KERALA WATER AUTHORITY

SEWERAGE CIRCLE KOCHI-11

DPR OF COMPREHENSIVE SEWERAGE SCHEME IN ALUVA MUNICIPALITY IN ERNAKULAM DISTRICT – PHASE-1

KERALA

2022

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EXECUTIVE SUMMARY

Kerala Water Authority is a public sector undertaking under the Government of Kerala formulated to plan, execute, operate and maintain water supply and sewerage schemes in Kerala. Aluva town, wastewater disposal is the main environmental issue that has created unsanitary conditions, odor and mosquito problems within the city, which causes nuisance to the residents and affects their health. At present there is no Sewage Treatment Plant (STP) and system in Aluva for treating the sewage/septage generated in the entire town.

Providing a sewage network in major cities and towns is given utmost importance considering the increasing pollution of water bodies due to lack of proper disposal of sewage. As per the direction of KWA and under "Rebuild Kerala Initiative (RKI), a comprehensive sewerage plan has been developed in the year 2020 for Ernakulam district. As a pilot project two urban local bodies (ULBs) of Ernakulam district have been selected (Kochi Corporation and Aluva Municipality) for implementation of sewerage scheme. Since one of the polluted river Periyar is flowing through the heart of Aluva Muncipality, it is high time to implement a sewerage system in Aluva Muncipality, therefore Aluva Muncipality has been selected as one of the ULB for the implementation of sewerage system. Even though the area of Muncipality is less, population density is higher compared to other Muncipalities.

Aluva Municipality has an area of 7.18 km^2 and land area is 5.81km^2. At present there is no sewerage system in this ULB. The only wastewater treatment plant functioning in the Muncipality was only to treat storm water which is defunct since the flood occurred in 2018.

The entire Municipality is divided into 5 zones based on natural and manmade boundaries like river Periyar, Railway line, National Highway and boundaries of adjacent Panchayaths. The zones are Zone-1 Thottakkattukara West, Zone-2 Thottakkattukara East, Zone-3 Market Area, Zone-4 Central Area and Zone-5 Sub Jail Area. This DPR deals with the implementation of sewerage system in Zone 1 and Zone 2 (Phase-1).

The population growth in Aluva Municipality is negative from 1991 census and hence the year 2011 is taken as base year for population forecasting, ie.22428 and provisions for floating population, non domestic water consumption, infiltration, unaccounted flow of water etc. are considered for sewerage load calculation. The calculated sewage load for zone1 and 2 are 0.64 MLD and 1.08 MLD respectively.

STP of capacity 1.72 MLD for these two zones are proposed in the land owned by Irrigation Department at zone-1.

The treatment technology for the proposed STP adopted in this DPR is Moving Bed Bio Reactor, as this technology is suitable for adopting shock loads and flexible in nature. Apart from sewerage treatment plant, a co-treatment facility is also proposed to treat the septage to be collected from the non network areas.

The network system consists of sewer network of 24000m, 954 manholes, and pumping main of 5000m. The project includes three collection wells , one in STP premises in Zone 1 and two numbers in Zone 2. Considering the practical difficulty to excavate in deeper depth owing to sandy/alluvial soil nature, provision for 17 Nos of lifting manholes are included in the DPR . The sewer network lines proposed are HDPE PE100 PN8 and pumping mains HDPE PE100 PN10. In these particular zones, NH crossing for laying pumping main is inevitable to avoid the construction of STP's on either side of NH and provision for NH crossing is included in the estimate. The amount required to get the statutory permissions from various departments/agencies are also included in the estimate as provisional sum.

As the sewerage connection to the households are to be provided in parallel with the construction of STP for the timely commissioning of the plant, provision for giving sewer connections to households are included in the estimate.

As the roads in the Municipality are narrow with heavy traffic, provision for conveying excavated soil (during excavation for trenches) to a suitable place within 0.5 km and conveying back to refill trenches are included in the estimate.

The total cost of the project including O&M cost comes to **INR 118.50 Crores**.

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PROJECT AT A GLANCE

Sl. No.	Item	Description
1	Name of the Project	DPR of comprehensive sewerage scheme in Aluva Municipality in Ernakulam District – Phase-1
2	Name of District	Ernakulam
3	Name of Municipality	Aluva
4	Project area covered(km^2)	2.43
5	Population benefitted	12783 Nos. (Including floating population, Year 2053 Projected)
6	STP Capacity	1.72 MLD
7	Total Network Length	24000 M
8	Number of Wells	3
9	Number of Pumping Stations	2
10	Number of Manholes	954
11	Number of Connections	2130
12	O&M cost for 10 Years including 18% GST (including electricity charges)	Rs.121,56,40,875.00
13	Electricity charge for one year	Rs. 73,20,631.00
14	Amount required for Land acquisition (Only for one well)	Rs.5000000.00
15	Total cost including 10years O&M cost(excluding power charges and land acquisition charges)	Rs.118,50,00,000.00
16	Implementation agency	Kerala Water Authority
17	Period of execution	2 year

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ABSTRACT OF COST		
Sl.No.	**Item Specification**	**Amount (INR)**
	Civil Works	792748421
	Mechanical Works	30634754
	Electrical Works	5615893
	O&M Charges for 10 years	76694915
	GST @18%	163024917
	Centage @10%	90569398
	DPR Preparation Charge @2.5%	20724977
	Contigencies including statutory clearances	4986726
	Grant Total	1185000000

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CHAPTER-1
INTRODUCTION

1.1 INTRODUCTION

Archaeologists have found evidence of settlements in Aluva as far back as 250