole shall be inserted for this purpose. The material of the House Service Sewer shall be either UPVC or HDPE rigid straight pipes of 6 kg/cm<sup>2</sup> pressure class in manufacture and as per IS: 15328 and IS: 4984 respectively.
- 10. The minimum earth cover above the crown shall be 90 cm and where this becomes impossible, the property owner shall be directed to depress his terminal chamber to comply with the above especially as the public sewer manhole shall start at its crown at 90 cm below ground level. Where such sewers cross the electricity power cables, the specifications of IS: 1255 of 1983 reaffirmed in 2001 in clauses 6.3.3 and 6.3.3.1 shall be followed without any exception that all such house service sewers shall be only above the power cable and the minimum clearance shall be 30 cm over the cable which itself shall be covered all around by 15 cm riddled soil and further protected on top by tiles, bricks or slabs.
- 11. The house owner shall be mandated to possess a "kraite" a type of non-corroding sufficiently flexible but rigid type of less than 10 mm diameter rod, which he/she shall use to rod the house service sewer freely up to the manhole and the labour of the local body shall not be deployed for any removal of obstructions in the house service sewer. Typically, it is possible to effect six service connections to a manhole.
- 12. It is also recommended to install collection chambers outside a group of houses and collect sewer load through pipes and connect chamber with manholes using pipes.
- 13. Sewer network system can be made efficient in operation using huge volume data obtained from individual sensors installed in the manholes and lifting points. This historical data will provide backbone for emergency routing plans for failure of a link or obstructions.
- 14. Sewer network system must be carefully examined using digital data for potential nodes of weakness or redundancies and specially addressed periodically.
- 15. There must be continuous coordination between the designer of the sewer network and the engineer in charge of the operation and maintenance of sewer system for addressing issues during repair, expansion of network and diagnostics of blocks.
- 16. A computer simulation model of the sewer network system must be constantly upgraded with data obtained from sensors for real time monitoring and future predictions of the versatility of the sewer carriage system. Similarly, all lifting manholes must also be continuously monitored in digital platform for performance appraisal and future modifications.

#### **CHAPTER 4**

## DESIGN OF UNIT OPERATIONS AND SEWAGE TREATMENT PROCESS 4.1 GENERAL

The constituents of concern found in wastewater are removed by physical, chemical, and biological methods. The individual methods usually are classified as physical unit operations, chemical unit processes, and biological unit processes. Treatment methods in which the application of physical forces predominate are known as physical unit operations. Examples of physical unit operations include screening, mixing, sedimentation, gas transfer, filtration and adsorption. Treatment methods in which the removal or conversion of constituents is brought about by the addition of chemicals or other chemical reactions are known as chemical unit processes. Examples of chemical unit processes include disinfection, oxidation and precipitation. Treatment methods in which the removal of constituents is brought about by biological activity are known as biological unit processes. Biological treatment is used primarily to remove the biodegradable organic constituents and nutrients in wastewater (Metcalf& Eddy, Inc).

From practical observations, the rates at which physical, chemical and biological reactions and conversions occur are important, as they will affect the size of the treatment facilities that must be provided. The rate at which reactions and conversions occur, and the degree of their completion, is generally a function of the constituents involved, the temperature, and the type of reactor. The fundamental basis for the analysis of the physical, chemical and biological unit operations and processes used for wastewater treatment is the material mass balance principle in which an accounting of the mass is made before and after reactions and conversions have taken place (Metcalf & Eddy).

In the following sections, the design of unit operations and chemical and biological unit processes are described. The sizes of the units and control parameters are determined.

## 4.2 COMPONENTS OF SEWAGE TREATMENT SYSTEM

The components of the sewerage treatment system are described in the process flow chart separately attached. The components are listed as follows:

SI. No.	Description unit	Nature of treatment
1	Receiving chambers	Receive sewage and septage separately
2	Oil and grease trap	Removes oil and scum from sewage and diluted septage
3	Coarse screen channel	Removes impurities of size greater than 20 mm by physical separation using screens
4	Fine screen channel	Removes impurities of size greater than 6 mm by physical separation using screens
5	Grit separator	Removes impurities of size greater than 0.15 mm by gravity settling
6	Flow channels	Gravity sewage flow open channels

7	Equalisation tank	Normalises flow by storing during peak hours and releasing during off peak hours
8	MBBR-1	Biological reactor with suspended and attached growth process for BOD removal from sewage
9	MBBR-2	Biological reactor for nitrification process
10	MBBR-3	Biological reactor for de-nitrification process in post anoxic condition
11	MBBR-4	Biological reactor for final stage of BOD removal after de- nitrification
12	Secondary clarifier with plate settler	Clarification of biologically treated water using sludge blanket and plate settler.
13	Chloring contact tank	Disinfection of clarified water
14	Filter feed tank	This is used for holding clarified and disinfected water before pumping to filter units
15	Pressure sand filter	Filtration of clarified water using sand and anthracite coal dual media for better results
16	Activated carbon filter	Filtration of clarified water using activated carbon filter
17	Treated water tank	This unit is used for holding filtered clear water
18	Sludge sump	Sludge from clarified is collected and transferred to sludge thickener
19	Sludge thickener	Sludge is thickened in gravity separation and supernatant is directed to equalisation tank
20	Centrifuge	Thickened sludge is further solidified by centrifugal action in a mechanical equipment

Table 12 Components of sewage treatment system

## **4.3 INITIAL COMPONENTS OF TREATMENT**

In the following sections, pre-treatment of the raw sewage before entering equalisation tank is illustrated. The characteristics of the raw sewage and treated sewage are taken from the observation of similar environment adopting conservative values. This is due to the absence of reliable data from the test results of laboratory analysis of samples. The characteristics of the raw sewage and expected treated water is also described below for the design of the STP with Moving Bed Bio Film Reactor (MBBR).

In the following section, the design of pre-treatment units is described in detail. There is a co-treatment unit separately provided to receive septage load collected from various points after desludging activities. The septage is diluted in a water tank with specified dilution ratio to obtain desirable values of COD, BOD and TSS. There are receiving chambers for both septage and sewage loads. Oil and grease trap unit is used to remove oil and grease generated from kitchen and wash water flows. Manual coarse and fine screen channel is used to remove physical impurities of size greater than 20 mm and 6 mm respectively. A grit separator is given to remove fine particles of size 0.15 mm and above. There are odour control units also, especially for the co-treatment units.

## **4.3.1 UNIT OPERATIONS**

DESIGN OF STP WITH MOVING BED BIOFILM-REACTOR (MBBR)							
Average flow from network	1	MLD					
Working hours	23						

		2				
Flow from septage dilution	12.63	m <sup>3</sup> /hour	0.30	MLD		
Design flow	1.35	MLD	1346577	LPD	1347	m <sup>3</sup> /day
			1347	KLD	56.11	m <sup>3</sup> /hour
Assumed peak factor	2.25					
Peak design flow	3.03	MLD	3029798	LPD	3030	m <sup>3</sup> /dav
					126.2	m <sup>3</sup> /hour
					120.2	III / HOUI
Raw Sewage Characteristics		2 /1				
Average sewage flow entering the STP	56.11	m <sup>3</sup> /hour				
Peak flow entering the STP	126.24	m <sup>3</sup> /hour				
COD	500	mg/l				
Primary ST/ET effluent BOD	250	mg/l				
Thickener overflow return as	0.15					
Thickener overflow return	0.202	MLD				
Thickener overflow return	350	mg/l				
BOD	330	ilig/1				
Centrate from sludge	0.006					
dewatering as fraction of						
plant flow	0 00000	MID				
dewatering return	0.00808	MLD				
Centrate from sludge	280	mg/l				
dewatering return BOD		8				
Influent BOD to aeration tank	263.1	mg/l				
TSS	400	mg/l				
Total Nitrogen (As N)	40	mg/l				
Total Phosphorous (As P)	7	mg/l				
Faecal Coliform	30000000	mpn/100 ml				
E Coliform	40000000	mpn/100 ml				
Chlorides as Cl	125	mg/l				
pH	6	• 、				
Treated Sewage Characteristics	s (after filtrat	10n)				
	50	mg/l				
	20	mg/1				
Total Nitrogan (AcN)	10	mg/l				
Total Phosphorous (As D)	10	mg/l				
E Coliform	100	mpn/100 ml				
pH	7	mpn/100 mi				
Receiving Chamber						
Average quantity of flow	56.11	m <sup>3</sup> /hour				
Peak flow	126.24	m <sup>3</sup> /hour				
	0.0351	m <sup>3</sup> /sec				
Average Retention Time for	180	sec	offset to	0.3	m	
Volume of the inlet chamber	6.31	m <sup>3</sup>	free board	0.85	m	
Assumed denth of flow	2.1	m	total height	2.95	m	
Area required for inlet	3.01	$m^2$	wall	0.25	m	
chamber	5.01		thickness	0.25		

Length of the tank	2.5	m	slab	0.3	m	
			thickness			
Breadth of the tank	1.20	fix	1.5	m	area in m <sup>2</sup>	9.36
Oil and Grease Trap		2.0				
Average quantity of flow	56.11	m <sup>3</sup> /hour				
Peak flow	126.24	m <sup>3</sup> /hour				
	0.0351	m <sup>3</sup> /sec				
Average Retention Time for peak flow	300	sec	offset to wall	0.15	m	
Volume of the inlet chamber	10.52	m <sup>3</sup>	free board	0.75	m	
Assumed depth of flow	2.5	m	total height	3.25	m	
Area required for inlet chamber	4.21	m <sup>2</sup>	wall thickness	0.3	m	
Length of the tank	2.8	m	slab thickness	0.35	m	
Breadth of the tank	1.50	fix	1.5	m	area in m <sup>2</sup>	8.88
Breadth of baffle wall inside	1.5	m				
Manual Coarse Screen Channe	1	2.				
Peak design flow	0.0351	m <sup>3</sup> /sec				
Number of screen	1					
Peak flow rate per screen	0.0351	m <sup>3</sup> /sec				
Velocity at peak flow	1	m/sec	assumed			
Velocity through clean bar	1.10	m/sec				
screen						
Length of channel U/S	1	m	wall thickness	0.25	m	
Width of channel provided	0.75	m	offset to wall	0.25	m	
Depth of flow	0.05	m	slab thickness	0.30	m	
Area required for screen	0.04	sqm				
Headloss through bar screen	0.02	m	assuming he	ad loss coe	efficient	= 0.7
Assumed depth of flow after	0.1	m	0.06	(control v	value)	
Width of channel required	0.35	m	fiv	0.75	m	
Clear har spacing	20	mm	(20 to 50 mm)	1)	111	
Bar thickness	10	mm	(5 to 15 mm)			
Number of bars	25		(5 10 15 mm)			
Clear bar spacing obtained	21	mm	OK			
Inside width of screen	0.5	m			area in m <sup>2</sup>	3.85
Full height of channel	1.2	m	fb	0.3		
Angle of inclination	45	degree	0.79	rad		
Actual velocity at peak flow	1.13	(between 0.60	) m/sec and 0.	90 m/sec)		
Length of channel required D/S	1.20	m	fix	1.2	m	
Manual Fine Screen Channel						
Peak design flow	0.0351	m <sup>3</sup> /sec				
Number of screen	1.2					
Peak flow rate per screen	0.0292	m <sup>3</sup> /sec				

Velocity through clean bar screen1.00m/secImwall thickness0.25mILength of channel provided0.75moffset to vall0.25mIDepth of flow0.07mslab0.30mIDepth of flow0.07mslab0.30mIHeadloss through bar screen0.04sqmsassuming head loss coefficient = 0.7Assumed depth of flow after inserting bar screen0.1mossuming head loss coefficient = 0.7Width of channel required0.42mfix0.75mIBar thickness10mm $(5 to 15 m)$ IIBar thickness0.28marea in m?4.375Number of bars47IIIIClear bar spacing obtained6mm0.6IIActual velosity at peak flow1.00(betreen 0.60 m/sec and 0.90 m/sec)IILength of channel required1.5mfix1.5mPull height of channel1.5mfixIIActual velosity at peak flow1.00(betreen 0.60 m/sec and 0.90 m/sec)IIDaily screening quantify0.015m²/1000 m³IIIDaily screening quantify0.020m²/dayIIIDaily screening quantify0.031m²/secIIIDaily screening quantify0.0351m²/secI <th>Velocity at peak flow</th> <th>0.7</th> <th>m/sec</th> <th>assumed</th> <th></th> <th></th> <th></th>	Velocity at peak flow	0.7	m/sec	assumed			
servern Length of channel U/S1mwall m0.25mMWidth of channel provided Depth of flow0.75moffset to wall0.25mmDepth of flow0.07nslab to m0.30mmArea required for screen0.04sqmmassumid battersmmArea required for screen0.04massumid battersm0.10control tocontrolAssumed depth of flow after inserting bar screen0.44massumid battersmmWidth of channel required0.42mfix0.75mmBar thickness10mm(5 to 15 mmfixarea m4.375Number of bars47marea m4.375mfixfixClear bar spacing obtained6mmOKmarea m4.375Inside width of screen (opening)1.50mfix1.5mfixAugle of inclination45degree0.79radiiAugle of inclination45m²/dayiiiiDaily screening quantity1346.58m²/dayiiiiDaily screening quantity0.15m²/dayiiiiDaily screening quantity1346.58m²/dayiiiiPack flow0.03m²/dayiiiii	Velocity through clean bar	1.00	m/sec				
Length of channel U/S1mwall m0.25mWidth of channel provided0.75moffset to wall0.25mDepth of flow0.07mslab slab0.30mArea required for screen0.04massuming head loss coefficient = 0.7Headloss through bar screen0.04massuming head loss coefficient = 0.7Assumed depth of flow after inserting bar screen0.1m0.10(control value)Width of channel required0.42mfix0.75mBar thickness10mm(fix to 15) mm)mmBar thickness10mm(fix to 15) mm)mmPart tickness10mm(fix to 15) mm)mmPart tickness1.5mfix1.5mPart tickness1.50mfix1.5mPaily screening quantity0.015m²/dayis<	screen						
Width of channel provided0.75moffset wallto 0.25mDepth of flow0.07mslab slab tickness0.30mArea required for screen0.04massuming head loss coefficient = 0.7Headloss through bar screen0.04massuming head loss coefficient = 0.7Assumed depth of flow after inserting bar screen0.1m0.10(control value)Width of channel required0.42mfix0.75mBar thickness10mm $yrrrrBar thickness10mmyrraterrNumber of bars47rrratearea4.375Clear bar spacing obtained6mmOKraterArgle of inclination45degree0.79radrateActual velocity at peak flow1.50mfix1.5mActual velocity at peak flow1.00(between 0.60 m/sec and 0.90 m/sec)rrDaily screening quantity0.015m³/dayrrrDaily screening quantity0.015m³/dayrrrDaily screening quantity0.031m³/secrrrDaily screening quantity0.035m³/secrrrPeak flow0.0351m³/secrrrrFlow in one unit0.0351m³/secrrrrSOR900<$	Length of channel U/S	1	m	wall thickness	0.25	m	
Depth of flow0.07mslab tickerss0.30mArea required for screen0.04sqmassuming head loss coefficient = 0.7Assumed depth of flow after inserting bar screen0.1massuming head loss coefficient = 0.7Assumed depth of flow after inserting bar screen0.42mfix0.75mWidth of channel required0.42mfix0.75mImage and the screenWidth of channel required0.42mfix0.75mImage and the screenNumber of bars10mm(5 to 15 	Width of channel provided	0.75	m	offset to wall	0.25	m	
Area required for serven Headloss through as a screen Resumed performant of the server of the server inserting bar screen0.04 m massuming head loss coefficient = 0.7 control value)Width of channel required (Clear bar spacing)0.42 mmfix0.75 mmBar thickness10mm mm (S to 15 mm)0.75m1Number of bars (opening)47 mm)min m2in m2Clear bar spacing obtained (opening)6 mmmmOKin m2Full height of channel (opening)1.5 mmfb0.3 min m2Full height of channel (opening)1.5 mmfb0.3 min m2Full height of channel (opening)1.50 mmfix1.5 mmFull height of channel (opening)1.50 mmfix1.5 mmFull screening quantity Daily screening quantity0.015 m2/1000 m3mininDaily screening quantity Ou202m3/dayinininPaily screening quantity Ou203m3/dayinininFix length of grit units1 SBSB0ininFix length of grit units1 SBSBinininFix length2.10 m3/3m3/secinininGrit sparatorinininininVolume of grit units1 S3, mSBininin <t< td=""><td>Depth of flow</td><td>0.07</td><td>m</td><td>slab thickness</td><td>0.30</td><td>m</td><td></td></t<>	Depth of flow	0.07	m	slab thickness	0.30	m	
Headloss through bar screen Assumed depth of flow after inserting bar screen0.04massuming head loss coefficient = 0.7Assumed depth of flow after inserting bar screen0.1m0.10(centrol value)Width of channel required0.42mfix0.75mClear bar spacing6mmup to 6 mmininBar thickness10mm(5 to 15) 	Area required for screen	0.04	sqm				
Assumed depth of low after inserting bar servern0.1m0.10control value)width of channel required0.42mfix0.75m1Bar thickness10mm $G5$ to 15 mm)mn111Number of bars47 $$ $$ area in m <sup>2</sup> 4.375Orear bar spacing obtained (openings)6mmOK $$ area in m <sup>2</sup> 4.375Inside width of screen (openings)0.28m $$ $$ area in m <sup>2</sup> 4.375Full height of channel (openings)1.5mfb0.3 $$ $$ Actual velocity at peak flow Log th of channel required D/S1.50mfix $1.5$ mDaily screening quantity1346.58 $m^3/day$ $$ $$ $$ Daily screening quantity0.015 $m^3/l000$ m <sup>3</sup> $$ $$ $$ Daily screening quantity0.020 $m^3/day$ $$ $$ $$ Daily screening quantity0.0351 $m^3/sec$ $$ $$ $$ Peak flow0.0351 $m^3/sec$ $$ $$ $$ Flow in one unit0.015 $m^3/rady$ $$ $$ $$ Flow in one unit0.016 $m^3/rady$ $$ $$ $$ Flow in one unit0.010 $m^3/rady$ $$	Headloss through bar screen	0.04	m	assuming he	ad loss coe	efficient	= 0.7
Width of channel required Clear bar spacing0.42mfix0.75mBar thickness10mm $lfo$ $lfo$ $mm$ $lfo$ $lfo$ Bar thickness10mm $lfo$ $lfo$ $lfo$ $mm$ $lfo$ $lfo$ Number of bars47 $mm$ $OK$ $mm$ $m$	Assumed depth of flow after inserting bar screen	0.1	m	0.10	(control v	value)	
Clear bar spacing         6         mm         upto 6 mm         (S to 15 mm)         (S to 15 mm)           Bar thickness         10         mm $(S to 15 mm)$ (S to 15 mm)         (S to 15 mm)           Number of bars         47         (S to 15 mm)	Width of channel required	0.42	m	fix	0.75	m	
Bar thickness10mm $(5 to 15 mm)$ InInNumber of bars47ImmImmImmImmClear bar spacing obtained6mmOKImmImmInside width of screen (openings)0.28mImmImmImmAngle of inclination45degree0.79radImmAngle of inclination45degree0.79radImmActual velocity at peak flow1.00(between 0.60 m/sec and 0.90 m/sec)ImmLength of channel required D/S1.50mIfix1.5mDaily screening quantity1346.58m³/dayImmImmImmOally screening quantity0.015m³/dayImmImmImmOally screening quantity0.0202m³/dayImmImmImmOally screening quantity0.031m³/secImmImmImmOally screening quantity0.031m³/secImmImmImmOally screening quantity0.031m³/secImmImmImmOally screening quantity0.031m³/secImmImmImmPeak flow0.031m³/secImmImmImmOally screening quantity0.16m³/secImmImmSore0.16mmImmImmImmSorefit harthele1.00m³/m²/secImmImmSorefit harthele1.00m³/m²/secImmImm<	Clear bar spacing	6	mm	upto 6 mm			
Number of bars47 $\end{fightarrow}$ <	Bar thickness	10	mm	(5 to 15 mm)			
Clear bar spacing obtained6mmOK $\blacksquare$ <td>Number of bars</td> <td>47</td> <td></td> <td></td> <td></td> <td></td> <td></td>	Number of bars	47					
Inside width of screen (openings)         0.28         m         area (by area in m <sup>2</sup> 4.375 (by area area by area by area (be by area (be by area by area (be by area by area (be by area (be by area (be by area (be by area (be by area (be by area) (be by area (be by area) (be by area (be by area) (be by area (be by area) (be	Clear bar spacing obtained	6	mm	OK			
Full height of channel       1.5       m       fb       0.3          Angle of inclination       45       degree       0.79       rad          Actual velocity at peak flow       1.00       (between 0.60 m/sec and 0.90 m/sec)           Length of channel required       1.50       m       fix       1.5       m          Daily screening quantity       1346.58       m³/day             Daily screening quantity       0.015       m³/day             Daily screening quantity       0.0202       m³/day             Grit Separator <td>Inside width of screen (openings)</td> <td>0.28</td> <td>m</td> <td></td> <td></td> <td>area in m<sup>2</sup></td> <td>4.375</td>	Inside width of screen (openings)	0.28	m			area in m <sup>2</sup>	4.375
Angle of inclination45degree0.79radActual velocity at peak flow1.00(between 0.60 m/sec and 0.90 m/sec)Length of channel required D/S1.50mfix1.5mDaily screening quantity1.50m <sup>3</sup> /dayDaily screening quantity0.015m <sup>3</sup> /1000 m <sup>3</sup> Rate of screening quantity0.020m <sup>3</sup> /dayDaily screening quantity0.020m <sup>3</sup> /dayDaily screening quantity0.020m <sup>3</sup> /dayDaily screening quantity0.020m <sup>3</sup> /dayDaily screening quantity0.020m <sup>3</sup> /day	Full height of channel	1.5	m	fb	0.3		
Actual velocity at peak flow1.00(between 0.60 m/sec and 0.90 m/sec)Length of channel required D/S1.50mfix1.5mDaily screening quantity1346.58 $m^3/day$ $$	Angle of inclination	45	degree	0.79	rad		
Length of channel required D/S         1.50         m         fix         1.5         m           Daily screening quantity         1346.58 $m^3/day$	Actual velocity at peak flow	1.00	(between 0.60	0 m/sec and 0.	90 m/sec)		
Daily screening quantity         1346.58         m³/day         Image: screening quantity	Length of channel required D/S	1.50	m	fix	1.5	m	
Daily sewage quantity         1346.58 $m^3/1000 m^3$ Image: sevening quantity         0.015 $m^3/1000 m^3$ Image: sevening quantity         0.020 $m^3/1000 m^3$ Image: sevening quantity         0.0202 $m^3/1000 m^3$ Image: sevening quantity         0.0202 $m^3/1000 m^3$ Image: sevening quantity         0.0202 $m^3/1000 m^3$ Image: sevening quantity         Image: sev	Daily screening quantity						
Rate of screening quantity $0.015$ $m^3/1000 m^3$ Image: margina screening quantity $0.0202$ $m^3/day$ Image: margina screening quantity $m^3/day$ </td <td>Daily sewage quantity</td> <td>1346.58</td> <td>m³/day</td> <td></td> <td></td> <td></td> <td></td>	Daily sewage quantity	1346.58	m³/day				
Daily screening quantity         0.0202         m³/day         I         similar         I         similar         I         SB         0         I         I           Grit Separator         Number of grit units         1         SB         0         I         I         SB           Peak flow         0.0351         m³/sec         I <td>Rate of screening quantity</td> <td>0.015</td> <td><math>m^3/1000 m^3</math></td> <td></td> <td></td> <td></td> <td></td>	Rate of screening quantity	0.015	$m^3/1000 m^3$				
Grit Separator           Number of grit units         1         SB         0         I         I           Peak flow         0.0351         m <sup>3</sup> /sec         I         I         I           Flow in one unit         0.0351         m <sup>3</sup> /sec         I         I         I           Grit particle size         0.15         mm         I         I         I           Grit particle size         0.15         mm         I         I         I           Volume of grit chamber         2.10         m <sup>3</sup> I         I         I           SOR         900         m <sup>3</sup> /m <sup>2</sup> /day         (Empirical, from observations)         I           Area required         3.37         m <sup>2</sup> Wall thickness         0.30         m           SWD         2.50         m         slab         0.30         m           Fix length         2.5         m         freeboard         0.8         m           Fix width         2         m         area given         5         m <sup>2</sup> OK           Shape factor         0.85         I         m         freeboard         0.8         m           Fix width         2.65         I	Daily screening quantity	0.0202	m <sup>3</sup> /day				
Number of grit units         1         SB         0           Peak flow         0.0351         m³/sec         Image: SB	Grit Separator			-			
Peak flow $0.0351$ m³/sec $i$ $i$ Flow in one unit $0.0351$ m³/sec $i$ $i$ $i$ Grit particle size $0.15$ mm $i$ $i$ $i$ HRT $60$ sec $(45 to 90 sec, typical 60)$ $i$ $i$ Volume of grit chamber $2.10$ m³ $i$ $i$ $i$ SOR900 $m^3/m^2/day$ (Empirical, from observations)0.010 $m^3/m^2/sec$ $i$ $i$ $i$ Area required $3.37$ $m^2$ wall thickness $0.30$ $m$ SWD $2.50$ $m$ slab thickness $0.30$ $m$ Side of square channel $1.83$ $m$ offset to wall $0.3$ $m$ Fix length $2.5$ $m$ freeboard given $0.8$ $m$ Fix width $2$ $m$ area given $5$ $m^2$ $OK$ Shape factor $0.85$ $i$ $v$ $i$ $i$ $i$ Specific gravity of liquid $2.65$ $m^2/sec$ $i$ $i$ $i$ $i$ Specific gravity of liquid $2.65$ $m^2/sec$ $i$ $i$ $i$ $i$	Number of grit units	1	SB	0			
Flow in one unit $0.0351$ $m^3/sec$ $m^3/sec$ $m^3/sec$ $m^3/sec$ Grit particle size $0.15$ mm $m^3$ $m^3$ $m^3$ HRT $60$ sec $(45 to 90 sec, typical 60)$ $m^3/sec$ Volume of grit chamber $2.10$ $m^3$ $m^3/m^2/day$ $(Empirical, from observations)$ SOR $900$ $m^3/m^2/day$ $(Empirical, from observations)$ $0.010$ $m^3/m^2/sec$ $m^2$ $vall$ $0.30$ $m$ Area required $3.37$ $m^2$ $vall$ $0.30$ $m$ SWD $2.50$ $m$ $slab$ $0.30$ $m$ Side of square channel $1.83$ $m$ offset to vall $0.3$ $m$ Fix length $2.5$ $m$ freeboard $0.8$ $m$ Fix width $2$ $m$ $area given$ $5$ $m^2$ $OK$ Shape factor $0.85$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ Specific gravity of liquid $2.65$ $m^2/sec$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ Specific gravity of liquid $2.65$ $m^2/sec$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ Subscription $1.003E m^2/sec$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uolline$ $uoline$	Peak flow	0.0351	m <sup>3</sup> /sec				
Grit particle size0.15mm $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ $<$ <t< td=""><td>Flow in one unit</td><td>0.0351</td><td>m<sup>3</sup>/sec</td><td></td><td></td><td></td><td></td></t<>	Flow in one unit	0.0351	m <sup>3</sup> /sec				
HRT60sec(45 to 90 sec, typical 60)Volume of grit chamber2.10 $m^3$ </td <td>Grit particle size</td> <td>0.15</td> <td>mm</td> <td></td> <td></td> <td></td> <td></td>	Grit particle size	0.15	mm				
Volume of grit chamber $2.10$ $m^3$ <td>HRT</td> <td>60</td> <td>sec</td> <td>(45 to 90 sec</td> <td>c, typical 6</td> <td>0)</td> <td></td>	HRT	60	sec	(45 to 90 sec	c, typical 6	0)	
SOR900 $m^3/m^2/day$ (Empirical, from observations)0.010 $m^3/m^2/sec$ Area required3.37 $m^2$ wall thickness0.30mSWD2.50mslab thickness0.30mSide of square channel1.83moffset to wall0.3mFix length2.5mfreeboard0.8mFix width2marea given5 $m^2$ OKShape factor0.85volume given12.5000 $m^3$ OKSpecific gravity of liquid2.65mMinematic viscosity1.003E- 06 $m^2/sec$	Volume of grit chamber	2.10	m <sup>3</sup>				
$0.010$ $m^3/m^2/sec$ $m^2$ $M^$	SOR	900	m <sup>3</sup> /m <sup>2</sup> /day	(Empirical, j	from obser	vations)	
Area required3.37m²wall thickness0.30mSWD2.50mslab thickness0.30mSide of square channel1.83moffset to wall0.3mFix length2.5mfreeboard0.8mFix width2marea given5m²OKShape factor0.85volume given12.5000m³OKSpecific gravity of liquid2.65m²/secinterventinterventVinematic viscosity1.003E- 06m²/secinterventinterventintervent		0.010	m <sup>3</sup> /m <sup>2</sup> /sec				
SWD2.50mslab thickness0.30mSide of square channel1.83moffset to wall0.3mFix length2.5mfreeboard0.8mFix width2marea given5m <sup>2</sup> OKShape factor0.85volume given12.5000m <sup>3</sup> OKSpecific gravity of liquid2.65Kinematic viscosity1.003E- 06m <sup>2</sup> /sec	Area required	3.37	m <sup>2</sup>	wall thickness	0.30	m	
Side of square channel1.83moffset to wall0.3mFix length2.5mfreeboard0.8mFix width2marea given5m²OKShape factor0.85volume given12.5000m³OKSpecific gravity of liquid2.65Kinematic viscosity1.003E- 06m²/sec	SWD	2.50	m	slab	0.30	m	
Fix length2.5mfreeboard0.8mFix width2marea given5m²OKShape factor0.85volume given12.5000m³OKSpecific gravity of liquid2.65Kinematic viscosity1.003E- 06m²/sec	Side of square channel	1.83	m	offset to wall	0.3	m	
Fix width2marea given5m²OKShape factor0.85volume given12.5000m³OKSpecific gravity of liquid2.65Kinematic viscosity1.003E- 06m²/sec	Fix length	2.5	m	freeboard	0.8	m	
Shape factor0.85volume given12.5000m³OKSpecific gravity of liquid2.65Kinematic viscosity1.003E- 06m²/sec	Fix width	2	m	area given	5	m <sup>2</sup>	OK
Specific gravity of liquid     2.65       Kinematic viscosity     1.003E- 06	Shape factor	0.85		volume given	12.5000	m <sup>3</sup>	OK
Kinematic viscosity $1.003E$ - $06$ $m^2/sec$	Specific gravity of liquid	2.65		8			
	Kinematic viscosity	1.003E- 06	m <sup>2</sup> /sec				

V <sub>p</sub> in m/sec	0.020	let $Nr < 1$ , apply Stoke's law to get terminal velocity vp					
Nr	3	apply Newton	s equation				
assumed velocity in m/sec	0.0146						
Nr	2	area in m <sup>2</sup> 11.84					
drag coefficient Cd	15.47						
vp in m/sec	0.014						
Critical displacement	0.0145	m/sec		R <sub>t</sub>	1.00		
velocity, Vc							
Horizontal velocity of flow,	0.0070	m/sec OK R <sub>v</sub> 2.06					
Vh							

#### 4.4 DESIGN OF CO-TREATMENT UNITS FOR SEPTAGE

Latrine or septic tank in FSM areas Primary emtying and transfer in vacuum trucks

Co-treatment in STP

Fig.23 Septage Management, Containment, Emptying, Transportation, Treatment, End Use / Disposal

For the areas considered as septage zones, the households, institutions, commercial entities etc., shall undertake de-sludging of the septic tanks and pit once in every three years or when get filled up whichever is earlier as per the NBC code and CPHEEO guidelines. The most satisfactory method of sludge removal is by vacuum tankers. Though de-sludging frequencies vary, it is generally recommended to de-sludge tanks once every two to three years, or when the tank becomes one third full. Periodical de-sludging also helps to reduce the pollution levels in the liquid effluent, which normally enters waterways untreated. However, a small amount of sludge should be left in the tank to ensure that a minimum level of the necessary microorganisms responsible for anaerobic digestion remain in the tank. The gas generated due to anaerobic digestion might escape when tank is open for de-sludging activities require well-organized community and public/private service providers. Because of the delicate nature of septic systems housing microbial processes, care should also be taken not to scrub the septic clean or use chemicals such as detergents etc. to avoid the complete destruction of favorable microbes in the tank.

#### **4.4.1 UNIT OPERATIONS**

The septage collected and transported to the STP is diluted in the tank by adding recycled water. The normalized values of BOD and TSS are calculated based on test results on samples performed. The detailed design is presented below:

DESIGN OF CO-TREATMEN REACTOR (MBBR)	T UNIT FOF	R SEPTAC	GE WITH I	MOVING	BED B	IOFILM-
Design population	58000					
Sludge deposit coefficient	95	litres/pers	on/year			
Sludge deposit	15.10	KLD				
Average septage flow	15.1	KLD				
Working hours	24					
Design flow	15.10	KLD	15100	LPD	15.1	m <sup>3</sup> /day
Maximum peak factor expected	1.5		15	KLD	0.63	m <sup>3</sup> /hour
Peak design flow	22.65	KLD	22650	LPD	23	m <sup>3</sup> /day
					0.94	m <sup>3</sup> /hour
Number of trips/days	8				0.0002	cum/sec
Quantity of septage obtained in	2.83	m <sup>3</sup>				
single trip with peak factor						
Raw Septage Characteristics						
COD	25000	mg/l				
BOD	5000	mg/l				
TSS	7000	mg/l				
Treated Sewage Characteristics (a	after filtration)					
COD	50	mg/l				
BOD	10	mg/l				
TSS	20	mg/l				
Receiving Chamber						
Average quantity of flow	0.63	m <sup>3</sup> /hour				
Peak flow	0.94	m <sup>3</sup> /hour				
	0.00026	m <sup>3</sup> /sec				
Average Retention Time for peak flow	600	sec	offset to wall	0.3	m	
Volume of the inlet chamber	0.1573	m <sup>3</sup>	free board	0.85	m	
Assumed depth of flow	1	m	total height	1.85	m	
Area required for inlet chamber	0.16	m <sup>2</sup>	wall thickness	0.25	m	
Length of the tank	1	m	slab thickness	0.3	m	
Breadth of the tank	0.16	fix	0.5	m	area in m <sup>2</sup>	3.36
Design of Dilution Chamber from	n Mass-balance	e Principle				
Target outflow BOD (actual incoming BOD to STP)	265	mg/l	offset to wall	0.45	m	
Target outflow TSS (actual incoming TSS to STP)	400	mg/l	free board	0.85	m	
Volume of recycled water used for dilution	54000	litres	total height	3.35	m	
Quantity of septage obtained as above	2.83	m <sup>3</sup>				
BOD of diluted septage	258.59	mg/l	ok			
TSS of diluted septage	367.73	mg/l	ok			
Total volume of dilution tank	56.83	m <sup>3</sup>				
Liquid depth adopted inside	2 50	m	wall	03	m	
dilution tank	2.50	111	thickness	0.5	111	

side of gauges toply	1 77		alah	0.45		
side of square tank	4.//	m	slad	0.45	m	
Length of dilution tank adopted	6.00	m	unoxitess			
Breadth of dilution tank adopted	4.00	m	ratio of dilu	tion	19.07	
Average outflow from dilution tank	12.63	m <sup>3</sup> /hour	volume	60.00	m <sup>3</sup>	ok
Average sewage flow entering the STP with diluted septage	8.00	m <sup>3</sup> /hour	% of dilu sewage	ited sep	tage to	157.86
Oil and Grease Trap						
Average quantity of flow	12.63	m <sup>3</sup> /hour				
Peak flow	18.94	m <sup>3</sup> /hour				
	0.00526	m <sup>3</sup> /sec				
Average Retention Time for peak flow	300	sec	offset to wall	0.15	m	
Volume of the inlet chamber	1.58	m <sup>3</sup>	free board	0.75	m	
Assumed depth of flow	1.5	m	total height	2.25	m	
Area required for inlet chamber	1.05	m <sup>2</sup>	wall thickness	0.25	m	
Length of the tank	1.5	m	slab thickness	0.3	m	
Breadth of the tank	0.70	fix	0.75	m	area in m <sup>2</sup>	3.565
Breadth of baffle wall inside	0.75	m				
Manual Coarse Screen Channel						
Peak design flow	0.00526	m <sup>3</sup> /sec				
Number of screen	1					
Peak flow rate per screen	0.0053	m <sup>3</sup> /sec				
Velocity at peak flow	0.8	m/sec	assumed			
Velocity through clean bar	0.85	m/sec				
screen						
Length of channel U/S	1	m	wall thickness	0.25	m	
Width of channel provided	0.6	m	offset to wall	0.25	m	
Depth of flow	0.01	m	slab thickness	0.30	m	
Area required for screen	0.01	sqm				
Headloss through bar screen	0.01	m	assuming h	ead loss a	coefficient	= 0.7
Assumed depth of flow after inserting bar screen	0.1	m	0.02	(control	value)	
Width of channel required	0.07	m	fix	0.6	m	
Clear bar spacing	20	mm	(20 to 50 m	m)		
Bar thickness	10	mm	(5 to 15 mm	)		
Number of bars	15					
Clear bar spacing obtained	32	mm	OK			
Inside width of screen (openings)	0.45	m			area in m <sup>2</sup>	4
Full height of channel	1.5	m	fb	0.3		
Angle of inclination	45	degree	0.79	rad		
Actual velocity at peak flow	0.69	(Between	0.60 m/sec a	nd 0.90 n	n/sec)	
Length of channel required D/S	1.50	m	fix	1.5	m	

Sewage pump- for pumping to receiving chamber/equalisation tank of STP								
Number of pumps	1	SB	1					
Type of pump set	submersible	centrifugal	sewage trans	fer-non c	log			
Average flow	12.63	m <sup>3</sup> /hour						
Peak design flow	18.94	m <sup>3</sup> /hour						
Working hours	23							
Flow capacity of each pump	19.77	m <sup>3</sup> /hour						
Peak factor	1.20							
Discharge	6.59	LPS	0.0066	m <sup>3</sup> /sec				
Head required	18	m						
Efficiency	50%							
Power required	3.16	HP	fix	3.25	HP			
Energy	54.27	kwh						

Recycled water pump- for pumping to dilution tank							
Number of pumps	1	SB	1				
Type of pump set	submersible	centrifugal sewa	ge transfer-	non clog			
Average flow	12.00	m <sup>3</sup> /hour					
Peak design flow	18.00	m <sup>3</sup> /hour					
Working hours	23						
Flow capacity of each pump	18.78	m <sup>3</sup> /hour					
Peak factor	1.20						
Discharge	6.26	LPS	0.0063	m <sup>3</sup> /sec			
Head required	20	m					
Efficiency	50%						
Power required	3.34	HP	fix	3.5	HP		
Energy	57.29	kwh					

## 4.5 DESIGN OF EQUALISATION TANK

Equalisation tank is used to normalise the flow towards chemical and biological processing units. This unit has been designed in accordance with the observation of flow for 24 hours in similar cases. A peak factor is obtained from the observed data for both BOD loading and discharge. The equalisation tank will store liquid during excess flow periods and release quantity during off-peak flow periods. The volume of equalisation tank is scientifically designed based on this concept. Hence there will be a normalised value for influent BOD also.

## **4.5.1 UNIT OPERATIONS**

Equalization Tank						
Average design flow	56.11	m <sup>3</sup> /hour				
Volume of tank required	350.0 0	m <sup>3</sup>	from detailed	l analysis	3	
HRT	6.24	hours				
SWD	3.6	m				
Area required for equalization tank	97.22	m <sup>2</sup>	free board	0.50	m	

Number of tanks proposed	1		offset to wall	0.45	m	
Area required for each tank	97.22	m <sup>2</sup>	wall thickness	0.3	m	
Diameter of circular tank	11.13	m	fix	11.2	m	
Side if square tank	9.86	m	fix length	10	m	
Thickness of foundation slab	0.45	m	fix breadth	10	m	
Actual capacity provided	354.7	m <sup>3</sup>	circular	OK		
	360	m <sup>3</sup>	rectangular	OK	area in m <sup>2</sup>	132.2

#### **4.6 DESIGN OF MBBR UNITS**

Biochemical oxygen demand (BOD) is an indirect measure of the concentration of biodegradable organic matter in water or wastewater. Organic matter (as measured by BOD) is one of the major constituents removed from wastewater in domestic wastewater treatment plants. The reason for being concerned about organic matter in water is its effect on dissolved oxygen in the receiving stream. Dissolved oxygen in water is essential for much of aquatic life, so organic contaminants that affect dissolved oxygen level in water are of concern.

The two major reactions that take place in the organic carbon cycle are biological oxidation of waste organic matter and photosynthesis, which is the process by which green plants produce organic matter from carbon dioxide and water in reactions that are catalysed by sunlight and the chlorophyll in the green plants. Through the biological oxidation process, aerobic microorganisms utilize oxygen in breaking down organic matter to carbon dioxide and water together with small amounts of other end products.

The photosynthesis and biological oxidation processes can be represented by the following two equations:

#### **Photosynthesis:**

 $CO_2 + H_2 O + sunlight \rightarrow organic plant matter (primarily C, H, & O) + oxygen (this reaction is catalysed by the chlorophyll in green plants)$ 

#### **Biological Oxidation:**

waste organic matter (primarily C, H & O) +  $O_2 \rightarrow CO_2 + H_2O$  + energy

The process takes place as aerobic microorganisms utilize the waste organic matter as their food (energy) source. The process uses oxygen, so if it is taking place in a water body, dissolved oxygen is consumed. A large quantity of organic matter in the water will result in multiplication of microorganisms and rapid removal of dissolved oxygen, leading to oxygen depletion below the level needed by aquatic life. This is also the process that takes place in biological oxidation processes in wastewater treatment plants for removal of organic matter from the incoming wastewater.

The MBBR process for wastewater treatment was invented and initially developed by Professor Hallvard Ódegaard in the late 1980s at the Norwegian University of Science and Technology. Use of this wastewater treatment process has spread rapidly.

The MBBR process is an attached growth biological wastewater treatment process. That is, the microorganisms that carry out the treatment are attached to a solid medium, as in trickling filter or RBC systems. By contrast, in a suspended growth biological wastewater treatment process, like the activated sludge process, the microorganisms that carry out the treatment are kept suspended in the mixed liquor in the aeration tank. In the conventional attached growth biological treatment processes, like trickling filter or RBC systems the microorganisms are attached to a medium that is fixed in place and the wastewater being treated flows past the surfaces of the medium with their attached biological growth. which are described in more detail in the next section. The MBBR treatment processes typically take place in a tank like an activated sludge aeration tank. In contrast, an MBBR process utilizes small plastic carrier media, which are kept suspended by a diffused air aeration system for an aerobic process or by a mechanical mixing system for an anoxic or anaerobic process. A sieve is typically used at the tank exit to keep the carrier media in the tank.

MBBR processes use plastic media support carriers like those shown in Figure 11. As shown in Figure, the carrier is typically designed to have a high surface area per unit volume, so that there is a lot of surface area on which the microorganisms attach and grow. Two properties of the carrier are needed for the process design calculations are the specific surface area in  $m^2 / m^3$  and the void ratio. The specific surface area of MBBR carriers is typically in the range from 350 to 1200  $m^2 / m^3$  and the void ratio typically ranges from 60% to 90%. Design values for these carrier properties should be obtained from the carrier manufacturer or vendor (Harlan H. Bengtson).

The MBBR wastewater treatment process is quite flexible and can be used in several different ways:

Single stage BOD removal 2. Two stage BOD removal 3. Two stage BOD removal and Nitrification
 Single stage tertiary Nitrification 5. Pre-Anoxic Denitrification 6. Post-Anoxic Denitrification (Harlan H. Bengtson).

The idea behind the development of the moving bed biofilm process was to adopt the best from both the activated sludge process and the biofilter processes without including the worst. Contrary to most biofilm reactors, the moving bed biofilm reactor utilises the whole tank volume for biomass growth, as does also the activated sludge reactor. Contrary to the activated sludge reactor, it does not need any sludge recycle, as also the case in other biofilm reactors. This is achieved by having the biomass grow on carriers that move freely in the water volume of the reactor, kept within the reactor by a sieve arrangement at the reactor outlet. Since no sludge recirculation takes place, only the surplus biomass must be separated – a considerable advantage over activated sludge process. The reactor may be used for both aerobic, anoxic or anaerobic processes (H. Ódegaard).







a. Aerobic reactor

b. Anoxic and anaerobic reactor

c. The biofilm carrier (K1)



Fig.24 MBBR Carrier media in a MBBR tank

The key design parameter for sizing the MBBR tank is the surface area loading rate (SALR), typically with units of  $g/m^2/day$ , that is g/day of BOD coming into the MBBR tank per m<sup>2</sup> of carrier surface area. Using design values for wastewater flow rate and BOD concentration entering the MBBR tank, the loading rate in g BOD/day can be calculated. Then dividing BOD loading rate in g/day by the SALR in  $g/m^2/day$  gives the required carrier surface area in m<sup>2</sup>. The carrier fill %, carrier specific surface area, and carrier % void space can then be used to calculate the required carrier volume, tank volume and the volume of liquid in the reactor (Harlan H. Bengtson).

To carry out denitrification of a wastewater flow (removal of the nitrogen from the wastewater), it is necessary to first nitrify the wastewater, that is, convert the ammonia nitrogen typically present in the influent wastewater to nitrate. Nitrification will only take place at a reasonable rate if the BOD level is quite low. Thus, an MBBR denitrification process will need a reactor for BOD removal, one for nitrification, and one for denitrification. The nitrification reactor will always follow the BOD removal reactor, because of the need for a low BOD level in the nitrification reactor. The denitrification reactor may be either before the BOD removal reactor (called pre-anoxic denitrification) or after the nitrification reactor (called post-anoxic denitrification).

The denitrification reactions, which convert nitrate ion to nitrogen gas, and hence remove it from the wastewater flow, will take place only in the absence of oxygen, that is, in an anoxic reactor. Also, the

denitrification reactions require a carbon source. In a pre-anoxic denitrification process, the BOD in the primary effluent wastewater is used as the carbon source for denitrification. In this process, however the primary effluent entering the pre-anoxic reactor still has ammonia nitrogen present rather than the nitrate nitrogen needed for denitrification.

In a post-anoxic denitrification process, the influent to the denitrification reactor comes from the nitrification reactor, so the wastewater influent ammonia nitrogen has been converted to nitrate as required for denitrification. The BOD has also been removed prior to the post anoxic denitrification reactor, however, so an external carbon source is required for the denitrification reactions.

The pre-anoxic denitrification process has the advantage of not requiring an external carbon source and it reduces the BOD load to the BOD removal part of the process because BOD is used in the denitrification reactions. However, the pre-anoxic process requires an influent C/N ratio greater than 4, where C/N is taken to be BOD/TKN, and the post-anoxic process can achieve a more complete nitrogen removal. In the present project, post-anoxic de-nitrification process is adopted to address the issues expected during the occurrence of higher values of total nitrogen in the incoming sewage load.

At each operation in reactor, the influent and effluent characteristics are monitored and if possible after de-nitrification the effluent can be directly taken for clarification. Also, there are provisions for bypassing de-nitrification reactor also. However, all these decisions largely depends upon the operational efficiency and continuous monitoring of the parameters in effluent at each stage.

Sewage pump- for pum	ping to MBB	R tank				
Number of pumps	1	SB	1			
Type of pump set	submersible	centrifugal sev	vage transfer-non	clog		
Average flow	1346.58	m <sup>3</sup> /day				
Peak design flow	3029.80	m <sup>3</sup> /day				
Working hours	23					
Flow capacity of each	58.55	m <sup>3</sup> /hour				
Peak factor	1.20					
Discharge	19.52	LPS	0.0195	m <sup>3</sup> /sec		
Head required	12	m				
Efficiency	60%					
Power required	5.20	HP	fix	5.5	HP	
Energy	89.29	kwh				
Moving Bed Bio-React	or (MBBR)-S	ingle Stage				
Average design flow	1346.58	m <sup>3</sup> /day				
Number of streams	1					
BOD of incoming sewage	263.13	mg/l				
TSS of incoming sewage	400	mg/l				
BOD expected after treatment	10	mg/l				

## 4.6.1 PROCESS ANALYSIS AND DESIGN

BOD to be removed	253.13	mg/l				
BOD removal %	96.20	U				
expected						
Number of tanks	1					
proposed		1 / 2/1	4 7 1 4 3 4 1			
BOD loading	4	kg/m³/day	4-7 kg/m³/day as	per M&E		
Actual ROD loading	35/ 33	ka/day				
rate	557.55	Kg/day				
Quantity of BOD to be	340.86	kg/day				
removed per day		C .				
Volume of reactor	88.58	m <sup>3</sup>				
required		. 2.1				
Surface area loading	7.50	g/m²/day				
removal						
Required carrier	47243.57	$m^2$				
surface area						
Specific surface area	600.00	$m^2/m^3$				
of carrier		2				
Required carrier	78.74	m				
Volume of media	40%					
required	1070					
	35.43	m <sup>3</sup>	depth of base	0.9	m	
Volume of tank	124.01	m <sup>3</sup>	slab thickness	0.35	m	
required-BOD						
loading rate/volume						
method	10607	2	22 11			
Volume of tank	196.85	m	offset to wall	0.45	m	
required- SALK						
Volume of each tank	196.85	m <sup>3</sup>	total height	4.10	m	
SWD	3.6	m	wall thickness	0.30	m	
Area of each tank	54.68	m <sup>2</sup>	fix dia	8.4	m	
Diameter of circular	8.34	m	length	7.4	m	
tank			6			
Side of square tank	7.39	m	breadth	7.4	m	
Actual capacity	199.50	m <sup>3</sup>	OK			
provided-circular	107.14	3	OV			
Actual capacity	19/.14	m	UK			
Fix capacity	197.14	m <sup>3</sup>				
Actual volume of	78.86	m <sup>3</sup>				
media obtained						
Actual carrier surface	47313.60	m <sup>2</sup>				
area		2				
Volume of liquid in	165.60	$m^3$				
the tank	2.05	have	177 1	minster		
Time _at _design	2.95	nours	1//.1	minutes		
average flow						
Hydraulic Retention	1.31	hours	78.7	minutes		
Time at peak flow						

SARR for the given SALR	6.94	g/m²/day		area in m	2	79.21
Estimated BOD removal rate	328.24	kg/day				
Actual BOD removal rate %	92.64	BOD of effluent		19.37	mg/l	not ok
Moving Bed Bio-React	or (MBBR)-S	ingle Stage Nit	rification			
Average design flow	1346.58	m <sup>3</sup> /day				
Number of streams	1					
BOD of incoming sewage	20.00	mg/l				
NH <sub>4</sub> -N of incoming sewage	40.00	mg/l				
Alkalinity as CaCO <sub>3</sub>	140.00	mg/l				
Target effluent NH <sub>3</sub> -N	3.30	mg/l	% removal	91.75		
DL level to be maintained in tank	2.00	mg/l				
Design minimum	20.00	°C				
temperature water						
SARR <sub>max</sub>	0.61	SARR temp	coefft. O		1.058	
Minimum NH <sub>3</sub> -N at SARR <sub>max</sub>	0.50		SARR <sub>T</sub>	0.81	g/m²/day	
Design value of SALR	0.88	g/m²/day				
NH <sub>3</sub> -N loading rate	53.86	kg/day				
Required carrier surface area	61113.77	m²/day				
Specific surface area of carrier	600.00	$m^2/m^3$				
Required carrier volume	101.86	m <sup>3</sup> /day	depth of base	0.65	m	
Volume of media required	40%		slab thickness	0.35	m	
Volume of tank required- SALR method	254.64	m <sup>3</sup>	offset to wall	0.45	m	
Volume of each tank	254.64	m <sup>3</sup>	total height	4.10	m	
SWD	3.6	m	wall thickness	0.30	m	
Area of each tank	70.73	m <sup>2</sup>	fix dia	9.5	m	
Diameter of circular tank	9.49	m	length	8.45	m	
Side of square tank	8.41	m	breadth	8.45	m	
Actual capacity provided-circular	255.18	m <sup>3</sup>	OK			
Actual capacity provided-rectangular	257.05	m <sup>2</sup>	ОК			
Fix capacity	257.05	m <sup>3</sup>				
Actual volume of media obtained	102.82	m <sup>3</sup>				
Actual carrier surface area	61692.00	m <sup>2</sup>			area in m <sup>2</sup>	99.00
Volume of liquid in the tank	215.92	m <sup>3</sup>				

Hydraulic Retension	3.85	hours	230.90	minutes		
Time at design	5.05	nours	230.70	minutes		
average flow						
Hydraulic Retension	1.71	hours	102.62	minutes		
Time at peak flow						
BOD SALR	0.44	g/m²/day	should be $< 0.5$	to achieve g	good nitrific	cation
Using the equivalent w	eight of CaC	$D_3$ as 50, the eq	uivalent weight o	f NaHCO3 a	as 84. the al	kalinity
use for nitrification as 7	.14 g CaCO <sub>3</sub> /	g NH <sub>3</sub> -N and th	e target effluent a	lkalinity as	80 mg/L as	CaCO <sub>3</sub> ,
give the calculated alka	linity require	ment as 118.5 1	ng/L as CaCO <sub>3</sub> .	ž	U	
T (1 , 11 1' ',	140.00	/1				
Influent alkalinity	140.00	mg/1				
l arget effluent	80.00	mg/1				
Alkalinity used for	714	$\alpha C \alpha C \Omega_{\rm r} / \alpha N$	H. N			
Nitrification	/.14	g CaCO <sub>3</sub> /g N	113-1N			
Alkalinity to be added	202.04	mg/l				
Rate of _alkalinity	272.06	kg/day				
addition needed as	2,2.00	ng du j				
CaCO <sub>3</sub> ds						
Equiv wt. of CaCO <sub>3</sub>	50.00	g/equivalent				
Equiv wt. of NaHCO <sub>3</sub>	84.00	g/equivalent				
Daily NaHCO	457.06	kg/day				
requirement	137.00	NaHCO <sub>2</sub>				
Moving Bed Bio React	or (MBBR)-p	ost-anoxic den	itrification			
Carbon:Nitrogen ratio	6.58					
(C/N)	0.00					
Average design flow	1347	m <sup>3</sup> /day				
Number of post-	1.00					
anoxic tanks	1.00					
Target effluent NO <sub>3</sub> -N	4.00	mg/l				
concentration		C				
SALR for post-anoxic	2.00	g NO <sub>3</sub> N				
stage		/m²/day				
Estimate of	0.886	mg/l				
SARR/SALR ratio	01.75					
Target % N removal	91.75	21_3				
Specific surface area	600.00	m²/m³				
NO N doily loading	10 12	ka/day				
rate	47.42	kg/uay				
Required <u>carrier</u>	24709 687	m <sup>2</sup>				
surface area	21,09.007					
Required carrier	41.18	m <sup>3</sup>				
volume						
Volume of media	40%		depth of base	0.65	m	
required						
Volume of tank	102.96	$m^3$	slab thickness	0.35	m	
required- SALR						
method	102.0		- ff + + 11	0.45		
volume of each tank	103.0	m	offset to wall	0.45	m	
SWD	3.6	m	total height	4.10	m	
Area of each tank	28.60	m <sup>2</sup>	wall thickness	0.30	m	
Diameter of circular	6.03	m	fix	6.1	m	

Side of square tank	5.35	m	length	5.4	m	
Actual capacity	105.21	m <sup>3</sup>	breadth	5.4	m	
provided-circular	100.21					
Actual capacity	104.98	m <sup>3</sup>	OK			
provided-rectangular		2				
Fix capacity	104.98	m <sup>3</sup>	OK			
Actual volume of	41.99	m <sup>3</sup>				
media obtained	25105 20	2				
Actual carrier surface	25195.20	m-				
Volume of liquid in	88.18	m <sup>3</sup>				
the tank	00110					
Hydraulic Retension	1.57	hours	94.30	hours		
Time at design						
average flow	0.70	houng	41.01	hours		
Time at peak flow	0.70	nours	41.91	nours		
SARR	1.77	g/m²/day				
Estimated NO <sub>2</sub> -N	44.65	kg/dav				
removal rate		ng auj				
NO <sub>3</sub> -N of effluent	3.54	mg/l				
Alkalinity produced	3.57	g CaCO <sub>3</sub> /g N	O <sub>3</sub> -N removed			
by denitrification						
Actual alkalinity to be added	83.66	mg/l				
Rate of alkalinity	112.65	kg/day				
addition needed as						
CaCO <sub>3</sub>		, . <b>.</b> .				
Equiv wt. of CaCO <sub>3</sub>	50.00	g/equivalent				
Equiv wt. of NaHCO <sub>3</sub>	84.00	g/equivalent				
Daily NaHCO <sub>3</sub> requirement	189.26	kg/day NaHCO3				
4.6 lb COD/lb NO <sub>3</sub> -N r	emoved and 1	.5 lb COD/lb I	Methanol. The req	uired meth	anol dosage	e is then
calculated as: $4.6/1.5 =$	3.1 lb methan	101 /lb NO <sub>3</sub> -N 1	emoved. The met	hanol requi	irement in l	b/day is
then equal to 3.1 times	the previously	calculated NC	O <sub>3</sub> -N removal rate			
in kø/dav	155.20	kg/uay				
Considering toxicity, ec	conomy and sc	ifety considera	tions it is better to	adopt retr	un activated	l sludge
feed into anoxic tank fo	r carbon sour	ce. Alkaline fei	rmentation can be	adopted fo	r better res	ults.
Design of mechanical n	nixer for denit	rification tank				
Capacity of de-						
nitrification tnk	10/ 08	m <sup>3</sup>				
Hydraulic Retension	104.90	111				
Time	1.57	hours				
Mixing rate	0.5	m <sup>3</sup> /hour				
Capacity of mixer	133.59	m <sup>3</sup> /hour				
Power transferred in						
mixing	5	Watts/m <sup>3</sup>				
Power required for	0.00	UD	<b>C</b>	1	UD	
mixer	0.90	HP	11X	1	нг	
Energy Moving Red Bio Reast	1/.10	KWN	nitrification			
Average design flow	13/6-59	m <sup>3</sup> /day				
Average design now	1340.38	m /uay				

Number of streams	1					
BOD of incoming	86.83	mg/l				
sewage (including	00.05	1116/1				
return activated						
sludge as carbon						
source)						
TSS of incoming	50	mg/l				
sewage		C				
BOD expected after	7	mg/l				
treatment		-				
BOD to be removed	79.83	mg/l				
BOD removal %	91.94					
expected						
Number of tanks	1					
proposed						
BOD loading	4	kg/m³/day	$4-7 \text{ kg/m}^3/\text{day} \text{ as}$	per M&E		
rate/volume						
Actual BOD loading	116.93	kg/day				
rate						
Quantity of BOD to be	107.50	kg/day				
removed per day	20.22	3				
Volume of reactor	29.23	m <sup>2</sup>				
required	15.00	~/~~?/.1				
Surface area loading	15.00	g/m²/day				
rate (SALK) for BOD						
Pequired corrier	7705 10	m <sup>2</sup>				
surface area	//95.19	111				
Surface area	600.00	$m^{2}/m^{3}$				
of carrier	000.00	111 / 111				
Required carrier	12.99	m <sup>3</sup>				
volume	12.77					
Volume of media	35%					
required						
	10.23	m <sup>3</sup>	depth of base	0.45	m	
Volume of tank	39.46	m <sup>3</sup>	slab thickness	0.35	m	
required-BOD						
loading rate/volume						
method						
Volume of tank	37.12	m <sup>3</sup>	offset to wall	0.45	m	
required- SALR						
method	•••	2				
Volume of each tank	39.46	m	total height	4.10	m	
SWD	3.6	m	wall thickness	0.30	m	
Area of each tank	10.96	$m^2$	fix dia	3.75	m	
Diameter of circular	3.74	m	length	3.35	m	
tank						
Side of square tank	3.31	m	breadth	3.35	m	
Actual capacity	39.76	m <sup>3</sup>	OK			
provided-circular						
Actual capacity	40.40	m <sup>3</sup>	OK			
provided-rectangular						
Fix capacity	40.40	m <sup>3</sup>				
Actual volume of	14.14	m <sup>3</sup>				
media obtained						

Actual carrier surface area	8484.00	m <sup>2</sup>				
Volume of liquid in the tank	34.74	m <sup>3</sup>				
Hydraulic Retension Time at design average flow	0.62	hours	37.2	minutes		
Hydraulic Retension Time at peak flow	0.28	hours	16.5	minutes		
SARR for the given SALR	13.13	g/m²/day		area in m	2	23.52
Estimated BOD removal rate	111.35	kg/day				
Actual BOD removal rate %	95.23	BOD of effluent		4.14	mg/l	ok

41.16	kg/day				
2 96					
5.80	kg/day				
.50	kg of O <sub>2</sub> /kg of BOD				
1.57	kg of O <sub>2</sub> /kg of NH <sub>3</sub> -N				
561.74	kg/day				
246.15	kg/day				
21.00					
3151.14	kg/day				
172.16	kg/day				
.225	kg/m <sup>3</sup>				
2572.36	m <sup>3</sup> /day				
956.87	m <sup>3</sup> /day				
0.075					
34298.17	m <sup>3</sup> /day				
2758.24	m <sup>3</sup> /day				
.20	2 #				
714.91	m <sup>3</sup> /hour				
537.91	m <sup>3</sup> /hour				
350.00	m <sup>3</sup>				
).016	m <sup>3</sup> /sec				
.25	m <sup>3</sup> /m <sup>3</sup> /hour				
3.00	m <sup>3</sup> /m <sup>3</sup> /hour				
350.00	m <sup>3</sup>				
137 50	m <sup>3</sup> /hour				
	.57 61.74 46.15 1.00 151.14 172.16 .225 572.36 56.87 .075 4298.17 2758.24 .20 714.91 37.91 50.00 .016 .25 .00 50.00	.57       kg of O <sub>2</sub> /kg of NH <sub>3</sub> -N         61.74       kg/day         46.15       kg/day         1.00	.57       kg of $O_2/kg$ of $NH_3$ -N         61.74       kg/day         46.15       kg/day         1.00	.57       kg of O <sub>2</sub> /kg of NH <sub>3</sub> -N         61.74       kg/day         46.15       kg/day         1.00       Image: state sta	.57       kg of O <sub>2</sub> /kg of NH <sub>3</sub> -N       Image: constraint of the symbol of th

	10.50	3			
Volume of air required for SI	10.50	m			
Total air required	2800.82	m <sup>3</sup> /hour			
Capacity of blower	2801.00	m <sup>3</sup> /hour			
Number of blowers working	2.00	SB	1		
Air required per blower	1400.50	m <sup>3</sup> /hour			
Pressure given	0.60	kg/cm <sup>2</sup>	5.89	m	
Volumetric efficiency	60%				
Power required for blower	51.24	HP	38.23	kw	
motor					
Fix power of blower motor	52.00	HP			
Energy	1862.02	kwh			

## **4.7 DESIGN OF CLARIFIER**

In the following sections, flocculation and clarification processes are described for the effluent from MBBR tanks. To achieve high degree of clarification, up flow hopper bottom type clarifier is used. The upper portion of the clarifier consists of the rectangular vessel in which tube settlers/plate settlers are installed for particle removal. Alum and Lime dosing is used for formation of aggregates or flocs from finely divided particles and from chemically destabilised particles. The settling of discrete, non-flocculating particles can be analysed by means of the classic laws of sedimentation formed by Newton and Stokes. The clarified is designed based on the various aspects of theory of sedimentation.

## **4.7.1 UNIT OPERATIONS**

Alum solution tank				
number of units	1			
dosage of alum	50	ppm		
requirement for 8 hours	22.440	kg		
volume of solution at 10%	0.2	m <sup>3</sup>		
strength/unit				
length of tank	0.6	m		
breadth of tank	0.6	m		
liquid depth	0.56	m		
total depth	1	m		
solution flow rate	0.0250	m <sup>3</sup> /hour		
Lime solution tank				
number of units	1			
dosage of lime	35	ppm		
requirement for 8 hours	15.71	kg		
volume of solution at 10%	0.14	m3		
strength/unit				
length of tank	0.6	m		
breadth of tank	0.6	m		
liquid depth	0.39	m		
total depth	1	m		
solution flow rate	0.01750	m <sup>3</sup> /hour		
Secondary Clarifier with Plate/Tub	e Settler			

Average output required from	1.347	56.11	m <sup>3</sup> /hour	15.59	LPS			
Number of batteries	1							
Average design flow as input in	1.35	56.11	m <sup>3</sup> /hour	15.59	LPS			
MLD/unit								
Width of plates in mm	900	space betw	een plates	20	mm	23.10		
Length of plates adopted in m	0.75							
Angle of inclination of tubes	60	1.05	rad					
adopted in deg.	27 5			0.3	122			
(dimensionless) $Lr = L/d$	57.5	wall thickn	ess	0.5	111			
Relative length is changed by L' =		wun unonn		0.35	m			
0.058 x [Vo x d/v]		column siz	e					
Where Vo is velocity of flow				0.6	m			
along tube settler		offset to wa	all	0.75				
v is kinematic viscosity of water		depth of ra	ft	0.75	m			
Effective relative length of tube L		deptil 01 1a		0.35	m			
= Lr- [0.058 x Vo x d/v]		slab thickn	ess					
Kinematic viscosity of water in	0.087264			0.6	m			
m/day	27.5	r-beam dep	th	17				
Effective relative length of	37.5	(-)	0.013	Vo				
	34 50							
desirable value of relative length	around 20 hut	below 40						
for one unit:		freeboard		0.5	m			
Vertical water height in chamber	2.4		t-beam	0.425	m			
in m			width					
Height of chamber in hopper	2.4		t-beam	0.45	m			
portion in m	1.0		depth	0.405				
Side of large square in m	4.2		r-beam	0.425	m			
Side of small square in m	1.5		inlet pipe	0.2	m			
	110		dia	0.2				
h <sub>3</sub> in m (height of the truncated	1.33							
cone)	<u></u>	00.05		60.60				
Angle of inclination of hopper	0.512	29.37	degree	60.63	deg. w	ith hor.		
Larger inclined length L: of	4 28	area in m <sup>2</sup>	9.00					
slanting slab in m			2.00					
Smaller inclined length li of	1.53	area in m <sup>2</sup>	1.15					
slanting slab in m								
Contact area in m <sup>2</sup>	31.39							
SOR in $m^3/m^2/day$ for upflow	42.90	<	50					
	(2.08	1		3	20.74			
That volume in m <sup>o</sup> of one unit	03.08	volume of .	nopper in m	·	20.74			
Detention time in hours	1.12	in square	0.75	111 honror	0.37	hours		
Fix volume	63.08	m <sup>3</sup>		nopper				
Performance paremater of tube set	$\log S = V_c/V_c$	$\lim_{n \to \infty} A + L x$	20sA1					
Performance parameter of tube settler $S = V s / V o x [sin \theta + L x cos \theta]$								
For laminar flow regime, critical pe	erformance para	meter value	for complete	e removal	of parti	cle,		
Critical value of performance	1.333	circular						
parameter, Sc =								
	54	Ļ						

	1.375	square				
	1	parallel pla	tes			
	_	r r				
Particle size in mm	0.025					
Settling velocity of particle in	0.0006	m/sec	48.08	m/d		
m/sec, V <sub>s</sub> (laminar)						
Reynolds number, Nr	0.014					
Trial value of flow along plate settler $V_o$ in m/day	226					
Shape of cross section of tubes	plates	(Square, cir	rcular, or pla	ites)		
Critical of performance parameter obtained, Sc	[(Vs/Vo) x (sin	$n\theta + L\cos\theta$ )				
	3.86					
Plate entrance area/one unit	5.71	$m^2$				
Number of modules of plates	2					
Number of plates required/module	158.61					
Fix number of plates required/module	158					
Length/module of tray holding plates	3900	mm				
Thickness of plate	1.5	mm				
Number of plates configured in one module	159.53	OK				
Height of plate module for 1m length of tubes inclined:	0.87					
Hence height of tube module	0.65	m				
Fix length of plate module	0.75	m				
Fix height of plate module	0.65	m				
Fix number of plates required per module	158					
Angle of inclination	60	degree to h	orizontal			
Contact area	213.3	m <sup>2</sup>		area in	m <sup>2</sup>	36.00
SOR in m <sup>3</sup> /m <sup>2</sup> /day for plate settler	6.05	<	40			
Total plate entrance area	5.69	m <sup>2</sup>				
Actual velocity of flow in m/day	226.88	now correc	t velocity			

#### 4.8 DESIGN OF FILTER FEED, CHLORINE CONTACT UNITS AND PRESSURE FILTERS

Pressure filters are used for treatment of the clarified water in the next stage. Pressure Sand Filter is used for removal of suspended solids and turbidity from the effluent from clarifier. Clarified water is passed through the pressure sand filter, the filter media (Fine quartz sand) is supported on gravel and pebbles bed of progressively larger sizes. During the filtration cycle, the filter bed retains the dirt and suspended particles from the water and accumulates within the filter bed. Clear water can be collected from the outlet of filter. Frequent backwashing of the media is also required.

Activated carbon filter process basically absorbs unwanted contaminants from wastewater. Activated carbon is initially treated with oxygen. This helps the charcoal open millions of tiny pores. Activated carbon is highly effective when it comes to absorption of contaminants from water. Filtration process includes activated carbon to remove the residual contaminants from sewage. Carbon absorbs

micropollutants such as chlorine, methane, organic compounds, and even the taste and odour from water. Activated carbon filter removes chlorine from wastewater. It has a large surface area which makes it highly effective to absorb contaminants from wastewater. Chlorine removal process fills the wide pores of the carbon. Hence, impurities are removed. Activated carbon needs replacement as its capacity to work reduces gradually. This process involves a low operating cost. Carbon in the activated carbon filter process also absorbs organic compounds. The capacity of this process will depend on the physical properties of the surface area of the activated carbon, the amount of hydrogen and oxygen contains, the concentration level of the impurities, duration of the treatment, and of course the pH level of the water used.

Chlorination is used for disinfection of the clarified water which is collected in a filter feed tank. Using filter feed pump sets, the effluent is fed to the pressure sand and activated carbon filter units.

Chlorine contact tank						
HRT	30	minutes	offset to wall	0.3	m	
Average flow	56.11	m <sup>3</sup> /hour	wall thickness	0.3	m	
Volume of tank	28.05	m <sup>3</sup>	slab thickness	0.35	m	
Assumed liquid depth	2	m	freeboard	0.35	m	
Area of the tank	14.03	m <sup>2</sup>		area in	m <sup>2</sup>	24.50
side of square tank	3.75	m	fix	3.75	m	
Filter feed tank						
HRT	20	minutes	offset to wall	0.3	m	
Average flow	56.11	m <sup>3</sup> /hour	wall thickness	0.25	m	
Volume of tank	18.70	m <sup>3</sup>	slab thickness	0.3	m	
Assumed liquid depth	2	m	freeboard	0.35	m	
Area of the tank	9.35	m <sup>2</sup>				
side of square tank	3.06	m	fix	3.1	m	
			fix breadth	3.1	m	
Volume provided	19.22	OK		area in	m <sup>2</sup>	17.64
Pressure Sand Filter						
Pressure Sand Filter Average flow	1346.58	m <sup>3</sup> /day				
Pressure Sand Filter Average flow Filter operating hours	1346.58 20	m <sup>3</sup> /day hours				
Pressure Sand Filter         Average flow         Filter operating hours         Operating flow	1346.58 20 67.33	m <sup>3</sup> /day hours m <sup>3</sup> /hour				
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading Rate	1346.58 20 67.33 12	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour				
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading RateArea of the filter required	1346.58 20 67.33 12 5.61	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour m <sup>2</sup>				
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading RateArea of the filter requiredNumber of filters	1346.58 20 67.33 12 5.61 1	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour m <sup>2</sup>				
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading RateArea of the filter requiredNumber of filtersArea of each filter	1346.58 20 67.33 12 5.61 1 5.61	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour m <sup>2</sup> sqm				
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading RateArea of the filter requiredNumber of filtersArea of each filterDiameter of filter required	1346.58 20 67.33 12 5.61 1 5.61 2.67	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour m <sup>2</sup> sqm m	fix	2.7	m	
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading RateArea of the filter requiredNumber of filtersArea of each filterDiameter of filter requiredHeight of the filter	1346.58 20 67.33 12 5.61 1 5.61 2.67 2.5	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour m <sup>2</sup> sqm m m	fix offset to wall	2.7 0.5	m m	
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading RateArea of the filter requiredNumber of filtersArea of each filterDiameter of filter requiredHeight of the filterOperating pressure	1346.58 20 67.33 12 5.61 1 5.61 2.67 2.5 3.5	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour m <sup>2</sup> sqm m m Bar	fix offset to wall	2.7 0.5	m m	
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading RateArea of the filter requiredNumber of filtersArea of each filterDiameter of filter requiredHeight of the filterOperating pressureFilter media	1346.58 20 67.33 12 5.61 1 5.61 2.67 2.5 3.5 Sand	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour m <sup>2</sup> sqm m m Bar	fix offset to wall	2.7 0.5 area in	m m m <sup>2</sup>	13.7
Pressure Sand FilterAverage flowFilter operating hoursOperating flowFilter Loading RateArea of the filter requiredNumber of filtersArea of each filterDiameter of filter requiredHeight of the filterOperating pressureFilter mediaActivated Carbon Filter	1346.58 20 67.33 12 5.61 1 5.61 2.67 2.5 3.5 Sand	m <sup>3</sup> /day hours m <sup>3</sup> /hour m <sup>3</sup> /m <sup>2</sup> /hour m <sup>2</sup> sqm m Bar	fix offset to wall	2.7 0.5 area in	m m m <sup>2</sup>	13.7

### 4.8.1 UNIT OPERATIONS AND STRUCTURAL DESIGN

Filter operating hours	20	hours				
Operating flow	67.33	m <sup>3</sup> /hour				
Filter Loading Rate	10	m <sup>3</sup> /m <sup>2</sup> /hour				
Area of the filter required	6.73	m <sup>2</sup>				
Number of filters	1					
Area of each filter	6.73	sqm				
Diameter of filter required	2.93	m	fix	3	m	
Height of the filter	2.5	m	offset to wall	0.5	m	
Operating pressure	3.5	Bar				
Filter media	Activated C	Carbon		area in	m <sup>2</sup>	16.00
Pump for clarified water to P	SF and ACF					
Type of pump set	CF					
Number of pumps	1.00	W	1	SB	1	
Discharge of clarified water	56.11	m <sup>3</sup> /hour				
required						
Working hours of pumps	20.00	hours				
Discharge required	67.33	m <sup>3</sup> /hour	1.9E-02	m <sup>3</sup> /sec		
Head required	35.00	m				
Efficiency	50%					
Power required	17.46	fix	17.50	HP		
Energy	260.44	kwh				
Treated Water Tank						
HRT	60	minutes	offset to wall	0.3	m	
Average flow	56.11	m <sup>3</sup> /hour	wall thickness	0.25	m	
Volume of the tank	56.1	m <sup>3</sup>	slab thickness	0.3	m	
Assumed liquid depth	2.5	m	freeboard	0.35	m	
Area of the tank	22.44	m <sup>2</sup>				
Number of tanks	1		fix length	4.75	m	
Area of one tank	22.44	$m^2$	fix breadth	4.75	m	
Side of square tank	4.74	m				
Volume provided	56.41	m <sup>3</sup>	OK			
Total area of units	332.98	m <sup>2</sup>		area in	m <sup>2</sup>	34.22
Movement space factor	1.5					
Total area required	741.75	m <sup>2</sup>				

STRUCTURAL DESIGN OF PRESSURE SAND FILTER							
Rate of filtration in normal working condition	[6000 to 15000	litres/hour/m <sup>2</sup> ]					
Rate of filtration adopted for design	12000	litres/hour/m <sup>2</sup>					
	12	m <sup>3</sup>	[safer side]	]			
Ultimate demand in MLD	1.35						
Hours of pumping adopted	20						
Actual ultimate discharge in MLD	1.62						
Allowance for wastage in %	1						
Design discharge adopted in MLD	1.632						
Area required in m <sup>2</sup>	5.67						

Required diameter in m	2.69	[range is 0.30 to 2.75 m]		
Fix diameter in m	2.7	2700	mm	
Maximum pressure in $k\sigma/cm^2$	4	0.408	Mna	
Factored stress in Mna	0.82	0.100	mpu	
Safe stress in steel in $ka/cm^2$	0.02			
	165	[mild steel]		minimum
Safa strass for MS adopted in design in	110.55	[iiiid steel]		mmmum
Mna	110.55			
Required thickness for the cylindrical shell in mm	pd/2µ			
	9.96	fix	12	mm
Required thickness for hemispherical part in mm	pd/4µ			
<u> </u>	4.98	fix	12	mm
For the condition of no distortion at the junction, $pd/4tc \ge [2-(1/m)] = pd/4ts \ge [1-(1/m)]$				
ts/tc = 0.43 for $1/m = 0.25$				
Then, thickness of spherical shell required in mm			5.16	ok
For the condition of same maximum stre	ess in cylindrical	and hemispheri	cal parts, pd	1/2tc = pd/4tc,
ts/tc = 0.5	1		-	-
Then, thickness of spherical shell			6	ok
required in mm			15 9715	alr
1100p sitess in cynnerical parts in Mpa			4 <i>3.</i> 871 <i>3</i> 6	UK
Hoop stress in spherical parts in Mpa			22.9357 8	ok
Hoop stress in spherical parts in Mpa if same thickness throughout			22.94	ok
If top and bottom portions are not sph	erical, then provi	ide parabolic do	ome of MS	with same
thickness of cylindrical portion	-			
Rise of the dome in mm			675	
Then, meridional stress in Mpa			32.81	ok
STRUCTURAL DESIGN OF ACTIVAT	TED CARBON F	ILTER		
Rate of filtration in normal working	[6000 to			
condition	15000			
	litres/hour/m <sup>2</sup>			
	10000	1:4		
Rate of illitation adopted for design	10000	11tres/hour/m		
	10	m <sup>3</sup>	[safer side]	]
Ultimate demand in MLD	1.346577			
Hours of pumping adopted	20			
Actual ultimate discharge in MLD	1.615892			
Allowance for wastage in %	1			
Design discharge adopted in MLD	1.632			
Area required in m <sup>2</sup>	6.80			
Required diameter in m	2.94	[range is 0.30 to 2.75 m]		
Fix diameter in m	3	3000	mm	
Maximum pressure in kg/cm^2	4	0.408	Mpa	
Hamman prossure in Kg/on 2	•	0.100	11pu	

	0.00			
Factored stress in Mpa	0.82			
Safe stress in steel in kg/cm <sup>2</sup>				
	165	[mild steel]		minimum
Safe stress for MS adopted in design in Mpa	110.55			
Required thickness for the cylindrical shell in mm	pd/2µ			
	11.07	fix	12	mm
Required thickness for hemispherical part in mm	pd/4µ			
	5.53	fix	12	mm
For the condition of no distortion at the junction, pd/4tc E [2-(1/m)] = pd/4ts E [1-(1/m)]				
ts/tc = 0.43 for $1/m = 0.25$				
Then, thickness of spherical shell required in mm			5.16	ok
For the condition of same maximum stretts/tc = $0.5$	ess in cylindrical	and hemispheric	cal parts, po	1/2tc = pd/4tc,
Then, thickness of spherical shell required in mm			6	ok
Hoop stress in cylindrical parts in Mpa			50.9684	ok
Hoop stress in spherical parts in Mpa			25.4842	ok
Hoop stress in spherical parts in Mpa if same thickness throughout			25.48	ok
If top and bottom portions are not sphe thickness of cylindrical portion	erical, then provi	ide parabolic do	ome of MS	with same
Rise of the dome in mm			750	
Then, meridional stress in Mpa			32.81	ok

## 4.9 SLUDGE DISPOSAL PLAN

Sludge is generated in primary, secondary and advanced wastewater treatment processes. Primary sludge consists of settleable solids carried in the raw wastewater. Secondary sludge consists of biological solids as well as additional settleable solids. In the treatment system, facility for thickening and dewatering of sludge is provided even though it is not essential for small STPs. This is to stabilize the sludge and generate an efficient sludge disposal mechanism. thickening is a procedure used to increase the solids content of sludge by removing a portion of the liquid fraction. Thickening is generally accomplished by physical means like gravity settling and it is adopted in the present system. Whereas centrifuges are used to thicken and dewater sludges. Thickening by centrifugation involves the settling of sludge particles under the influence of centrifugal forces. The design of various components of sludge handling units are illustrates as follows:

Sludge Sump				
Average flow	1346.58	m <sup>3</sup> /day		
TSS	400	mg/l		
BOD	263.13	mg/l		
Assumed TSS Sludge	30%			
Assumed BOD Sludge	35%			

Sludge generated-TSS	161.6	kg/day				
Sludge generated-BOD	124.0	kg/day				
Total sludge	285.60	kg/day				
% sludge with 1.02	10%					
specific gravity						
Sludge volume per day	28.00	m <sup>3</sup> /day				
	1.17	m <sup>3</sup> /hour				
Assumed HRT	3	hours	freeboard	0.5	m	
Volume of tank	3.50	m <sup>3</sup>	slab thickness	0.3	m	
Assumed SWD	1.5	m	offset to wall	0.3	m	
Area of the tank	2.33	m <sup>2</sup>	wall thickness	0.3	m	
Diameter of circular tank	1.72	m	fix	1.75	m	
Actual capacity provided	3.61	m <sup>3</sup>		area in 1	m <sup>2</sup>	2.95
Pump for Sludge transfer to	o Thickener					
Number of pumps	1.00	W	1	SB		
Specific gravity of liquid	1.03					
Type of pump set	submersible centrifu	gal sewage tr	ansfer-non clog			
Working hours	5.00	hours				
Discharge required	5.60	m <sup>3</sup> /hour	0.001556	m <sup>3</sup> /sec		
Required head	15.00	m				
Velocity in sludge	0.70	m/sec				
transfer pipe adopted			~			
Pipe diameter required	53.19	mm	fix	100	m m	
Efficiency	50%					
Power required	0.62	HP	fix	1.00	HP	
Energy	2.32	kwh				
Sludge Thickener						
Number of units	1					
Total sludge	285.60	kg/day				
Solids Loading Rate	40	kg/m²/day				
Thickening area required	7.14	$m^2$				
Surface Loading Rate	12	m <sup>3</sup> /m <sup>2</sup> /da y				
Thickening area required	2.33	m <sup>2</sup>	freeboard	0.5	m	
Maximum area	7.14	m <sup>2</sup>	slab thickness	0.35	m	
Area of distribution chamber	20%		offset to wall	0.35	m	
Total area required	8.57	m <sup>2</sup>	wall thickness	0.3	m	
Diameter of circular tank	3.30	m	fix	3.3	m	
Thickening area available	8.55	m <sup>2</sup>				
SWD	2	m				
Actual volume provided	17.11	m <sup>3</sup>				
Thickened sludge consistency	3%	of total slud	lge volume			
Thickened sludge volume	8.57	m <sup>3</sup> /day	area in m <sup>2</sup>			4.60
Pump for Sludge transfer to	o Centrifuge					

Type of pump set	Screw pump				
Number of pumps	1.00	W	1	SB	
Volume of thickened sludge to be pumped	8.57	m <sup>3</sup> /day			
Working hours of centrifuge	5.00	hours			
Discharge required	1.71	m <sup>3</sup> /hour	4.8E-04	m <sup>3</sup> /sec	
Head required	15.00	m			
Efficiency	50%				
Power required	0.190	fix	0.50	HP	
Energy	0.710	kwh			
Sludge Centrifuge and Dos	ing Tanks				
Number of centrifuges	1	SB	1		
Capacity of centrifuge	0.25	m <sup>3</sup> /hour			
Poly electrolyte dozing for centrifuge & thickener	10%				
Sludge volume	285.60	kg/day			
Dose	2	kg/1000 kg			
Quantity of Poly Electrolyte	0.57	kg/day			
Concentration	0.1				
Volume of tanks @ 24 hour	0.57	m <sup>3</sup>			
	571.21	litres			
Volume	23.80	litres/hour			
Volume required for 8 hours	0.19	m <sup>3</sup>			
Liquid depth of tank	1	m			
Area required	0.19	m <sup>2</sup>			
side of square tank	0.44	m	fix	0.5	

#### 4.10 PRELIMINARY STRUCTURAL DESIGN OF COMPONENTS

For the various units of the STP, structural analysis and design have been performed in accordance with the stipulations of all relevant Indian Standard Codes of practice. For the reinforced concrete elements, special attention has been given to arrive at the preliminary dimensions to satisfy norms and conditions for the water retaining structures. For the metallic structures like pressure filter units, similar approach has been adopted. Since the units are constantly in contact with aggressive environment like sewage, non-corrosive coating for reinforcing steel and water proofing application for the inner side of reinforced concrete structures are recommended. These provisions are already given in the detailed estimates. During the execution stage, a detailed structural analysis of the components can be performed. However, the dimensions are expected to fall within the limits of the values obtained from the preliminary analysis. In the case of foundations, simple raft and beam-slab type raft is adopted for safety considerations. Since the soil nature is observed to be satisfactory to withstand medium loading conditions, deep foundations are not suggested. Soil analysis reports available for the locality has been examined to arrive at a decision. However, during the execution stage, detailed soil investigations can

be performed. Cover for the reinforced concrete elements is to be given in accordance with the exposure conditions given in the IS 456 Code of practice. Even though, most of the components are designed as reinforced concrete, innovative materials with high strength to weight ratio like Fibre Reinforce Polymers (FRPs) can also be tried after performing detailed structural analysis.

Manholes and pipelines are to be checked for external traffic loads pertaining to the characteristics of each road and soil conditions. Since the accurate data of this will be obtained during the execution stage of the project, the detailed structural analysis of the pipelines and manholes will be required to be performed later and the changes are to be incorporated accordingly.

## 4.11 SITE PROPOSED FOR COLLECTION WELLS AND STP

The tentative sites proposed for the collection wells and sewage treatment plant is given as follows:

SI. No.	Type of structure	Location	Coordinates as per GPS	Extent of land
1	Collection well – 1	Near Kummayachira	10.66490908 Lat, 76.24553288 Long	0.014 Hectare
2	Collection well – 2	Near Kummayachira	10.66512067 Lat, 76.24575758 Long	0.014 Hectare
3	STP	Near ground at EK Nayanar road	10.66530753 Lat, 76.2439404 Long	0.1618 Hectare

#### Table 13 Site proposed for collection wells and STP

The soil conditions are observed to be medium to hard soil and at some locations in lateritic nature. However, during execution of the project detailed soil investigations are to be performed. Any changes are the site locations must be incorporated in the hydraulic models and analysed for successful routing subsequently.

## 4.12 DIMENSIONS AND MATERIAL OF CONSTRUCTION OF STP UNITS

The details of functional sizing and materials of construction of Sewage Treatment Plant (STP) units are illustrated below:

SIZI	NG OF STP UNITS					
Sl.	COMPONENT	SIZING	(m)		Nos.	TYPE OF
No.						CONSTRUCTION
	CIVIL CONSTRUCTION UNIT	ſS				
		L	В	Н		
1	Receiving Chamber-STP	2.5	1.5	2.95	1	RCC
2	Receiving Chamber-CTU	1	0.5	1.85	1	RCC
3	Oil and Grease Trap-STP	2.8	1.5	3.25	1	RCC
4	Oil and Grease Trap-CTU	1.5	0.75	2.25	1	RCC
5	Manual Coarse Screen Channel-STP	2.2	0.75	1.2	1	RCC

6	Manual Coarse Screen Channel-CTU	2.5	0.6	1.5	1	RCC
7	Manual Fine Screen Channel- STP	2.5	0.75	1.5	1	RCC
8	Grit Separator	2.5	2	3.30	1	RCC
9	Equalisation Tank	10	10	4.10	1	RCC
10	Moving Bed Biofilm Reactor-1	7.4	7.4	4.10	1	RCC
11	Moving Bed Biofilm Reactor-2	8.45	8.45	4.10	1	RCC
12	Moving Bed Biofilm Reactor-3	5.4	5.4	4.10	1	RCC
13	Moving Bed Biofilm Reactor-4	3.35	3.35	4.10	1	RCC
14	Clarifier with Plate Settler	4.2	4.2	4.8	1	RCC
15	Filter feed tank	3.1	3.1	2.35	1	RCC
16	Sludge Sump	Dia	1.75	3.1	1	RCC
17	Sludge Thickener	Dia	3.3	2.5	1	RCC
18	Chlorine Contact Tank	3.75	3.75	2.35	1	RCC
19	Treated Water Tank	4.75	4.75	2.85	1	RCC
20	Pump house (fabricated)	1.5	1.5	4	1	Steel Truss and Bricks (common)
21	Sludge Yard	2	2		1	Steel Truss and Bricks (common)
22	Centrifuge Shed	1	1		1	Steel Truss and Bricks (common)
23	Control Room				1	Steel Truss and Bricks (common)
24	Generator Basement	1.5	1		1	RCC
25	Alum solution tank	0.6	0.6	1	2	FRP/HDPE
26	Lime solution tank	0.6	0.6	1	2	FRP/HDPE
27	Hypo dosing tank	0.6	0.6	1	2	FRP/HDPE
28	Control Room					Common Space
29	Office					Common Space
SIZI	NG OF STP UNITS					
Sl.	COMPONENT	Details			Nos.	TYPE OF
No.						CONSTRUCTION
	ELECTRO-MECHANICAL UN	ITS				
1	Sewage transfer pump to MBBR	7.5	HP		2	Submersible Centrifugal
2	Manual Coarse Screen-STP	20	mm	openin g	1	SS 304
3	Manual Coarse Screen-CTU	20	mm	openin g	1	SS 304
4	Manual Fine Screen-STP	6	mm	openin g	1	SS 304
5	Air Grid and Diffused aeration system for ET, MBBR Tanks and Sludge Tank			As per de	esign	PVC
6	MBBR carrier			As per de	esign	PVC/HDPE
7	Air Blowers	2800.8 2	m <sup>3</sup> /hou	r	2	Positive displacement
8	Plate Settlers			As per de	esign	PVC
9	Sludge transfer pump to thickener	1.00	HP		2	Submersible Centrifugal
10	Sludge transfer pump to centrifuge	0.50	HP		2	Screw type pump

11	Sludge Centrifuge	0.25	m <sup>3</sup> /hour		2	
12	Pump for clarified water to PSF and ACF	17.50	HP		2.00	Submersible Centrifugal
13	Pressure Sand Filter (Dual media)	Dia	2.7	m	1	MS with all specials
14	Activated Carbon Filter	Dia	3	m	1	MS with all specials
15	Jetting/Cleaning machine				1	High pressure pump
16	Generator				1	Diesel type automatic switch over
17	Chlorinator					Electro type of similar
18	IoT based sensors					Discharge, BOD, DO, TSS, ph sensors

Table 14 Dimensions and material of construction of sewage treatment system
#### **CHAPTER 5**

#### **DETAILED ESTIMATES**

### 5.1 GENERAL

The detailed estimate for the STP components is prepared in accordance with the Delhi Schedule of Rates (DSR) 2018 provisions after applying District Cost Index. For certain items, market rates are adopted. For simplicity and rapid work plan, the dimensions of the design of unit operations, chemical and biological process and structural dimensions of components are given as the input values for the data spread sheet of detailed estimate.

### **5.2 DETAILED ESTIMATE OF COMPONENTS**

The detailed estimates have been divided into four sections: a] civil construction b] mechanical works c] electrical and instrumentation works d] operation and maintenance. In following sections, the detailed estimates are illustrated.

#### **5.3 RECEIVING CHAMBER**

RECE	RECEIVING CHAMBER											
Item No.	Item Code	Description	No	L	В	Η	V	Unit	Rate	Amount		
1	2.6.1	Earth work in over areas (ex including getti m, as directed	excava ceedin ng out by Eng	ation by g 30 cr and dis gineer-in	/ mecha m in de posal o n-charge	nical m pth, 1.3 f excava	neans (Hy 5 m in w ated earth	draulic idth as lead up	excavator)/max well as 10 squ to 50 m and li	nual means m on plan) ft up to 1.5		
		For receiving chamber- STP	1	3.6	2.6	3.4	31.82	m <sup>3</sup>				
		For receiving chamber- CTU	1	1.55	1.6	2.15	5.33	m <sup>3</sup>				
		Total					37.15	m <sup>3</sup>				
		Say		37.1 5	m <sup>3</sup>		@	Rs	213.85	7944.9		
		GST component						Rs	38.96	1447.69		
2	4.1.6	Providing and of centering an sand (zone-III)	laying nd shut : 6 gra	in posi ttering - ded stor	tion cer - All wo ne aggro	nent con ork up t egate 40	ncrete of s to plinth l ) mm nom	specified evel : 1: ninal size	l grade excludi :3:6 (1 Cement e)	ing the cost t : 3 coarse		
		For receiving chamber- STP	1	3.6	2.6	0.15	1.4	m <sup>3</sup>				
		For receiving chamber- CTU	1	1.55	1.6	0.15	0.37	m <sup>3</sup>				
		Total					1.77	m <sup>3</sup>				
		Say		1.77	m <sup>3</sup>		æ	Rs	7202.3	12748.15		

		GST						Rs	1312.38	2322.92
3	5.37.1 +5.34. 1	Providing and concrete work mix, manufact transit mixer f design of spec R.M.C. from t finishing and r as per IS : 910 impairing strea Cement conten design mix is p	laying , using ured ir or all 1 ified g ransit 1 einford )3 to a ngth an nt cons payable	in positi Sulphat fully a eads, ha rade for mixer to cement, ccelerat nd dural idered i e/recove	ion read te Resis utomati aving co r reinfor site of includin e/ retard bility as n this i trable se	y mixed tant Ce c batch ontinuou rced ce laying ng cost d setting s per di tem is ( eparatel	d M-30 gra ment (SR) ing plant us agitated ment cond , excludin of admixt g of concur rection of @ 330 kg y).	ade conc C) conte and tran d mixer, crete wo g the co ures in r rete, imp <sup>2</sup> the Eng / <sup>3</sup> .Exces	rete for reinfor nt as per appro- sported to site manufactured rk, including p st of centering recommended prove workabil gineer-in-charg s/less cement	ced cement oved design of work in as per mix pumping of , shuttering proportions ity without ge. (Note :- used as per
		For receiving chamber- STP								
		Bottom slab	1	3.60	2.60	0.3	2.81	m <sup>3</sup>		
		Long wall	2	3.00	0.25	2.95	4.43	m <sup>3</sup>		
		Short wall	2	1.50	0.25	2.95	2.21	m <sup>3</sup>		
		For receiving chamber- CTU								
		Bottom slab	1	1.55	1.60	0.30	0.74	m <sup>3</sup>		
		Long wall	2	1.50	0.25	1.85	1.39	m <sup>3</sup>		
		Short wall	2	0.50	0.25	1.85	0.46	m <sup>3</sup>		
		Total					12.04	m <sup>3</sup>		
		Say		12.0	m <sup>3</sup>		@	Rs	9956.30	119873.9
		GST component						Rs	1814.20	21843.02
4	5.37.1	Providing and concrete work, automatic batch having continue for reinforced to site of laying including cost retard setting of as per direction item is @ payable/recover	laying , using p lous ag cemen g, excl of adm f concr n of th 330 k erable s	in positi cement lant and gitated r t concre uding th ixtures rete, imp e Engin cg/ cum separate	ion read content d transp nixer, n ete work ne cost o in recor prove we neer-in-con n. Exc ly).	y mixed as per orted to nanufac , includ of center nmende orkabili charge. ess/less	d M-25 gra approved o site of w ctured as p ding pump ring, shutt ed proport ity withou (Note :- C cement	ade conc design n vork in t ber mix bing of H ering fin ions as p t impairi Cement o used	rete for reinfor nix, manufactur ransit mixer for design of spec R.M.C. from tr hishing and rein per IS : 9103 to ing strength and content consid as per desig	reed cement red in fully or all leads, bified grade ansit mixer aforcement, accelerate/ d durability ered in this gn mix is
		Top slab- STP	1	3	2	0.15	0.9	m <sup>3</sup>		
		Top slab- CTU	1	1.25	1	0.15	0.19	m <sup>3</sup>		
		Total					1.09	m <sup>3</sup>		
		Deduction								
		Manhole	2	0.6	0.45	0.15	0.08	m <sup>3</sup>		
		Total					0.08	m <sup>3</sup>		
		Total after deduction					1.01	m <sup>3</sup>		
		Say		1.01	m <sup>3</sup>		@	Rs	9874.30	9973.04

		GST						Rs	1799.26	1817.25
		component								
5	5.22.6	Epoxy coated bending, placi Mechanically	steel in ng in Freateo	reinforc position l bars of	ement f n and b f grade ]	for R.C pinding Fe-500I	C.C. work all comp O or more	includi olete up	ng straightenir to plinth leve	ng, cutting, l. Thermo-
		Quantity as per item No.3	1		12.0 4	m <sup>3</sup>	120	kg/m	1444.8	kg
		Quantity as per item No.4	1		1.01	m <sup>3</sup>	100	kg/m	101	kg
		Total							1545.8	kg
		Say		1546	kg		(a)	Rs	98.17	151752.7
		GST component						Rs	17.89	27651.87
6	4.12	Extra for prov doses by weigh	iding and of co	and mix ement as	king wa s per ma	ter proo nufactu	ofing mat arer's spec	erial in ificatior	cement concre n.	ete work in
		Quantity as per item No.3	1		12.0 4	m <sup>3</sup>	340	kg/m	4093.6	kg
		Quantity as per item No.4	1		1.01	m <sup>3</sup>	330	kg/m	333.3	kg
		Total							4426.9	kg
		Say		88.5	bags		(a)	Rs	66.4858	5886.53
		GST component						Rs	12.11	1072.62
7	5.9.1	Centering and Foundations,	shutte footing	ering ind gs, bases	cluding s of colu	struttin Imns, et	g, proppi c. for mas	ng etc. ss concre	and removal c ete	of form for
		Bottom slab- STP	1	6.2		0.3	1.86	m <sup>2</sup>		
		Bottom slab- CTU	1	4.7		0.3	1.41	m <sup>2</sup>		
		Total					3.27	m <sup>2</sup>		
		Say		3.27	m <sup>2</sup>		a	Rs	334.898	1095.12
		GST						Rs	61.02	199.55
8	5.9.2	Centering and :Walls (any thi etc.	shutte ckness	ering ind s) includ	cluding ling atta	struttin ched pi	g, proppi lasters, bi	ng etc. ittresses	and removal o , plinth and str	of form for ing courses
		For walls outside-STP	2	5		2.95	29.50	m <sup>2</sup>		
		For walls inside-STP	2	4		2.95	23.60	m <sup>2</sup>		
		For walls outside-CTU	1	3.5		1.85	6.48	m <sup>2</sup>		
		For walls inside-CTU	1	2.5		1.85	4.63	m <sup>2</sup>		
		Total					64.20	$m^2$		
		Say		64.2	$m^2$		@	Rs	716.354	45989.96
		GST component						Rs	130.53	8380.13

9	5.9.3	Centering and shuttering including strutting, propping etc. and removal of form for: Suspended floors, roofs, landings, balconies and access platform										
		Top slab- STP	2	5		0.15	1.50	m <sup>2</sup>				
		Bottom portion-STP	1	2.5	1.5		3.75	m <sup>2</sup>				
		Top slab- CTU	1	3.5		0.15	0.53	m <sup>2</sup>				
		Bottom portion-CTU	1	1	0.5		0.50	m <sup>2</sup>				
		Total					6.28	$m^2$				
		Say		6.28	$m^2$		@	Rs	814.819	5112.99		
		GST						Rs	148.473	931.67		
10	2.25	Filling availab foundations et layer by ramm	ble ex c. in la ing and	cavated yers no d wateri	earth ot excee ng, lead	(exclue ding 20 l up to 5	ding rock ocm in de 50 m and	c) in tr pth, con lift up to	enches, plinth solidating each 1.5 m.	n, sides of h deposited		
		Quantity as per item 1	1				37.15	m <sup>3</sup>				
		Deductions	1				1 77	m <sup>3</sup>				
		Rottom slab	1				3.55	m <sup>3</sup>				
		Receiving	1				3.33 8.40	m <sup>3</sup>				
		chamber	1				0.77	III				
		Top slab	1				1.09	m <sup>3</sup>				
		Quantity after deductions	1				22.25	m <sup>3</sup>				
		Say		22.2 5	m <sup>3</sup>		@	Rs	258.2427	5745.9		
		GST component						Rs	47.056103	1047		
11	22.23. 1	Providing and waterproofing water tanks, ro subway and bi crystalline slut negative (inter the requirement concrete by m resistant to 16 capable of self all complete as performance slut two coats @ 0	appl treatm oof slat ridge d rry : 2 rry : 1 nal) si- nore th bar hy -healin per sp hall can .70 kg	ying in hent to bs, podi eck etc. 2 parts part wa de with specific an 90% drostati og of cra ecification rry guar per squ	the gral the RCC ums, re , prepar water) for the help ed in A compa- c pressu cks up t ion and antee for	crystall C struct servoir, red by r for ver r horizo p of syn CI212- ared wi are on n to a wid the dire or 10 yea	ine slurr tures like sewage of nixing in tical surf ontal surfa ontal surfa ontal surfa of the contro the contro th of 0.50 ction of th ars agains	y of hy retainin & water the ratio aces and aces and ore brush i.e by l concre- ide. The mm. The engine at any lea	ydrophilic in g walls of the treatment plan o of 5 : 2 (5 pa d 3 : 1 (3 pa l applying the n. The material reducing perm ete as per DIN crystalline slu e work shall be eer-in-charge. Takage. For vert	nature for e basement, nt, tunnels / arts integral same from l shall meet neability of N 1048 and rry shall be e carried out The product ical surface		
		Inside of walls-STP	2	4		2.95	23.60	m <sup>2</sup>				
		Inside of walls-CTU	1	2.5		1.85	4.63	m <sup>2</sup>				
		Total					28.23	m <sup>2</sup>				
		Say		28.2 3	m <sup>2</sup>		@	Rs	569.568	16076.07		

		GST						Rs	103.78	2929.33
12	22.23.	Providing and	l appl	ying in	tegral	crystall	ine slurr	y of hy	ydrophilic in	nature for
	2	water tanks, ro	treatm of slal	ent to to bs. podi	the RCC	C struct	tures like sewage d	retainin & water	g walls of the treatment plan	basement,
		subway and br	idge d	eck etc.	, prepar	red by r	nixing in	the ratio	p  of  5 : 2 (5 pa)	irts integral
		crystalline slut	rry : 2 ry : 1	2 parts part wa	water) ater) foi	for ver horizo	tical surfa	aces and aces and	a 3 : 1 (3 pa applying the	same from
		negative (inter	nal) si	de with	the help	p of syı	nthetic fib	re brush	h. The material	shall meet
		concrete by m	nts as ore th	an 90%	compa	ared wi	th contro	1.e. by l concre	te as per DIN	1048 and
		resistant to 16	bar hy	drostati	c pressu	ire on n	egative si	de. The	crystalline slu	rry shall be
		all complete as	per sp	ecificati	ion and	the dire	ction of th	e engine	er-in-charge.	The product
		performance s	hall ca	arry gua	arantee	for 10	years aga	ainst any	v leakage. For	horizontal
		Bottom slab	1 1	2.5	1.5		3.75	m <sup>2</sup>		
		inside-STP Bottom slab	1	1	0.5		0.5	$m^2$		
		inside-CTU	1	1	0.5		0.5	111		
		Total					4.25	$m^2$		
		Say		4.25	m <sup>2</sup>		<i>(a)</i>	Rs	439.006	1865.78
		GST						Rs	/9.99	339.98
13	13.7.1	12 mm cement fine sand)	t plaste	er finish	ed with	a float	ting coat	of neat o	cement :1:3 (1	cement : 3
		Inside of walls-STP	2	4		2.95	23.6	m <sup>2</sup>		
		Base slab inside-STP	1	2.5	1.5		3.75	m <sup>2</sup>		
		Top slab bottom-STP	1	2.5	1.5		3.75	m <sup>2</sup>		
		Inside of walls-CTU	2	2	0.5	1.85	7.4	m <sup>2</sup>		
		Base slab inside-CTU	I	1	0.5		0.5	m <sup>2</sup>		
		Top slab bottom-CTU	1	1	0.5		0.5	m <sup>2</sup>		
		Total					39.5	$m^2$		
		Deduction	1	0.6	0.45		0.27	$m^2$		
		Total	1	0.0	0.45		0.27	$m^2$		
		Total after					39.23	m <sup>2</sup>		
		deduction		20.2	m <sup>2</sup>			Da	420.00	17222.22
		Say		3	111		u	13		17222.23
		GST component						Rs	79.99	3138.18
14	19.18. 1	Supplying and C.I. cover (light	fixing nt duty	C.I. co ) the we	ver with eight of	nout fra	me for ma er to be no	anholes ot less th	:455x610 mm an 23 kg	rectangular
		C	2	2	N		2	No.	1550.27	2110 55
		Say GST		2	No.		a	Rs Rs	284.12	5118.55 568.25
		component								200.20

15	Providing and fixing uPVC pipes & fittings including jointing of pipes with one step uPVC solvent cement, testing of joints complete as per direction of Engineer in Charge. 110mm dia 6Kgf/cm <sup>2</sup> - for vent pipe											
		1	0.45			0.45	m					
	Total					0.45	m					
	Say		0.45	m		(a)	Rs	1222.7289	550.23			
	GST component						Rs	222.80149	100.26			
	Total- Receiving Chamber								₹ 4,04,956			
	GST component								₹ 73,790			

## 5.4 OIL AND GREASE TRAP

OIL A	OIL AND GREASE TRAP												
Item No.	Item Code	Description	No	L	В	Н	V	Uni t	Rate	Amount			
1	2.6.1	Earth work in ex over areas (exce including getting 1.5 m, as directe	cavatio eding g out a d by E	on by me 30 cm i nd dispo ngineer-	echanica n depth osal of e -in-charg	l means , 1.5 m xcavateo ge	(Hydrauli in width a d earth lea	c exca as well ad up t	vator)/ma l as 10 sq o 50 m ar	nual means m on plan) id lift up to			
		For oil and grease trap- STP	1	3.7	2.4	3.55	31.52	m <sup>3</sup>					
		For oil and grease trap- CTU	1	2.3	1.55	2.25	8.02	m <sup>3</sup>					
		Total					39.54	m <sup>3</sup>					
		Say		39.5 4	m <sup>3</sup>		@	Rs	213.86	8456.02			
		GST component						Rs	38.97	1540.83			
2	4.1.6	Providing and la cost of centering coarse sand (zon	aying i g and s ae-III):	n positio hutterin 6 grade	on ceme g - All v d stone a	ent conci work up aggregat	to plinth to plinth te 40 mm	ecified level : nomin	grade ex 1:3:6 (1 al size)	cluding the Cement : 3			
		For oil and grease trap- STP	1	3.7	2.4	0.15	1.33	m <sup>3</sup>					
		For oil and grease trap- CTU	1	2.3	1.55	0.15	0.53	m <sup>3</sup>					
		Total					1.86	m <sup>3</sup>					
		Say		1.86	m <sup>3</sup>		@	Rs	7202.3 4	13396.36			
		GST component						Rs	1312.3 9	2441.04			
3	5.37. 1 + 5.34. 1	Providing and la cement concrete approved design to site of work manufactured as	aying i work mix, n in tra per n	n positi c, using nanufact nsit mix nix desig	on ready Sulpha tured in f er for a gn of sp	y mixed te Resis fully auto all leads ecified g	M-30 gra stant Cem omatic bat , having o grade for t	ade con ent (S tching continu reinfor	ncrete for SRC) cont plant and uous agita reed ceme	reinforced tent as per transported ated mixer, nt concrete			

work, including pumping of R.M.C. from transit mixer to site of laying, excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/3.Excess/less cement used as per design mix is payable/recoverable separately).

· · · ·								
For oil and grease trap- STP								
Bottom slab	1	3.70	2.40	0.35	3.11	m <sup>3</sup>		
Long wall	2	3.40	0.30	3.25	6.63	m <sup>3</sup>		
Short wall	2	1.50	0.30	3.25	2.93	m <sup>3</sup>		
For oil and grease trap- CTU								
Bottom slab	1	2.30	1.55	0.30	1.07	m <sup>3</sup>		
Long wall	2	2.00	0.25	2.25	2.25	m <sup>3</sup>		
Short wall	2	0.75	0.25	2.25	0.84	m <sup>3</sup>		
Total					16.83	m <sup>3</sup>		
Say		16.8 3	m <sup>3</sup>		@	Rs	9956.3 05	167564.6 2
GST component						Rs	1814.2 04	30533.05

5.37.

Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying, excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ cum.Excess/less cement used as per design mix is payable/recoverable separately).

		Top slab-STP	1	3.4	2.1	0.15	1.07	m <sup>3</sup>		
		Top slab-CTU	1	2.0	1.25	0.15	0.38	m <sup>3</sup>		
		Total					1.45	m <sup>3</sup>		
		Deduction								
		Manhole	2	0.6	0.45	0.15	0.08	m <sup>3</sup>		
		Total					0.08	m <sup>3</sup>		
		Total after deduction					1.37	m <sup>3</sup>		
		Say		1.37	m <sup>3</sup>		@	Rs	9874.3 0	13527.79
		GST component						Rs	1799.2 6	2464.99
5	5.22. 6	Epoxy coated sto bending, placing Mechanically Tr	eel rein g in po reated l	nforcem sition ar bars of g	ent for I nd bindi grade Fe-	R.C.C. w ng all c -500D o	vork inclu omplete u r more.	ding s ıp to p	traighteni linth leve	ng, cutting, l. Thermo-
		Quantity as per item No 3	1		16.8 3	m <sup>3</sup>	120	kg/ m <sup>3</sup>	2019.6	kg

		Quantity as per	1		1.37	m <sup>3</sup>	100	kg/	137	kg
		item No.4						m <sup>3</sup>	<b>015</b> 66	
		Total		01.57			0	D	2156.6	kg
		Say		2157	kg		<u>(a)</u>	Rs	98.17	211715.6 3
		GST component						Rs	17.89	38578.1
6	4.12	Extra for provid	ing an	d mixing	g water p	proofing	material	in cem	ent concr	ete work in
		doses by weight	of cen	nent as p	ber manu	ifacturer	's specific	cation.	5700.0	
		Quantity as per item No.3	1		16.8 3	m	340	$\frac{\text{kg}}{\text{m}^3}$	5722.2	кg
		Quantity as per item No.4	1		1.37	m <sup>3</sup>	330	kg/ m <sup>3</sup>	452.1	kg
		Total							6174.3	kg
		Say		123. 5	bags		@	Rs	66.49	8210.08
		GST component						Rs	12.11	1496.01
7	5.9.1	Centering and sl :Foundations, fo	hutterin otings	ng inclu , bases o	ding stru of colum	utting, pr ns, etc. f	ropping e for mass c	tc. and	removal e	of form for
		Bottom slab- STP	2	6.1		0.35	4.27	m <sup>2</sup>		
		Bottom slab- CTU	2	3.85		0.30	2.31	m <sup>2</sup>		
		Total					6.58	m <sup>2</sup>		
		Say		6.58	m <sup>2</sup>		(a)	Rs	334.9	2203.63
		GST					0	Rs	61.0	401.54
		component								
8	5.9.2	Centering and sl :Walls (any thic courses etc.	hutterii ckness	ng incluo ) includ	ding stru ing atta	itting, pi ched pi	ropping e lasters, bi	tc. and uttress	removal es, plinth	of form for and string
		For walls	2	5.5		3.25	35.75	m <sup>2</sup>		
		For walls	2	4.3		3.25	27.95	$m^2$		
		For walls	2	3.25		2.25	14.63	m <sup>2</sup>		
		For walls	2	2.25		2.25	10.13	m <sup>2</sup>		
		Total					88.45	m <sup>2</sup>		
		Say		88.4 5	m <sup>2</sup>		@	Rs	716.35	63361.56
		GST						Rs	130.53	11545.53
9	5.9.3	Centering and sl :Suspended floo	hutterii rs, roo	ng inclu fs, landi	ding stru ngs, balo	utting, pr conies an	ropping e nd access	tc. and platfor	removal rm	of form for
		Top slab-STP	2	5.5		0.15	1.65	m <sup>2</sup>		
		Bottom	1	2.8	1.5		4.2	m <sup>2</sup>		
		Top slab-CTU	2	3.25		0.15	0.975	m <sup>2</sup>		
		Dettern	1	1.5	0.75		1 1 2 5	<b>m</b> 2		
		Bottom	1	1.5	0.75		1.123	III <sup>-</sup>		
		portion-CTU	1	1.5	0.75		1.125	III-		

		Say		7.95	m <sup>2</sup>		(a)	Rs	814.82	6477.82
		GST						Rs	148.47	1180.37
10	2.25	Filling available foundations etc. layer by rammin	e exca in laye ig and	vated e ers not e watering	arth (ex cceeding g, lead u	cluding g 20cm in p to 50 r	rock) in n depth, co n and lift	trencl onsolic up to 1	nes, plint lating eac 5 m.	h, sides of h deposited
		Quantity as per item 1	1				39.54	m <sup>3</sup>		
		Deductions					1.0.6	2		
		PCC	1				1.86	m		
		Bottom slab	1				4.18	m <sup>3</sup>		
		Oil and grease trap	1				12.65	m <sup>3</sup>		
		Top slab	1				1.45	m <sup>3</sup>		
		Quantity after deductions	1				19.40	m <sup>3</sup>		
		Say		19.4 0	m <sup>3</sup>		@	Rs	258.24	5009.91
		GST component						Rs	47.06	912.89
11	22.2 3.1	Providing and waterproofing tr water tanks, roo / subway and bri crystalline slurry regative (interna the requirements concrete by mor resistant to 16 b be capable of se carried out all c charge. The pro- leakage. For ver	applyin eatmen f slabs dge de y : 2 p y : 1 pa al) side s as sp re than ar hydr elf-hea comple oduct p tical su	ng integ nt to the , podium ck etc., j parts wa art water with the pecified 190% co rostatic ling of o te as pe performa urface tv	ral crys RCC st as, reserved orepared ter) for b) for ho e help of in ACI2 ompared pressure cracks u r specifi nice sha vo coats	stalline ructures voir, sew by mixi vertical rizontal 'syntheti 12-3R-2 l with cc on nega p to a v ication a all carry @ 0.70	slurry of like retain vage & wa ng in the r surfaces surfaces a ic fibre bru 010 i.e. b ontrol con tive side. vidth of 0 and the di guarantee kg per squ	hydro ning w atter tre ratio of and 3 nd app ush. Th y redu crete a The cr .50mm rection e for 1 n	philic in alls of the atment pla 5 : 2 (5 pa : 1 (3 pa olying the ne materia cing perm s per DIN rystalline n. The wo n of the e	nature for e basement, ant, tunnels arts integral rts integral same from l shall meet neability of N 1048 and slurry shall ork shall be ngineer-in- against any
		Inside of walls- STP	2	4.3		3.25	27.95	m <sup>2</sup>		
		Inside of walls- CTU	2	2.25		2.25	10.13	m <sup>2</sup>		
		Total					38.08	$m^2$		
		Say		38.0 8	m <sup>2</sup>		@	Rs	569.57	21686.31
		GST component						Rs	103.78	3951.61

12	22.2 3.2	Providing and waterproofing the water tanks, roo / subway and bri- crystalline slurry negative (interna- the requirement concrete by mor- resistant to 16 b be capable of se- carried out all of charge. The pro- leakage. For hor-	vaterproofing treatment to the RCC structures like retaining walls of the basement, vater tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnels subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fibre brush. The material shall meet he requirements as specified in ACI212-3R-2010 i.e. by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in- charge. The product performance shall carry guarantee for 10 years against any eakage. For horizontal surface one coat @1.10 kg per sqm.										
		Bottom slab inside-STP	1	2.8	1.5		4.2	m <sup>2</sup>					
		Bottom slab inside-CTU	1	1.5	0.75		1.125	$m^2$					
		Sov		5 2 2	$m^2$		9.525 @	III Do	420.01	2227 71			
		Say		5	111		W	IXS	JJ.01	2557.71			
		GST						Rs	79.99	425.97			
13	13.7.	12 mm cement r	olaster	finished	with a f	loating	coat of nea	at cem	ent :1:3 (1	cement : 3			
	1	fine sand)				U			Ň				
		for STP	1	0.6		2.05	27.05	2					
		Inside of walls	I	8.6		3.25	27.95	m²					
		Base slab inside	1	2.8	1.5		4.2	$m^2$					
		Top slab bottom	1	2.8	1.5		4.2	m <sup>2</sup>					
		for CTU						2					
		Inside of walls	1	4.5		2.25	10.13	m <sup>2</sup>					
		Base slab inside	1	1.5	0.75		1.125	m <sup>2</sup>					
		Top slab bottom	1	1.5	0.75		1.125	m <sup>2</sup>					
		Total					48.73	$m^2$					
		Deduction						_					
		Manhole	2	0.6	0.45		0.54	$m^2$					
		Total					0.54	$m^2$					
		Total after deduction					48.19	m <sup>2</sup>					
		Say		48.1 9	m <sup>2</sup>		@	Rs	400.74	19309.54			
		GST component	GST Rs 73.02 3518.52										
14	19.1 8.1	Supplying and rectangular C.I.	fixing cover	g C.I. c (light du	over w ty) the v	ithout f veight o	rame for	manh r to be	noles :45: not less t	5x610 mm han 23 kg			
			1				1	No.					
		Say		2	No.		@	Rs	1559.2 7	3118.55			

GST component			Rs	284.13	568.25
Total-Oil and Grease Trap					₹ 5,46,376
GST component					₹ 99,559

## 5.5 GRIT CHAMBER AND SCREEN CHANNELS

GRIT	SEPER	ATOR AND SCREE	N CHA	ANNEI	LS					
Item No.	Item Cod e	Description	No	L	В	Η	V	Unit	Rate	Amount
1	2.6. 1	Earth work in excav over areas (exceedin including getting ou 1.5 m, as directed by	ation b ng 30 t and o y Engin	by meel cm in disposa neer-in	hanica depth, al of ez -charg	l means 1.5 m i kcavatec e	(Hydrau in width l earth le	llic excava as well a ead up to	ator)/mar as 10 sqr 50 m and	ual means n on plan) d lift up to
		For grit separator	1	3.7	3.2	3.75	44.4	m <sup>3</sup>		
		For screen channel-STP	2	9.7	1.7 5	1.65	56.0 2	m <sup>3</sup>		
		For screen channel-CTU	1	3.0 0	1.6 0	1.65	7.92	m <sup>3</sup>		
		Total					108. 3	m <sup>3</sup>		
		Say		108 .3	m <sup>3</sup>		@	Rs	213.8 6	23169.5 9
		GST component						Rs	38.97	4221.88
2	4.1. 6	Providing and layin cost of centering an coarse sand (zone-II	g in p d shut I): 6 g	osition tering raded s	- All v stone a	nt concr vork up ggregate	to plint to plint e 40 mm	pecified g h level : 1 nominal	grade exc .:3:6 (1 ( size)	luding the Cement : 3
		For grit separator	1	3.7	3.2	0.15	1.78	m <sup>3</sup>		
		For screen channel-STP	2	9.7	1.7 5	0.15	5.09	m <sup>3</sup>		
		For screen channel-CTU	1	3	1.6 0	1.15	5.52	m <sup>3</sup>		
		Total					12.3 9	m <sup>3</sup>		
		Say		12. 39	m <sup>3</sup>		@	Rs	7202. 34	89237.0 4
		GST component						Rs	1312. 39	16260.4 7
3	5.37 .1 + 5.34 .1	Providing and layin cement concrete w approved design mix to site of work in manufactured as per work, including pur the cost of centerin admixtures in recom of concrete, improv direction of the Eng is @ 330 kg/ <sup>3</sup> .Exce separately).	g in p ork, u , man transit r mix o ng, sh mendo e worl ineer-i ess/less	osition sing S ufactur mixer design of R.M utterin ed prop kability n-char s ceme	a ready Sulphat red in f for a of spe I.C. fro g finis portion y with ge. (No nt use	y mixed e Resis fully auto ll leads ecified g om trans shing ar s as per out impa- tote :- Ce d as per	M-30 g tant Ce omatic b , having grade for sit mixer nd reinfa IS : 910 airing st ement co r design	grade cond ment (SR patching pl g continue r reinforce to site of orcement, 3 to accel trength an ontent con mix is p	crete for (C) control lant and t bus agita ed cemer f laying , includin erate/ ret id durabi sidered i bayable/re	reinforced ent as per ransported ted mixer, at concrete excluding ng cost of ard setting lity as per n this item ecoverable

		D 1.1	1	27	2.2	0.20	2 5 5	3		
		Bottom slab	I	3.7 0	3.2 0	0.30	5.55	m		
		Walls	2	5.1 0	0.3 0	3.30	10.1	m <sup>3</sup>		
		Top slab	1	3.1 0	2.6 0	0.15	1.21	m <sup>3</sup>		
		Total					14.8 6	m <sup>3</sup>		
		Deduction								
		Manhole	1	0.6	0.4 5	0.15	0.04	m <sup>3</sup>		
		Total					0.04	m <sup>3</sup>		
		Total after deduction					14.8 2	m <sup>3</sup>		
		Say		14. 82	m <sup>3</sup>		@	Rs	9956	147552. 45
		GST component						Rs	1814. 20	26886.5
		For screen channel								
		Bottom slab-STP	2	9.7 0	1.7 5	0.30	10.1 9	m <sup>3</sup>		
		Bottom slab-CTU	1	3.0 0	1.6 0	0.30	1.44	m <sup>3</sup>		
		Wall-STP	4	9.7 0	0.2 5	1.20	11.6 4	m <sup>3</sup>		
		Wall-CTU	2	2.5 0	0.2 5	1.50	1.88	m <sup>3</sup>		
		Top slab-STP	2	9.7 0	1.2 5	0.15	3.64	m <sup>3</sup>		
		Top slab-CTU	1	2.5 0	1.1 0	0.15	0.41	m <sup>3</sup>		
		Total					29.2	m <sup>3</sup>		
		Deduction								
		Manhole	3	0.6	0.4 5	0.15	0.12	m <sup>3</sup>		
		Total					0.12	m <sup>3</sup>		
		Total after deduction					29.0 8	m <sup>3</sup>		
		Say		29. 08	m <sup>3</sup>		@	Rs	9956. 31	289529. 36
		GST component						Rs	1814. 20	52757.0 5
4	5.22 .6	Epoxy coated steel bending, placing in Mechanically Treate	reinfor positi ed bars	on and of gra	t for F l bindi de Fe-	R.C.C. wing all c 500D or	vork incl complete more.	luding stra upto pli	aightenin nth level	ng, cutting, l. Thermo-
		Quantity as per item No.3	1		43. 9	m <sup>3</sup>	120	kg/m <sup>3</sup>	5268	kg
		Total							5268	kg
		Say		526 8	kg		a	Rs	98.17	517164. 96
		GST component						Rs	17.89	94236.0 3
5	4.12	Extra for providing doses by weight of c	and m	ixing v as per	vater p manu	proofing facturer	materia s specifi	l in cemer cation.	nt concre	ete work in

		Quantity as per item No.3	1		43. 9	m <sup>3</sup>	340	kg/m <sup>3</sup>	1492 6	kg
		Total							1492 6	kg
		Say		298 .5	bag s		@	Rs	66.49	19847.3 7
		GST component						Rs	12.11	3616.52
6	5.9. 1	Centering and shutter: Foundations, footing	ering in gs, bas	ncludi es of c	ng stru columr	tting, pr is, etc. fe	opping or mass	etc. and re concrete	emoval o	of form for
		Bottom slab-grit separator	2	6.9		0.30	4.14	m <sup>2</sup>		
		Bottom slab- screen channel- STP	4	9.7		0.30	11.6 4	m <sup>2</sup>		
		Bottom slab- screen channel- CTU	2	2.5		0.30	1.50	m <sup>2</sup>		
		Total					17.2 8	m <sup>2</sup>		
		Say		17. 28	m <sup>2</sup>		@	Rs	334.9 0	5787.04
		GST component						Rs	61.02	1054.5
7	5.9.	Centering and shutte	ering in	ncludi	ng stru	tting, pr	opping	etc. and re	emoval c	of form for
	2	:Walls (any thickne courses etc.	ess) ind	cluding	g attac	hed pila	asters, b	utteresses	, plinth	and string
		For walls outside- grit separator	2	5.7 0		3.30	37.6 2	m <sup>2</sup>		
		For walls inside- grit separator	2	4.5 0		3.30	29.7 0	m <sup>2</sup>		
		For walls outside- channel-STP	4	9.7 0		1.20	46.5 6	m <sup>2</sup>		
		For walls inside- channel-STP	4	9.7 0		1.20	46.5 6	m <sup>2</sup>		
		For walls outside- channel-CTU	2	2.5 0		1.50	7.50	m <sup>2</sup>		
		For walls inside- channel-CTU	2	2.5 0		1.50	7.50	m <sup>2</sup>		
		Total					175. 44	m <sup>2</sup>		
		Say		175 .44	m <sup>2</sup>		<i>(a)</i>	Rs	716.3 5	125677. 24
		GST component						Rs	130.5 3	22900.4 8
8	5.9. 3	Centering and shutte :Suspended floors, re	ering ii oofs, la	ncludii anding	ng stru s, balc	tting, pronies an	opping d access	etc. and rosplatform	emoval o	of form for
		Top slab-grit separator	2	5.7		0.15	1.71	m <sup>2</sup>		
		Bottom portion- grit separator	1	2.5 0	2		5.00	m <sup>2</sup>		
		Top slab-channels- STP	4	9.7 0		0.15	5.82	m <sup>2</sup>		
		Bottom portion- channels-STP	2	9.7 0	0.7 5		14.5 5	m <sup>2</sup>		
		Top slab-channels- CTU	2	2.5		0.15	0.75	m <sup>2</sup>		

		Bottom portion- channels-CTU	1	2.5 0	0.6		1.50	m <sup>2</sup>		
		Total					29.3 3	m <sup>2</sup>		
		Say		29. 33	m <sup>2</sup>		@	Rs	814.8 2	23898.6 6
		GST component						Rs	148.4 7	4354.73
9	22.2 3.1	Providing and apply waterproofing treatr water tanks, roof slat / subway and bridge crystalline slurry : 1 negative (internal) si the requirements as concrete by more th resistant to 16 bar h be capable of self-h carried out all comp charge. The product	ying in nent to bs, poor deck e 2 parts part v de wit specifican 90° ydrosta ealing plete a t perfor surfac	integra the R diums, tc., pro- s water water) h the h fied in % con- atic pro- of cra s per ormance two	l crys CC str reserve pared r) for for hor elp of ACI2 pared essure acks up specifi ce shal coats (	talline s voir, sew by mixin vertical izontal s syntheti 12-3R-2 with co on nega to a w cation a ll carry @ 0.70 h	slurry of like reta vage & w ng in the surfaces c fibre b 010 i.e ntrol co tive side vidth of guarante cg per so	f hydroph ining wal vater treat ratio of 5 and 3 : and apply rush. The by reduci ncrete as e. The cry 0.50mm. direction ee for 10	hilic in lls of the ment pla : 2 (5 pa 1 (3 pan ying the material ing perm per DIN stalline s The wor of the en years a	nature for basement, nt, tunnels rts integral same from shall meet eability of 1048 and slurry shall rk shall be ngineer-in- gainst any
		Inside of walls-grit separator	2	4.5		3.30	29.7	m <sup>2</sup>		
		Inside of walls- channels-STP	4	9.7		1.20	46.5 6	m <sup>2</sup>		
		Inside of walls- channels-CTU	2	2.5		1.50	7.5	m <sup>2</sup>		
		Total					83.7 6	m <sup>2</sup>		
		Say		83. 76	m <sup>2</sup>		@	Rs	569.5 7	47707.0 4
		GST component						Rs	103.7 8	8693.01
10	22.2 3.2	Providing and apply waterproofing treatr water tanks, roof slat / subway and bridge crystalline slurry : 1 negative (internal) si the requirements as concrete by more the resistant to 16 bar he be capable of self-he carried out all composition charge. The produce leakage. For horizon Bottom slab inside-grit box	ying in nent to bs, poo deck e 2 parts part v de wit specifican 90° ydrosta ealing plete a t perfor tal sur 1	te., pre- s wate: vater) i h the h h the h h the h fied in % con atic pre- of cra s per prmano face of 2.5	1 crys CC str reserve pared r) for for hor elp of ACI2 npared essure acks up specifice shall ne coat	talline s ructures voir, sew by mixin vertical fizontal s syntheti 12-3R-2 with co on nega p to a w cation a ll carry t @1.10	slurry of like reta vage & w ng in the surfaces c fibre b 010 i.e ntrol co tive side vidth of guarante kg per s 5.00	f hydroph ining wal vater treat ratio of 5 s and 3 : and apply rush. The by reducin ncrete as c. The cry 0.50mm. direction ee for 10 qm. m <sup>2</sup>	hilic in lls of the ment pla : 2 (5 pa 1 (3 par ying the material ing perm per DIN stalline s The wor of the en years a	nature for basement, nt, tunnels rts integral rts integral same from shall meet eability of 1048 and slurry shall rk shall be ngineer-in- gainst any
		Bottom slab inside-channels-	2	9.7	0.7 5		14.5 5	m <sup>2</sup>		
		Bottom slab inside-channels- CTU	1	2.5	0.6		1.50	m <sup>2</sup>		

		Total					21.0	<sup>2</sup>		
		10(a)					5	III.		
		Say		21. 05	m <sup>2</sup>		@	Rs	439.0 1	9241.09
		GST component						Rs	79.99	1683.88
11	13.7 .1	12 mm cement plast fine sand)	er finis	shed w	ith a fl	oating c	oat of n	eat cemen	t :1:3 (1	cement : 3
		Inside of walls-grit separator	2	4.5		3.30	29.7	m <sup>2</sup>		
		Base slab inside- grit separator	1	2.5	2		5.00	m <sup>2</sup>		
		Top slab bottom- grit box	1	2.5	2		5.00	m <sup>2</sup>		
		Inside of walls- channels-STP	4	9.7		1.20	46.5 6	m <sup>2</sup>		
		Base slab inside- channels-STP	2	9.7	0.7 5		14.5 5	m <sup>2</sup>		
		Top slab bottom- channels-STP	2	9.7	0.7 5		14.5 5	m <sup>2</sup>		
		Inside of walls- channels-CTU	2	2.5		1.50	7.5	m <sup>2</sup>		
		Base slab inside- channels-CTU	1	2.5	0.6		1.5	m <sup>2</sup>		
		Top slab bottom- channels-CTU	1	2.5	0.6		1.5	m <sup>2</sup>		
		Total					125. 86	m <sup>2</sup>		
		Deduction								
		Manhole	2	0.6	0.4 5		0.54	$m^2$		
		Total					0.54	m <sup>2</sup>		
		Total after deduction					125. 32	m <sup>2</sup>		
		Say		125 .32	m <sup>2</sup>		@	Rs	400.7 4	50220.4 4
		GST component						Rs	73.02	9151
12	2.25	Filling available ex	cavate	ed ear	th (exe	cluding	rock) in	n trenche	s, plinth	, sides of
		foundations etc. in la layer by ramming ar	ayers n nd wate	ot exc ering, l	eeding ead up	20cm in to 50 m	n depth, n and lift	consolida upto 1.5	ting each m.	deposited
		Quantity as per item 1	1				108. 3	m3		
		Deductions								
		PCC	1				12.3 9	m3		
		Bottom slab	1				15.1 8	m3		
		Tank/channel	1				37.3 2	m3		
		Top slab	1				5.26	m3		
		Quantity after deductions	1				38.2	m3		
		Say		38. 2	m <sup>3</sup>		@	Rs	258.2 4	9861.51
		GST component						Rs	47.06	1796.93

13	19.1 8.1	Supplying and fixing rectangular C.I. cover	ing C. er (ligh	I. cov nt duty	ver wi ) the w	thout freight of	rame fo the cove	or manho er to be no	les :455 ot less tha	x610 mm an 23 kg
			3				3	No.		
		Say		3	No.		@	Rs	1559. 27	4677.82
		GST component						Rs	284.1 3	852.38
14		Providing and fixing uPVC solvent ceme Charge. 110mm dia	g uPVC ent, tes 6Kgf/c	C pipes sting c cm²- fc	s & fitt of joint or vent	ings incl ts comp pipe	luding jo lete as j	pinting of per direct	pipes wit ion of E	th one step ngineer in
			1	0.4 5			0.45	m		
		Total					0.45	m		
		Say		0.4 5	m		a)	Rs	1222. 73	550.23
		GST component						Rs	222.8 0	100.26
		Total-Grit Separator	and S	creen	Channe	el				₹ 13,64,12 2
		GST component								₹ 2,48,566

# 5.6 EQUALISATION TANK

EQUA	LISAT	TON TANK								
Item No.	Item Cod e	Description	No	L	В	Η	V	Unit	Rate	Amount
1	2.6. 1	Earth work in exc over areas (exceed including getting 1.5 m, as directed	cavatio eding 3 out ar l by Er	on by mech 30 cm in c nd disposa ngineer-in-	anical m lepth, 1. l of exca charge	neans ( 5 m in avated	Hydraul n width earth lea	ic excar as well ad up to	vator)/ma as 10 sq 5 50 m ar	nual means m on plan) d lift up to
		Shape of tank	1	(put 1 for	r rectang	ular a	nd 2 for	circular	.)	
		Equalisation tank	1	11.50	11.5	4.9 5	654.6	m <sup>3</sup>		
		Total					654.6	m <sup>3</sup>		
		Say		654.6	m <sup>3</sup>		@	Rs	213.8 6	140001.3 1
		GST component						Rs	38.97	25510.56
2	4.1. 6	Providing and lay of centering and s sand (zone-III): 6	ring in shutter grade	position ce ing - All v d stone ag	ement co vork up gregate 4	ncrete to plin 40 mm	of speci th level nomina	fied gra : 1:3:6 Il size)	de exclud (1 Cemen	ing the cost t : 3 coarse
		Equalisation tank	1	11.5	11.5	0.1 5	19.84	m <sup>3</sup>		
		Total					19.84	m <sup>3</sup>		
		Say		19.84	m <sup>3</sup>		(a)	Rs	7202	142894.5
		GST component						Rs	1312	26037.75

3	5.37 .1 + 5.34 .1	Providing and la cement concrete approved design to to site of work manufactured as work, including p the cost of cent admixtures in rec of concrete, imp direction of the E is @ 330 kg/ <sup>3</sup> .E separately).	cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying, excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ <sup>3</sup> .Excess/less cement used as per design mix is payable/recoverable separately).										
		For equalisation											
		Bottom slab	1	11.50	11.50	0.4	59.51	m <sup>3</sup>					
		I ong wall	2	10.60	0.30	5 43	27.67	m <sup>3</sup>					
		Long wan	2	10.00	0.50	5	27.07	111					
		Short wall	2	10.00	0.30	4.3 5	26.1	m <sup>3</sup>					
		Top slab	1	10.60	10.60	0.1 5	16.85	m <sup>3</sup>					
		Total					130.1	m <sup>3</sup>					
		Deduction											
		Manhole	1	0.6	0.45	0.1 5	0.04	m <sup>3</sup>					
		Total					0.04	m <sup>3</sup>					
		Total after deduction					130.1	m <sup>3</sup>					
		Say		130.09	m <sup>3</sup>		@	Rs	9956	1295215. 77			
		GST						Rs	1814. 20	236009.7 9			
4	5.22 .6	Epoxy coated ste bending, placing Mechanically Tre	el rein in pos eated b	forcement sition and ars of grad	for R.C binding le Fe-50	C.C. w g all co 0D or 1	ork inclu omplete more.	uding st upto p	traighteni linth leve	ng, cutting, l. Thermo-			
		Quantity as per item No.3	1		130.0 9	m <sup>3</sup>	120	kg/ m <sup>3</sup>	15610 .8	kg			
		Total							15610 .8	kg			
		Say		15611	kg		a)	Rs	98.17	1532528. 23			
		GST component						Rs	17.89	279252.0 6			
5	4.12	Extra for providi doses by weight	ng and of cem	mixing went as per	vater pro manufac	ofing : turer's	material specific	in cem ation.	ent concr	ete work in			
		Quantity as per 1130.0 $m^3$ 340kg/44230kg $9$ $m^3$ $.6$											
		Total							44230 6	kg			
		Say		884.6	bags		a	Rs	66.49	58814.21			
		GST						Rs	12.11	10716.92			
6	59	component Centering and sh	utterin	g includin	a strutti	ng pr	nning a	te and	removal	of form for			
	1.9.	:Foundations, for	otings,	bases of co	olumns,	etc. fo	r mass c	oncrete	removal				

		D 11	•			0.4		า		
		Bottom slab	2	23		0.4 5	20.70	m²		
		Total					20.70	m <sup>2</sup>		
		Say		20.70	m <sup>2</sup>		@	Rs	334.9 0	6932.4
		GST						Rs	61.02	1263.2
7	5.0	component	uttorin	a includin	a strutti		nning	to and	romoval	of form for
/	2	:Walls (any thic	kness)	including	g attache	ed pila	isters, b	uttresse	s, plinth	and string
		For walls outside	2	21.20		4.3 5	184.4 4	m <sup>2</sup>		
		For walls inside	2	20.00		4.3 5	174.0 0	m <sup>2</sup>		
		Total					358.4 4	m <sup>2</sup>		
		Say		358.44	$m^2$		@	Rs	716.3 5	256770.1 3
		GST component						Rs	130.5 3	46787.78
8	5.9. 3	Centering and sh :Suspended floors	utterin s, roofs	g includin s, landings	g struttin, balconi	ng, pro ies and	opping e l access	tc. and platform	removal n	of form for
		Top slab	1	21.2		0.1 5	3.18	m <sup>2</sup>		
		Bottom portion	1	10.00	10		100.0 0	m <sup>2</sup>		
		Total					103.1 8	m <sup>2</sup>		
		Say		103.18	$m^2$		@	Rs	814.8 2	84073.08
		GST component						Rs	148.4 7	15319.51
9	3.1	Providing and a waterproofing tre water tanks, roof subway and bridg crystalline slurry crystalline slurry negative (internal the requirements concrete by more resistant to 16 ba be capable of set carried out all co charge. The proof leakage. For verti	pplyin atmen slabs, ge deck : 2 p : 1 pa ) side as spo e than r hydr lf-heal omplet duct po ical sur	g integral t to the R0 podiums, i a etc., prep arts water rt water) f with the ho ecified in 90% com ostatic pre ing of cra e as per s erformance face two o	crystal CC struc reservoir pared by : ) for ver or horize elp of syn ACI212 pared w ssure on cks up t pecificat e shall o coats @ (	tures 1 , sewa mixing rtical sontal sontal sontal sontal sontal sonthetic -3R-20 ith con negat o a wittion an carry sontal sontal sontal 0.70 k	iturry of ike retai ge & wa g in the r surfaces urfaces fibre br 010 i.e b ntrol cor ive side. idth of ( nd the d guarante g per squ	hydroj ning wa ter treat and 3 and app rush. Th by reduc nerete a . The cr 0.50mm lirection e for 1 m	philic in alls of the tment plan 5 : 2 (5 pa : 1 (3 pa lying the e materia cing pern s per DIN ystalline . The wo of the e 0 years a	nature for e basement, nt, tunnels / arts integral rts integral same from l shall meet neability of N 1048 and slurry shall ork shall be engineer-in- against any
		Inside of walls	2	20		4.3 5	174	m <sup>2</sup>		
		Total					174	m <sup>2</sup>		
		Say		174	m <sup>2</sup>		@	Rs	569.5 7	99104.88
		GST component						Rs	103.7 8	18058.55

10	22.2 3.2	Providing and a waterproofing tree water tanks, roof subway and bridg crystalline slurry crystalline slurry negative (internal the requirements concrete by more resistant to 16 ba be capable of sel carried out all co charge. The proof leakage, For horiz	waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fibre brush. The material shall meet the requirements as specified in ACI212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in- charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.										
		Bottom slab inside	1	10	10		100	m <sup>2</sup>					
		Total					100	m <sup>2</sup>					
		Say		100	m <sup>2</sup>		@	Rs	439.0 1	43900.67			
		GST component						Rs	79.99	7999.43			
11	13.7	12 mm cement pl	2 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3										
	.1	fine sand)	ine sand)										
		Inside of walls	2	20.0		4.3 5	174	m <sup>2</sup>					
		Base slab inside	1	10	10		100	$m^2$					
		Top slab bottom	1	10	10		100	$m^2$					
		Total					374	m <sup>2</sup>					
		Deduction											
		Manhole	1	0.6	0.45		0.27	m <sup>2</sup>					
		Total					0.27	m <sup>2</sup>					
		Total after deduction					373.7	m <sup>2</sup>					
		Say		373.7	m <sup>2</sup>		@	Rs	400.7 4	149767.6 8			
		GST component						Rs	73.02	27290.16			
12	2.25	Filling available foundations etc. i layer by ramming	excav n layer g and w	vated earth rs not exce vatering, le	h (exclu eding 20 ead up to	ding )cm in 50 m	rock) in depth, c and lift	trench consolid up to 1.	nes, plint lating eac 5 m.	h, sides of h deposited			
		Quantity as per item 1	1				654.6	m3					
		Deductions											
		PCC	1				19.84	m3					
		Bottom slab	1				59.51 100 7	m3					
		Tank	1				488.7	m3					
		Top slab	1				16.85	m3					
		Quantity after deductions	1	(0.7	2		69.7	m3	0.50.0	17000.0			
		Say		69.7	m		(a)	Rs	258.2 4	17992.8			
		GST						Rs	47.06	3278.59			
		component											
					83								

13	19.1 8.1	Supplying and fix C.I. cover (light c	ting C. luty) th	I. cover wi ne weight o	thout fra	me for ver to	r manhol be not le	es :455: ess than	x610 mm 23 kg	rectangular
			1				1	No.		
		Say		1	No.		a)	Rs	1559. 27	1559.27
		GST component						Rs	284.1 3	284.13
14		Providing and fix uPVC solvent ce Charge. 110mm c	ting uP ement, lia 6Kg	VC pipes testing of gf/cm <sup>2</sup> - for	& fitting joints vent pij	gs inclu compl pe	uding joi ete as p	inting o er direc	f pipes w ction of I	ith one step Engineer in
			1	0.45			0.45	m		
		Total					0.45	m		
		Say		0.45	m		@	Rs	1222. 73	550.23
		GST component						Rs	222.8 0	100.26
		Total Equalisation	n Tank	[						₹ 38,30,105
		GST component								₹ 6,97,909

## **5.7 DILUTION TANK**

DILUI	DILUTION TANK FOR CO-TREATMENT-rectangular											
Item No.	Item Code	Description	No	L	В	Н	V	Unit	Rate	Amount		
1	2.6.1	Earth work in excav over areas (exceeding including getting ou 1.5 m, as directed b	ration ng 30 ut and y Eng	by mech cm in c disposa ineer-in-	anical n lepth, 1 l of exc charge	neans ( .5 m i avated	(Hydraul n width l earth le	ic excav as well ad up to	vator)/mar as 10 sqr 50 m an	nual means m on plan) d lift up to		
		Dilution tank	1	7.50	5.50	4.1 0	169.1	m <sup>3</sup>				
		Total					169.1	m <sup>3</sup>				
		Say		169.1	m <sup>3</sup>		(a)	Rs	213.86	36170.14		
		GST component						Rs	38.97	6590.8		
2	4.1.6	Providing and layin cost of centering an coarse sand (zone-I	ng in p nd shu II): 6 g	oosition ttering - graded s	cement All wo tone agg	concr rk up gregate	ete of sp to plinth e 40 mm	ecified level : nomina	grade exe 1:3:6 (1 e 11 size)	cluding the Cement : 3		
		Dilution tank	1	7.50	5.50	0.1 5	6.19	m <sup>3</sup>				
		Total					6.19	m <sup>3</sup>				
		Say		6.19	m <sup>3</sup>		a	Rs	7202.3 4	44582.51		
		GST component						Rs	1312.3 9	8123.67		

3	5.37. 1 + 5.34. 1	Providing and layin cement concrete w approved design mi to site of work in manufactured as pe work, including put the cost of centeri admixtures in recorr of concrete, improv direction of the Eng is @ 330 kg/ <sup>3</sup> .Excu separately).	cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ <sup>3</sup> .Excess/less cement used as per design mix is payable/recoverable separately).											
-		Dilution tank Bottom slab	1	7.50	5.50	0.4	18.56	m <sup>3</sup>						
		Long wall	2	6.60	0.30	5 3.3	13.27	m <sup>3</sup>						
		Short wall	2	4 00	0.30	5	8 04	m <sup>3</sup>						
		Short wan	2	<b>4.00</b>	0.50	5	0.04	111						
		Top slab	1	6.60	4.60	0.1 5	4.55	m'						
		Total	Yotal     44.42     m <sup>3</sup>											
		Deduction	1	0.6	0.45	0.1	0.04	m <sup>3</sup>						
						5	0.04	3						
		Total after					0.04	$m^3$						
		deduction					50	111						
		Say		44.38	m <sup>3</sup>		@	Rs	9956.3 1	441860.8 3				
		GST component						Rs	1814.2 0	80514.37				
4	5.22. 6	Epoxy coated steel bending, placing in Mechanically Treat	reinfo posit ed bar	orcement tion and rs of grac	for R.0 binding le Fe-50	C.C. w g all c 00D or	ork inclusion inclusion inclusion in the second sec	uding st upto p	raightenin linth leve	ng, cutting, l. Thermo-				
		Quantity as per item No.3	1		44.3 8	m <sup>3</sup>	120	kg/m	5325.6	kg				
		Total		5006			0	D	5325.6	kg				
		Say		5326	кg		<u>a</u>	Ks	98.17	522819.6 1				
		GST component						Rs	17.89	95266.4				
5	4.12	Extra for providing doses by weight of	and n	nixing w nt as per	ater pro manufa	oofing cturer	material 's specifi	in cem cation.	ent concre	ete work in				
		Quantity as per item No.3	1		44.3 8	m <sup>3</sup>	340	kg/m	15089. 2	kg				
		Total							15089. 2	kg				
		Say         301.8         bags         @         Rs         66.49         20064.38												
		GST component						Rs	12.11	3656.06				
6	5.9.1	Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete												
		Bottom slab	2	13.00		0.4 5	11.70	m <sup>2</sup>						
		Total					11.70	m <sup>2</sup>						

		Say		11.70	m <sup>2</sup>		$\widehat{a}$	Rs	334.90	3918.31
		GST component		11170			U	Rs	61.02	713.98
7	5.9.2	Centering and shutt :Walls (any thicknow courses etc.	ering ess) ir	includin 1cluding	g strutti attache	ing, pr ed pila	opping e isters, bi	etc. and atteresse	removal o es, plinth	of form for and string
		For walls outside	2	11.20		3.3 5	75.04	m <sup>2</sup>		
		For walls inside	2	10.00		3.3 5	67.00	m <sup>2</sup>		
		Total					142.0 4	m <sup>2</sup>		
		Say		142.0 4	m <sup>2</sup>		@	Rs	716.35	101751
		GST component						Rs	130.53	18540.72
8	5.9.3	Centering and shutt Suspended floors, r	ering oofs, l	includin andings,	g strutti balcon	ing, proies and	opping e d access	tc. and platform	removal o n	of form for:
		Top slab	1	11.2		0.1 5	1.68	m <sup>2</sup>		
		Bottom portion	1	6.00	4.00		24.00	m <sup>2</sup>		
		Total					25.68	m <sup>2</sup>		
		Say		25.68	m <sup>2</sup>		(a)	Rs	814.82	20924.56
		GST component						Rs	148.47	3812.8
9	22.2 3.1	Providing and app waterproofing treats water tanks, roof sla / subway and bridge crystalline slurry : 1 negative (internal) si the requirements as concrete by more the resistant to 16 bar he be capable of self- carried out all com- charge. The product	lying ment t abs, po deck 2 part ide wi speci han 90 hydros healin plete ct pert il surfa	integral to the RC odiums, f etc., prep ts water) for the the he fied in 20% comp tatic pre g of crace as per s formance	crysta CC struct reservoir pared by or horiz elp of sy ACI212 pared w ssure of cks up pecificate e shall coats @	lline s ctures ir, sew y mixin ertical ontal s ontal s ontal s ontheti- -3R-20 vith co n nega to a w ation a carry 0.70 l	slurry of like retain age & wong in the surfaces c fibre br 010 i.e. Introl con- tive side ridth of ( nd the d guarantee kg per sq	hydroj ining wa ater trea ratio of and 3 and app ush. Th by redu ncrete a . The cr 0.50mm lirection the for 1 m	philic in alls of the atment pla 5 : 2 (5 pa : 1 (3 pa olying the e material cing perm s per DIN systalline s the two of the en 0 years a	nature for basement, ant, tunnels arts integral same from shall meet neability of 1048 and slurry shall rk shall be ngineer-in- gainst any
		Inside of walls	2	10.00		3.3 5	67	m <sup>2</sup>		
		Total		(7	2		67	m <sup>2</sup>	5 (0.55	20161.00
		Say		67	m²		(a)	Rs	569.57	38161.08
		GST component						Rs	103.78	6953.58

10	22.2 3.2	Providing and app waterproofing treat water tanks, roof sla / subway and bridge crystalline slurry : negative (internal) s the requirements as concrete by more t resistant to 16 bar h be capable of self- carried out all com charge. The produc	waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of $5:2$ (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and $3:1$ (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fibre brush. The material shall meet the requirements as specified in ACI212-3R-2010 i.e. by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-incharge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.											
		Bottom slab inside	1	6.00	4.00		24	m <sup>2</sup>						
		Total					24	m <sup>2</sup>						
		Say		24	m <sup>2</sup>		(a)	Rs	439.01	10536.16				
		GST component					0	Rs	79.99	1919.86				
11	13.7.	12 mm cement plas	ter fin	ished wi	th a flo	ating c	oat of ne	eat ceme	ent :1:3 (1	cement : 3				
	1	fine sand)				0			- (	-				
		Inside of walls	2	10.0		3.3 5	67	m <sup>2</sup>						
		Base slab inside	1	6.00	4.00	C	24	m <sup>2</sup>						
		Top slab bottom	1	6	4		24	m <sup>2</sup>						
		Total					115	m <sup>2</sup>						
		Deduction												
		Manhole	1	0.6	0.45		0.27	m <sup>2</sup>						
		Total					0.27	$m^2$						
		Total after deduction					114.7	m <sup>2</sup>						
		Say		114.7	m <sup>2</sup>		a	Rs	400.74	45976.63				
		GST component						Rs	73.02	8377.7				
12	2.25	Filling available e foundations etc. in l layer by ramming a	xcava layers nd wa	ted earth not exce tering, le	n (excl eding 2 ead up t	uding 0cm ir to 50 n	rock) ir n depth, c n and lift	trench consolid upto 1.	nes, plinth lating each 5 m.	n, sides of n deposited				
		Quantity as per item 1	1				169.1	m3						
		Deductions	1				6.10	2						
		PCC	1				6.19	m3						
		Bottom slab	1				18.56	m3						
		Tank	1				101.7 1	m3						
		Top slab	1				4.55	m3						
		Quantity after deductions	1				38.1	m3						
		Say		38.1	m <sup>3</sup>		(a)	Rs	258.24	9845.24				
		GST component						Rs	47.06	1793.97				
13	19.1 8.1	Supplying and fix rectangular C.I. cov	ting C ver (lig	C.I. cove ght duty)	er with the we	out fiight of	rame for for the cove	r manh er to be	oles :455 not less th	5x610 mm nan 23 kg				
			1				1	No.						
		Say		1	No.		@	Rs	1559.2 7	1559.27				

	GST component						Rs	284.13	284.13			
14	Providing and fixing uPVC pipes & fittings including jointing of pipes with uPVC solvent cement, testing of joints complete as per direction of Eng Charge. 110mm dia 6Kgf/cm <sup>2</sup> - for vent pipe											
		1	0.45			0.45	m					
	Total					0.45	m					
	Say		0.45	m		@	Rs	1222.7 3	550.23			
	GST component						Rs	222.80	100.26			
	Total Dilution Tank								₹ 12,98,72 0			
	GST component								₹ 2,36,648			

### 5.8 MBBR TANK FOR BOD REMOVAL

MOV	ING BEI	D BIOFILM REA	<b>CTO</b>	R TANK	-BOD I	REMO	VAL			
Ite m No.	Item Code	Description	No	L	В	Η	V	Unit	Rate	Amount
		Shape of tank	1	(put 1 f	or recta	ngular	and 2 fo	r circula	ur)	
1	2.6.1	Earth work in ex over areas (exc including gettin 1.5 m, as direct	xcavat eeding ng out ed by ]	ion by m g 30 cm and disp Engineer	echanic in depth osal of -in-chai	al mea n, 1.5 n excava rge	ns (Hydr m in wid ated earth	aulic exe th as w n lead u	cavator)/ma ell as 10 sc p to 50 m a	anual means am on plan) and lift upto
		MBBR Tank- base	1	8.90	8.90	0.9 0	71.29	m <sup>3</sup>		
		Total					71.29	m <sup>3</sup>		
		Say		71.29	m <sup>3</sup>		(a)	Rs	213.86	15246.08
		GST component						Rs	38.97	2778.09
2	7.1.1	Random rubble up with cement	maso	nry in ha ete 1:6:1	urd ston 2 up to	e in fo plinth	undation level wit	and pli h cemer	nth includi at mortar 1:	ng levelling 6
		MBBR Tank- base	1	8.90	8.9	0.9 0	71.29	m <sup>3</sup>		
		Total					71.29	m <sup>3</sup>		
		Say		71.29	m <sup>3</sup>		@	Rs	7196.2	513019.2 4
		GST component						Rs	1311.3	93480.61
3	4.1.6	Providing and l cost of centerin coarse sand (zor	aying Ig and ne-III)	in positi shutterir : 6 grade	on cem ng - All ed stone	ent cor work aggreg	ncrete of up to pli gate 40 n	specifient of the specifient o	ed grade ex el: 1:3:6 (1 inal size)	Cement : 3
		MBBR tank- base	1	8.90	8.9	0.1 5	11.88	m <sup>3</sup>		
		Total					11.88	m <sup>3</sup>		
		Say		11.88	m <sup>3</sup>		@	Rs	7202.34	85563.84
		GST component						Rs	1312.39	15591.15

4	5.37.1 + 5.34.1	cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying, excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ <sup>3</sup> .Excess/less cement used as per design mix is payable/recoverable separately).												
		Base slab	1	8.90	8.90	0.3 5	27.72	m <sup>3</sup>						
		Tank walls	2	15.40	0.30	4.1 0	37.88	m <sup>3</sup>						
		Total					65.61	m <sup>3</sup>						
		Say		65.61	m <sup>3</sup>		@	Rs	9956.31	653208.3 1				
		GST component						Rs	1814.20	119025.3 9				
5	5.22.6	Epoxy coated s bending, placin Mechanically T	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete up to plinth level. Thermo- Mechanically Treated bars of grade Fe-500D or more.											
		Quantity as per item No.2	$\begin{array}{c c c c c c c c c c c c c c c c c c c $											
		Total					_		7872.9	kg				
		Say		7873	kg		@	Rs	98.17	772890.6 6				
		GST component						Rs	17.89	140833.5				
6	4.12	Extra for provid doses by weigh	ling ant tof ce	nd mixing ment as j	g water per man	proofi ufactu	ng mater rer's spec	rial in ce	ement conci n.	rete work in				
		Quantity as per item No.2	1		65.6 1	m <sup>3</sup>	340	kg/m	22306.5 5	kg				
		Total							22306.5 5	kg				
		Say		446.1	bags		a	Rs	66.49	29661.41				
		GST component						Rs	12.11	5404.8				
7	5.9.1	Centering and s Foundations, fo	hutter ooting	ing inclu s, bases o	ding str of colun	rutting, nns, et	, proppin c. for ma	g etc. ai ss concr	nd removal rete	of form for				
		Bottom slab	2	17.80		0.3 5	12.46	m <sup>2</sup>						
		Total					12.46	$m^2$						
		Say	Say 12.46 m <sup>2</sup> @ Rs 334.90 4172.83											
		GST component						Rs	61.02	760.36				
8	5.9.2	Centering and s :Walls (any thi courses etc.	hutter	ing inclu s) includ	ding str ling att	rutting, ached	, proppin pilasters	g etc. ai , buttres	nd removal sses, plinth	of form for and string				
		For walls outside	2	16.00		4.1 0	131.2 0	m <sup>2</sup>						

		For walls	2	14.80		4.1	121.4	m <sup>2</sup>		
		Total				0	252.5	m <sup>2</sup>		
		Sav		252.5	$m^2$		6	Re	716 35	180922.5
		Say		6	111		W	IXS	/10.55	180922.5
		GST component						Rs	130.53	32967.08
9	22.23.	Providing and waterproofing t water tanks, roo / subway and br crystalline slurr negative (intern the requirement concrete by mo resistant to 16 b be capable of s carried out all charge. The pro- leakage. For ver-	apply reatme of slabs idge do y : 2 y : 1 p al) sid s as sp re that oar hyce elf-heat compli- oduct rtical s	ing integent to the s, podium eck etc., parts water e with th pecified n 90% c drostatic aling of ete as per performa-	gral cry RCC s ns, reserved prepared ter) for r) for ho e help o in ACL ompared pressure cracks of er speci- ance sh wo coats	stallin tructur cvoir, s d by m vertic orizont f synth 212-3R d with e on ne up to a fication all car	e slurry es like re ewage & ixing in t cal surface etic fibre 2-2010 i.4 control o egative si a width o n and the ry guara 70 kg per	of hyd etaining water t he ratio ces and es and a brush." e. by re- concrete de. The of 0.50n e direction ntee for	rophilic in walls of the reatment pl of 5 : 2 (5 p 3 : 1 (3 pa pplying the The materia ducing perf e as per DII crystalline m. The wo on of the e	nature for e basement, ant, tunnels arts integral arts integral e same from al shall meet meability of N 1048 and slurry shall ork shall be engineer-in- against any
		Inside of walls	2	14.80	vo cour	4.1	121.3	m <sup>2</sup>		
		Total				0	121.3	m <sup>2</sup>		
		Say		121.3 6	m <sup>2</sup>		<i>a</i>	Rs	569.57	69122.81
		GST						Rs	103.78	12595.32
10	22.23. 2	Providing and waterproofing t water tanks, roc / subway and br crystalline slurr negative (intern the requirement concrete by mo resistant to 16 b be capable of s carried out all charge. The pro- leakage. For ho	apply reatme of slabs idge de y : 2 y : 1 p al) sid s as sp re that oar hyce elf-heat comple oduct rizonta	ing integent to the s, podium eck etc., parts way oart wates e with th pecified n 90% c lrostatic aling of ete as per performant	gral cry RCC s ns, reserved prepared tter) for the help o in ACI2 ompared pressured cracks to er speci ance sh e one co	stallin tructur cvoir, s d by m vertic prizont f synth 212-3R d with e on ne up to a fication all car at @1	e slurry es like re ewage & ixing in t cal surfac etic fibre control o control o cative si a width c n and the ry guara	of hyd etaining water t he ratio ces and es and a brush.' e. by re- concrete de. The of 0.50n e direction nte for r sqm.	rophilic in walls of the reatment pl of $5: 2$ (5 p 3: 1 (3 pa pplying the The materia ducing perfection e as per DII crystalline in. The wo on of the e	nature for e basement, ant, tunnels arts integral e same from al shall meet neability of N 1048 and slurry shall ork shall be engineer-in- against any
		Bottom slab	1	7.40	7.4		54.76	m <sup>2</sup>		
		Total					54.76	m <sup>2</sup>		
		Say		54.76	$m^2$		(a).	Rs	439.01	24040.01
		GST component						Rs	79.99	4380.49
11	13.7.1	12 mm cement fine sand)	plaster	finished	l with a	floatin	g coat of	neat ce	ment :1:3 (1	l cement : 3
		Inside of walls	2	14.80		4.1 0	121.3 6	m <sup>2</sup>		
		Base slab	1	7.40	7.4		54.76	m <sup>2</sup>		

Total			176.1 2	m <sup>2</sup>		
Say	176.1 2	m <sup>2</sup>	@	Rs	400.74	70577.91
GST component				Rs	73.02	12860.47
Total-MBBR T	ank-1					₹ 24,18,426
GST component						₹ 4,40,677

# 5.9 MBBR TANK FOR NITRIFICATION

MOV	ING BED	BIOFILM REA	ACTO	OR TANI	K- NITF	RIFICA	TION			
Item No.	Item Code	Description	No	L	В	Η	V	Unit	Rate	Amount
		Shape of tank	1	(put 1 f	or recta	ngular	and 2 for	r circular	)	
1	2.6.1	Earth work in means over an plan) including up to 1.5 m, as	n exc eas (e g getti s direc	avation 1 xceeding ing out an eted by En	by mee 30 cm nd dispo ngineer-	hanica in dep osal of in-cha	l means th, 1.5 m excavate rge	(Hydrau in widtl d earth l	llic excavat n as well as ead up to 50	or)/manual 10 sqm on ) m and lift
		MBBR Tank-base	1	9.95	9.95	0.6 5	64.35	m <sup>3</sup>		
		Total					64.35	m <sup>3</sup>		
		Say		64.35	m <sup>3</sup>		a	Rs	213.86	13761.89
		GST component						Rs	38.97	2507.64
2	7.1.1	Random rubbl up with cemen	e mas it cone	onry in l crete 1:6:	hard stor 12 up to	ne in f plinth	oundation	n and pli ith cemer	nth includir nt mortar 1:0	ng levelling 6
		MBBR Tank-base	1	9.95	9.95	0.6 5	64.35	m <sup>3</sup>		
		Total					64.35	m <sup>3</sup>		
		Say		64.35	m <sup>3</sup>		(a)	Rs	7196.2	463077.4
		GST component						Rs	1311.3	84380.38
3	4.1.6	Providing and cost of centeri coarse sand (ze	layin ng an one-Il	g in posi d shutter I): 6 grac	tion cer ing - Al led ston	nent co l work e aggro	oncrete o up to pl egate 40	f specifie inth leve mm nom	ed grade ex 1 : 1:3:6 (1 iinal size)	cluding the Cement : 3
		MBBR tank- base	1	9.95	9.95	0.1 5	14.85	m <sup>3</sup>		
		Total					14.85	m <sup>3</sup>		
		Say		14.85	m <sup>3</sup>		(a)	Rs	7202.34	106954.8
		GST component						Rs	1312.39	19488.94

4	5.37.1 + 5.34.1	cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying, excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ <sup>3</sup> .Excess/less cement used as per design mix is payable/recoverable separately).											
		Base slab	1	9.95	9.95	0.3 5	34.65	m <sup>3</sup>					
		Tank walls	2	17.50	0.30	4.1 0	43.05	m <sup>3</sup>					
		Total					77.70	m <sup>3</sup>					
		Say		77.70	m <sup>3</sup>		a	Rs	9956.31	773613.6 4			
		GST component						Rs	1814.20	140965.2 4			
5	5.22.6	Epoxy coated bending, placi Mechanically	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.										
		Quantity as per item No.2	1		77.7 0	m <sup>3</sup>	120	kg/m <sup>3</sup>	9324.10 5	kg			
		Total							9324.10 5	kg			
		Say		2738	kg		@	Rs	98.17	268792.2 6			
		GST component						Rs	17.89	48978.41			
6	4.12	Extra for prov doses by weig	iding ht of o	and mixi cement as	ng wate s per ma	r proot inufact	fing mate urer's spe	erial in ce ecificatio	ment concr n.	ete work in			
		Quantity as per item No.2	1		77.7 0	m <sup>3</sup>	340	kg/m <sup>3</sup>	26418.2 9	kg			
		Total							26418.2 9	kg			
		Say		528.3 7	bags		a	Rs	66.49	35128.88			
		GST component						Rs	12.11	6401.06			
7	5.9.1	Centering and :Foundations,	shutte footin	ering incl ngs, bases	luding s s of colu	trutting mns, e	g, proppi etc. for m	ng etc. ai ass conci	nd removal rete	of form for			
		Bottom slab	2	19.90		0.3 5	13.93	m <sup>2</sup>					
		Total	Total 13.93 m <sup>2</sup>										
		Say	bay 13.93 m <sup>2</sup> @ Rs 334.90 4665.13										
		GST component						Rs	61.02	850.06			
8	5.9.2	Centering and :Walls (any th courses etc.	shutte	ering incl ess) inclu	luding s iding at	trutting tached	g, proppi pilasters	ng etc. an , buttere	nd removal sses, plinth	of form for and string			

		For walls	2	18.10		4.1	148.4	m <sup>2</sup>		
		outside	2	16.00		0	2	2		
		For walls inside	2	16.90		4.1 0	138.6	m²		
		Total					287.0 0	m <sup>2</sup>		
		Say		287.0 0	m <sup>2</sup>		@	Rs	716.35	205593.7 6
		GST component						Rs	130.53	37462.59
9	22.23. 1	Providing and waterproofing water tanks, ro / subway and integral crysta integral crysta same from ne material shall reducing perm concrete as per side. The crys of 0.50mm. The direction of the for 10 years ag	l appl treatm of sla bridg lline s gative meet neabil tr DIN talline ne wo e engigainst	ying intenent to the bs, podiuse deck essiurry : 2 slurry : 2 slurry : 1 e (international the receiption of con- ity of con- ity of con- ity of con- ity of con- slurry state rk shall the neer-in-co- any leaka	egral er ne RCC ums, reso tc., prep 2 parts 2 part w al) side juiremen oncrete nd resist hall be o be carrie charge. 7	ystallin structur ervoir, pared b water) f with nts as by m ant to capable ed out a The pro- vertic	ne slurry vires like i sewage & oy mixin for verti or horizo the help specifie ore than 16 bar h e of self- all compl oduct per al surface	y of hyd retaining & water t g in the cal surfa ontal surf of synth d in AC 90% co ydrostation healing co ete as per formance e two coa	rophilic in walls of the reatment pla ratio of 5 : ces and 3 : faces and ap netic fibre I212-3R-20 ompared w c pressure of f cracks up r specificat e shall carry ats @ 0.70 k	nature for basement, ant, tunnels 2 (5 parts 1 (3 parts oplying the brush. The 010 i.e. by ith control on negative to a width ion and the y guarantee ag per sqm
		Inside of	2	16.90		4.1	138.5	m <sup>2</sup>		-811
		Total				0	8 138.5 8	m <sup>2</sup>		
		Say		138.5 8	m <sup>2</sup>		@	Rs	569.57	78930.77
		GST component		-				Rs	103.78	14382.5
10	22.23. 2	Providing and waterproofing water tanks, ro / subway and integral crystal integral crystal same from ne material shall reducing perm concrete as per side. The cryst of 0.50mm. The direction of the for 10 years age	l appl treatm of sla bridg lline s gative meet neabil tr DIN talline ne wo e engi gainst	ying intenent to the bs, podiu e deck e slurry : 2 slurry : 1 e (international the receiption ity of control 1048 are slurry si rk shall be neer-in-control	egral er ne RCC ums, rese tc., prep 2 parts v al) side part w al) side puiremen oncrete nd resist hall be o be carrie charge. To	ystallin structur ervoir, pared b water) f with nts as by m ant to capable ed out a The pro-	ne slurry res like r sewage & oy mixin for verti or horizo the help specified ore than 16 bar h e of self- all compl oduct per maal surfa	y of hyd retaining & water t g in the cal surfa ontal surf of synth d in AC 90% co ydrostati- healing c ete as pe formance	rophilic in walls of the reatment pla ratio of 5 : ces and 3 : faces and a netic fibre 1212-3R-20 compared w c pressure of f cracks up r specificat e shall carry oat @1.101	nature for basement, ant, tunnels 2 (5 parts 1 (3 parts oplying the brush. The 10 i.e. by ith control on negative to a width ion and the g guarantee kg per sqm.
		Bottom slab	1	8.45	8.45		71.40	m <sup>2</sup>		
		Total					71.40	m <sup>2</sup>		
		Say		71.40	m <sup>2</sup>		a	Rs	439.01	31346.18
		GST component						Rs	79.99	5711.79
11	13.7.1	12 mm cemen 3 fine sand)	t plast	er finish	ed with	a float	ing coat	of neat c	ement :1:3	(1 cement :
		Inside of walls	2	16.90		4.1 0	138.6	m <sup>2</sup>		
					93					

	Base inside	slab	1	8.45	8.45	71.40	m <sup>2</sup>		
	Total					210	m <sup>2</sup>		
	Say			210	m <sup>2</sup>	(a)	Rs	400.74	84147.89
	GST compon	ent					Rs	73.02	15333.14
	Total-M	IBBR 1	Tank-	2					₹ 20,66,01 3
	GST compon	ent							₹ 3,76,462

# 5.10 MBBR TANK FOR DE-NITRIFICATION

MOV	ING BEI	D BIOFILM REA	ACTO	R TANI	K- POS'	T ANC	DXIC DE	-NITRIFI	CATION	
Ite m No.	Item Code	Description	No	L	В	Η	V	Unit	Rate	Amount
		Shape of tank	1	(put 1 f	or recta	ngular	and 2 fo	r circular)	)	
1	2.6.1	Earth work in e over areas (exc including gettin 1.5 m, as direct	xcava ceedin ng out ced by	tion by n g 30 cm and disp Enginee	nechani in dep posal of er-in-cha	cal me th, 1.5 f excav arge	ans (Hyd m in wi rated eart	raulic exc dth as we h lead up	avator)/ma 11 as 10 sq to 50 m ar	nual means m on plan) Id lift up to
		MBBR Tank- base	1	6.90	6.9	0.6 5	30.95	m <sup>3</sup>		
		Total					30.95	m <sup>3</sup>		
		Say		30.95	m <sup>3</sup>		a	Rs	213.86	6618.97
		GST component						Rs	38.97	1206.09
2	7.1.1	Random rubble up with cement	e maso t conc	onry in h rete 1:6:	ard stor 12 up to	ne in f o plinth	oundation level wi	n and plin th cement	th includint t mortar 1:6	ig levelling
		MBBR Tank- base	1	6.90	6.9	0.6 5	30.95	m <sup>3</sup>		
		Total					30.95	m <sup>3</sup>		
		Say		30.95	m <sup>3</sup>		@	Rs	7196.2	222723.3 2
		GST component						Rs	1311.3	40583.88
3	4.1.6	Providing and cost of centerin coarse sand (zo	laying ng anc ne-III	g in posit l shutteri l): 6 grad	tion cen ng - Al led ston	nent co l work e aggro	oncrete o up to pl egate 40	f specifie inth level mm nomi	d grade exe : 1:3:6 (1 nal size)	cluding the Cement : 3
		MBBR tank- base	1	6.9	6.9	0.1 5	7.14	m <sup>3</sup>		
		Total					7.14	m <sup>3</sup>		
		Say		7.14	m <sup>3</sup>		@	Rs	7202.34	51424.73
		GST component						Rs	1312.39	9370.44

4	5.37.1 + 5.34.1	Providing and cement concrete approved desit transported to a mixer, manufa concrete work, excluding the cost of admixtu setting of concrete as per direction this item is payable/recover	laying te wo gn n site of ctured inclu cost o tres in rete, i n of th @ 3 rable	g in posi ork, usin nix, mar work in l as per ding pur f centeri recomm mprove he Engin 30 kg/ <sup>3</sup> separatel	tion rea g Sulph nufactur transit mix des nping o ng, shu ended p workab eer-in-c .Excess y).	dy mix nate R red in mixer sign of f R.M. ttering proport ility w charge. /less	xed M-30 esistant fully a for all le f specifie C. from finishin ions as p ithout in (Note :- cement	0 grade c Cement ( automatic ads, havir ed grade f transit m g and rein er IS : 91( npairing s Cement used as	oncrete for (SRC) cont batching ng continuo for reinford ixer to site nforcement 03 to accele trength and content co per desig	reinforced tent as per plant and ous agitated ced cement of laying , , including trate/ retard d durability nsidered in gn mix is		
		Base slab	1	6.9	6.9	0.3	16.66	m <sup>3</sup>				
		Cover slab with central beam	1	6.00	6.00	0.1 5	5.40	m <sup>3</sup>				
		Central beams of cover slab	2	5.4	0.3	0.3	0.97	m <sup>3</sup>				
		Tank walls	2	11.40	0.30	4.1 0	28.04	m <sup>3</sup>				
		Total					51.08	m <sup>3</sup>				
		Say		51.08	m <sup>3</sup>		(a)	Rs	9956.31	508563.1		
		GST						Rs	1814.20	92668.63		
5	5.22.6	Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete up to plinth level. Thermo- Mechanically Treated bars of grade Fe-500D or more.										
		Quantity as per item No.2	Quantity as 1 $51.0$ $m^3$ $120$ $kg/m^3$ $6129.54$ $kg$ per item No.28									
		Total							6129.54	kg		
		Say		2738	kg		(a)	Rs	98.17	268792.2 6		
		GST component						Rs	17.89	48978.41		
6	4.12	Extra for provi	ding a	and mixin ement as	ng wate	r proof nufacti	ing mate	crial in cer	ment concre	ete work in		
		Quantity as	1	ement as	51.0	m <sup>3</sup>	340	kg/m <sup>3</sup>	17367.0	kø		
		per item No.2			8				3	8		
		Total							17367.0 3	kg		
		Say		347.3 4	bags		(a)	Rs	66.49	23093.25		
		GST component						Rs	12.11	4207.97		
7	5.9.1	Centering and Foundations, f	shutte ooting	ring incl gs, bases	uding st of colu	trutting mns, e	g, proppin tc. for ma	ng etc. an ass concre	d removal ete	of form for		
		Bottom slab	2	13.80		0.3 5	9.66	m <sup>2</sup>				
		Total					9.66	m <sup>2</sup>				
		Say		9.66	m <sup>2</sup>		a	Rs	334.90	3235.12		
		GST component						Rs	61.02	589.49		

8	5.9.2	Centering and a :Walls (any the courses etc.	shutte	Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.										
		For walls outside	2	12.00		4.1 0	98.40	m <sup>2</sup>						
		For walls inside	2	10.80		4.1 0	88.6	m <sup>2</sup>						
		Top slab	1	5.40	5.4		29.2	m <sup>2</sup>						
		Top beams	2	5.40		0.9 0	9.7	m <sup>2</sup>						
		Total					225.8 4	m <sup>2</sup>						
		Say		225.8 4	m <sup>2</sup>		@	Rs	716.35	161781.5 1				
		GST component						Rs	130.53	29479.27				
		water tanks, roo / subway and bi crystalline slur crystalline slur negative (interr the requiremen concrete by mo resistant to 16 b be capable of s carried out all charge. The pr leakage. For ve	of slat ridge of ry : 2 ry : 1 hal) sid ts as ore that bar hy self-hat comproduct roduct	os, podiu leck etc., parts w part wate de with the specified an 90% of drostatic ealing of lete as p perform surface t	ms, reso prepare (ater) for er) for h he help of l in AC compare pressu cracks per spec- hance sl two coa	ervoir, ed by n or verti- torizon of synt I212-3 ed with re on n up to ification nall ca ts @ 0	sewage & nixing in cal surfa tal surfa hetic fibr R-2010 in control negative s a width on and th rry guara .70 kg pe	& water tr the ratio of ices and 2 ces and ap e brush. T i.e by red concrete side. The of 0.50m he directio antee for er sqm	eatment pla of 5 : 2 (5 pa 3 : 1 (3 pa oplying the The material ucing perm as per DIN crystalline s m. The wo on of the en 10 years a	ant, tunnels arts integral rts integral same from I shall meet neability of I 1048 and slurry shall rk shall be ngineer-in- ngainst any				
		Inside of walls	2	10.80		4.1 0	88.56	m <sup>2</sup>						
		Top slab	1	5.40	5.4		29.16	$m^2$						
		Top beams	2	5.40		0.9 0	9.7	m <sup>2</sup>						
		Total					127.4 4	m <sup>2</sup>						
		Say		127.4 4	m <sup>2</sup>		@	Rs	569.6	72585.78				
		GST component						Rs	103.8	13226.33				
10	22.23. 2	Providing and waterproofing to water tanks, roo / subway and bin crystalline slur crystalline slur negative (intern the requirement concrete by more resistant to 16 bin be capable of signature carried out all charge. The pro- leakage. For hore	apply treatm of slat ridge of ry : 2 ry : 1 hal) sid ts as ore that bar hy self-he comp roduct	ying inter- ent to thos, podiu deck etc parts we part wate de with the specified an 90% of drostatic ealing of lete as p perform tal surface	egral cr e RCC ms, reso prepare (ater) for er) for h he help of l in AC compare pressu cracks per spec hance sl ce one c	ystallin structu ervoir, ed by n or verti orizon of synt I212-3 ed with re on n up to ification nall ca oat @	ne slurry rres like r sewage & nixing in cal surfa tal surfa hetic fibr R-2010 i n control regative s a width on and th rry guara 1.10 kg p	y of hydr retaining y & water tr the ratio of ces and a ces and a ces and a e brush. T i.e by red concrete side. The of 0.50m he directio antee for er sqm.	ophilic in walls of the eatment pla of 5 : 2 (5 pa 3 : 1 (3 par oplying the The material ucing perm as per DIN crystalline s m. The wo on of the en 10 years a	nature for basement, ant, tunnels arts integral rts integral same from I shall meet neability of V 1048 and slurry shall rk shall be ngineer-in- ngainst any				

		Bottom inside	slab	1	5.40	5.4		29.16	m <sup>2</sup>		
		Total						29.16	m <sup>2</sup>		
		Say			29.16	$m^2$		(a)	Rs	439.01	12801.44
		GST compone	ent						Rs	79.99	2332.63
11	13.7.1	12 mm c 3 fine sau	ement 1d)	plast	er finishe	ed with	a float	ing coat	of neat ce	ement :1:3 (	(1 cement :
		Inside walls	of	2	10.80		4.1 0	88.56	m <sup>2</sup>		
		Base inside	slab	1	5.40	5.4		29.16	m <sup>2</sup>		
		Total						117.7	$m^2$		
		Say			117.7	$m^2$		a	Rs	400.74	47174.84
		GST compone	ent						Rs	73.02	8596.04
		Total-MI	3BR T	`ank-2	2						₹ 13,78,79 4
		GST compone	ent								₹ 2,51,239

# 5.11MBBR TANK FOR BOD REMOVAL AFTER DE-NITRIFICATION

MOVI	NG BEI	O BIOFILM REACT	TOR T	ANK-C	HAMB	ER A	FTER D	E-NITI	RIFICATIC	N	
Item No.	Item Code	Description	No	L	В	Н	V	Unit	Rate	Amount	
		Shape of tank	1 (put 1 for rectangular and 2 for circular)								
1	2.6.1	Earth work in excar over areas (exceed including getting o 1.5 m, as directed b	vation l ing 30 out and by Engi	oy mech cm in c disposal ineer-in-	anical r lepth, 1 l of exc charge	neans .5 m avated	(Hydrau in width l earth le	lic exca as wel ead up t	avator)/man 1 as 10 sqn to 50 m and	ual means n on plan) l lift up to	
		MBBR Tank- base	1	4.85	4.85	0.4 5	10.59	m <sup>3</sup>			
		Total					10.59	m <sup>3</sup>			
		Say		10.59	m <sup>3</sup>		(a)	Rs	213.86	2264.78	
		GST component						Rs	38.97	412.68	
2	7.1.1	Random rubble masonry in hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 up to plinth level with cement mortar 1:6									
		MBBR Tank- base	1	4.85	4.85	0.4 5	10.59	m <sup>3</sup>			
		Total					10.59	m <sup>3</sup>			
		Say		10.59	m <sup>3</sup>		@	Rs	7196.2	76208.0 8	
		GST component						Rs	1311.3	13886.3 8	
3	4.1.6	Providing and layi cost of centering a coarse sand (zone-)	ng in p nd shư III): 6 g	oosition ttering - graded st	cement All wo tone ag	conci ork up gregat	rete of s to plintl e 40 mm	pecified h level h nomin	l grade exc : 1:3:6 (1 C al size)	luding the Cement : 3	
		MBBR tank-base	1	4.85	4.85	0.1 5	3.53	m <sup>3</sup>			
		Total					3.53	m <sup>3</sup>			

		Say		3.53	m <sup>3</sup>		@	Rs	7202.34	25424.2 7
		GST component						Rs	1312.39	4632.72
4	5.37. 1 + 5.34. 1	Providing and layi cement concrete v approved design m to site of work in manufactured as p work, including put the cost of center admixtures in record of concrete, impro direction of the En- is @ 330 kg/ <sup>3</sup> .Exc separately).	ng in p vork, u ix, man transit er mix mping ing, sh mmend ve wor gineer- cess/les	oosition using Su ufacture t mixer design of R.M. uttering ed prop- kability in-charg s cemer	ready r ilphate ed in ful for all of spec .C. fror finish ortions withou ge. (Not at used	mixed Resis Ily auto leads ified g n trans ing an as per at imp e :- Co as pe	M-30 g tant Cer omatic b , having grade for sit mixer nd reinfo IS : 910 airing st ement co r design	rade co ment ( atching contine reinfo to site orceme 3 to acc rength ontent c mix is	oncrete for SRC) conte plant and tr nuous agitat rced cemen of laying , nt, includir celerate/ ret and durabi onsidered in payable/re	reinforced ent as per ransported ted mixer, it concrete excluding ng cost of ard setting lity as per n this item ecoverable
		Base slab	1	4.85	4.85	0.3 5	8.23	m <sup>3</sup>		
		Tank walls	2	7.30	0.30	4.1 0	17.96	m <sup>3</sup>		
		Total					26.19	m <sup>3</sup>		
		Say		26.19	m <sup>3</sup>		@	Rs	9956.31	260764. 35
		GST component						Rs	1814.20	47515.5 9
5	5.22. 6	Epoxy coated steel bending, placing in Mechanically Trea	reinfo n posit ted bar	rcement ion and s of grac	for R. bindin le Fe-5	C.C. w g all o 00D o	vork incl complete r more.	luding s e upto j	straightenin olinth level	g, cutting, . Thermo-
		Quantity as per item No.2	1		26.1 9	m <sup>3</sup>	120	kg/ m <sup>3</sup>	3142.90 5	kg
		Total							3142.90 5	kg
		Say		2738	kg		@	Rs	98.17	268792. 26
		GST component						Rs	17.89	48978.4 1
6	4.12	Extra for providing doses by weight of	g and m	nixing w t as per	ater pro manufa	oofing icturer	materia 's specif	l in cen ication.	nent concre	te work in
		Quantity as per item No.2	1		26.1 9	m <sup>3</sup>	340	kg/ m <sup>3</sup>	8904.89 75	kg
		Total							8904.89 75	kg
		Say		178.1 0	bags		@	Rs	66.49	11841
		GST component						Rs	12.11	2157.63
7	5.9.1	Centering and shut Foundations, footi	tering ngs, ba	includin uses of c	g strutt olumns	ing, pı , etc. f	ropping for mass	etc. and concre	l removal o te	f form for
		Bottom slab	2	9.70		0.4 5	8.73	m <sup>2</sup>		
		Total					8.73	m <sup>2</sup>		
		Say		8.73	m <sup>2</sup>		(a)	Rs	334.9	2923.66
		GST component						Rs	61.0	532.74
8	5.9.2	Centering and shut :Walls (any thickn courses etc.	tering tess) in	includin Icluding	g strutt attach	ing, pi ed pili	ropping asters, b	etc. and outteress	l removal o ses, plinth	f form for and string

For walls inside       2 $6.70$ $4.1$ $54.9$ $m^2$ Total       Total $119.7$ $m^2$ $2$ $m^2$ Say $119.7$ $m^2$ $@$ Rs								
For walls inside       2 $6.70$ $4.1$ $54.9$ $m^2$ Total       119.7 $m^2$ Say       119.7 $m^2$ @       Rs								
Total $119.7$ $m^2$ Say $119.7$ $m^2$ $2$ $@$ Rs								
Say 119.7 m <sup>2</sup> @ Rs 2								
	716.35	85761.9 7						
GST component Rs	130.53	15627.2 5						
<ul> <li>9 22.2 Providing and applying integral crystalline slurry of hydro waterproofing treatment to the RCC structures like retaining w water tanks, roof slabs, podiums, reservoir, sewage &amp; water tre / subway and bridge deck etc., prepared by mixing in the ratio of crystalline slurry : 2 parts water) for vertical surfaces and 3 crystalline slurry : 1 part water) for horizontal surfaces and app negative (internal) side with the help of synthetic fibre brush. Th the requirements as specified in ACI212-3R-2010 i.e. by redu concrete by more than 90% compared with control concrete a resistant to 16 bar hydrostatic pressure on negative side. The crube capable of self-healing of cracks up to a width of 0.50mm carried out all complete as per specification and the direction charge. The product performance shall carry guarantee for 1 leakage. For vertical surface two coats @ 0.70 kg per sqm</li> </ul>	waterproofing treatment to the RCC structures like retaining walls of the bas water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, / subway and bridge deck etc., prepared by mixing in the ratio of $5:2$ (5 parts i crystalline slurry : 2 parts water) for vertical surfaces and $3:1$ (3 parts i crystalline slurry : 1 part water) for horizontal surfaces and applying the sam negative (internal) side with the help of synthetic fibre brush. The material sha the requirements as specified in ACI212-3R-2010 i.e. by reducing permeab concrete by more than 90% compared with control concrete as per DIN 10 resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurr be capable of self-healing of cracks up to a width of 0.50mm. The work s carried out all complete as per specification and the direction of the engine charge. The product performance shall carry guarantee for 10 years again leakage. For vertical surface two coats @ 0.70 kg per sqm							
Inside of walls         2 $6.70$ $4.1$ $54.94$ $m^2$								
0 Tatal 54.04 m <sup>2</sup>								
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	569.57	31292.0						
GST component Rs	103.78	8 5701.94						
<ul> <li>22.2 Providing and applying integral crystalline slurry of hydro waterproofing treatment to the RCC structures like retaining w water tanks, roof slabs, podiums, reservoirs, sewage &amp; water tre / subway and bridge deck etc., prepared by mixing in the ratio of crystalline slurry : 2 parts water) for vertical surfaces and 3</li> </ul>	philic in r alls of the l atment plan 5:2(5  par) :1(3  part) plying the s ne material s icing perme	hature for basement, ht, tunnels ts integral ts integral came from shall meet						
crystalline slurry : 1 part water) for horizontal surfaces and app negative (internal) side with the help of synthetic fibre brush. The the requirements as specified in ACI212-3R-2010 i.e. by reduce concrete by more than 90% compared with control concrete as resistant to 16 bar hydrostatic pressure on negative side. The crib be capable of self-healing of cracks up to a width of 0.50mm carried out all complete as per specification and the direction charge. The product performance shall carry guarantee for 1 leakage. For horizontal surface one coat @1.10 kg per sqm.	as per DIN rystalline sl n. The worl n of the en 10 years ag	eability of 1048 and lurry shall k shall be gineer-in- gainst any						
crystalline slurry : 1 part water) for horizontal surfaces and appresented in equivalence (internal) side with the help of synthetic fibre brush. The the requirements as specified in ACI212-3R-2010 i.e. by reduced concrete by more than 90% compared with control concrete a resistant to 16 bar hydrostatic pressure on negative side. The crube capable of self-healing of cracks up to a width of 0.50mm carried out all complete as per specification and the direction charge. The product performance shall carry guarantee for 1 leakage. For horizontal surface one coat @1.10 kg per sqm.Bottomslab13.353.3511.22m²	as per DIN rystalline sl 1. The worl n of the en 10 years ag	eability of 1048 and lurry shall k shall be gineer-in- gainst any						
crystalline slurry : 1 part water) for horizontal surfaces and appregative (internal) side with the help of synthetic fibre brush. The the requirements as specified in ACI212-3R-2010 i.e. by reduce concrete by more than 90% compared with control concrete a resistant to 16 bar hydrostatic pressure on negative side. The crube capable of self-healing of cracks up to a width of 0.50mm carried out all complete as per specification and the direction charge. The product performance shall carry guarantee for 1 leakage. For horizontal surface one coat @1.10 kg per sqm.Bottom slab13.353.3511.22m²Inside11.22m²11.22m²	as per DIN rystalline sl n. The worl n of the en 10 years ag	eability of 1048 and lurry shall k shall be gineer-in- gainst any						
crystalline slurry : 1 part water) for horizontal surfaces and appressive (internal) side with the help of synthetic fibre brush. The the requirements as specified in ACI212-3R-2010 i.e. by reduce concrete by more than 90% compared with control concrete a resistant to 16 bar hydrostatic pressure on negative side. The crube capable of self-healing of cracks up to a width of 0.50mm carried out all complete as per specification and the direction charge. The product performance shall carry guarantee for 1 leakage. For horizontal surface one coat @1.10 kg per sqm.Bottom slab13.353.3511.22m²TotalInsideInsideInsideInsideInsideInsideSayI1.22m²@Rs	AS per DIN rystalline sl n. The worl n of the en 10 years ag 439.006 71	eability of 1048 and lurry shall k shall be gineer-in- gainst any 4926.75						
crystalline slurry : 1 part water) for horizontal surfaces and appregative (internal) side with the help of synthetic fibre brush. The requirements as specified in ACI212-3R-2010 i.e. by reduconcrete by more than 90% compared with control concrete a resistant to 16 bar hydrostatic pressure on negative side. The crube capable of self-healing of cracks up to a width of 0.50mm carried out all complete as per specification and the direction charge. The product performance shall carry guarantee for 1 leakage. For horizontal surface one coat @1.10 kg per sqm.Bottom slab 13.353.3511.22m²Total11.22m²@RsGST componentInsideInsideInsideRs	AS per DIN rystalline sl n. The work n of the en 10 years ag 439.006 71 79.9943 03	4926.75 897.74						
crystalline slurry : 1 part water) for horizontal surfaces and appregative (internal) side with the help of synthetic fibre brush. The requirements as specified in ACI212-3R-2010 i.e. by reduconcrete by more than 90% compared with control concrete a resistant to 16 bar hydrostatic pressure on negative side. The crube capable of self-healing of cracks up to a width of 0.50mm carried out all complete as per specification and the direction charge. The product performance shall carry guarantee for 1 leakage. For horizontal surface one coat @1.10 kg per sqm.Bottom slab13.353.3511.22m²TotalInsideInsideInsideInsideInsideSayInsideInsideInsideInsideRsInsideInsideInsideInsideRsInsideInsideInsideInsideRsInsideInsideInsideInsideRsInsideI	As per DIN rystalline sl n. The worl n of the en 10 years ag 439.006 71 79.9943 03 ent:1:3 (1 c	4926.75 897.74 cement : 3						

	Base slab inside	1	3.35	3.35	11.22	m <sup>2</sup>		
	Total				66.16	m <sup>2</sup>		
	Say		66.16	$m^2$	(a)	Rs	400.74	26513.8
	GST component					Rs	73.02	4831.25
	Total-MBBR Tank	-2						₹ 7,96,713
	GST component							₹ 1,45,174

## 5.12 SECONDARY CLARIFIER WITH PLATE SETTLER

SECC	ONDARY	CLARIFIER W	ITH F	PLATE S	ETTLE	R					
Item No.	Item Code	Description	No	L	В	Н	V	Unit	Rate	Amount	
1	2.6.1	Earth work in areas (exceedi out and dispo Engineer-in-cl	excav ng 30 sal of narge	ation by cm in dep excavate	mechani oth, 1.5 n d earth	ical me n in wio lead up	ans (Hyd dth as wel o to 50 m	raulic ex ll as 10 so and lift	cavator)/mar qm on plan) in up to 1.5 m	nual means over ncluding getting , as directed by	
		For clarifier	1	6	6	0.75	27	m <sup>3</sup>			
		Total					27	m <sup>3</sup>			
		Say		27	m <sup>3</sup>		a	Rs	213.86	5774.22	
		GST component						Rs	38.97	1052.16	
2	4.1.6	Providing and centering and III): 6 graded	layin shutter stone a	g in posit ring - All aggregate	ion cem work up 40 mm	ent con to plin nomina	ncrete of th level : al size)	specified 1:3:6 (1 (	l grade exclu Cement : 3 co	ding the cost of arse sand (zone-	
		For clarifier foundation	1	6	6	0.15	5.4	m <sup>3</sup>			
		Total					5.4	m <sup>3</sup>			
		Say		5.4	m <sup>3</sup>		a	Rs	7202.34	38892.66	
		GST component						Rs	1312.39	7086.89	
3	5.37.1 + 5.34.1	Providing and concrete work manufactured mixer for all I specified grad transit mixer reinforcement accelerate/ ret durability as p this item is @ separately). U	component Providing and laying in position ready mixed M-30 grade concrete for reinforced cement concrete work, using Sulphate Resistant Cement (SRC) content as per approved design mix, manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for reinforced cement concrete work, including pumping of R.M.C. from transit mixer to site of laying , excluding the cost of centering, shuttering finishing and reinforcement, including cost of admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in-charge. (Note :- Cement content considered in this item is @ 330 kg/ <sup>3</sup> .Excess/less cement used as per design mix is payable/recoverable separately). Up to plinth level.								
		Base slab- raft beam slab type	1	6	6	0.35	12.60	m <sup>3</sup>			
		Base slab- inverted beams	4	4.38	0.42	0.6	4.46	m <sup>3</sup>			
		Total					17.06	m <sup>3</sup>			
		Say		17.06	m <sup>3</sup>		@	Rs	9956.31	169879.46	
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		GST						Rs	1814.20	30954.86	
4	5.37.2	component Providing and	lavin	g in posit	ion read	lv mixe	ed M-30	grade co	ncrete for rei	nforced cement	
	+	concrete work	, using	g Sulphate	e Resista	nt Cen	nent (SRC	C) conten	t as per appro	ved design mix,	
	5.34.1	manufactured	in ful	ly automa	atic bate	hing p	lant and	transpor	ted to site of	work in transit	
		mixer for all l	eads,	having co	ontinuou 1 cemen	is agita	ted mixer	r, manuf	actured as pe	r mix design of $P M C$ from	
		transit mixer	to site	of laying	g, exclu	uding t	the cost of	of center	ing, shutterin	g finishing and	
		reinforcement	, inclu	ding cost	of admix	xtures i	in recomm	nended p	proportions as	per IS : 9103 to	
		accelerate/ ret	ard se	tting of c	oncrete,	impro neer_in	ve worka	bility wi Note :- (	thout impairi	ng strength and	
		this item is @	330 k	g/m <sup>3</sup> .Exc	ess/less	cement	t used as j	per desig	n mix is paya	able/recoverable	
		separately). A	bove p	olinth leve	el.						
		Columns- long	4	0.35	0.35	3.1	1.52	m <sup>3</sup>			
		Columns- short	4	0.35	0.35	0.7	0.34	m <sup>3</sup>			
		Clarifier-	4	4.50	0.3	2.9	15.66	m <sup>3</sup>			
		square									
		Clarifier-	4	3.15	0.3	2.75	10.41	m <sup>3</sup>			
		hopper									
		container Ton beams						m <sup>3</sup>			
		Total	4	4.65	0.2	1.05	3.91	m <sup>3</sup>			
		Deductions					51.20	111			
		Inlet pipe	1	0.031	0.3		0.01	m <sup>3</sup>			
		Total					31.83	m <sup>3</sup>			
		Say		31.83	m <sup>3</sup>		(a)	Rs	11606.5	369402.43	
		GST					$\bigcirc$	Rs	2114.9	67311.25	
		component									
5	5.22.6	Epoxy coated	steel r	einforcen	hent for l	R.C.C.	work incl	luding st	raightening, c	utting, bending,	
		Treated bars o	f grad	e Fe-500I	D or moi	re.	ele up it	, pinnin	ievei. Therm	o-weenameany	
		Ouantity as	1		17.06	m <sup>3</sup>	120	kg/m <sup>3</sup>	2047.5	kg	
		per item						U		U	
		No.3									
		per item	1		31.83	m <sup>3</sup>	120	kg/m <sup>3</sup>	3819.2774	kg	
		No.4						C		0	
		Total		59(7	1			Da	5866.7774	kg	
		GST		380/	кg		W	KS	98.2	3/394/.33	
		component						Rs	17.9	104947.19	
6	4.12	Extra for prov by weight of c	iding ement	and mixin as per m	ng water anufactu	r proof irer's si	ing mater	rial in ce on.	ment concret	e work in doses	
		Quantity as	1		17.06	m3	340	kg/m <sup>3</sup>	5801.3	kg	
		per item						8-11		0	
		No.3									

		0								
		Quantity as per item No.4	1		31.83	m3	340	kg/m <sup>3</sup>	10821.286	kg
		Total							16622.5	kg
		Say		332.5	bags		a	Rs	66.5	22103.28
		GST						Re	12.1	4027 58
		component						13	12.1	4027.38
7	5.9.1	Centering and Foundations,	l shut footin	tering in gs, bases	cluding of colun	strutti nns, etc	ng, propp c. for mas	s concre	. and remov te	al of form for
		Base slab- raft beam slab type	4	6.00		0.35	8.40	m <sup>2</sup>		
		Base slab- inverted beams	4	4.80		0.6	11.52	m <sup>2</sup>		
		Base slab- inverted beams	4	3.95		0.6	9.48	m <sup>2</sup>		
		Top channels	4	5.25		1.20	25.20	m <sup>2</sup>		
		Total					54.60	m <sup>2</sup>		
		Say		54.60	m <sup>2</sup>		@	Rs	334.9	18285.45
		GST						D.	(1.0	2221 01
		component	-					KS	01.0	3331.91
8	22.23.1	component Providing and treatment to the podiums, reserved prepared by movertical surfaces surfaces and a brush. The mare reducing perm DIN 1048 and shall be capabi- out all comple performance s coats @ 0.701	apply e RCC rvoir, s ixing i eas and pplyin aterial teabilit resista le of so te as p hall ca cg per	ing integr C structure sewage & in the rati 1 3 : 1 (3 g the sam shall me ty of conc ant to 16 b elf-healin er specifie urry guara sqm	al crysta es like re- to of 5 : 2 parts in he from r eet the r- par hydro g of crac cation ar intee for	Illine sl etaining reatmen 2 (5 pan tegral o negativ equirer more th ostatic p static p ks up t nd the o 10 yea	urry of hy g walls of nt plant, t rts integra crystalling e (interna nents as nan 90% c pressure c o a width lirection c rs against	Ks ydrophili the base unnels / il crystall e slurry : 1) side w specified compared on negati- of 0.50m of the eng	c in nature for ment, water ta subway and b line slurry : 2 1 part water ith the help o 1 in ACI212- 1 with control ve side. The c m. The work gineer-in-char cage. For vert	or waterproofing anks, roof slabs, oridge deck etc., parts water) for c) for horizontal f synthetic fibre 3R-2010 i.e by concrete as per crystalline slurry shall be carried rge. The product ical surface two
8	22.23.1	component Providing and treatment to th podiums, reserved prepared by m vertical surface surfaces and a brush. The mar- reducing perm DIN 1048 and shall be capab- out all comple- performance s coats @ 0.70 H Inside of walls-upper	apply le RCC rvoir, s ixing : ees anc pplyin aterial leabilit resista le of se te as p hall ca cg per	ing integr C structure sewage & in the rati 1 3 : 1 (3 g the sam shall me ty of conce ant to 16 b elf-healin er specifie urry guara sqm 4.20	al crysta es like re water tr o of 5 : 2 parts in the from r eet the r erete by r oar hydro g of crac cation ar ntee for	Illine sl etaining reatmen 2 (5 par tegral on negativ equirer more th ostatic p ks up t nd the d 10 yea	urry of hy g walls of nt plant, t crystalling e (interna nents as nan 90% of pressure of o a width lirection of rs against	Ks ydrophili the base unnels / il crystall e slurry : i) side w specifiec compared on negati of 0.50m of the eng any leal m <sup>2</sup>	c in nature for ment, water ta subway and b line slurry : 2 i 1 part water ith the help o i in ACI212- d with control ve side. The c m. The work gineer-in-chan tage. For vert	or waterproofing anks, roof slabs, oridge deck etc., parts water) for c) for horizontal f synthetic fibre 3R-2010 i.e by concrete as per rrystalline slurry shall be carried rge. The product ical surface two
8	22.23.1	component Providing and treatment to th podiums, reserved prepared by m vertical surfaces surfaces and a brush. The man reducing perm DIN 1048 and shall be capable out all complet performance s coats @ 0.70 h Inside of walls-upper	apply le RCC rvoir, s ixing i ees and pplyin aterial le abilit resista le of se te as p hall ca cg per 4	ing integr C structure sewage & in the rati 1 3 : 1 (3 g the sam shall me ty of conc ant to 16 b elf-healin er specific urry guara sqm 4.20 2.85	al crysta es like re- water th o of 5 : 2 parts in the from r bet the r crete by r oar hydro g of crac cation ar ntee for	Illine sl etaining reatmen 2 (5 pan tegral d negativ equirer more th ostatic p ks up t nd the d 10 yea 2.9 2.75	urry of hy g walls of nt plant, t crystalling e (interna nents as nan 90% o pressure o o a width lirection o rs against 48.72 31.39	KS ydrophili the base unnels / l crystall e slurry : l) side w specified compared on negatir of 0.50m of the eng c any leak m <sup>2</sup> m <sup>2</sup>	c in nature for ment, water tr subway and b line slurry : 2 1 part water ith the help o 1 in ACI212- d with control ve side. The c m. The work gineer-in-char cage. For vert	or waterproofing anks, roof slabs, oridge deck etc., parts water) for c) for horizontal f synthetic fibre 3R-2010 i.e by concrete as per crystalline slurry shall be carried rge. The product ical surface two
8	22.23.1	component Providing and treatment to the podiums, reser- prepared by m vertical surfaces surfaces and a brush. The mar- reducing perm DIN 1048 and shall be capab- out all compler performance s coats @ 0.70 H Inside of walls-upper Inside of walls-lower Top channels	apply e RCC rvoir, s ixing : ixing : ixing : plyin aterial eabilit resista le of so te as p hall ca cg per 4 4	ing integr C structure sewage & in the rati 1 3 : 1 (3 g the sam shall me ty of conce ant to 16 b elf-healin er specifie urry guara sqm 4.20 2.85 5.25	al crysta es like re water th o of 5 : 2 parts in he from r eet the r crete by r oar hydro g of crac cation ar ntee for 1.05	Illine sl etaining reatmen 2 (5 par tegral o negativ equirer more th ostatic p ks up t nd the o 10 yea 2.9 2.75	urry of hy g walls of nt plant, t rts integra crystalling e (interna nents as nan 90% of pressure of o a width lirection of rs against 48.72 31.39 22.05	KS ydrophili the base unnels / il crystall e slurry : l) side w specifiec compared on negati of 0.50m of the eng any leak m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	c in nature for ment, water ta subway and b line slurry : 2 1 part water ith the help o 1 in ACI212- d with control ve side. The c mm. The work gineer-in-chan cage. For vert	or waterproofing anks, roof slabs, oridge deck etc., parts water) for c) for horizontal f synthetic fibre 3R-2010 i.e by concrete as per crystalline slurry shall be carried rge. The product ical surface two
8	22.23.1	component Providing and treatment to the podiums, reserved prepared by me vertical surface surfaces and a brush. The ma reducing perme DIN 1048 and shall be capable out all complex performance s coats @ 0.70 He Inside of walls-upper Inside of walls-lower Top channels Total	apply e RCC rvoir, s ixing i ees and pplyin aterial heabilit resista le of so te as p hall ca cg per 4 4	ing integr C structure sewage & in the rati 1 3 : 1 (3 g the sam shall me ty of conc ant to 16 k elf-healin er specifie urry guara sqm 4.20 2.85 5.25	al crysta es like re- vater th o of 5 : 2 parts in the from r bet the r berete by r oar hydro g of crac cation ar ntee for 1.05	Illine sl etaining reatmen 2 (5 pan tegral d negativ equirer more th ostatic p ks up t nd the d 10 yea 2.9 2.75	urry of hy g walls of nt plant, t rts integra crystalling e (interna nents as nan 90% c pressure c o a width lirection c rs against 48.72 31.39 22.05 102.16	KS ydrophili the base unnels / l crystall e slurry : l) side w specified compared on negatir of 0.50m of the eng any leak m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	c in nature for ment, water to subway and b line slurry : 2 1 part water ith the help o 1 in ACI212- d with control ve side. The control ve side. The work gineer-in-char tage. For vert	or waterproofing anks, roof slabs, oridge deck etc., parts water) for c) for horizontal f synthetic fibre 3R-2010 i.e by concrete as per rystalline slurry t shall be carried orge. The product ical surface two
8	22.23.1	component Providing and treatment to the podiums, reser- prepared by m vertical surfaces surfaces and a brush. The mar- reducing perm DIN 1048 and shall be capab- out all comple performance s coats @ 0.70 H Inside of walls-upper Inside of walls-lower Top channels Total Say	apply e RCC rvoir, s ixing i eas and pplyin aterial eabilit resista le of so te as p hall ca cg per 4 4 4	ing integr C structure sewage & in the rati 1 3 : 1 (3 g the sam shall me ty of conce ant to 16 b elf-healin, er specific urry guara sqm 4.20 2.85 5.25	al crysta es like re- vater the o of 5 : 2 parts in he from r eet the r part by n car hydro g of crace cation ar ntee for 1.05 m <sup>2</sup>	Illine sl etaining reatmen 2 (5 par tegral o negativ equirer more th ostatic p ks up t nd the o 10 yea 2.9 2.75	urry of hy g walls of nt plant, t rts integra crystalling e (interna nents as nan 90% of pressure of o a width lirection of rs against 48.72 31.39 22.05 102.16 @	KS ydrophili the bases unnels / il crystall e slurry : l) side w specified compared on negative of 0.50m of the eng any leak m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> Rs	c in nature for ment, water ta subway and b line slurry : 2 i 1 part water ith the help o l in ACI212- d with control ve side. The c m. The work gineer-in-chan cage. For vert	5331.91 or waterproofing anks, roof slabs, oridge deck etc., parts water) for c) for horizontal f synthetic fibre 3R-2010 i.e by concrete as per crystalline slurry shall be carried orge. The product ical surface two 58187.91
8	22.23.1	component Providing and treatment to the podiums, reserved prepared by me vertical surface surfaces and a brush. The ma reducing perm DIN 1048 and shall be capable out all complex performance s coats @ 0.70 Here Inside of walls-upper Inside of walls-lower Top channels Total Say GST	apply le RCC rvoir, s ixing i ixing i res and pplyin aterial le abilit resista le of so te as p hall ca cg per 4 4 4	ing integr C structure sewage & in the rati 1 3 : 1 (3 g the sam shall me ty of conc ant to 16 b elf-healin er specifie urry guara sqm 4.20 2.85 5.25 102.16	al crysta es like re- vater the o of 5 : 2 parts in he from r eet the r cation ar ntee for 1.05 m <sup>2</sup>	Illine sl etaining reatmen 2 (5 pai tegral d negativ equirer more th ostatic j ks up t nd the d 10 yea 2.9 2.75	urry of hy g walls of nt plant, t rts integra crystalling e (interna nents as nan 90% c pressure c o a width lirection o rs against 48.72 31.39 22.05 102.16 @	KS ydrophili the base unnels / l crystall e slurry : l) side w specified compared on negative of 0.50m of the eng cany lead m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> RS P-	c in nature for ment, water to subway and b line slurry : 2 1 part water ith the help o 1 in ACI212- d with control ve side. The comm. The work gineer-in-chan cage. For vert	58187.91 or waterproofing anks, roof slabs, oridge deck etc., parts water) for c) for horizontal f synthetic fibre 3R-2010 i.e by concrete as per crystalline slurry c shall be carried rge. The product ical surface two

9	22.23.2	treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of $5:2$ (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and $3:1$ (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fibre brush. The material shall meet the requirements as specified in ACI212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For horizontal surface one coat @1.10 kg per sqm.												
		Bottom slab inside	1	1.50	1.5		2.25	m <sup>2</sup>						
		Total					2.25	m <sup>2</sup>						
		Say		2.25	m <sup>2</sup>		(a)	Rs	439.01	987.77				
		GST component						Rs	79.99	179.99				
10	13.7.1	12 mm cemen sand)	t plast	ter finishe	ed with a	a floati	ng coat o	f neat ce	ement :1:3 (1	cement : 3 fine				
		Inside of walls-upper	4	4.20		2.9	48.72	m <sup>2</sup>						
		Inside of walls-lower	4	2.85		2.75	31.39	m <sup>2</sup>						
		Top channels	4	5.25		1.05	22.05	m <sup>2</sup>						
		Base slab inside	4	1.50	1.5		9.00	m <sup>2</sup>						
		Total					111.16	m <sup>2</sup>						
		Say		111.16	m <sup>2</sup>		a	Rs	400.74	44546.57				
		GST component						Rs	73.02	8117.12				
		Total-Seconda	ry Cla	rifier wit	h Plate S	Settler				₹ 13,04,007				
		GST component								₹ 2,37,612				

#### 5.13 SLUDGE SUMP

SLUDGE SUMP-circular												
Item No.	Item Code	Description	No	L	В	Η	V	Unit	Rate	Amount		
1	2.6.1	Earth work in e areas (exceedin out and dispose Engineer-in-cha	excavat g 30 cm al of ex arge	ion by n n in dept ccavated	hechan h, 1.5 r l earth	ical me n in wie lead up	ans (Hyddth as we o to 50 r	draulic e ell as 10 s n and lif	excavator)/ma sqm on plan) ft up to 1.5 n	nual means over including getting n, as directed by		
		For sludge sump	1	2.95	2.95	3.25	28.28	m <sup>3</sup>				
		Total					28.28	m <sup>3</sup>				
		Say		28.28	m <sup>3</sup>		@	Rs	213.86	6047.96		

		GST						Rs	38.97	1102.04
		component								
2	4.1.6	Providing and l centering and s (zone-III): 6 gra	aying i hutteri ided sto	in positi ng - All one aggi	on cem work regate 4	up to p 10 mm	ncrete of plinth le nominal	f specifie vel : 1:3 size)	ed grade excl :6 (1 Cement	uding the cost of t : 3 coarse sand
		For sludge sump	1	2.95	2.95	0.15	1.31	m <sup>3</sup>		
		Total					1.31	m <sup>3</sup>		
		Say		1.31	m <sup>3</sup>		a	Rs	7202.3	9435.07
		GST component						Rs	1312.4	1719.23
3	5.37.1 + 5.34.1	Providing and l concrete work, w manufactured in mixer for all leas specified grade transit mixer to reinforcement, is to accelerate/ re durability as per this item is @ 2 separately).	aying t using S n fully ads, ha for reio site o includi tard set r direct 330 kg/	in positi ulphate automa ving co nforced f laying ng cost tting of c ion of th <sup>3</sup> .Exces	on read Resista tic bata ntinuou cemen ; , excl of adm concret he Engi s/less c	ly mixed ant Cent ching p us agita at concr uding t ixtures e, impr neer-in ement	ed M-30 nent (SR plant and ted mixe rete work the cost in recon- ove work -charge. used as	grade cd C) content I transpo er, manu k, includ of cente mmended kability v (Note :- per desig	oncrete for re nt as per appr rted to site o factured as p ing pumping ring, shutteri d proportions vithout impai Cement cont gn mix is pay	einforced cement oved design mix, f work in transit er mix design of g of R.M.C. from ng finishing and as per IS : 9103 ring strength and ent considered in vable/recoverable
		Base slab	1	2.95	2.95	0.3	2.61	m <sup>3</sup>		
		Tank walls	1	6.44	0.3	3.1	5.99	m <sup>3</sup>		
		Total					8.60	m <sup>3</sup>		
		Say		8.60	m <sup>3</sup>		(a)	Rs	9956.31	85595.95
		GST					0	Rs	1814.20	15597
4	5.22.6	Epoxy coated st placing in post Treated bars of	eel rein ition a grade ]	nforcem nd bind Fe-500E	ent for ing all or mo	R.C.C. comp re.	work ind lete upt	cluding s o plinth	traightening, level. Therr	cutting, bending, no-Mechanically
		Quantity as per item No.3	1		8.60	m <sup>3</sup>	120	kg/m <sup>3</sup>	1031.6592	kg
		Total							1031.6592	kg
		Say		1032	kg		(a)	Rs	98.17	101279.04
		GST						Ks	17.89	18454.72
5	4.12	Extra for provid by weight of ce	ling an ment a	d mixin s per ma	g wate	r proof urer's s	ing mate pecificat	erial in co ion.	ement concre	ete work in doses
		Quantity as per item No.3	1		8.60	m <sup>3</sup>	340	kg/m <sup>3</sup>	2923.0344	kg
		Total							2923.0344	kg
		Say		58.46	bags		@	Rs	66.5	3886.81
		GST component						Rs	12.1	708.24
6	5.9.1	Centering and Foundations, for	shutte	ring inc , bases o	luding	strutti mns, et	ng, proj c. for ma	oping et ass concr	c. and remo	val of form for
		Bottom slab	4	2.95		0.3	3.54	m <sup>2</sup>		
		Total					3.54	m <sup>2</sup>		
		Say		3.54	m <sup>2</sup>		a	Rs	334.9	1185.54

		GST							Rs	61.0	216.03
7	5.9.2	component Centering at	nd s	hutteri	ng inclu	ding st	rutting	proppir	ng etc. ar	nd removal of	f form for ·Walls
	01912	(any thickne	ess)	includi	ing attac	hed pil	asters,	buttress	es, plinth	and string c	ourses etc.
		For wa outside	lls	1	7.38		3.1	22.87	m <sup>2</sup>		
		For wa	lls	1	5.50		3.1	17.0	m <sup>2</sup>		
		Total						39.91	m <sup>2</sup>		
		Say			39.91	m <sup>2</sup>		a	Rs	716.4	28589.28
		GST component							Rs	130.5	5209.44
		treatment to podiums, re prepared by vertical surf surfaces and brush. The reducing per DIN 1048 ar shall be capa out all comp performance coats @ 0.7	the serv faces app mate rmea able olete e sha 0 kg	RCC s oir, sev ing in s and 3 olying t erial sh ability esistant of self as per all carry per so	tructure wage & the ratio : 1 (3 p the same nall mee of concr to 16 ba -healing specific y guarar m	s like re water the of 5 : 2 parts in the from r t the re t the re t hydro of crace ation ar tee for	etaining reatme 2 (5 part tegral negative equirer more the ostatic postatic teks up the d the c 10 yea	g walls o nt plant, rts integr crystallin re (intern nents as nan 90% pressure to a widtl direction trs agains	f the basis tunnels / al crysta ne slurry al) side v specifie compare on negat n of 0.50 of the en st any lea	ement, water subway and lline slurry : 1 i 1 part water with the help d in ACI212 ed with control ive side. The mm. The wor gineer-in-cha- kage. For very	tanks, roof slabs, bridge deck etc., 2 parts water) for er) for horizontal of synthetic fibre -3R-2010 i.e. by ol concrete as per crystalline slurry k shall be carried arge. The product rtical surface two
		Inside	of	1	5.50		3.1	17.03	m <sup>2</sup>		
		walls						17.03	$m^2$		
		Sav			17.03	m <sup>2</sup>		17.05 @	III Re	569 57	9702 31
		GST			17.05	111		u	Rs	103 78	1767.92
		component							105	105.70	1707.92
9	22.23.2	Providing an treatment to podiums, re prepared by vertical surf surfaces and brush. The reducing per DIN 1048 an shall be capa out all comp performance one coat @1	nd aj the serv mix faces 1 app mate rmea able blete e sha 1.10	pplying RCC s oir, sev ing in s and 3 olying t erial sh ability esistant of self as per all carr kg per	g integra tructure wage & the ratio : 1 (3 p the same of concr to 16 ba -healing specific ry guaran	I crysta s like re water to of 5 : 2 parts in e from r t the re of crace of crace ation ar ntee for	alline s etaining reatme 2 (5 par tegral hegativ equirer more th ostatic beks up t hd the c 10 ye	lurry of l g walls o nt plant, rts integr crystallin re (intern nents as nan 90% pressure to a widtl lirection ars agair	nydrophi f the base tunnels / al crysta ne slurry al) side v specifie compare on negat n of 0.50 of the en ast any le	lic in nature f ement, water subway and lline slurry : 1 : 1 part wate with the help d in ACI212 ed with contro ive side. The mm. The wor gineer-in-cha eakage. For h	For waterproofing tanks, roof slabs, bridge deck etc., 2 parts water) for er) for horizontal of synthetic fibre -3R-2010 i.e. by bl concrete as per crystalline slurry k shall be carried arge. The product orizontal surface
		Bottom sl	lab	1	2.41			2.41	m <sup>2</sup>		
		Total						2.41	m <sup>2</sup>		
		Say			2.41	m <sup>2</sup>		@	Rs	439.0	1055.94
		GST component							Rs	80.0	192.41

10	13.7.1	12 mm cement sand)	plaster	finishe	d with	a floati	ng coat	of neat c	ement :1:3 (1	1 cement : 3 fine
		Inside of walls	1	5.50		3.1	17.03	m <sup>2</sup>		
		Base slab inside	1	2.41			2.41	m <sup>2</sup>		
		Total					19.44	$m^2$		
		Say		19.44	m <sup>2</sup>		(a)	Rs	400.74	7790.25
		GST component						Rs	73.02	1419.51
		Total-Sludge S	ump							₹ 2,54,568
		GST component								₹ 46,387

## 5.14 SLUDGE THICKENER

SLUI	DGE THI	CKENER-circular								
Ite m No.	Item Code	Description	No	L	В	Н	V	Unit	Rate	Amount
1	2.6.1	Earth work in 6 means over areas plan) including g upto 1.5 m, as dir	excava s (exc getting rected	ation by eeding 3 g out and l by Engi	mecha 0 cm in disposa neer-in-	nical 1 depth, al of ex charge	neans ( 1.5 m i acavated	Hydraul n width earth le	ic excava as well as ead upto 50	tor)/manual 10 sqm on 0 m and lift
		For sludge thickener	1	4.6	4.6	3	63.4 8	m <sup>3</sup>		
		Total					63.4 8	m <sup>3</sup>		
		Say		63.48	m <sup>3</sup>		(a)	Rs	213.86	13575.83
		GST component						Rs	38.97	2473.74
2	4.1.6	Providing and la cost of centering coarse sand (zone	ying i and s e-III):	in positio shuttering 6 gradeo	on ceme g - All v l stone a	nt cond vork uj iggrega	crete of p to plin ate 40 m	specifie th level m nomi	d grade ex : 1:3:6 (1 nal size)	cluding the Cement : 3
		For sludge thickener	1	4.6	4.6	0.1 5	3.17	m <sup>3</sup>		
		Total					3.17	m <sup>3</sup>		
		Say		3.17	m <sup>3</sup>		æ	Rs	7202.3	22831.43
		GST component						Rs	1312.4	4160.27
3	5.37.1 + 5.34.1	Providing and la cement concrete approved design transported to sit mixer, manufact concrete work, in excluding the co cost of admixture setting of concre as per direction of this item is @ payable/recovera	ying work or mix e of v ured a ncludi st of es in ro te, im of the 330 ble se	in positic c, using k, manu vork in tr as per m ing pump centering ecommer prove w Enginee D kg/ <sup>3</sup> .E eparately	on ready Sulphat factured ansit mi ix desig bing of l g, shutte nded pro orkabili er-in-cha xcess/le	y mixed e Resident of s in for exer for grin of s R.M.C. rring fin portion ty with urge. (1 ss cent	d M-30 istant C ully au r all lead pecified from tr nishing ns as per lout imp Note :- 0 ment u	grade ce ement ( tomatic ds, havir grade f ransit m and rein S : 91( bairing s Cement sed as	oncrete for SRC) con batching ag continue for reinfor ixer to site nforcemen 3 to accele trength and content co per desig	reinforced tent as per plant and ous agitated ced cement of laying , t, including erate/ retard d durability onsidered in gn mix is

								2		
		Base slab	1	4.6	4.6	0.3 5	7.41	m <sup>3</sup>		
		Tank walls	1	11.30	0.3	2.5	8.48	m <sup>3</sup>		
		Total					15.8 8	m <sup>3</sup>		
		Say		15.88	m <sup>3</sup>		@	Rs	9956.3 1	158145.9 6
		GST						Rs	1814.2 0	28816.82
4	5.22.6	Epoxy coated ste bending, placing Mechanically Tre	el rei in po eated	nforceme osition ar bars of g	ent for R nd bindi rade Fe-	R.C.C. ng all 500D	work in comple or more	cluding te upto j	straighteni plinth leve	ng, cutting, el. Thermo-
		Quantity as per item No.3	1		15.8 8	m <sup>3</sup>	120	kg/m	1906.0 8	kg
		Total							1906.0 8	kg
		Say		1906	kg		@	Rs	98.17	187121.8 3
		GST component						Rs	17.89	34096.7
5	4.12	Extra for providi doses by weight	ng an of cer	d mixing nent as p	water p er manu	roofing facture	g materi er's spec	al in cer ification	nent conci	ete work in
		Quantity as per item No.3	1		15.8 8	m <sup>3</sup>	340	kg/m	5400.5 6	kg
		Total							5400.5 6	kg
		Say		108.0 1	bags		@	Rs	66.49	7181.22
		GST component						Rs	12.11	1308.54
6	5.9.1	Centering and sh :Foundations, for	utteri otings	ng includ , bases of	ling stru f columi	tting, p 1s, etc.	propping for mas	g etc. and	d removal ete	of form for
		Bottom slab	4	4.60		0.3 5	6.44	m <sup>2</sup>		
		Total					6.44	m <sup>2</sup>		
		Say		6.44	$m^2$		(a)	Rs	334.9	2156.75
		GST component						Rs	61.0	392.99
7	5.9.2	Centering and sh :Walls (any thic courses etc.	utteri kness	ng includ ) includi	ling stru ng attao	tting, p ched p	propping ilasters,	g etc. and buttress	d removal ses, plinth	of form for and string
		For walls outside	1	12.25		2.5	30.6 2	m <sup>2</sup>		
		For walls inside	1	10.36		2.5	25.9	m <sup>2</sup>		
		Total					56.5 2	m <sup>2</sup>		
		Say		56.52	m <sup>2</sup>		æ	Rs	716.35	40488.36
		GST component						Rs	130.53	7377.65

8	22.23.	Providing and a waterproofing tree water tanks, roof / subway and brid crystalline slurry crystalline slurry negative (internal the requirements concrete by more resistant to 16 ba be capable of sel carried out all co charge. The proof leakage. For vert	waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of $5:2$ (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and $3:1$ (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fibre brush. The material shall meet the requirements as specified in ACI212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in- charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm Inside of walls 1 10.36 2.5 25.9 m <sup>2</sup>												
		Inside of walls	$\begin{array}{cccccccccccccccccccccccccccccccccccc$												
		Totur					1	111							
		Say		25.91	m <sup>2</sup>		@	Rs	569.6	14754.67					
		GST component						Rs	103.8	2688.54					
	2	waterproofing tre water tanks, roof / subway and brid crystalline slurry crystalline slurry negative (internal the requirements concrete by more resistant to 16 ba be capable of sel carried out all co charge. The proof leakage. For hori	slabs slabs ge de : 2 p : 1 pa side as sp than r hydi f-hea omple luct p zonta	, podiums ck etc., pr parts water art water) with the ecified in 90% con- rostatic p ling of cr te as per performan l surface	s, reserver repared for hor help of h ACI21 mpared ressure racks up specific nce shall one coa	voir, sev by mix vertica izontal synthet 2-3R-2 with c on neg to a cation ll carry t @1.1	wage & ing in the surface surface tic fibre 2010 i.e ontrol c ative sid width of and the guarar 0 kg per	water tr ne ratio c es and 3 s and ap brush. T by red oncrete de. The c f 0.50mm direction tee for r sqm.	eatment pl of 5 : 2 (5 pa 3 : 1 (3 pa oplying the 'he materia ucing perm as per DIN crystalline m. The wo on of the e 10 years a	ant, tunnels arts integral arts integral same from 1 shall meet neability of N 1048 and slurry shall ork shall be engineer-in- against any					
		Bottom slab inside Total	1	8.55			8.55	$m^2$ $m^2$							
		Say		8.55	m <sup>2</sup>		( <i>a</i> ).	Rs	439.01	3754.83					
		GST component						Rs	79.99	684.19					
10	13.7.1	12 mm cement pl 3 fine sand)	laster	finished	with a f	floating	g coat of	f neat ce	ment :1:3	(1 cement :					
		Inside of walls	1	3.77		1.7 5	6.59	m <sup>2</sup>							
		Base slab inside	1	1.13			1.13	m <sup>2</sup>							
		Total					7.72	m <sup>2</sup>							
		Say         7.75         m <sup>2</sup> @         Rs         400.74         3105.72													
		GST Rs 73.02 565.91													
		Total- Sludge Th	Total- Sludge Thickener ₹ 4 53 117												
		GST component								₹ 82,565					

# 5.15 CHLORINE CONTACT TANK

Item No.Item CodeDescription NoNoLBHVUnitRateArr12.6.1Earth work in reans over areas (exceeding 30 cm in dept), 1.5 m in width as well as 10 s plan) including getting out and disposal of excavated earth lead upto 50 m a upto 1.5 m, as directed by Engineer-in-chargeItem is 0 s planItem is 0 s planArrArr1Earth work in planexcavated is 0 s planis 0 s is 0 s planis 0 s is 0 s planis 0 s is 0 s is 0 s planis 0 s is 0 s is 0 s is 0 sis 0 s is 0 s is 0 s is 0 sis 0 s is 0 s is 0 s is 0 sis 0 s is 0 s is 0 s is 0 s is 0 sis 0 s is 0 s is 0 s is 0 sis 0 s is 0 s	mount /manual sqm on and lift 361.97 ·34.77 ling the nent : 3
12.6.1Earth work in excavation by mechanical means (Hydraulic excavator)/r means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 s plan) including getting out and disposal of excavated earth lead upto 50 m a upto 1.5 m, as directed by Engineer-in-charge1A.95A.952.562.4 sm³m³m³1TotalA.95A.952.562.4 sm³m³m³2Say62.48 sm³and and and and and and and and and and	/manual sqm on and lift 361.97 ·34.77 ling the nent : 3
For chlorine contact tank Total14.954.952.5 $62.4$ 8m³m³m³Say $62.48$ 8m³ $62.4$ 8m³ $62.4$ 8m³ $62.4$ 8m³ $62.4$ 8m³ $7000000000000000000000000000000000000$	361.97 34.77 ling the nent : 3
TotalFor chlorine14.954.950.13.68 $m^3$ (a)Rs213.8613324.1.6Providing and laying in position cement concrete of specified grade excluding costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cemerotaria costs of centering	361.97 34.77 ling the nent : 3
Say $62.48$ $m^3$ $@$ Rs $213.86$ $133$ GST componentGST componentRs $38.97$ $243$ 2 $4.1.6$ Providing and laying in position cement concrete of specified grade excluding cost of centering and shuttering - All work up to plinth level : $1:3:6$ (1 Cemeroarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size) $m^3$ $m^3$ 2 $For chlorine contact tank$ 1 $4.95$ $4.95$ $0.1$ $3.68$ $m^3$ $m^3$ $m^3$ 3 $Total$ $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ 3 $GST$ component $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ 4 $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ $m^3$ 4 $m^3$ $m^3$ <t< th=""><th>3361.97 334.77 ling the nent : 3</th></t<>	3361.97 334.77 ling the nent : 3
GST componentGST componentRs $38.97$ $243$ 2 $4.1.6$ Providing and laying in position cement concrete of specified grade excludin cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cem coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)Rs $38.97$ $243$ $4.1.6$ Providing and laying in position cement concrete of specified grade excludin coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size) $1.3.68$ $m^3$ $1.3.68$ $m^3$ $1.3.68$ $m^3$ $1.3.68$ $m^3$ $1.3.68$ $1.3$	434.77 ling the nent : 3
2       4.1.6       Providing and laying in position cement concrete of specified grade excludit cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cem coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)         Image: Second control of content tank       1       4.95       4.95       0.1       3.68       m <sup>3</sup> Image: Second content tank         Image: Second contact tank       1       4.95       4.95       0.1       3.68       m <sup>3</sup> Image: Second contact tank       Image: Second contact tank <th>ling the nent : 3</th>	ling the nent : 3
For chlorine contact tank       1       4.95       4.95       0.1       3.68       m <sup>3</sup> Total       -       -       3.68       m <sup>3</sup> -       -	504 (2
Total       3.68       m <sup>3</sup> 6         Say       3.68       m <sup>3</sup> 6       8         GST       Rs       1312.4       482	504 (2
Say         3.68         m <sup>3</sup> @         Rs         7202.3         265           GST         component         Rs         1312.4         482	504 (2
GST Rs 1312.4 482	504.62
	29.58
<ul> <li>5.37.1 Providing and laying in position ready mixed M-30 grade concrete for rein cement concrete work, using Sulphate Resistant Cement (SRC) content approved design mix, manufactured in fully automatic batching plan transported to site of work in transit mixer for all leads, having continuous agmixer, manufactured as per mix design of specified grade for reinforced concrete work, including pumping of R.M.C. from transit mixer to site of la excluding the cost of centering, shuttering finishing and reinforcement, inc cost of admixtures in recommended proportions as per IS : 9103 to accelerate/setting of concrete, improve workability without impairing strength and dur as per direction of the Engineer-in-charge. (Note :- Cement content conside this item is @ 330 kg/<sup>3</sup>.Excess/less cement used as per design n payable/recoverable separately).</li> </ul>	nforced as per int and agitated cement laying, cluding e/ retard trability lered in mix is
Base slab 1 $4.95$ $4.95$ $0.3$ $8.58$ m <sup>3</sup> 5	
Tank walls     4     4.05 $0.3$ $2.3$ $11.4$ $m^3$ 5     2	
Total 20.0 m <sup>3</sup> 0	
Say 20.00 m <sup>3</sup> @ Rs 9956.31 199	9094.9
GST component Rs 1814.20 362	278.41
4 5.22.6 Epoxy coated steel reinforcement for R.C.C. work including straightening, c bending, placing in position and binding all complete upto plinth level. The Mechanically Treated bars of grade Fe-500D or more.	cutting, `hermo-
Quantity as per item No.31 $20.0$ $0$ m³ $120$ $3$ $120$ $3$ kg/m $2399.625$ kgTotal $2399.625$ $3$ kg	,

		Say		2400	kg		(a)	Rs	98.17	235573.6 4
		GST component						Rs	17.89	42925.42
5	4.12	Extra for provi doses by weigh	ding an nt of ce	nd mixin ment as	g water per man	proofi ufactu	ng mate rer's spe	rial in c cificatio	ement concr	ete work in
		Quantity as per item No.3	1		20.0 0	m <sup>3</sup>	340	kg/m	6798.937 5	kg
		Total							6798.937 5	kg
		Say		135.9 8	bags		@	Rs	66.49	9040.67
		GST						Rs	12.11	1647.36
6	5.9.1	Centering and	shutter	ing inclu	iding str	utting.	proppi	ng etc. a	and removal	of form for
		:Foundations, f	footing	s, bases o	of colun	nns, etc	c. for m	ass conc	erete	
		Bottom slab	4	4.95		0.3 5	6.93	m <sup>2</sup>		
		Total					6.93	m <sup>2</sup>		
		Say		6.93	$m^2$		@	Rs	334.9	2320.85
		GST						Rs	61.0	422.9
7	5.9.2	Centering and	shutter	ing inclu	iding str	utting,	proppi	ng etc. a	and removal	of form for
		:Walls (any the courses etc.	nicknes	s) incluc	ling atta	ached	pilaster	s, buttre	esses, plinth	and string
		For walls outside	4	4.35		2.3 5	40.8 9	m <sup>2</sup>		
		For walls inside	4	3.75		2.3 5	35.3	m <sup>2</sup>		
		Total					76.1 4	$m^2$		
		Say		76.14	m <sup>2</sup>		@	Rs	716.35	54543.24
		GST						Rs	130.53	9938.68
8	22.23.	Providing and waterproofing water tanks, ro / subway and b crystalline slun crystalline slun negative (intern the requirement concrete by mar- resistant to 16 be capable of carried out all charge. The pro- leakage, For ver-	apply treatm of slab ridge d ry : 2 ry : 1 nal) sid nts as s ore tha bar hyd self-he compl roduct	ing integent to the s, podium eck etc., parts wate a with th pecified n 90% c drostatic aling of ete as per perform surface to	gral cry e RCC s prepared ter) for r) for ho e help o in ACL ompared pressure cracks t er speci- ance sh wo coats	stalling tructur voir, s d by m vertic orizonta f synth 212-3R d with e on ne up to a fication all car s @ 0.7	e slurry es like i ewage a ixing in al surfa al surfa etic fibr -2010 i control egative s width n and th ry guar 70 kg pe	y of hydretaining & water the ratio aces and ces and e brush. .e. by re- concret side. The of 0.50 me direct antee for	drophilic in g walls of the treatment pl of $5: 2$ (5 pc 3: 1 (3 pc applying the The materia educing permi- e as per DIff e crystalline mm. The wor- tion of the e- or 10 years a	nature for e basement, ant, tunnels arts integral same from l shall meet neability of N 1048 and slurry shall ork shall be engineer-in- against any
		Inside of walls	4	3.75		2.3	35.2	$m^2$		
		Total				5	35.2 5	m <sup>2</sup>		
		Say		35.25	m <sup>2</sup>		@	Rs	569.6	20077.28
		GST						Rs	103.8	3658.41
		component								

9	22.23. 2	Providing and waterproofing water tanks, ro / subway and b crystalline slun crystalline slun negative (intern the requirement concrete by marries resistant to 16 be capable of carried out all charge. The p leakage. For he	apply treatmo of slabs ridge d rry : 2 ry : 1 p nal) sid nts as s ore tha bar hyc self-he compl roduct prizonta	ing integ ent to the s, podiun eck etc., j parts wa part water e with the pecified n 90% co drostatic aling of ete as per performa al surface	gral cry RCC s ns, reser prepared ter) for cher) for ho e help of in ACI2 ompared pressure cracks u er specifient ance shi e one co	stallin tructur voir, s d by m vertic orizont f synth 212-3R d with e on ne up to a fication all car. at @1.	e slurry es like ewage a ixing in cal surfa al surfa etic fibr control control cative s u width n and th ry guar .10 kg p	v of hyd retaining & water the ratio aces and ces and	drophilic in g walls of the treatment pla of $5: 2$ (5 pa 3: 1 (3 pa applying the The materia educing perm e as per DIN e crystalline nm. The wo tion of the e r 10 years a	nature for e basement, ant, tunnels arts integral same from l shall meet neability of N 1048 and slurry shall ork shall be engineer-in- against any			
		Bottom slab	1	3.75	3.75		14.0 6	m <sup>2</sup>					
		Total					14.0 6	m <sup>2</sup>					
		Say		14.06	m <sup>2</sup>		(a)	Rs	439.01	6173.53			
		GST component						Rs	79.99	1124.92			
10	13.7.1	12 mm cement 3 fine sand)	t plaste	r finished	l with a	floatii	ng coat	of neat of	cement :1:3	(1 cement :			
		Inside of walls	4	3.75		2.3 5	35.2 5	m <sup>2</sup>					
		Base slab inside	1	3.75	3.75		14.0 6	m <sup>2</sup>					
		Total					49.3 1	m <sup>2</sup>					
		Say		49.31	m <sup>2</sup>		@	Rs	400.74	19761.38			
		GST component	BST omponent Rs 73.02 3600.85										
		Total-Chlorine	Total-Chlorine Contact Tank ₹ 5.86.452										
		GST component								₹ 1,06,861			

### 5.16 FILTER FEED TANK

FILTE	FILTER FEED TANK-rectangular													
Item No.	Item Cod e	Description	escription No L B H V Unit Rate Amou											
1	2.6.1	Earth work in excavat over areas (exceeding including getting out a m, as directed by Eng	rth work in excavation by mechanical means (Hydraulic excavator)/manual means er areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) luding getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 as directed by Engineer-in-charge											
		For filter feed tank	1	4.2	4.2	2.5	44.1	m <sup>3</sup>						
		Total					44.1	m <sup>3</sup>						
		Say		44.1	m <sup>3</sup>		(a)	Rs	213.9	9431.23				
		GST component						Rs	39.0	1718.53				

2	4.1.6	Providing and laying cost of centering and coarse sand (zone-III)	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level : 1:3:6 (1 Cement : 3 coarse sand (zone-III): 6 graded stone aggregate 40 mm nominal size)										
		For filter feed tank	1	4.2	4.2	0.1 5	2.65	m <sup>3</sup>					
		Total					2.65	m <sup>3</sup>					
		Say		2.65	m <sup>3</sup>		a	Rs	7202.3	19086.21			
		GST component						Rs	1312.4	3477.82			
3	5.37. 1 + 5.34. 1	Providing and laying cement concrete wor approved design mix, to site of work in tr manufactured as per work, including pump the cost of centering admixtures in recomm of concrete, improve direction of the Engin is @ 330 kg/ <sup>3</sup> .Excess separately).	Providing and laying in position ready mixed M-30 grade concrete for reinforce ement concrete work, using Sulphate Resistant Cement (SRC) content as p approved design mix, manufactured in fully automatic batching plant and transport o site of work in transit mixer for all leads, having continuous agitated mix nanufactured as per mix design of specified grade for reinforced cement concre- vork, including pumping of R.M.C. from transit mixer to site of laying, excludi he cost of centering, shuttering finishing and reinforcement, including cost idmixtures in recommended proportions as per IS : 9103 to accelerate/ retard settion of concrete, improve workability without impairing strength and durability as p direction of the Engineer-in-charge. (Note :- Cement content considered in this ite s @ 330 kg/3.Excess/less cement used as per design mix is payable/recoveral exparately). Base slab 1 4.2 4.2 0.3 5.29 m <sup>3</sup> Fank walls 2 6.70 0.25 2.3 7.87 m <sup>3</sup>										
		Base slab	1	4.2	4.2	0.3	5.29	m <sup>3</sup>					
		Tank walls	2	6.70	0.25	2.3 5	7.87	m <sup>3</sup>					
		Total					13.1 6	m <sup>3</sup>					
		Say		13.1 6	m <sup>3</sup>		@	Rs	9956.3 1	131069.7 8			
		GST component						Rs	1814.2 0	23883.09			
4	5.22. 6	Epoxy coated steel re bending, placing in p Mechanically Treated	einforc positio l bars o	ement f n and b of grade	for R.C pinding Fe-500	.C. wo all co D or 1	ork inclu omplete nore.	uding st upto pl	raightenir linth level	ng, cutting, l. Thermo-			
		Quantity as per item No.3	1		13.1 6	m <sup>3</sup>	120	kg/m	1579.7 4	kg			
		Total							1579.7 4	kg			
		Say		158 0	kg		(a)	Rs	98.17	155084.6 9			
		GST component				~		Rs	17.89	28259			
5	4.12	Extra for providing an	nd mix ment a	ting wa	ter proc	ofing n turer's	naterial specific	in ceme	ent concre	ete work in			
		Quantity as per item No.3	1	as per in	13.1 6	m <sup>3</sup>	340	kg/m	4475.9 3	kg			
		Total							4475.9 3	kg			
		Say		89.5 2	bags		@	Rs	66.49	5951.72			
		GST component						Rs	12.11	1084.5			
6	5.9.1	Centering and shutter Foundations, footing	ring in s, base	cluding es of col	struttin umns,	ng, pro etc. for	pping e r mass c	etc. and concrete	removal o	of form for			
		Bottom slab	2	8.40		0.3	5.04	m <sup>2</sup>					
		Total					5.04	m <sup>2</sup>					

		Say		5.04	m <sup>2</sup>		(a)	Rs	334.9	1687.89		
		GST component						Rs	61.0	307.56		
7	5.9.2	Centering and shutter :Walls (any thickness	ring in s) inc	cluding luding	struttir attache	ng, pro d pila	pping e sters, b	etc. and outtresse	removal o s, plinth	of form for and string		
		For walls outside	2	7.20		2.3 5	33.8 4	m <sup>2</sup>				
		For walls inside	2	6.20		2.3 5	29.1	m <sup>2</sup>				
		Total					62.9 8	m <sup>2</sup>				
		Say		62.9 8	m <sup>2</sup>		@	Rs	716.35	45116.01		
		GST component						Rs	130.53	8220.89		
	3.1	waterproofing treatme water tanks, roof slab / subway and bridge d crystalline slurry : 2 crystalline slurry : 1 p negative (internal) sid the requirements as s concrete by more that resistant to 16 bar hyd be capable of self-he carried out all compli- charge. The product leakage. For vertical s	vaterproofing treatment to the RCC structures like retaining walls of the basement vater tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnel subway and bridge deck etc., prepared by mixing in the ratio of $5:2$ (5 parts integra crystalline slurry : 2 parts water) for vertical surfaces and $3:1$ (3 parts integra crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fibre brush. The material shall meet the requirements as specified in ACI212-3R-2010 i.e. by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry sha be capable of self-healing of cracks up to a width of 0.50mm. The work shall b carried out all complete as per specification and the direction of the engineer-ir charge. The product performance shall carry guarantee for 10 years against an eakage. For vertical surface two coats @ 0.70 kg per som									
		Inside of walls	2	6.20		2.3 5	29.1 4	m <sup>2</sup>				
		Total				-	29.1 4	m <sup>2</sup>				
		Say		29.1 4	m <sup>2</sup>		@	Rs	569.6	16597.22		
		GST component						Rs	103.8	3024.29		
9	22.2 3.2	Providing and applying integral crystalline slurry of hydrophilic in nature waterproofing treatment to the RCC structures like retaining walls of the basen water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tur / subway and bridge deck etc., prepared by mixing in the ratio of $5:2$ (5 parts integraves crystalline slurry : 2 parts water) for vertical surfaces and $3:1$ (3 parts integraves crystalline slurry : 1 part water) for horizontal surfaces and applying the same finegative (internal) side with the help of synthetic fibre brush. The material shall a the requirements as specified in ACI212-3R-2010 i.e. by reducing permeabilit concrete by more than 90% compared with control concrete as per DIN 1048 resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry is be capable of self-healing of cracks up to a width of 0.50mm. The work shall carried out all complete as per specification and the direction of the enginee charge. For horizontal surface one coat @1.10 kg per sqm.								nature for basement, ant, tunnels rts integral rts integral same from shall meet heability of 1048 and slurry shall rk shall be ngineer-in- gainst any		
		Total					9.61	m <sup>2</sup>				
		Say		9.61	m <sup>2</sup>		(a)	Rs	439.01	4218.85		
		GST component						Rs	79.99	768.75		

10	13.7. 1	12 mm cement plaster fine sand)	12 mm cement plaster finished with a floating coat of neat cement :1:3 (1 cement : 3 fine sand)											
		Inside of walls	$\begin{array}{cccccccccccccccccccccccccccccccccccc$											
		Base slab inside	1	3.10	3.1		9.61	m <sup>2</sup>						
		Total					38.7 5	m <sup>2</sup>						
		Say		38.7 5	m <sup>2</sup>		@	Rs	400.74	15528.58				
		GST component						Rs	73.02	2829.57				
		Total- Filter Feed Tank												
		GST component								₹73,574				

#### 5.17 TREATED WATER TANK

TREA	TREATED WATER TANK-rectangular									
Item No.	Item Code	Description	N o	L	В	Η	V	Unit	Rate	Amount
1	2.6.1	Earth work in means over ar plan) includin upto 1.5 m, as	n exc eas (e g gett direc	avation exceeding ing out a ted by Er	by mec 30 cm nd disp ngineer-	hanical in dept osal of in-char	means h, 1.5 m excavate ge	(Hydrau in widtl d earth I	ilic excavat h as well as lead upto 50	or)/manual 10 sqm on ) m and lift
		For treated water tank	1	5.85	5.85	3	102.7	m <sup>3</sup>		
		Total					102.7	m <sup>3</sup>		
		Say		102.7	m <sup>3</sup>		a	Rs	213.86	21957.01
		GST component						Rs	38.97	4000.93
2	4.1.6	Providing and cost of centeri coarse sand (z	layin ng an one-I	ig in posi id shutter II): 6 grad	tion cen ing - Al ded stor	nent co ll work ne aggre	ncrete of up to pli egate 40 f	f specifie inth leve mm nom	ed grade ex 1 : 1:3:6 (1 ninal size)	cluding the Cement : 3
		For treated water tank	1	5.85	5.85	0.15	5.13	m <sup>3</sup>		
		Total					5.13	m <sup>3</sup>		
		Say		5.13	m <sup>3</sup>		@	Rs	7202.3	36948.02
		GST component						Rs	1312.4	6732.54
3	5.37.1 + 5.34.1	Providing and cement concre approved des transported to mixer, manufa concrete work excluding the cost of admixt setting of conc as per direction this item is payable/recover	layin ete w ign 1 site o acture , incli cost ures in crete, n of @ erable	ng in pos ork, usir mix, ma of work ir of as per uding pu of center n recomm improve the Engin 330 kg/-	ition rea ng Sulp nufactur n transit mix de mping o ing, shu nended j workat deer-in-o 3.Excess ely).	ady mix hate Re red in mixer f sign of of R.M. uttering proporti- bility with charge.	ted M-30 esistant ( fully a for all lea specifie C. from finishing ions as pe- ithout im (Note :- cement	) grade of Cement utomatic ads, havi d grade transit n g and re er IS : 91 opairing Cement used as	concrete for (SRC) con batching ng continue for reinfor- nixer to site inforcement 03 to accele strength and content co per desig	reinforced tent as per plant and ous agitated ced cement of laying , t, including erate/ retard d durability nsidered in gn mix is
		Base slab	1	5.85	5.85	0.3	10.27	m		
		Tank walls	2	10.00	0.25	2.85	14.25	$m^3$		

InitialInitialInitialInitialInitialInitialInitialInitialInitial3ay24.52m³(a)Rs9956.31244096.25GSTcomponentRs1814.2044478.384478.3845.22.6Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, beading, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.2942.01kgQuantity as124.5m³120kg/m2942.01kgTotal2942kg(a)(a)Rs98.17288820.1AttacGST2942kg(a)(a)Rs17.8952627.82componentSay2942kg(a)(a)(a)8335.69kg54.12Extra for providing and mixing water proofing material in cement concret work in doses by weight of cement as per manufacturer's specification.8335.69kgQuantity as 124.5m²(a)Rs66.4911084.12IntialIntialIntialRs12.112019.7165.9.1Centering and shuttering including strutting, propping etc. and removal of form for from for from for from and shuttering including strutting, propping etc. and removal of form for from for walls 210.502.8559.85m²75.9.2Centering and shuttering including strutting, propping etc. and removal of form for Walls (any thickness) including strutting, propping etc. and removal of form for Walls (			TT ( 1					04 50	2		
Say24.52 m³m³@Rs9956.31 956.31244096.2 54GST componentFor work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo- Mechanically Treated bars of grade Fe-500D or more.Rs1814.2044478.3845.22.6Expay coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo- Mechanically Treated bars of grade Fe-500D or more.2942.01kg9Quantity as rotal124.5m³120kg/m9Say2942kg@Rs98.1728820.14.12Say2942kg@@Rs17.8952627.8254.12Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.24.5m³340kg/m s8335.69kg6Say166.7bags@Rs12.112019.719GST component166.7bags@Rs12.112019.719GST component17.02m²M334.92350.992350.999GST component7.02m²M48.33.92350.999GST component7.02m²M48.33.92350.999GST componentCentering and shuttering including strutting, propping etc. and removal of form for :For walls 21			Total					24.52	m		
GST componentRs1814.2044478.38 component45.22.6Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo- Mechanically Treated bars of grade Fe-500D or more.2942.01kg4Say124.5m³120kg/m2942.01kg75.2.6Say2942kg $@$ Rs98.17288820.147Say2942kg $@$ $@$ Rs98.17288820.147Say2942kg $@$ $@$ Rs98.17288820.147Say2942kg $@$ $@$ Rs98.17288820.149GST componentcomponentremental in cement concrete work in doses by weight of cement as per manufacturer's specification.288335.69kg9124.5m³340kg/m 38335.69kg9Total124.5m³340kg/m 38335.69kg9Say166.7bags@Rs101.112019.719Say166.7bags@Rs12.112019.719Say166.7bags@Rs12.112019.719Say166.7bags@Rs10.41223.929Say10Rs12.112019.719			Say		24.52	m <sup>3</sup>		a	Rs	9956.31	244096.2 5
4       5.22.6       Epoxy coated steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more.         Quantity as per item No.3       1       24.5       m³       120       kg/m       2942.01       kg         Total       2       m³       120       kg/m       2942.01       kg         GST       2942       kg       @       Rs       98.17       288820.1         GST       component       24.5       m³       340       kg/m       8335.69       kg         Quantity as 1       24.5       m³       340       kg/m       8335.69       kg         Quantity as 1       24.5       m³       340       kg/m       8335.69       kg         Quantity as 1       2       m³       340       kg/m       8335.69       kg         Total       0       0       0       83       8335.69       kg         Say       166.7       bags       @       Rs       10.11       2019.71         GST       component       0       0       7.02       m²       0       334.9       2350.99         S.9.1       Centering and shutt			GST component						Rs	1814.20	44478.38
bending, placing in position and binding all complete upto plinth level. Thermo- Mechanically Treated bars of grade Fe-500D or more. Quantity as 1 24.5 m <sup>3</sup> 120 kg/m 2942.01 kg Total 2942.01 kg Say 2942 kg @ Rs 98.17 288820.1 4.12 Stra for providing and mixing water profing material in exment concrete work in doses by weight of cement as per manufacturer's specification. Quantity as 1 24.5 m <sup>3</sup> 340 kg/m 8335.69 kg per item 2 2 m <sup>3</sup> 340 kg/m 8335.69 kg Say 166.7 bags @ Rs 66.49 11084.12 GST component GST component 2 Rs 12.11 2019.71 component GST component 2 Rs 12.11 2019.71 component GST component 2 Rs 12.11 2019.71 component GST component 2 Rs 12.11 2019.71 component 2 Rs 61.0 428.39 Component 2 Rs 6	4	5.22.6	Epoxy coated	steel	reinforce	ment fo	r R.C.C	C. work in	ncluding	straighteni	ng, cutting,
Quantity as per item No.3124.5 2m³120kg/m2942.01kgTotalTotal2942kg2942.01kg2942.01kgGST componentGST componentRs98.17288820.1 44.12Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.8335.69kgQuantity as per item No.3124.5 2m³340kg/m 38335.69kgTotal2166.7 1bags@Rs66.4911084.12GST component166.7 1bags@Rs66.4911084.12GST component166.7 1bags@Rs12.112019.71GST component166.7 1bags@Rs12.112019.71GST component1160.7 1bags@Rs12.112019.71GST component1160.7 1bags@Rs334.92350.99GST component211.700.37.02m²Image: Sign of the sign of th			bending, placi Mechanically	ng in Treate	position ed bars o	and bin f grade	nding a Fe-5001	ll comple D or mor	ete upto e.	plinth leve	el. Thermo-
PertonNetholdPertonPer			Quantity as	1		24.5	m <sup>3</sup>	120	kg/m	2942.01	kg
Total2942kg2942.01kgGST componentCST componentRs98.17288820.1 44GST componentRs17.8952627.8254.12Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.8335.69kg9Quantity as 1 per item No.324.5 2m³340kg/m 58335.69kg1TotalI 2II 2Rs66.4911084.121GST componentI 1I 1I 2I 2Rs66.4911084.121GST componentI 1I 1I 2I 2Rs10.410.465.9.1Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete1Bottom slab211.700.37.02m²I75.9.2Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.Rs51.0428.3975.9.2Centering and shuttering including attached pilasters, buttresses, plinth and string courses etc.29.502.8559.25m²75.9.2Centering and shuttering including attached pilasters, buttresses, plinth and string courses etc.29.502.8554.2m²			No.3			2					
Say2942kg $@$ Rs98.17288820.1GST componentGST componentRs17.8952627.82 $5$ 4.12Extra for providing and mixing water proofing material in current concurse to work in doses by weight of current as per manufacturer's specification.Rs17.8952627.82 $6$ 4.12Extra for providing and mixing water proofing material in current concurse to work in doses by weight of current as per manufacturer's specification.8335.69kg $0$ Quantity as per item No.3124.5m³340kg/m 38335.69kg $1$ Total2166.7bags@Rs66.4911084.12 $1$ GST component1IIIRs12.112019.71 $6$ 5.9.1Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrustII $7$ 5.9.2Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) incl			Total							2942.01	kg
GST componentRs17.8952627.8254.12Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.Quantity as 1 per item24.5m³340kg/m s8335.69kgQuantity as 1 No.324.5m³340kg/m s8335.69kgTotal2124.5m³340kg/m s8335.69kgTotal2166.7bags@Rs66.4911084.12GST component11112019.712019.7165.9.1Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete1275.9.2Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form for :Walls (any thickness) including strutting, propping etc. and removal of form fo			Say		2942	kg		@	Rs	98.17	288820.1 4
54.12Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification.Quantity as per item 			GST component						Rs	17.89	52627.82
doses by weight of cement as per manufacturer's specification.Quantity as per item No.3124.5 	5	4.12	Extra for provi	iding	and mixi	ng wate	r proof	ing mater	rial in ce	ement concr	ete work in
Quantity as per item No.3       1       24.5       m³       340       kg/m       8335.69       kg         Total       Total       Image: Say       166.7       bags       Image: Say       8335.69       kg         GST       Image: Say       166.7       bags       Image: Say       Imag			doses by weigh	ht of o	cement a	s per ma	anufacti	urer's spe	cificatio	on.	
per item No.3235TotalTotalRR8335.69kgSay166.7 1bags 1@Rs66.4911084.12GST component1Rs12.112019.71Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concreteRs12.11Bottom slab211.700.37.02m²Image: Constraint of the strutting of the strutter of the			Quantity as	1		24.5	m <sup>3</sup>	340	kg/m	8335.69	kg
TotalImage: Say166.7 1bagsImage: Say $8335.69$ 5kgGST componentGST componentImage: SayImage: SayImage			per item No.3			2			3	5	
Say166.7 1bags l $@$ Rs66.4911084.12GST componentGST 			Total							8335.69 5	kg
GST componentGST componentRs12.112019.7165.9.1Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concretform for 			Say		166.7 1	bags		@	Rs	66.49	11084.12
6       5.9.1       Centering and shuttering including strutting, propping etc. and removal of form for :Foundations, footings, bases of columns, etc. for mass concrete         8       Bottom slab       2       11.70       0.3       7.02       m <sup>2</sup> 7       Total       7.02       m <sup>2</sup> Rs       334.9       2350.99         7       Say       7.02       m <sup>2</sup> Rs       61.0       428.39         7       S.9.2       Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.         7       S.9.2       For walls       2       10.50       2.85       59.85       m <sup>2</sup> 8       For walls       2       9.50       2.85       54.2       m <sup>2</sup> m <sup>2</sup> 9       Say       114.0       m <sup>2</sup> @       Rs       716.4       81664.42			GST component						Rs	12.11	2019.71
Foundations, footings, bases of columns, etc. for mass concreteBottom slab211.700.37.02m²Image: concreteTotal7.02m²Image: concretem²Image: concreteImage: concreteSay7.02m²Image: concretem²Image: concreteImage: concreteGST componentImage: concreteImage: concreteImage: concreteImage: concreteImage: concrete75.9.2Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.Image: concreteImage: concrete75.9.2For walls 210.502.8559.85m²Image: concrete7For walls 29.502.8559.85m²Image: concreteImage: concrete7TotalImage: concreteImage: concreteImage: concreteImage: concreteImage: concreteImage: concrete8For walls 210.502.8559.85m²Image: concreteImage: concreteImage: concrete9For walls 29.502.8554.2m²Image: concreteImage: concreteImage: concrete9For walls 29.50Image: concreteImage: concreteImage: concreteImage: concreteImage: concreteImage: concrete9For walls 29.50Image: concreteImage: concreteImage: concreteImage: concreteImage: concreteImage: concrete <th>6</th> <th>5.9.1</th> <th>Centering and</th> <th>shutt</th> <th>ering inc</th> <th>luding s</th> <th>trutting</th> <th>, proppir</th> <th>ng etc. ai</th> <th>nd removal</th> <th>of form for</th>	6	5.9.1	Centering and	shutt	ering inc	luding s	trutting	, proppir	ng etc. ai	nd removal	of form for
Bottom slab211.700.37.02 $m^2$ $m^2$ $m^2$ Total $m^2$ $m^2$ $m^2$ $m^2$ $m^2$ $m^2$ $m^2$ Say7.02 $m^2$ $m^2$ $m^2$ $m^2$ $2350.99$ GST component $m^2$ $m^2$ $m^2$ $m^2$ $m^2$ 75.9.2Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc. $m^2$ $m^2$ 8For walls210.50 $2.85$ $59.85$ $m^2$ 9For walls29.50 $2.85$ $54.2$ $m^2$ 9Total $m^2$ $m^2$ $m^2$ $m^2$ 9 $m^2$ $m^2$ $m$			:Foundations,	tootir	igs, bases	s of colu	imns, et	tc. for ma	ass conc	rete	
TotalTotal7.02 $m^2$			Bottom slab	2	11.70		0.3	7.02	$m^2$		
Say7.02 $m^2$ $@$ Rs334.92350.99GST componentGST componentRs $61.0$ $428.39$ 75.9.2Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.For walls 2 $10.50$ $2.85$ $59.85$ $m^2$ 8For walls 2 $9.50$ $2.85$ $54.2$ $m^2$ $114.0$ $m^2$ $m^2$ 9Say $114.0$ $m^2$ $@$ Rs $716.4$ $81664.42$			Total					7.02	$m^2$		
GST component       Rs       61.0       428.39         7       5.9.2       Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.         For walls 2       10.50       2.85       59.85       m <sup>2</sup> For walls 2       9.50       2.85       54.2       m <sup>2</sup> Image: Constant of the structure of the str			Say		7.02	$m^2$		a	Rs	334.9	2350.99
7       5.9.2       Centering and shuttering including strutting, propping etc. and removal of form for :Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.         For walls       2       10.50       2.85       59.85       m <sup>2</sup> Image: Second string outside       2       9.50       2.85       54.2       m <sup>2</sup> Image: Second string string outside       114.0       m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> Say       114.0       m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>			GST						Rs	61.0	428.39
Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.         For walls 2       10.50       2.85       59.85       m <sup>2</sup> For walls 2       9.50       2.85       54.2       m <sup>2</sup> Total       114.0       m <sup>2</sup> 0       Rs       716.4       81664.42	7	592	Centering and	shutt	ering inc	ludino s	truttino	proppir	ig etc. ai	nd removal	of form for
For walls 2       10.50       2.85       59.85       m <sup>2</sup> For walls 2       9.50       2.85       54.2       m <sup>2</sup> Total       114.0       m <sup>2</sup> 0       Rs       716.4       81664.42	,	5.9.2	:Walls (any the	nickne	ess) inclu	uding at	ttached	pilasters	, buttres	sses, plinth	and string
outside $1.14$ $0.161$ $0.161$ $0.161$ $1.14$ </th <th></th> <th></th> <th>For walls</th> <th>2</th> <th>10.50</th> <th></th> <th>2.85</th> <th>59.85</th> <th>m<sup>2</sup></th> <th></th> <th></th>			For walls	2	10.50		2.85	59.85	m <sup>2</sup>		
For walls inside       2       9.50       2.85       54.2 $m^2$ Total       114.0 $m^2$ $m^2$ $m^2$ $m^2$ Say       114.0 $m^2$ $m^2$ $m^2$ $m^2$			outside								
Total     114.0     m <sup>2</sup> Say     114.0     m <sup>2</sup> @     Rs     716.4       81664.42			For walls inside	2	9.50		2.85	54.2	$m^2$		
Say 114.0 m <sup>2</sup> @ Rs 716.4 81664.42			Total					114.0 0	m <sup>2</sup>		
			Say		114.0 0	m <sup>2</sup>		a	Rs	716.4	81664.42
GST Rs 130.5 14880.61			GST						Rs	130.5	14880.61

8	22.23. 1	Providing and a waterproofing tr water tanks, roof / subway and br integral crystalli integral crystalli same from nega material shall r reducing perme concrete as per l side. The crystal of 0.50mm. The direction of the of for 10 years again	waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fibre brush. The material shall meet the requirements as specified in ACI212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. For vertical surface two coats @ 0.70 kg per sqm Inside of 2 9.50 2.85 54.15 m <sup>2</sup>												
		Inside of 2 walls	9.50		2.85	54.15	m <sup>2</sup>								
		Total	tal 54.15 $m^2$ 20842.12												
		Say	ay $54.15 \text{ m}^2$ @ Rs $569.6$ $30842.$												
		GST	GST Rs 103.8 5												
9	22.23. 2	component Providing and a waterproofing tr water tanks, roof / subway and br integral crystalli integral crystalli same from nega material shall r reducing perme concrete as per side. The crystal of 0.50mm. The direction of the of for 10 years again	applying in eatment to the filles and the filles applying in filles applying to the filles applying applying the slurry is work shall engineer-in- nst any leak	tegral c the RCC ums, res etc., pre 2 parts 1 part w hal) side equireme concrete and resis shall be be carrie charge. tage. For	rystallin structu ervoir, pared b water) vater) fr with the with tant to capable ed out a The pro- horizo	ne slurry res like r sewage & oy mixing for vertic or horizo the help specifiec ore than 16 bar hy e of self-l all compl oduct per ntal surfa	of hyd etaining & water f g in the cal surfa ntal sur of synt 1 in AC 90% c ydrostati nealing o ete as pe formanc ace one c	arophilic in walls of the reatment pl ratio of 5 aces and 3 faces and a hetic fibre CI212-3R-20 ompared w c pressure of cracks up er specificat e shall carr coat @1.10	nature for e basement, ant, tunnels : 2 (5 parts : 1 (3 parts pplying the brush. The D10 i.e. by vith control on negative to a width tion and the y guarantee kg per sqm.						
		Bottom slab 1 inside	4.75	4.75		22.56	m <sup>2</sup>								
		Total				22.56	m <sup>2</sup>								
		Say	22.56	m <sup>2</sup>		a	Rs	439.01	9905.09						
		GST					Rs	79.99	1804.87						
10	13.7.1	12 mm cement p 3 fine sand)	olaster finisl	ned with	a float	ing coat o	of neat c	ement :1:3	(1 cement :						
		Inside of 2 walls	2 9.50		2.85	54.15	m <sup>2</sup>								
		Base slab 1 inside	4.75	4.75		22.56	m <sup>2</sup>								
		Total				76.71	m <sup>2</sup>								
		Say         76.71         m <sup>2</sup> @         Rs         400.74         30741.59													
		GST component	GST Rs 73.02 5601.63												
		Total- Treated w	Total- Treated water Tank₹7,58,410												
		GST component							₹ 1,38,195						

SEWE	R NETV	WORK WITH	PIPES,	MANHO	LES, IN	SPECTI	ON CHA	MBERS	S AND WE	LLS
Item No.	Item Code	Description	No	L	В	Н	V	Unit	Rate	Amount
1	2.6.1	Earth work i over areas (ex getting out ar by Engineer-	n excava kceeding nd dispos in-charg	ation by 1 30 cm in sal of exca e	mechani depth, 1 wated ea	cal mea .5 m in v urth lead	ns (Hydra vidth as w upto 50 n	aulic exo ell as 10 n and lift	cavator)/ma sqm on pla upto 1.5 m	nual means n) including , as directed
		For manholes- class 1 (0.9 m dia)	459	1.90	1.90	1.56	2585	m <sup>3</sup>		
		For manholes- class 2 (1.2 m dia)	43	2.30	2.30	2.50	568.7	m <sup>3</sup>		
		For manholes- class 3 (1.5 m dia)	61	2.70	2.70	3.53	1570	m <sup>3</sup>		
		Extra depth for lift manholes	6	2.70	2.70	0.50	21.87	m <sup>3</sup>		
		For collection well-1	1	6.90	6.90	6.70	319	m <sup>3</sup>		
		For collection well-2	1	6.90	6.90	6.70	319	m <sup>3</sup>		
		For lift manhole panel board foundation	6	1.00	0.45	0.60	1.62	m <sup>3</sup>		
		For sewer chambers	1126	1.30	1.30	1.00	1903	m <sup>3</sup>		
		Total			2		7288	m <sup>3</sup>	<b>010</b> 0	
		Say		7288	m		<u>(a)</u>	Ks	213.9	1558558
		component						Rs	30.97	283995
2	4.1.6	Providing an of centering a (zone-III): 6	d laying and shutt graded s	in positic ering - Al tone aggr	on cemer I work u egate 40	nt concr p to plin mm nor	ete of spe th level : minal size	cified g 1:3:6 (1 2)	rade exclud Cement : 3	ing the cost coarse sand
		For manholes- class 1 (0.9 m dia)	459	1.90	1.90	0.15	248.6	m <sup>3</sup>		
		For manholes- class 2 (1.2 m dia)	43	2.30	2.30	0.15	34.12	m <sup>3</sup>		
		For manholes-	61	2.70	2.70	0.15	66.7	m <sup>3</sup>		

	$a_{1}^{1}a_{2}a_{3}^{2}$ (1.5)								
	m dia)								
	For collection well-1	1	6.90	6.90	0.15	7.14	m <sup>3</sup>		
	For collection well-2	1	6.90	6.90	0.15	7.14	m <sup>3</sup>		
	For lift manhole panel board foundation	6	1.00	0.45	0.60	1.62	m <sup>3</sup>		
	For sewer chambers	1126	1.30	1.30	0.15	285.4	m <sup>3</sup>		
	For pipeline support base/6 m	3404	0.30	0.30	0.1	30.64	m <sup>3</sup>		
	Total					681.4	m <sup>3</sup>		
	Say		681.4	m <sup>3</sup>		@	Rs	7202.3	4907316. 85
	GST component						Rs	1312.4	894194.5 1
	R.M.C. from finishing and as per IS : 9 impairing str Cement conte	transit i reinforce 103 to a rength an ent cons	nixer to s cement, in ccelerate/ nd durabil idered in t	ite of la cluding retard s lity as p this item	ying, ex cost of setting o er direc n is @ 3.	admixture f concrete tion of th 30 kg/m <sup>3</sup> .	he cost o es in reco e, impro e Engin Excess/l	of centering ommended ve workabi eer-in-charg ess cement	g, shuttering proportions lity without ge. (Note :- used as per
	impairing str Cement conto design mix is	ength an ent cons payable	nd durabil idered in t e/recovera	lity as p this iten ble sepa	er direct n is @ 3. mately).	tion of th 30 kg/m <sup>3</sup> .	e Engin Excess/1	eer-in-charg ess cement	ge. (Note :- used as per
	Base slab - manhole class-1	459	1.90	1.90	0.35	579.95	m		
	Base slab - manhole class-2	43	2.30	2.30	0.40	90.99	m <sup>3</sup>		
	Base slab - manhole class-3	61	2.70	2.70	0.45	200.11	m <sup>3</sup>		
	Base slab collection well-1	1	6.90	6.90	0.45	21.42	m <sup>3</sup>		
	Base slab collection well-2	1	6.90	6.90	0.45	21.42	m <sup>3</sup>		
	Walls- manhole class-1	459	0.90		1.06	438.86	m <sup>3</sup>		
	Walls- manhole class-2	43	1.41		1.95	118.51	m <sup>3</sup>		
	Walls- manhole class-3	61	2.03		2.93	364.02	m <sup>3</sup>		
				118					

		<b>T</b> 41								
		for lift	6	2.03		0.50	6.10	m <sup>3</sup>		
		Walls- collection	1	7.85		6.10	47.86	m <sup>3</sup>		
		Walls- collection well-2	1	7.85		6.10	47.86	m <sup>3</sup>		
		Top slab- manhole class-1	459	1.54		0.2	141.32	m <sup>3</sup>		
		Top slab- manhole class-2	43	2.54		0.2	21.88	m <sup>3</sup>		
		Top slab- manhole class-3	61	3.80		0.2	46.38	m <sup>3</sup>		
		Chamber slab	1126	1.00	1.00	0.2	225.20	m <sup>3</sup>		
		Chamber walls	1126	2.40	0.20	0.5	270.24	m <sup>3</sup>		
		Chamber cover slab	1126	1.00	1.00	0.1	112.60	m <sup>3</sup>		
		Deduct manhole cover (600 mm dia)	563	0.28		0.15	-23.88	m <sup>3</sup>		
		Total					2730.8	m <sup>3</sup>		
		Say		2730.8	m <sup>3</sup>		@	Rs	9956.3	27189160
		GST						Rs	1814.2	4954315. 96
4	5.22. 6	Epoxy coate bending, pla Mechanically	d steel a cing in 7 Treated	reinforcer position l bars of g	nent for and bir grade Fe	R.C.C. nding al -500D o	work in l complet r more.	cluding te upto	straighteni plinth leve	ng, cutting, el. Thermo-
		Quantity as per item No.3	1		2730 .8	m <sup>3</sup>	110	kg/m	300393. 32	kg
		Total							300393. 32	kg
		Say		3E+05	kg		@	Rs	98.17	29489920 .14
		GST component						Rs	17.89	5373552. 51
5	4.12	Extra for prov by weight of	viding ar cement	nd mixing as per ma	water pr nufactur	roofing r er's spec	naterial in ification.	i cement	concrete w	ork in doses
		Quantity as per item No.3	1		2730 .8	m <sup>3</sup>	340	kg/m	928488. 45	kg
		Total							928488. 45	kg
		Say		18570	bags		@	Rs	66.49	1234627. 53

		GST						D	10.11	224969.6
		component						Ks	12.11	1
6	5.9.1	Centering an	d shutte	ring inclu	uding st	rutting,	propping	etc. and	d removal	of form for
		:Foundations	, tooting	s, bases o	of colum	ns, etc. f	for mass c	oncrete		
		Ease slab	<i>A</i> 50	7.6		0.35	1221	m <sup>2</sup>		
		manholes-	439	7.0		0.55	1221	111		
		class 1								
		For	43	9.2		0.40	158.2	$m^2$		
		manholes-								
		For	61	10.8		0.45	296.5	m <sup>2</sup>		
		manholes-	-							
		class 3						2		
		For	1	27.6		0.45	12.42	m²		
		well-1								
		For	1	27.6		0.45	12.42	m <sup>2</sup>		
		collection well-2								
		For sewer chambers	1126	4.00		0.20	900.8	m <sup>2</sup>		
		Total					2601.3	m <sup>2</sup>		
		Say		2601.3	m <sup>2</sup>		a	Rs	334.9	871164.5
		GST						Rs	61.0	1 158740.6
		component						IX3	01.0	2
7	5.9.2	Centering an	d shutte	ring inclu	uding st	rutting,	propping	etc. and	d removal	of form for
		:Walls (any t	hickness	s) includir	ng attach	ed pilas	ters, buttr	esses, pl	linth and st	ring courses
		etc. For walls								
		outside								
		For	459	4.40		1.06	2136.0	m <sup>2</sup>		
		manholes-								
		For	43	5.65		1.95	473.81	m <sup>2</sup>		
		manholes-	15	2102		1.90	1,5101			
		class 2						2		
		For	61	6.91		2.93	1236.2	m <sup>2</sup>		
		class 3								
		Extra depth								
		for lift	6	6.01		0.50	20.7	m <sup>2</sup>		
		For	0	0.91 18.84		0.50 6.10	20.7	$m^2$		
		collection well-1	1	10.01		0.10	111.72			
		For	1	18.84		6.10	114.92	m <sup>2</sup>		
		collection well-2								
		For sewer	1126	4.00		0.50	2252.0	m <sup>2</sup>		
		chambers								
		inside								
		For	459	2.83		1.06	1373.1	m <sup>2</sup>		
		manholes-								
		class 1			120					

	Г	40	2 77		1.05	215.0	2		
	For manholes-	43	3.//		1.95	315.9	m		
	class 2								
	For	61	4.71		2.93	842.9	$m^2$		
	manholes-								
	For	1	16.01		6.10	97.7	m <sup>2</sup>		
	collection well-1	1	10.01		0.10	51.1			
	For collection well-2	1	16.01		6.10	97.7	m <sup>2</sup>		
	For sewer chambers	1126	2.40		0.50	1351.2	m <sup>2</sup>		
	Total					10427	m <sup>2</sup>		
	Say		10427	m <sup>2</sup>		@	Rs	716.35	7469400
	GST component						Rs	130.53	1361049
	with the help specified in	p of syr ACI212- ed with (	othetic fib -3R-2010	i.e. by a	n. The reducing	naterial s permeab	hall me oility of d resista	et the requ concrete by	irements as more than hydrostatic
	pressure on n up to a width and the dire	egative of 0.50 ection of	side. The o mm. The y f the eng	erystallin work sha gineer-in	ne slurry all be car -charge.	shall be c ried out a The pro	apable o ll compl oduct pe	of self-healing lete as per serformance	ng of cracks pecification shall carry
	pressure on n up to a width and the dire guarantee for	egative of 0.50 ection of 10 year	side. The one of the engrish against a	crystallin work sha gineer-in any leak	ne slurry all be can -charge. age. For	shall be c ried out a The provertical s	apable of apable of all compl oduct pe aurface to	of self-healin lete as per s erformance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	pressure on n up to a width and the dire guarantee for sqm	egatives of 0.50 ection of 10 year	side. The o mm. The v f the eng s against a	crystallin work sha gineer-in any leak	ne slurry all be can -charge. age. For	shall be c rried out a The pro vertical s	apable of all compl oduct pe ourface ty	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	pressure on n up to a width and the dire guarantee for sqm Inside of walls	egative of 0.500 ection of 10 year	side. The c mm. The v f the eng s against	crystallin work sha ineer-in any leak	ne slurry ill be can -charge. age. For	shall be c rried out a The pro vertical s	apable c Il compl oduct pe urface ty	of self-healin lete as per s erformance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	pressure on n up to a width and the dire guarantee for sqm Inside of walls For manholes- class 1	egative s of 0.50 ection o 10 year 459	side. The one of the eng s against	crystallin work sha jineer-in any leak	ne slurry all be can -charge. age. For 1.06	shall be c ried out a The provertical s 1373.1	m <sup>2</sup>	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	pressure on n up to a width and the dire guarantee for sqm Inside of walls For manholes- class 1 For manholes- class 2	459	2.83 3.77	crystallin work sha ineer-in any leak	1.06 1.95	shall be c ried out a The provertical s 1373.1 315.9	m <sup>2</sup>	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	<ul> <li>90% compare</li> <li>pressure on n</li> <li>up to a width</li> <li>and the dire</li> <li>guarantee for</li> <li>sqm</li> <li>Inside of</li> <li>walls</li> <li>For</li> <li>manholes-</li> <li>class 1</li> <li>For</li> <li>manholes-</li> <li>class 2</li> <li>For</li> <li>manholes-</li> <li>class 3</li> </ul>	459 43	2.83 3.77 4.71	crystallin work sha jineer-in any leak	1.06 1.95 2.93	<ul> <li>shall be c</li> <li>rried out a</li> <li>The provertical s</li> <li>1373.1</li> <li>315.9</li> <li>842.9</li> </ul>	m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	<ul> <li>90% compare</li> <li>pressure on n</li> <li>up to a width</li> <li>and the dire</li> <li>guarantee for</li> <li>sqm</li> <li>Inside of</li> <li>walls</li> <li>For</li> <li>manholes-</li> <li>class 1</li> <li>For</li> <li>manholes-</li> <li>class 2</li> <li>For</li> <li>manholes-</li> <li>class 3</li> <li>Extra depth</li> <li>for lift</li> <li>manholes</li> </ul>	459 43 6	<ul> <li>a. 2.83</li> <li>3.77</li> <li>4.71</li> </ul>	crystallin work sha ineer-in any leak	<ul> <li>1.06</li> <li>1.95</li> <li>2.93</li> <li>0.50</li> </ul>	<ul> <li>shall be c</li> <li>rried out a</li> <li>The provertical s</li> <li>1373.1</li> <li>315.9</li> <li>842.9</li> <li>14.1</li> </ul>	m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	<ul> <li>90% compare</li> <li>pressure on n</li> <li>up to a width</li> <li>and the dire</li> <li>guarantee for</li> <li>sqm</li> <li>Inside of</li> <li>walls</li> <li>For</li> <li>manholes-</li> <li>class 1</li> <li>For</li> <li>manholes-</li> <li>class 2</li> <li>For</li> <li>manholes-</li> <li>class 3</li> <li>Extra depth</li> <li>for lift</li> <li>manholes</li> <li>For</li> <li>collection</li> <li>well-1</li> </ul>	459 43 61	<ul> <li>a. a. a</li></ul>	crystallin work sha ineer-in any leak	1.06         1.95         2.93         0.50         6.10	shall be c         ried out a         The provertical s         1373.1         315.9         842.9         14.1         97.7	m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	<ul> <li>90% compare</li> <li>pressure on n</li> <li>up to a width</li> <li>and the dire</li> <li>guarantee for</li> <li>sqm</li> <li>Inside of</li> <li>walls</li> <li>For</li> <li>manholes-</li> <li>class 1</li> <li>For</li> <li>manholes-</li> <li>class 2</li> <li>For</li> <li>manholes-</li> <li>class 3</li> <li>Extra depth</li> <li>for lift</li> <li>manholes</li> <li>For</li> <li>collection</li> <li>well-1</li> <li>For</li> <li>collection</li> <li>well-2</li> </ul>	459 43 61	<ul> <li>a. Side. The of the eng s against a</li> <li>2.83</li> <li>3.77</li> <li>4.71</li> <li>4.71</li> <li>16.01</li> <li>16.01</li> </ul>	crystallin work sha ineer-in any leak	1.06         1.95         2.93         0.50         6.10	10 10 an         shall be c         ried out a         The provertical s         1373.1         315.9         842.9         14.1         97.7         97.7	m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	<ul> <li>90% compare</li> <li>pressure on n</li> <li>up to a width</li> <li>and the dire</li> <li>guarantee for</li> <li>sqm</li> <li>Inside of</li> <li>walls</li> <li>For</li> <li>manholes-</li> <li>class 1</li> <li>For</li> <li>manholes-</li> <li>class 2</li> <li>For</li> <li>manholes-</li> <li>class 3</li> <li>Extra depth</li> <li>for lift</li> <li>manholes</li> <li>For</li> <li>collection</li> <li>well-1</li> <li>For</li> <li>collection</li> <li>well-2</li> <li>For sewer</li> <li>chambers</li> </ul>	459 43 61 1 1126	<ul> <li>2.83</li> <li>3.77</li> <li>4.71</li> <li>4.71</li> <li>16.01</li> <li>16.01</li> <li>2.40</li> </ul>	erystallin work sha ineer-in any leak	1.06         1.95         2.93         0.50         6.10         0.50	<ul> <li>1373.1</li> <li>315.9</li> <li>842.9</li> <li>14.1</li> <li>97.7</li> <li>97.7</li> <li>1351.2</li> </ul>	m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	90% comparepressure on nup to a widthand the direguarantee forsqmInside ofwallsFormanholes-class 1Formanholes-class 2Formanholes-class 3Extra depthfor liftmanholesForcollectionwell-1Forcollectionwell-2For sewerchambersTotal	459 43 61 1 1126	<ul> <li>2.83</li> <li>3.77</li> <li>4.71</li> <li>4.71</li> <li>16.01</li> <li>16.01</li> <li>2.40</li> </ul>	crystallin work sha ineer-in any leak	1.06         1.95         2.93         0.50         6.10         0.50	<ul> <li>1373.1</li> <li>1373.1</li> <li>315.9</li> <li>842.9</li> <li>14.1</li> <li>97.7</li> <li>97.7</li> <li>1351.2</li> <li>4092.6</li> </ul>	m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	of self-healin lete as per s performance wo coats @	ng of cracks pecification shall carry 0.70 kg per
	90% comparepressure on nup to a widthand the direguarantee forsqmInside ofwallsFormanholes-class 1Formanholes-class 2Formanholes-class 3Extra depthfor liftmanholesForcollectionwell-1ForFor sewerchambersTotalSay	459 43 61 1 1126	2.83 3.77 4.71 4.71 16.01 16.01 2.40	m <sup>2</sup>	1.06         1.95         2.93         0.50         6.10         0.50	<ul> <li>shall be c</li> <li>shall be c</li> <li>ried out a</li> <li>The provertical s</li> <li>1373.1</li> <li>315.9</li> <li>842.9</li> <li>14.1</li> <li>97.7</li> <li>97.7</li> <li>1351.2</li> <li>4092.6</li> <li>Ø</li> </ul>	m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup> m <sup>2</sup>	569.6	2330987.

		CST								1217116
		component						Rs	103.8	3
9	22.2 3.2	Providing an waterproofing tanks, roof sl and bridge de slurry : 2 par 1 part water) with the help specified in 2 90% compare pressure on n up to a width and the dire guarantee for sqm.	nd appl g treatmo abs, pod eck etc., ts water for horiz o of syr ACI212- ed with c egative s of 0.500 ction of 10 year	ying inte ent to the iums, reso prepared ) for verti zontal sur athetic fib -3R-2010 control conside. The o mm. The of f the eng s against a	gral cry RCC stru- ervoir, s- by mixin cal surfa faces an- ore brush i.e. by n ncrete as crystallin work sha ineer-in my leaka	ystalline actures l ewage & ng in the aces and d applyin. The n reducing s per DIN ne slurry all be can -charge. For	slurry of ike retaining water tree ratio of 5 3 : 1 (3 p ng the sam naterial s permeab N 1048 an shall be c rried out a The pro- horizonta	of hydr ng walls eatment 5 : 2 (5 p arts inte ne from hall me ility of d resista apable o ll comp oduct pe l surface	ophilic in s of the base plant, tunne oarts integra egral crystal negative (in et the requ concrete by ant to 16 bar of self-healing lete as per s erformance e one coat @	nature for ment, water els / subway l crystalline line slurry : nternal) side irements as / more than hydrostatic ng of cracks pecification shall carry 01.10 kg per
		Bottom slab								
		For manholes- class 1	459	0.64			292.0	m <sup>2</sup>		
		For manholes- class 2	43	1.13			48.6	m <sup>2</sup>		
		For manholes- class 3	61	1.77			107.8	m <sup>2</sup>		
		For collection well-1	1	20.43			20.4	m <sup>2</sup>		
		For collection well-2	1	20.43			20.4	m <sup>2</sup>		
		For sewer chambers	1126	0.36			405.4	m <sup>2</sup>		
		I otal		201 65	ma <sup>2</sup>		894.65	m² Da	420.01	2027566
		Say		094.05			W	IXS	-1.59.01	9
		GST component						Rs	79.99	71566.78
10	2.25	Filling avail foundations of layer by rami	able ex etc. in la ning and	cavated ayers not d watering	earth (e exceedin g, lead uj	excludin ng 20cm p to 50 r	g rock) n in depth n and lift	in trend , consol upto 1.5	ches, plintl lidating eac m.	n, sides of h deposited
		Quantity as per item 1	1				7286.9	m <sup>3</sup>		
		Deductions	1				601 4			
		Bottom	1				081.4	$m^3$		
		slab- manholes+ chambers	1				1090.2	111		
		Bottom slab- collection wells	1				42.8	m <sup>3</sup>		

		Walls-	1				1191.6	m <sup>3</sup>		
		manholes+								
		chambers	1				05.7			
		Walls-	1				95.7			
		wells								
		Ton slab-	1				322.2	m <sup>3</sup>		
		manholes+	1				522.2	111		
		chambers								
		Quantity	1				3995.5	m <sup>3</sup>		
		after								
		deductions								
		Say		3995.5	m <sup>3</sup>		(a)	Rs	258.2	1031808.
										3
		GST						Rs	47.1	188012.5
1.1	100	component	- D' I		10 100	1.	c ·		4004/2016	8
11	100.	Supply of Pl	2 Pipe, F	'E100, PN	N8, 180 i	nm dia,	conformi	ng to IS	4984/2016	
	98.1 20									
	39									
		For	1126	6			6756	m		
		connection								
		trom								
		chamber to								
		Total					6756			
	D	Four		6756			0730	III Da	956 1	Ŧ
		Say		0730	111		W	KS	830.1	57.83.474
		GST						Rs	154.1	₹
		component								10,41,025
12	100.	Supply of PI	E Pipe, F	PE100, PN	J8, 225 r	nm dia,	conformi	ng to IS	4984/2016	
	98.1									
	41		1							
		For sewer								
		network	1	12((9			12((0			
			1	12008			12008	m		
		Total					12668	m		
	19									
		Sav		12668	m		$\widehat{a}$	Rs	1337	₹
		Say		12000	111		u	13	1557	1.69.36.3
										52
		GST						Rs	241	₹
		component								30,48,543
13	100.	Supply of PI	E Pipe, F	PE100, PN	J8, 280 r	nm dia,	conformi	ng to IS	4984/2016.	
	98.1									
	43									
		For sewer ne	twork							
			1	578 3			578	m		
		Total	1	570.5			578.3	m		
		Sov		570 2	m		070.5	n Da	2066.2	Ŧ
		Say		578.5	m		W	KS	2000.3	11 94 900
		GST						Rs	371.93	₹
		component							5,100	2,15,082

14	100. 98.1 45	Supply of PI	E Pipe, P	'E100, PN	18, 355 r	nm dia,	conformi	ng to IS	4984/2016.	
		For sewer								
		network	1	421			421	m		
		Total	-				421	m		
		Say		421	m		(a)	Rs	3313.8	₹
							Ŭ	_		13,95,089
		GST component						Rs	596.5	₹ 2,51,116
15	100. 98.1 61	Supply of PI	E Pipe, P	E100, PN	10, 225	mm dia	, conform	ing to IS	5 4984/2010	5.
		For sewer network pumping line-lifting stations	2	180			360	m		
		For well-2 to well-1	2	50			100	m		
		Total					460	m		
		Say		460	m		a	Rs	1643.5	₹ 7.56.010
		GST						Rs	295.83	₹
		component								1,36,082
16	100. 98.1 63	Supply of Pl	E Pipe, P	'E100, PN	110, 280	mm dia	, conform	ing to IS	5 4984/2016	5.
		For well-1 to STP	2	900			1800	m		
		Total		1900			1800	m Da	2529	7
		Say		1800	m		W	KS	2338	45,68,220
		GST component						Rs	457	₹ 8,22,280
17	2.10. 1	Excavating t sockets, and out the excav cm in depth, and disposing	renches dressing ated soil includir g of surp	of require of sides, i , and then ng consoli lus excave	ed width ramming returnin dating e ated soil	for pip g of bott ng the sc each dep as direc	bes, cables oms, dept bil as requ posited lay cted, with	s, etc in h upto 1 ired, in 1 yer by ra in a lead	cluding exc .5 m, includ ayers not ex amming, wa of 50 m :	cavation for ding getting xceeding 20 atering, etc.
	2.10. 1.2	Pipes, cables	etc. exc	eeding 80	mm dia	. but not	t exceedin	ig 300 m	m dia	
		For depth 0 - 1.50 m								
			1				19104	m <sup>3</sup>		
		For lifting stations	1	120.00	1.20	1.40	201.6	m <sup>3</sup>		
		From well- 2 to well-1	1	35.00	1.20	1.40	58.8	m <sup>3</sup>		
		Total					19365	m <sup>3</sup>		
		Say		19365	m <sup>3</sup>		$\overline{a}$	Rs	428.19	8291835

		GST						Rs	78.02	1510910
		component						IX3	70.02	1510710
18	2.11	For depth								
		1.50 - 3.00 m								
		111	1				3082	m <sup>3</sup>		
		For lifting	1	60.00	1.20	2.50	180	m <sup>3</sup>		
		stations	1	15.00	1 20	2.20	20.6			
		2 to well-1	1	13.00	1.20	2.20	39.0	III		
		Total					3302	m <sup>3</sup>		
		Say		3301.8	m <sup>3</sup>		@	Rs	543.80	1795532
		GST component						Rs	99.09	327176
19	2.12	For depth 3.00 - 4.50								
			1				198.4	m <sup>3</sup>		
		Pumping								
		lines-Lift Stations								
		Pumping								
		lines-well								
		to well & STP								
		511								
		Total					198.4	m <sup>3</sup>		
		Say		198.45	m <sup>3</sup>		@	Rs	1349.01	267708
		GST						Rs	245.81	48781
20	100	component	E nines	(IS · 108)	1)on lan	d portio	n includir	a conve	ving within	initial lead
20	10.6	and aligning electrofusion pressure and trenches alre back filling a complete but	the pipes the pip machine after tes ady mac nd level excludin	bes, elect es, testing sting , alig le, testing ing the tre ng cost of	the pipe gning the the line the line ches in pipe an	n weldi e line thu e pipelir e to suit cluding d fitting	ng using s fabricat ne, loweri able press all labour s.	automa ed to sui ng the p sure wit charge,	tic or sem t the hydrau ipe in posit h potable v hire for app	i automatic ilic working ion into the vater before pliances etc.
		For sewer network - 180 mm OD HDPE pipes								
			1	6756			6756	m		
		Total					6756	m		-
		Say		6756	m		<u>(a)</u>	Rs	265.55	₹ 17,94,076
		GST						Rs	47.80	₹
		component								3,22,934

21	100. 10.8	Laying HDPl and aligning electrofusion pressure and trenches alrea back filling a complete but	aying HDPE pipes (IS : 4984)on land portion including conveying within initial lead nd aligning the pipes, electro-fusion welding using automatic or semi automatic lectrofusion machines, testing the pipe line thus fabricated to suit the hydraulic working ressure and after testing , aligning the pipeline, lowering the pipe in position into the enches already made, testing the line to suitable pressure with potable water before ack filling and leveling the trenches including all labour charge, hire for appliances etc. omplete but excluding cost of pipe and fittings.										
		For sewer network - 225 mm OD HDPE											
		pipes											
		Sewer network	1	12668			12668	m					
		Lifting lines	1	360			360	m					
		Well-2 to well-1	1	100			100	m					
		Total					13128	m					
		Say		13128	m		@	Rs	377.28	₹ 49,53,063			
		GST component						Rs	67.91	₹ 8.91.551			
	0	electrofusion pressure and trenches alrea back filling a complete but	after tes after tes ady mac nd level	es, testing sting, alig le, testing ing the tre ng cost of	the pipe gning the gning the g the line enches in pipe an	e line thu e pipelir e to suit cluding d fitting	is fabricat ne, loweri able press all labour s.	ed to sui ng the p sure wit charge,	t the hydrau ipe in posit h potable v hire for app	lic working ion into the vater before pliances etc.			
		For sewer network - 280 mm OD HDPE pipes											
		Sewer network	1	578.3			578.3	m					
		Well-1 to STP	1	1800			1800	m					
		Total					2378	m					
		Say		2378	m		@	Rs	519.78	₹ 12 36 103			
		GST						Rs	93.56	12,50,195 ₹ 2,22,515			
23	100	Laving HDP	F nines	$(15 \cdot 498)$	4)on lan	d portio	n includir	o conve	ving withir	2,22,313			
23	100. 10.1 2	and aligning electrofusion pressure and trenches alrea back filling a complete but	and aligning the pipes (is : +)o+)on hand portion including conveying within initial fead and aligning the pipes, electro-fusion welding using automatic or semi automatic electrofusion machines, testing the pipe line thus fabricated to suit the hydrulic working pressure and after testing , aligning the pipeline, lowering the pipe in position into the trenches already made, testing the line to suitable pressure with potable water before back filling and leveling the trenches including all labour charge, hire for appliances etc. complete but excluding cost of pipe and fittings.										
		For sewer net	twork	355 mm C	DD HDP	E pipes							
			1	421			421	m					
		Total					421	m					

	Say		421	m		@	Rs	655.58	₹ 2,75,998
	GST component						Rs	118	₹ 49,680
24	Supply and fi	ixing 250	0 mm but	terfly va	lves				
	For pumping lines								
		8				8	m		
	Total					8	m		
	Say		8	m		@	Rs	25000	₹ 2,00,000
	GST component						Rs	4500	₹ 36,000
25	Road restora Concrete (BM	tion cha ABC), in	rges for terlocked	excavate tiled su	ed portion rface an	ons of Bit d municip	tumen N oal roads	Aacadam ai	nd Bitumen
	For sewer network including manholes								
	BM/BC roads	1	4160	1.2		4992	m <sup>2</sup>		
	Deduct for m	1	240.95	1.2		289	m <sup>2</sup>		
	Total- pipeline portion					4703	m <sup>2</sup>		
	Manholes portion	1				376	m <sup>2</sup>		
	Total					5079	$m^2$		
	Say		5079.2	m <sup>2</sup>		@	Rs	3633.5	18455293
	GST component						Rs	654.03	3321953
26	Interlocked tiled surfaces	1	840	1.2		1008	m <sup>2</sup>		
	Deduct for manholes	1	48.65	1.2		58.38	m <sup>2</sup>		
	Total- pipeline portion					949.62	m <sup>2</sup>		
	Manholes portion	1				75.99	m <sup>2</sup>		
	Total					1025.6	m <sup>2</sup>		
	Say		1025.6	m <sup>2</sup>		@	Rs	3747.1	3843059
	GST component						Rs	674.478	691751
27	Municipal roads	1	9748	1.2		11698	m <sup>2</sup>		
	Deduct for manholes	1	564.60	1.2		678	m <sup>2</sup>		

								2		
		Total-					11020	m <sup>2</sup>		
		pipeline								
		Manholes	1				882	$m^2$		
		portion	1				002	111		
		Total					11902	m <sup>2</sup>		
		Say		11902	m <sup>2</sup>		@	Rs	2759.4	32842229
		GST						Rs	496 692	5911601
		component						105	190.092	5711001
28	OD	Providing ste not exceeding x 50mm x 6 f	el sheet g 6.00m mm M.S	shoring to using 6 n . angles d	o the sid nm M.S. Iriving d	es of the sheet 0 own ver	e trenches .50 M wic tically on	to dept le stiffer either s	hs of above 1 on edges ide one afte	e 4.00 m but with 50 mm er another in
		lines and leve of 0.50 M b suitably brac side at interv intervals and dismantling,	els with s elow the ed by he vals not maintai cleaning	suitable pi e bottom prizontal exceeding ning the g and rest	le drivin of the p walling j g 1.50M shoring tacking	g equipr proposed pieces a and how till the for reuse	nent and a l excavati t 75 x 150 rizontal so pipes are e includir	accessor ion 0.5 0 mm x crew jac laid and ng all la	ies to a max M above g 8 mm angl k type stru l works are bour, hire o	imum depth round level es on either ts at 1.50M completed, charges and
		conveyance f	or equip	ment, too	ols and p	lants and	d sundries	etc. cor	nplete.	
		For trenches	1				2808.2	m <sup>2</sup>		
		above 2.0 m depth								
		Total					2808.2	m <sup>2</sup>		
		Say		2808.2	m <sup>2</sup>		a	Rs	749.13	2103755
		GST						Rs	134.84	378676
20	OD	component		1 1	1 1	1				
29	OD	Taking conne	ection to	r manhole	es and cl	nambers				
			2252	1			2252	Nos.		
		Total					2252	Nos.		
		Say		2252	Nos.		(a)	Rs	756.4	₹ 17,03,413
		GST						Rs	136.152	₹
30		Fencing one	side of t	renches. 1	50 m he	eight wit	th two rov	vs of 10	cm plastic	caution tane
		in vertical ca	suarina j	pole (girth	n 15cm te	o 24cm)	fixed at 2	2 m inter	vals.	
			2	14798			29595	m		
		Total					29595	m		
		Say		29595	m		@	Rs	31.39	₹ 9.28.970
		GST						Rs	5.65	₹
31	19.1	560 mm diam	neter C.I	. cover (h	eavy dut	ty) the w	veight of t	he cover	to be not le	1,07,215 ess than 108
	8.3	kg	5.60	ì			5(2)	٦T		
			563	1			563	Nos.		
		Total					563	Nos.	0.05	_
		Say		563	Nos.		(a)	Rs	8021.1	₹ 45,15,880
								Rs	1461.5	₹
										8,22,868



### 5.19 ECO-FRIENDLY UNITS AND OTHER SYSTEMS

ECO-	FRIEND	DLY UNITS								
Item	Item	Description	Ν	L	В	Η	V	Unit	Rate	Amount
No.	Code	Dalt Canadal Eastering W	0	. 1	. 1 т	1.				
а	Green	Belt, Special Exterior W		arden a	na L	and	scapi	ng	115500	1155000
			1	Nos			(a)	Rs	115500 0	1155000
		GST component						Rs	207900	207900
		Total- Eco-friendly uni	ts							₹ 13,62,900.00
b	Facility	y for Recycling Purposes	5							
			1	Nos			@	Rs	150000	150000
		GST component						Rs	27000	27000
		Total- Facility for recy	cling	purpos	es					₹ 1,77,000.00
c	Buildir	ng with Trussed Roof and	d Eco	-friend	ly w	alls				
		STP	1	Nos			@	Rs	281050 0	2810500
		Wells	2	Nos			@	Rs	616000	1232000
		Total								4042500
		GST component						Rs	727650	727650
		Total- Building with tr	ussed	roof an	nd eo	co-fr	iend	ly walls		₹47,70,150.00
d	Equipn	nent, Laboratory items, I	Furnit	ure and	l Co	mpu	ter sy	ystem fo	or CIPS of I	оТ
			1	Nos			@	Rs	600000	600000
		GST component						Rs	108000	108000
		Total- Equipment, La system etc.	borat	ory ite	ems,	Fur	nitur	e and	Computer	₹ 7,08,000.00
e	Supply	and installation of steel	cover	r slab p	refal	orica	nted f	or equa	lisation tan	k
			1	Nos			@	Rs	200000	200000
		GST component						Rs	36000	36000
		Total- Equipment, La system etc.	borat	ory ite	ems,	Fur	nitur	e and	Computer	₹ 2,36,000.00

#### **5.20 MECHANICAL ITEMS**

MECH	IANIC	AL ITEMS								
Item No.	Ite m Co de	Description	No	L	В	Н	V	Unit	Rate	Amount
1		Sewage transfer submersible sew reputed make.	pump - age ha	· Supply, ndling ty	Installa pe pum	ition, Co p, with	ommiss specif	sioning ied diso	, testing an charge and	nd trial run of I head and of
		Power of pump required	7.5	HP	Q	19.52	LP S	Н	12	m
			2	Nos.			@	Rs	207338 .4	₹ 4,14,677
		GST component						Rs	37320. 91	74642
2		Bar Screen-coars to be fitted in bar gap between bar rake arm with ra transfer of the co Inclination: 45 D	se- Sup screen s. The acks fo lected egree,	ply and i chambe frame to r remova solids. F Spacing:	nstallati r of spec be mou al of co Flow Rat 20mm	on, of n cified wi inted on llected s te and ho	nanual dth, w the cl solids eight s	bar ser ith MS hamber and tro hould b	reen, MS – flat bars a and provi ough to be be as specif	epoxy frame nd 20 mm c/c ided with MS provided for fied. Angle of
		Width of screen channel-STP	0.75	m	Q	0.035	m <sup>3</sup> / sec	Н	1.2	m
		Width of screen channel-CTU	0.6	m	Q	0.005	m <sup>3</sup> / sec	Н	1.5	m
			2	No.			(a)	Rs	25000	₹ 50,000
		For lift stations	6	No.			(a)	Rs	25000	₹ 1,50,000
		Total								₹2,00,000
		GST component						Rs	₹ 36,000	36000
3		Bar Screen-fine- be fitted in bar s gap between bar rake arm with ra transfer of the co Inclination: 45 D	Supply creen c s. The acks fo ollected egree,	and ins hamber frame to r remova solids. F Spacing:	tallation of speci be mou al of co flow Rat 6mm	, of mar fied wid inted on llected s te and he	th, with th, with the classifier classifier the classifier classifier classifier the classifier cla	th MS that hamber and trophould be the second secon	n, MS – ep flat bars an and provi ough to be be as specif	boxy frame to ad 20 mm c/c ided with MS provided for fied. Angle of
		Width of screen channel	0.75	m	Q	0.035	m <sup>3</sup> / sec	Н	0.0350 671	m
			1	No.			(a)	Rs	25000	₹ 25,000
		GST component						Rs	4500	4500
4		MBBR media- S polypropylene co surface area, leng or as directed by	upplyin onstruct gth 10-2 Engine	ng and fix tion Sp. ( 20 mm, o eer in Ch	king of r Gravity dia 20-2 arge	on-clog 0.93 for 5 mm co	ging fi MBBI omplet	reely m R reacto e as pe	oving bior or with req r technical	nass media of uired specific specification
		Specific surface	area of	carrier	600. 00	$m^2/m^3$				
			1		237. 81	m <sup>3</sup>	@	Rs	27500	₹ 65,39,720
					130					

	GST						Rs	4950	1177150
5	Air Blower Supp indoor application pulleys, pressure suitable flanges, arrangement inter technical specific	oly, ere on com gauge commo rconne cation c	ction, tes plete wi s, pressu on motor cting line or as Dire	sting and th acou- ure relie and com with fla ected by	d comm stic can f valve, pressor inges ind Enginee	issioni opy, a acous base fi cluding er in C	ing of t ir filter tic hoo rame w g all acc harge.	win lobe a r, motor o d, suction ith motor b cessories co	air blower for f 1500 rpm , silencer with belt tightening omplete as per
	Capacity of blow	ver		2801 .0	m <sup>3</sup> /hou	ır			
	Power of motor			52.0 0	HP				
		3				a	Rs	780000	₹23,40,000
	GST						Rs	140400	421200
	component								
6	Bubble Diffuser type fine bubble Monomer (EPDM mm, SS C clamp Washer, SS hos of for specified air	for MB diffus M) mak suitabl clamp, flow	BBR- Finders of 90 e with S2 e for 1"C RCC blo	e Bubble )mm dia Stee1"x I ).D, hose ck comp	e Diffus 1,1500m 1",SS lif e, PP Rc plete as j	er Sup m leng ting ho pe, PP per tec	plying gth, Etl ook 8 m swivel hnical	and fixing hylene Pro um, SS fou l nut, PP sl specificatio	of retrievable pylene Diene ndation bolt 6 eeve, Silicone on compatible
		3				a	Rs	50000	₹ 1,50,000.0
	GST						Rs	9000	27000
-	component		1 1		c · ·	(111		11 .	. 1 1
	Air Grid Pipe Su	apply a	nd instal	the blox	t air pip	es (HI	JPE) as tanks (	ssembly in	to valves and
		2					D	50000	<b>x</b>
	~~~	3				<u>a</u>	KS	50000	< 1,50,000.0
	GST component						Rs	9000	27000
8	Tube settler med shaped, 750mm I The plan settling The media is to b	lia- Me neight a garea s pe prov	dia to be ind about hould be ided alon	e of UV 1.0mm betwee ng with 1	stabiliz thick an n 10 – 1 ock nuts	ed PV d with 2 m <sup>2</sup> /1 s as rec	C mate tongue m <sup>3</sup> /day quired.	rial, hexag e and groov 7 minimum	gonal chevron ve tube fitting. 1 at 60° slope.
	Total contact area	213.3		m <sup>2</sup>					
		1				@	Rs	202635	₹ 2,02,635.0
	GST component						Rs	36474. 3	36474
9	Electromagnetic electromagnetic control system flow/quality/pres arrangements and in the incoming p Charge	Flow me flow me with sure i d all ac pipeline	meter, pres flow ntegrator cessories to STP o	ressure sure and recorder with includition at the	and qua l quality r, digit sensors, ng housi Screen	lity se sensor al flo total ing arr channe	ensors- rs comp ow/qua iser, tr angeme el as dir	Supply an patible to Id lity/pressu ransmittal ents, etc. co rected by th	d erection of oT and central re indicator, and display omplete to fix the Engineer in
		3				<u>w</u>	KS	30000	2.50.000 0
	GST component						Rs	9000	45000
10	Filter feed pum submersible filte of reputed make.	p - Su red wat	pply, Inter handl	stallationing type	n, Com pump, v	missio vith sp	ning, t becified	esting and discharge	l trial run of and head and

	Power of pump	17.5	HP	0	18.70	LP	Н	35.00	m	
	required	0		•		S				
		2.00	Nos.			@	Rs	402447 .5	₹ 8,04,895	
	GST component						Rs	72440. 55	144881	
11	Pressure Sand Filter- Supply, installation and erection, testing and commissioning of of Pressure Sand Filter - MS vessel construction. Filter to be of MS construction with multiport valve for operations. Suitable stand / support should be provided along with the filter. Filtration rate should not be greater than 12 m <sup>3</sup> /hour/m <sup>2</sup> of the filtration area. Dirt loading capacity to be sufficient to initiate backwash once in 8 hours i.e. once / shift. Filter to have inlet and outlet piping, inlet and outlet for backwash and air vent. Sand filter to be fitted with pressure gauge at inlet and outlet. Sand filter main header is to be fitted with flow meter – turbine type / rotameter type with range up to minimum of 125% of the rated flow through the pipeline. Media to consist of graded pebble, coarse and fine sand. Depth of media to be as per recommendations provided in CPHEEO manual and all relevant IS Codes of practice. Cost includes supporting foundation.									
	Flow	67.3 3	m <sup>3</sup> /ho ur	Diam eter	2.7	m	Н	2.5	m	
		1				@	Rs	165000 0	₹ 16,50,000	
	GST component						Rs	297000	297000	
	Activated Carbo construction with provided along w of the filtration ar and air vent. Car of graded pebble recommendation quality for remo includes for foun	n Filte n multi vith the rea. Filt bon filt , coarso s provi val of dation	er - MS port valv filter. Fi ter to hav ter to be e, fine sa ded in C impuriti- also.	composize for op ltration we inlet a fitted we nd and a PHEEO es and t	ite vess perations rate show nd outle ith press activated manual to be us	el cor s. Suit uld no t pipin sure ga d carbo l. Activ ed for	astruction able states t be green auge at auge at on. Dep vated c	on. Filter and / supp cater than 1 and outlet outlet. Me oth of medi arbon shou water puri	to be of MS ort should be .0 m <sup>3</sup> /hour/m <sup>2</sup> for backwash edia to consist a to be as per ild be of high fication. Cost	
	Flow	67.3 3	m <sup>3</sup> /ho	Diam eter	3	m	Н	2.5	m	
		1				@	Rs	190000 0	₹ 19,00,000.0	
	GST component Total						Rs	342000	342000 ₹ 22.42.000	
13	Alum and Lime Dosing System- Supply, installation, commissioning and testing of Alum dosing tank having capacity 50 litre in LLDPE/ FRP/PP material and alum dosing electronic metering type pump of 1-3 LPH range with 2.5 bar working pressure									
		4				a	Rs	25000	₹ 1,00,000	
	GST component						Rs	4500	18000	
14	Hypo Dosing System - Supply, installation, commissioning and testing of Hypo dosing tank having capacity 50lit in LLDPE/ FRP/PP material and hypo dosing electronic metering type pump of 1-3lph range with 2 bar working pressure									
		2				$\widehat{a}$	Rs	30000	<b>T</b> (0,000	
		-				Ċ		20000	₹ 60,000	
	GST component	_				e	Rs	5400	10800	

		2				a	Rs	30000	₹ 60,000	
	GST						Rs	5400	10800	
16	component Sludge transfer t	o thick	ener nun	m - Sun	nlv Ins	tallatio	on Cor	nmissionin	o testing and	
10	trial run of submersible sewage handling type pump, with specified discharge and head and of reputed make.									
	Power of pump required	1.00	HP	Q	1.56	LP S	Н	15.00	m	
		2	Nos.			@	Rs	27645. 12	₹ 55,290.24	
	GST component						Rs	4976.1 2	9952	
17	Sludge transfer Commissioning, specified dischar	to c testing ge and	entrifuge and trial head and	e pump run of s l of repu	o of so submersi ited mak	erew ible se æ.	type wage h	- Supply, andling typ	Installation, be pump, with	
	Power of pump required	0.50	HP	Q	0.48	LP S	Н	15.00	m	
		2	Nos.			@	Rs	13822. 56	₹ 27,645.12	
	GST component						Rs	2488.1	4976	
18	Filter backwash pumps - Supply, Installation, Commissioning, testing and trial run of filter backwash pump, with specified discharge and head and of reputed make with all accessories.									
	Power of pump required	2.00	HP							
		2	Nos.			@	Rs	55290	₹ 1,10,580.4	
	GST component						Rs	9952.2	19904	
19	Filtrate cum dilu	tion pu	mp to eq	ualisatio	on tank					
	Power of pump required	1.00	HP			$\sim$	D	07645	T 55 000 04	
		2	Nos.			<u>(a)</u>	Rs	27645. 12	₹ 55,290.24	
	GST component						Rs	4976.1	9952	
20	Recycled water t	ransfer	pump fo	or dilutic	on tank					
	Power of pump required	3.50	HP							
		2	Nos.			@	Rs	96757. 9	₹ 1,93,515.8	
	GST component						Rs	17416. 4	34833	
21	Diluted septage t	ransfer	pump fo	or STP						
	Power of pump required	3.50	HP							
		2	Nos.			(a)	Rs	96758	₹ 1,93,515,8	
	GST component						Rs	17416	34833	
22	Sewage transfer submersible sew reputed make.	pump - age ha	- Supply, ndling ty	, Installa pe pum	ntion, Co p, with	ommis specif	sioning ied dis	, testing an charge and	nd trial run of d head and of	

	For lifting stations								
	LF-1	0.5	HP	Q	0.69	LP S	Н	6	m
	LF-2	1	HP	Q	3.0	LP S	Н	6	m
	LF-3	0.5	HP	Q	0.20	LP S	Н	6	m
	LF-4	0.5	HP	Q	0.40	LP S	Η	6	m
	LF-5	1.5	HP	Q	7.98	LP S	Н	6	m
	LF-6	0.5	HP	Q	0.06	LP S	Н	6	m
	From well to well	3	HP	Q	7.38	LP S	Н	12	m
	Numbers	2							
	From well to STP	7.5	HP	Q	11.53	LP S	Н	18	m
	Numbers	2							
						a	Rs	170017 4.9	₹ 17,00,175
	GST component						Rs	306031 .48	₹ 3,06,031
	Total								₹20,06,206
23	Supply and instal	llation	of centri	fuge incl	luding fo	oundat	ion		
		2	Nos.			(a)	Rs	200000	₹4,00,000
	GST component						Rs	36000	72000
	Total								₹4,72,000
24	Supply and insta	llation	of mixin	g equipr	nent for	de-niti	rificatio	on tank	
		2	Nos.			(a)	Rs	25000	₹ 50,000
	GST component						Rs	4500	9000
	Total								₹ 59,000
25	Supply of GPS f including de-sluc	fitted v lging e	acuum ti quipmen	ruck of ot the second s	capacity aning do	3000 evices	litres f	or septage	management
		2	Nos.			@	Rs	450000 0	₹ 90,00,000
	GST component						Rs	810000	1620000
	Total								₹ 1,06,20,000
26	Piping, initial cha fire-fighting arra	annel ar ngemer	rangeme nts	ents, byp	ass arrar	ngemei	nts, stee	el ladder, fr	amework and
		1	Nos.			(a)	Rs	350000	₹ 3,50,000
	GST component						Rs	63000	63000
	Total								₹ 4,13,000
	Total-mechanica	l items							₹ 2,67,32,939
	Total-GST								₹ 48,11,929

# 5.21 ELECTRICAL AND INSTRUMENTATION WORKS

ELEC	TRICAL	AND INSTRUMENTA	TION '	WORK	S					
Item No.	Item Code	Description	No	L	В	Н	V	Unit	Rate	Amount
1		Interconnecting piping system: • All process piping is to be in uPVC of approved ISI make, Class 2 minimum • All process valves to be in PP/PVC of Ball / Globe type• For valves in piping of ID > 150 mm, Butterfly valves are preferred • NRV should be provided at the common discharge header of all process pumps • Dosing lines to be in flexible Teflon / rigid PVC / HDPE. Detailed hydraulic analysis must be done for the system before supply and installation.								
			1	Nos			@	Rs	450000	₹ 4,50,000
		GST component						Rs	81000	81000
		Total								₹ 5,31,000
2		ELECTRICAL & INSTRUMENTATION-Instrumentation items consisting of pressure gauges, level switches, electromagnetic flow meter, normal flow meter , pressure gauges, IoT based sensors, electrical panels – Powder coated MCC Panel shall be Non compartmentalized free standing floor mounted, dust and vermin proof, with reinforcement of suitable size angle iron, channel, T -iron flats as required. Panel shall be suitable for 415V, 3-Phase,50 Hz incomer. Switchgear components to include, but not limited to, MCCB for incomer and for each switchgear, suitable OLR and contactor provisions to be given as per guidelines of the Electrical authority. Panel to be fabricated based on the Motor Load List as given in the technical specifications AC: MS powder coated panel with switchgear components as per motor load list, fixed, floor mounted and non-compartmentalized pane. Interconnection cables – Outgoing feeders from AC panel to each prime mover will be based on CEIG guidelines. Cables to be suitably protected either through (a) PVC conduit or (b) armoured cables as appropriate Cabling includes glanding and termination for each prime mover. Cables should not be run on the ground or directly on the walls. Cables to be mounted on suitable runners / cable trays / PVC conduits as appropriate. All interconnecting cabling and glanding, termination accessories as								
			1	Nos			a	Rs	825000	₹ 8,25,000
		GST component						Rs	148500	148500
3		Supply, installation and	d comm	issioni	ng o	f die	sel g	enerator	r	
			7	Nos			a)	Rs	120000	₹ 8,40,000
		GST component						Rs	21600	151200
4		Supply and installation lifting stations and coll	of acce	essories vells in	s for clud	elec ling :	trica foun	l connec dations	ction and co	ntrol units for
		Lifting stations	6	Nos			a)	Rs	25000	₹ 1,50,000
		Collection wells	2	Nos			a)	Rs	75000	₹ 1,50,000
		Total								₹ 3,00,000
		GST component						Rs	₹ 54,000	₹ 54,000
5		Supply, installation and commissioning of solar units for lifting stations and collection wells								

		8	Nos			æ	Rs	20000	₹ 1,60,000
	GST component						Rs	3600	₹ 28,800
6	Supply, installation and commissioning of solar units for STP								
		1	Nos			@	Rs	1000000	₹ 10,00,000
	GST component						Rs	180000	₹ 1,80,000

### **5.22ABSTRACT OF COST**

ABSTRACT OF COST							
Sl. No.	ITEM	AMOUNT					
CIVIL IT	EMS						
1	Site Preparation-LS	₹ 5,000					
2	OG Trap, Receiving Chamber, Screen, Grit Chamber	₹ 36,79,575					
3	Equalisation Tank	₹ 38,30,105					
4	Dilution Tank for Co-treatment	₹ 12,98,720					
5	Moving Bed Biofilm Reactors	₹ 66,59,946					
9	Clarifier with Tube/Plate Settler	₹ 13,04,007					
10	Sludge Sump and Thickener	₹ 7,07,685					
11	Chlorine Contact Tank and Filter Feed Tank	₹ 9,90,224					
12	Treated Water Tank	₹ 7,58,410					
13	Green Belt and Landscaping	₹ 11,55,000					
14	Facility for Recycling Purposes	₹ 1,50,000					
15	Building with Trussed Roof and Eco-friendly walls	₹ 42,42,500					
16	Equipment, Laboratory items, Furniture and Computer	₹ 6,00,000					
17	Sewer network with pipelines and chambers	₹ 19,03,16,567					
	TOTAL OF CIVIL ITEMS	₹ 21,56,97,739					
	GST Component (18%)	₹ 3,88,22,126					
MECHAN	NICAL ITEMS						
1	Gates and Screens	₹ 2,25,000					
2	Pump sets and Aeration system	₹ 61,95,584					
3	PSF & ACF	₹ 35,50,000					
4	Centrifuge	₹ 4,00,000					
5	Bypass arrangements, steel ladder and frame work	₹ 3,50,000					
6	MBBR Carrier and other items	₹ 65,89,720					
7	Tube settler media	₹ 2,02,635					
8	Alum and Lime dosing systems	₹ 1,60,000					
9	Odour Control Unit	₹ 60,000					
10	GPS fitted Vacuum Trucks	₹ 90,00,000					
	TOTAL OF MECHANICAL ITEMS	₹ 2,67,32,939					
	GST Component (18%)	₹ 48,11,929					
1							
1	Interconnecting piping system	₹ 4,50,000					
2	Diesel Generator	₹ 8,40,000					
3	Electrical works, IoT based sensor and control units	₹ 15,25,000					
4	Electrical installations for lifting stations and collection wells	₹ 3,00,000					
5	Installation of solar units for lifting stations, wells and STP	₹ 11,60,000					
	TOTAL OF ELECTRICAL ITEMS	₹ 42,75,000					
	GST Component (18%)	₹ 7,69,500					
---------	---------------------------------------------------------------------	----------------					
ABSTRA	CT OF COST						
Sl. No.	ITEM	AMOUNT					
1	Civil Works	₹21,56,97,739					
2	Mechanical Works	₹ 2,67,32,939					
3	Electrical Works	₹ 42,75,000					
	Total Project Cost	₹ 24,67,05,678					
	GST Component (18%)	₹ 4,44,03,556					
	DPR preparation charge @ 2.5%	₹ 61,67,642					
	Centage charges@10%	₹ 2,46,70,568					
	Unforeseen	₹ 556					
	GRAND TOTAL	₹ 32,19,48,000					
	(Rs. Thirty Two Crores Nineteen Lakhs Forty Eight Thousand Only)						
	Total O&M cost for 10 years	₹ 11,09,10,000					
	TOTAL COST including 10 years O&M	₹ 43,28,58,000					
	s. Forty Three Crores Twenty Eight Lakhs Fifty Eight Thousand Only)						

#### **CHAPTER 6**

#### **OPERATION AND MAINTENANCE**

#### 6.1 GENERAL

For the success of a sewerage treatment system, it is inherent to note that meticulous operation and maintenance planning is the key. In the following sections various aspects of effective operation and maintenance, cost analysis, application of modern technologies for monitoring and process control and maintenance of an eco-friendly system are illustrated.

In engineering parlance, the term operation refers to the daily operation of the components of a sewerage system such as collection system, sewage pumping stations (SPS), pumping mains, sewage treatment plants (STP), machinery and equipment, etc., in an effective manner by various technical personnel, and is a routine function. The term maintenance refers to the art of keeping the structures, plants, machinery and equipment and other facilities in optimum working order and includes preventive maintenance or corrective maintenance of mechanical adjustments, repairs, and planned maintenance. However, replacements, correction of defects etc., are considered as actions excluded from preventive maintenance.

#### **6.2 PLANNING FOR EFFECTIVE OPERATION AND MAINTENANCE**

Three categories of variability that can affect the design, performance and reliability of a wastewater treatment plant are a) variability of the influent wastewater flowrate and characteristics, b) inherent variability in wastewater treatment processes and c) variability caused by mechanical breakdown, design deficiencies and operational failures.

It may be noted that effective use of the equalisation facility will balance most of the issues related with the variability of the influent flowrate and abnormal BOD levels at certain points of time. Many of the treatment units exhibit variability in performance despite the efficient planning and design. However, these problems can be eliminated at the design stage itself by adopting some conservative values. At the operational stage, some of the design deficiencies can be addressed by few additions in the system which will not affect the total operational cost. Occurrence of mechanical and electrical breakdown can be addressed by careful planning of maintenance activities. There is a provision for diesel generator back up and solar energy sources also can be relied upon.

It is recommended to form an internal monitoring committee for periodical inspection and control of activities related to the function, efficiency and operation of the STP. Help from Kudumbasree for support activities of monitoring and control can be sought.

Operation and maintenance for 10 years is to be performed by the firm who carries out the construction and commissioning of the STP.

#### **6.3 TYPE OF MAINTENANCE**

There are three types of maintenance of a sewerage system – preventive, routine and emergency. Preventive or routine maintenance should be carried out to prevent any breakdown of the system and to avoid emergency operations to deal with clogged sewer lines or overflowing manholes or backing up of sewage into a house or structural failure of the system. Preventive maintenance is more economical and provides for reliability in operations of the sewer facilities. Emergency repairs, which would be very rare if proper maintenance is carried out well, also, must be provided for. Proper inspection and preventive maintenance are necessary.

#### 6.4 INSPECTION AND EXAMINATION OF SEWER

Sewer collection systems are intended to be a reliable method of conveying sewage from individual discharge to sewage treatment plants. Inspection and examination are the techniques used to gather information to develop operation and maintenance programmes to ensure that new and existing collection systems serve their intended purposes on a continuing basis. Inspection and testing are necessary to do the following:

- Identify existing or potential problem areas in the collection system,
- Evaluate the seriousness of detected problems,
- Locate the position of problems, and
- Provide clear, concise, and meaningful reports to supervisors regarding problems.

Two major purposes of inspection and examination are to prevent leaks from developing in the sewers and to identify existing leaks so they can be corrected. Due to age, deterioration of the material of the sewer by attack of hydrogen sulphide or other chemicals, settlement of foundations and leaking joints may result in the structural failure of the sewer. It takes a very long time from the onset of the first initial defect to the collapse of the sewer. A crack or a leaking joint will allow subsoil water and soil mixture to enter the sewer causing cavities around it leading to slow settlement of foundation and the eventual collapse of the sewer.

Very often soil with water is carried away below the bedding along the length of the sewer. The type of failures often gives a clue to the cause. A shear failure due to faulty foundation or movement of earth is a clean vertical break in the pipe or barrel. Excessive loading, either internally or externally, causes horizontal breaks. Breaks caused by internal pressure leads to cracks in the sewer while external overload causes the top of the pipe to be crushed. Regular inspection of the sewer can pinpoint the sewer that needs to be attended to before there is a complete failure or collapse. For preventing the above serious instances

of damages to the sewer system, the maintenance engineer should establish adequate inspection and examination programmes.

## **6.5 SEWER CLEANING**

To operate and maintain a sewer collection system to function as intended, the maintenance engineer should try to strive towards the following objectives:

• Minimize the number of blockages per unit length of sewer, and

• Minimize the number of odour complaints. For this purpose, sewer-cleaning using hydraulic or mechanical cleaning methods needs to be done on a scheduled basis to remove accumulated debris in the pipe such as sand, silt, grease, roots and rocks. If debris is allowed to accumulate, it reduces the capacity of the pipe and blockage can eventually occur resulting in overflows from the system onto streets, yards and into surface waters. Roots and corrosion also can cause physical damage to sewers.

#### 6.6 PROTECTION OF SEWER SYSTEMS

A sewer may get damaged if other facilities such as water pipe or electric cable work are done beside or at the cross-section of a sewer. Especially, fluctuations due to ground excavation (pile, underground water drops and pile method) may have a serious impact. To avoid damages of sewer, the maintenance engineer should do the following:

1. Collect all related information about the construction activities which are planned around the sewer location,

2. Advise appropriate construction methods to minimize impact for sewer, and

3. If necessary, request the concerned agencies to adopt the protective measures for sewer prior to the work commencement.

#### 6.7 INSPECTION OF MANHOLES AND APPURTENANCES

Because they are part of the collection system, manholes require the same inspection and attention as the rest of sewer network. When located in streets, these structures are subject to vibrations and pounding by vehicle traffic. Manholes may settle at a different rate than connected sewer, creating cracks in sewer pipe joints. The objectives of manhole inspection are therefore, to determine the proper elevations or grades around the lid, to confirm that the lid is not buried, and to examine structural integrity (look for cracks) of the manhole and its functional capacity. The condition of the pipelines coming into a manhole may be known merely by observing the content and volume of flows from a specific direction.

Manhole inspection and examination are made by visually inspecting the condition of the cover and the internal parts. Manhole inspection should be carried out together with the inspection and examination of sewer. It is generally carried out together with the cleaning of the sewer. Before entering any manhole,

adequate safety measures should be taken in accordance with stipulations. Safety measures during the work should be formulated considering traffic safety, oxygen deficiency, poisoning due to toxic gas such as hydrogen sulphide and so on.

#### **6.8 CLEANING OF MANHOLES**

Manhole cleaning should be performed by the most appropriate work method that suits the actual conditions of the work location. In manholes at starting point, junction manholes and manholes at sharp curve of sewers, sand and silt get deposited and environmental problems such as foul odours occur. For this reason, periodic cleaning is necessary. Moreover, when large debris flows in, it should be removed immediately otherwise there is a possibility of an overflow accident, float-off and dispersion of cover. Manhole inspection should be generally carried out together with the cleaning of the sewer. The work on the silt and sand in the bottom part should be pursuant to cleaning of the sewer pipe, while the dirt on the sidewall should be cleaned by high-pressure jet washing vehicle.

#### **6.9 SAFTEY PRACTICES**

Sewer cleaning is an occupation that has an overall accident frequency rate that is relatively higher than any other industry. The employer has the responsibility of providing the worker with a safe place to work. Nevertheless, the worker has the overall responsibility and must ensure that it is a safe place to work. This can only be done by constantly thinking of safety and working safely. The worker has the responsibility of protecting not only himself, but also all other plant personnel or visitors by establishing safety procedures for the plant and then ensuring they are followed. He must train himself to analyse jobs, work areas and procedures from a safety standpoint and learn to recognize potentiality hazardous actions or conditions. When he recognizes a hazard, he must take immediate steps to eliminate it through corrective action. If correction is not possible, guard against the hazard by proper use of warning signs and devices / by establishing and maintaining safety procedures. As an individual, the supervisor can be held liable for injuries or property damage, which results from an accident caused by his negligence.

#### 6.10 OPERATION AND MAINTENANCE OF LIFT STATIONS

In general, lift stations are invariably used in gravity sewer network where depth of cut of sewers poses a problem in high water prone areas. The procedure is to sink a wet well on the road shoulder or an acquired plot after the shoulder and divert the deeper sewer there. The submersible pump will lift the sewage and discharge it to the next online shallow sewer. This is a very useful practice in such locations. Equipment located in the wet well should be minimized, including suction and discharge valves, check valves, or other equipment that require routine, periodic maintenance.

#### 6.11 OPERATION AND MAINTENANCE OF PUMPING STATIONS

Pumping machinery is subjected to wear & tear, erosion and corrosion due to its nature of functioning, and therefore it is vulnerable to failures. Generally, failures or interruptions are mostly attributed to

pumping machinery rather than any other component. Therefore, correct operation and timely maintenance and upkeep of pumping stations and pumping machinery are of vital importance. Sudden failures can be avoided by timely inspection, follow up actions on observations of inspection and planned periodical maintenance. Downtime can be reduced by maintaining inventory of fast moving spare parts. Obviously due attention needs to be paid to all such aspects for efficient and reliable functioning of pumping machinery.

#### **6.11.1 OPERATION OF PUMPS**

The following points should be observed while operating the pumps.

A. Dry running of the pumps should be avoided.

B. Centrifugal pumps if installed with negative suction should be primed before starting.

C. Pumps should be operated only within the recommended range of the head-discharge characteristics of the pump.

• If pump is operated at a point away from duty point, the pump efficiency normally reduces.

• Operation near the shut-off point should be avoided, as it causes substantial recirculation within the pump, resulting in overheating of sewage in the casing and consequently, overheating of the pump.

D. As far as possible positive suction is to be provided to avoid priming during design itself.

E. Voltage during operation of the pump-motor set should be within  $\pm 10$  % of the rated voltage. Similarly, current should be below the rated current shown on the name plate of the motor.

F. When parallel pumps are to be operated, the pumps should be started and stopped with a time lag between two pumps to restrict change of flow velocity to minimum and to restrict the dip in voltage in the incoming feeder and should be adequate to allow the pump head to stabilise.

G. When the pumps are to be operated in series, they should be started and stopped sequentially, but with minimum time lag. Any pump next in sequence should be started immediately after the delivery valve of the previous pump is even partly opened. Due care should be taken to keep open the air vent of the pump next in sequence, before starting that pump.

H. The stuffing box should allow a drip of leakage to ensure that no air passes into the pump and that the packing gets adequate wetness for cooling and lubrication. When the stuffing box is sealed with grease, adequate refill of the grease should be maintained.

I. The running of duty pumps and standby pumps should be scheduled so that no pump remains idle for a long period and all pumps are in ready-to-run condition. Similarly, the running schedules should be ensured so that all pumps do not wear equally needing simultaneous overhaul. J. If any undue vibration or noise is noticed, the pump should be stopped immediately and the cause for vibration or noise should be checked and rectified.

K. Generally, the number of starts per hour shall not exceed four. Frequent starting and stopping should be avoided as each start causes overloading of motor, starter, contactor and contacts. Although overloading lasts only for a few seconds, it reduces the life of the equipment.

# 6.12 SMART MANAGEMENT AND ONLINE MONITORING USING INTERNET OF THINGS (IoT)

Advancement in the field of digital technology has enabled the wastewater treatment system operators and managers to control and enhance the performance of various components of the system. Internet of things (IoT) consists of a network of physical objects using various sensors as end points to enable monitoring from a remote station.

For the sewerage treatment plant, a network of various sensors can capture the variations of values of parameters like temperature, dissolved oxygen, chemical composition, TDS etc. at different control points of the system. The continuous data obtained through IoT is used by a customised algorithm for synthesis to impart a decision-making procedure. A centralised information processing system (CIPS) can be formed for this task. In addition to this smart water flow meters can also be coupled to this digital environment. IoT in wastewater management can also be used to calculate residual chemicals after the treatment. This data can be further used to calculate the efficiency of the treatment process and ensure that water quality standards are met before it is discharged in a water body.

By using real-time data gathered through different embedded sensors, performance characteristics of machines can be monitored that further increase the productivity of equipment and boost maintenance tasks. In the present study for the municipality, provision for implementing an IoT based control of the units have been suggested.



Fig.25 The continuous data obtained through IoT is used by a customised algorithm for synthesis to impart a smart decision-making procedure (photo courtesy-google)

#### 6.13 ODOUR CONTROL METHODS

Odours are a complex combination of a wide variety of compounds; however, there are certain compounds and groups of compounds that contribute specifically to sewage odours, and significantly determine the selection of the control technology. These include the following:

- Hydrogen sulphide, and
- Ammonia.

Odour control is a complex and time-consuming challenge, often requiring a combination of methods for treating odorous gases and for removing or reducing the potential causes of the odours. If an odour problem is severe enough to affect the community, an emergency response and solution to the problem must be carried out quickly. The approach for selecting an odour control method or technology includes the following steps:

A. Identify the odour source and characteristics through sampling and analysis.

B. List and assign priorities to controlling a specific odour problem, recognizing considerations such as cost, plant location, future upgrading of various sewage processes, severity of the odour problem, and the nature of the affected area.

C. Select one or more odour control method or technology for implementation to meet the objectives of steps "a" and "b", taking into consideration the advantages and disadvantages of each.

D. Monitor odour emissions from the treated air for process adjustments and for feedback to evaluate the solution's effectiveness.

Hydrogen sulphide (H2 S) is the most common odorous gas found in sewage collection and treatment systems and results from the reduction of sulphate by bacteria under anaerobic conditions. Its characteristic rotten-egg odour is well known. The gas is corrosive, toxic and soluble in sewage. Hydrogen sulphide is considered a broad-spectrum poison, meaning it can poison several different systems in the body.

#### 6.13.1 PREVENTION OF ODOUR

Hydrogen sulphide production can be controlled by maintaining conditions that prevent the build-up of sulphides in the sewage. The presence of oxygen at concentrations of more than 1.0 mg/L in the sewage prevents sulphide build-up because sulphide produced by anaerobic bacteria is aerobically oxidized. Maintaining an aerobic environment inhibits the anaerobic degradation process, which contributes to the generation of hydrogen sulphide. A checklist is given below:

• Prevent corrosion in the collection well of the facility by blowing air through the facility

• Avoid storing screenings and grit generated in the grit chamber for a long time. Dispose of screenings and grit at appropriate intervals

• Retention time of sludge in the sludge treatment facilities should be appropriate (Do not retain sludge for a long time)

• Maintain sewage at neutral pH range because most of the sulphide is present at a pH value of less than 7.

Following is a short checklist of operational considerations for controlling odours of primary treatment facilities: (May also apply in other facilities)

• Remove scum routinely, with increased frequency during warm weather.

• Remove sludge before it can bubble or float.

• Wash weirs and other points where floatable and slime collect. Some facilities use submerged pipes with holes rather than effluent troughs. The submerged pipes do not splash the primary effluent, thereby reducing the release of hydrogen sulphide.

• Wash down all spills and grease coatings.

• When draining a tank, immediately flush it completely. If sludge does not drain quickly, spray lime, calcium hypochlorite, or potassium permanganate on the sludge surface to reduce odours. Because even a clean tank can produce odours, flushing the tank with a chlorine solution or keeping the tank floor covered with a low concentration of chlorine solution will reduce odours.

• If the sewage is septic, add chemicals in the collection system or at the plant, as appropriate, to reduce sulphides.

• If tanks are covered for odour control, keep plates and access hatches in place.

• Routinely check any odour scrubbers or deodorizers for plugging, adequate supply of chemicals, proper pressures for demisting, and/or effectiveness of carbon.

• The splashing of primary sewage into weir troughs and effluent channels can result in the release of hydrogen sulphide. If possible, try to minimize the splashing of primary sewage into the channel or weirs. If it cannot be accomplished operationally, then installing submerged sewer pipes may be necessary. This will require tank modifications to verify the plant hydraulics and provide proper control to avoid fluctuations in the tank levels.

• Minimize the stripping of hydrogen sulphide from the sewage when using channel air diffuser systems. Adoption of the following regular practices will not only increase removal efficiency but will provide better working conditions for the operator: • Regularly remove accumulations from the inlet baffles and outlet weirs with a hose or a broom with stiff bristles. Only experience will determine the necessary frequency.

• Clean scum removal equipment regularly; otherwise, obnoxious odours and an unsightly appearance will result.

• Keep cover plates in place except when operations or maintenance require their removal.

• Immediately flush and remove all sewage and sludge spills. Avoid hosing down motors and enclosed control devices.

• Establish a housekeeping schedule for the primary treatment area, including galleries, stairwells, control rooms, and related buildings, and assign responsibility for each item to a specific employee.

• Repaint surfaces as necessary for surface protection and appearance.

#### 6.13.2 CONTROL OF ODOUR BY CHEMICAL ADDITION

Chemical addition can control odours in STP by preventing anaerobic conditions or controlling the release of odorous substances.

Chemical	Effective against					
	Oxidizers					
Ozone	Atmospheric hydrogen sulphide only					
Hydrogen peroxide	Hydrogen sulphide, also acts as oxygen source					
Chlorine	Hydrogen sulphide and other reduced sulphur compounds					
Sodium and calcium hypochlorite	Hydrogen sulphide and other reduced sulphur compounds					
Potassium permanganate	Hydrogen sulphide and other reduced sulphur compounds					

Table 15 Control of odour by chemical addition

#### 6.14 MAINTAINING AN ECO-FRIENDLY SYSTEM

In the proposed system of sewerage treatment, care has been taken to treat the sewage and sullage effectively and efficiently to protect the environment. Hence the natural water sources are also benefitted, and a portion of the recycled water can be used for toilet flushing, gardening etc. Since the treated water contains plant nutrients also, it will be beneficial for the environment when discharged as soil infiltration. Care has also been taken to properly treat the sludge produced during the operation. It may also be noted that a septic tank complying with the Indian Standard Code of practice has been designed and given at the initial treatment stage to reduce any shock of load to the biological treatment units.

It has also been decided to impart a green environment to the STP units with special methods of growing plants at the exterior of plant components and space between units. Maximum utilisation of space has been taken at the planning and design stage itself and using the natural treatment properties of the soil, such decentralized systems provide good opportunities to use the natural environment. They can help reduce the level of difficulty and cost to treat pollutants, such as nutrients, and keeping them from entering lakes, rivers, and streams.

Some aspects of the green landscaping eco-friendly unit management are described below for the proposed STP:

**Soil:** The soil acts as a natural filter and provides final treatment by removing harmful bacteria, viruses, and nutrients.

**Odour management:** Special attention is also given to proper odour management by using green belt inspired landscaping and chemical application whenever needed at extreme cases.

**Trees:** barrier formed with fast growing trees are planned for protection against pollution, for defining boundaries and for assisting in the creation of beautiful landscaping. Some of the plants are Casuarina Equisetifolia, golden bamboo, Grevillea Robusta etc.

**Shrubs:** the use of shrubs in the mass as a basic constituent in the planning of landscape is important. Shrubs with properties of hardiness, vigorous growth and an emphasis on evergreen plants are selected.

**Creeping plants for exterior of units:** plants like climbing hydrangea attaches itself to walls and grow to impart a green environment.

Air purifying plants: Polluted air contains particles, odours and harmful gases like nitrogen oxides, sulphur dioxide and ammonia. These pollutants settle on the leaves of trees and plants. The leaves and plant surface absorb these pollutants and through their stomata (pores) and filter these harmful substances from the air. Trees also trap heat and reduce greenhouse gases in the atmosphere. They also reduce the ground level ozone level and enrich the air around us with life giving oxygen. For combating a variety of respiratory troubles and other illnesses caused by air pollution, there can be no better way than planting some chosen varieties of plants that can cleanse the air and make our environment better.

The bamboo palm is a popular purifying houseplant due to its tropical look and insect-repelling quality. The bamboo palm can remove substances like benzene, formaldehyde, chloroform, carbon monoxide, and xylene.

## 6.15 OCCUPATIONAL HEALTH HAZARDS AND SAFTEY MEASURES

The sanitation workers, engaged in operation and maintenance (O&M) of sewerage system or septic tanks, are exposed to different types of occupational hazards like injuries caused by physical actions, chemicals contacts, infections caused by pathogenic organisms, and dangers inherent with oxygen

deficiency, hydrogen sulphide, and combustible gases. The employers are obligated to provide their employees with safety equipment or protective gears as well as cleaning devices and ensure observance of safety precautions appropriate for each hazardous condition to reduce the employees' risks to health and safety. Moreover, to guard against human error and carelessness, proper safety training and adequate effective supervision by safety personnel are most essential.

The GOI enacted the "Employment of Manual Scavengers and Construction of Dry Latrines (Prohibition) Act, 1993," which declared the employment of scavengers or the construction of dry latrines to be an offence, considering the foregoing, another bill titled "The Prohibition of Employment as Manual Scavengers and their Rehabilitation Bill, 2013" was introduced in the Parliament in September 2013 and has since been passed. The Bill aims to eliminate manual scavenging and insanitary latrines and provides for proper rehabilitation of manual scavengers in alternative occupations so that they can lead a life of dignity. In addition to the Acts mentioned above, employees shall follow "Contract Labour Regulation and Abolition Act, 1970" for secure operational health and safety at their sites. O&M of sewerage facilities, which should not be discontinued at any moment, requires health and safety consciousness equal to or greater than one that is needed for construction projects. In India, "health and safety policy" is defined in construction project management by Bureau of Indian Standard (BIS). Therefore, the same health and safety policy for construction projects may also be adopted for O&M of sewerage facilities. STPs are subject to safety audits, which confirm the status of safety and health organizational setup, education / training, provision / inspection of personal protection, and records of safety, to ensure occupational safety and health at the work sites. The plant engineer should rectify failures immediately, if any. The audit shall be implemented as per IS: 14489 "Code of Practice on Occupational Safety and Health Audit." Standard safety audit procedures of the inspectorate of factories shall be at a frequency of a month and compliance reported to that agency.

#### **1.16 COST ANALYSIS**

OPERATION & MAINTENANCE COSTS										
Sl. No.	Item	Rate			Expenditure					
1	Power Charges for STP @ Rs. 7.2 for kwh @	71399.2		kwh/month	5,14,074					
2	Power Charges for network @ Rs. 7.2 for kwh @	6848.3		kwh/month	49,308					
3	Operators rate/month-STP	25000.0	3	Nos.	75,000					
4	Operators rate/month-Wells	15000.0	3	Nos.	45,000					
5	Fitter rate/month-STP	20000.0	1	Nos.	20,000					
6	Driver for septage handling vehicle/month	20000.0	2	Nos.	40,000					
7	Cleaner for septage handling vehicle/month	15000.0	2	Nos.	30,000					
8	Fuel for generator/month				20,000					

	Fuel for vehicle/month@150 km/day for				42.750
	both vehicles	1425			5.000
9	Gas Chlorine/month				5,000
10	Alum and Lime dosing/month				7,500
11	Chemicals for odour management/month				7,500
12	Chemicals for lab tests/month				5,000
13	Spares and replacements/month				5,000
14	Network routine inspection, flushing, cleaning including for manholes/month@	1% of cost of network/year			2,37,896
	Total per month				11,04,028
	Total per month excluding power charges				5,40,646
	Annual Operation & Maintenance Charge				1,32,48,333
	Annual Operation & Maintenance Charge excluding power charges				64,87,748
	Treatment Cost per Day				36,297
	Unit Cost of Treatment per Kilo Litre				27
10 Y	EAR ANNUAL O&M COST CONSIDERI	NG 8% ANNU	AL IN(	CREASE E	VERY YEAR
	Excluding po	ower charges			
1	1 <sup>st</sup> year				₹ 64,87,748
2	2 <sup>nd</sup> year				₹ 70,06,768
3	3 <sup>rd</sup> year				₹ 75,67,310
4	4 <sup>th</sup> year				₹ 81,72,695
5	5 <sup>th</sup> year				₹ 88,26,510
6	6 <sup>th</sup> year				₹ 95,32,631
7	7 <sup>th</sup> year				₹ 1,02,95,242
8	8 <sup>th</sup> year				₹ 1,11,18,861
9	9 <sup>th</sup> year				₹ 1,20,08,370
10	10 <sup>th</sup> year				₹ 1,29,69,039
	Total O&M cost for 10 years				₹ 9,39,85,174
	GST @ 18%				₹ 1,69,17,331
	Unforeseen charges				₹ 7,495
	Total O&M cost for 10 years including GST				₹ 11,09,10,000

#### **CHAPTER 7**

#### CONCLUSIONS

#### 7.1 OBSERVATIONS FROM ANALYSIS

From the analysis performed for the Wadakkanchery Municipality, Thrissur with respect to the planning designing and implementation of a sewerage system, it can be observed that both the Local Body and the society mutually benefits substantially once the project is realised. Adopting a meticulous operation and maintenance plan, the system can be successfully run for a longer period without experiencing any troubles. Since there are many innovative digital technologies for controlling the performance of the system, it is an easy task for the institution to own and run the sewerage system. This will also pave the way for a wider acceptance in the society for decentralised sewerage system applications. Adopting non-conventional energy sources like solar energy, it will be an easy affair to run many of the low-capacity pump sets. Also, a building envelope with eco-friendly materials and construction technologies will give an aesthetically pleasing and healthy system.

#### 7.2 INSTITUTIONAL ARRANGEMENTS

Kerala Water Authority (KWA) has set up four sewerage circles under the sewerage vertical concept recently. The idea and vision behind it are to visualize and materialize complete sewerage schemes for the State. The Sewerage Circle, Thrissur has been assigned the task of preparation of Detailed Engineering Report (DER) for the Districts of Thrissur, Palakkad and Malappuram. The Project Planning and Development wing (PPD), Kochi has been given the additional charge of Sewerage Circle, Thrissur at present.

It is imperative that the institutional structures for the delivery of sewerage services are streamlined. The urban sanitation sector can learn from counterpart rural area programming such as Total Sanitation Campaign (TSC), National Rural Health Mission (NRHM), Sarva Shiksha Abhiyan (SSA), Integrated Child Development Services (ICDS) in establishing such institutional structures with clearly laid out roles and responsibilities. Until Local Self Government Institutions LSGI's develop their robust capacities, it is desired that the technical support is extended in planning, designing, implementation and O&M of sanitation services by other departments. Active involvement of local NGOs, community organizations, self-help groups of women will be ensured through awareness creation and community mobilization for increased ownership of the overall sanitation agenda at the local level. Promotion of active support to specially formed groups at the Ward level with primary focus in eliciting women participation will be paramount to the achievement of the goals of the State Sanitation Strategy.

#### 7.2.1 DISRTICT LEVEL APPROACH

At each district level, water and sanitation mission headed by the District Collector is constituted and all officials pertaining to the sewerage planning and implementation process can contribute to the achievement of complete coverage for the district. District level monitoring committee can also be formed with involvement of representatives of beneficiaries and local bodies. District level offices of KWA can closely associate with the district level sewerage activities of district administration.

#### 7.2.2 URBAN LOCAL BODY (ULB) LEVEL APPROACH

A multi stakeholder comprising of representatives from shops and establishments, sanitary workers unions, educational institutions, women groups, contractors, NGO's, line departments, political and eminent personalities to be led by the Mayor/Chairman/Chairperson along with the Executive head of the ULB shall be constituted. The City Sanitation task force shall be duly supported by a City Sanitation Cell (CSC) that is staffed with relevant human resources. The cell shall be responsible for preparation and implementation of the city sanitation plan.

#### 7.3 PLANNING FOR IMPLEMENTATION

It can be observed that for the perspective of Kerala in social conditions, status of urbanisation, public health issues and environmental characteristics, habitations can be divided into several zones of smaller strength of population for planning and implementing effective sewerage schemes. Hence a decentralised approach is beneficial.

The decentralized sewerage concept implies localized collection and localized treatment of excreta and sullage in micro zones within a major habitation keeping it in tandem with densification and progressively duplicating it as and when other micro zones densify. It will ensure that every micro zone owns up its excreta and sullage management and cannot expect a faraway habitation to receive and inherit it - a prospect which will sooner or later lead to inter conflicts and destabilize progress. Thus, the provision of both the collection system and treatment can be made compatible to the pace of development by juxtaposing on site sanitation as well in its fold.

As described in detail in the previous sections, GIS can be generously made use for the initial planning stages. Several factors influencing the sewage production characteristics and its carriage towards a desirable site for treatment and disposal can be meticulously planned using data analysis with the help of versatile applications of GIS.

In general, prediction of sewage volumes is far easier in decentralized sewerage micro collection areas and to that extent the design becomes realistic. Flows in a decentralized sewerage are relatively smaller than conventional sewerage and this implies that environmental damages from any mishaps are also minimal. Given the smaller flows, the sewer sizes are also smaller, and the depths of cut are also lesser thus making it easy to construct and maintain. Additions of newer service areas are independent of the existing system and the need to augment or enlarge the existing sewers and STPs are avoided. The STPs are smaller, and it is easier to find the reuse prospects nearby as compared to all the sewage being treated in one far corner. It is also easier to lay out return lines of treated sewage for use in medians, industrial supplies, flushing far flung head manholes, etc. The ecology of rivers, streams and receiving waters are better managed by smaller volumes of discharges of treated sewage at multiple locations than one massive volume in a single location and if the single STP is out of order, the entire stretch of the water course gets polluted.

#### 7.4 DATA INFORMATION AND MANAGEMENT

Accurate and reliable data information and management is a prerequisite for successful operation and maintenance of sewerage systems. As far as KWA is concerned, every district can have a district office with effective subunits for multi-pronged activities in data analysis and decision making. Modern technologies can be utilised for upgrading the existing systems and informed decision-making process can be sorted out for maintaining desirable level of performance of sewerage schemes.

Similarly, it may be noted that LSG officials are to be trained to make latest state of art maps of adequate resolution (1:10,000 and better) and uses WGS84 (World Global System 1984) as the datum for all their spatial information. Such an information system shall make best use of the GIS and MIS platforms that are rapid to access and retrievable for use in planning for urban and rural infrastructure, creates compatible data formats and transforms MIS information (e.g. for property mapping, census etc.) into spatial geo-referenced GIS files for further analysis and interpretation for all the important sectors (e.g. water, waste water, solid waste, storm water).Since ULBs and other LSG's have the final responsibility for ensuring all service delivery of sanitary and environmental outcomes, it is necessary that the state is refining and complementing existing national standards wherever adaption to the regional settings is required if and when required.

# 7.5 ENVIRONMENTAL IMPACT MANAGEMENT

The project area is not falling under environmental sensitive zones. There are no natural reserve forests or parks or the presence of coastal belt.

During the construction phase, the emissions from movement of vehicles used for project activity may affect the air quality due to the particulate matter generated during loading, transporting, unloading of materials during construction. Movement of heavy vehicles and concrete mixer would generate considerable noise in the surrounding environment. Hence a proper traffic management plan is recommended during the construction activities.

Sludge generated in the STP must be properly disposed off by transforming it into fertilizer products or bricks for low impact construction activities. Recycled water generated from the STP is to be used as per the guidelines already given.

Regarding the positive impacts, it is to be noted that water quality of the rivers and streams will be greatly improved along with the general environment. The large quantity of recycled water will be useful for multiple purposes including agriculture.

#### 7.6 GENDER EQUALITY AND SOCIAL IMPLICATIONS

The project is envisaged to provide substantial improvements in the life of the people belong to the project area, especially for the womanhood. During the operation of the STP and the sewer network, the ULB can form a special monitoring group comprising of dedicated workforce especially from "Kudumbasree" units or similar groups for continuous appraisal of the sewerage scheme and subsequent upgradations. There must be special programmes organised for capacity building of the beneficiaries and all workforce associated with the operation and maintenance of the sewerage project.

## 7.7 FINANCIAL PLANNING AND OUTCOMES

It may be noted that overall costs (capital and operating) and financial sustainability must be determined to arrive at the most optimum solution. Hence during the detailed engineering survey and investigations stage these factors are to be considered for better performance of the system.



#### Fig.27 Operating cost planning

The Disability-Adjusted-Life-Years (DALY) is a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death. Originally developed by the WHO, it is becoming increasingly common in the field of public health and health impact assessment (HIA). It extends the concept of potential years of life lost due to premature death – to include equivalent years

of 'healthy' life lost by virtue of being in states of poor health or disability. In doing so, mortality and morbidity are combined into a single common-matrix.

As per the WHO report, 80% of the diseases in human being are water-borne and water-related. It is mainly due to water pollution or water contamination and water logging. Though water logging may be location and weather specific, but water pollution and contamination is a common phenomenon which can occur at any place at any point of time if community is not careful about adverse impact of indiscriminate disposal of sewage. The indiscriminate disposal of human excreta or sewage from habitations may contain hazardous micro-organisms (pathogens) for water pollution and harbouring vectors which act as carriers of pathogens. Improvements in water supply and sanitation including management of municipal solid waste can substantially reduce the incidences and severity of these diseases, as well as infant mortality associated with diarrhoea.

From the above statements, it is evident that environmental pollution by liquid and solid wastes adversely affects the environment and human health directly or indirectly resulting in loss of life and heavy financial burden on exchequers.

#### 7.8 ACTION PLAN FOR IMPLEMENTATION

The following sequence of implementation plan for the institution may be more effective in realising the goals of providing the sewerage system.

Priority	Plan
Ι	Preparation of a detailed engineering report
II	Appraisal of the report
Ш	Sanction of the project
IV	Fund mobilisation
V	Invitation of Tender for work
VI	Execution of work
VII	Formation of monitoring committee
VIII	Regular maintenance
IX	Assessment of performance
X	Modifications in process/unit operations

Table 16 Action plan for implementation

#### 7.8.1 IMPLEMENTATION SCHEDULE

Sl. No.	Activity	Oct-Nov 2021	Dec-Jan 2021-22	Feb-Mar 2021	Apr-May 2022	Jun-Jul 2022	Aug-Sept 2022	Oct-Nov 2022	Dec-Jan 2022-23	Feb-Mar 2023	Apr-May 2023	Jun-Jul 2023	Aug-Sept 2023
1	Basicplanninganddiscussionswithgovernmentdepartments												
2	Survey on Related Plans												
3	Survey on Existing Facilities												
4	SurveyonResourcesofSewerageSystemand itsUtilization												
5	Finalization of design and detailed engineering report												
6	Appraisal of the report												
7	Sanction of the project												
8	Fund mobilisation												
9	Implementation												
10	Trial and commissioning												

#### Fig.28 Implementation schedule

#### 7.9 RECOMMENDATIONS

The success of the system largely depends upon the commitment and attitude of the people benefitted from it and hence it is inherent that the Local Body will investigate every detail of the sewerage treatment plant and its supporting units to render a model of its kind in the State. Some of the points of action to be taken to enhance the performance of the system are outlined as follows:

For better performance of the system, testing of influent and effluent samples at regular intervals are to be done

For effective control of operation and maintenance activities, a monitoring cell at the institution level is to be formed Using solar energy sources and IoT based sensors for operation of the plant, operational cost and time for inspection of quality at various stages can be reduced

Re-use of the recycled water for gardening and toilet flushing is suggested. From the feedback of performance at initial periods, process/unit operations can be modified for optimum results

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# ANNEXURE VIII(A)



1.35 MLD CAPACITY SEWERAGE SYSTEM FOR WADAKKANCHERY MUNICIPALITY DATE: 28-12-2021 TITLE : PROFILE PLOT

SCALE :

FILE NO : PPD/TSR/SEW-3/2021 DRAWING NO :











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ANNEXURE VIII(B)







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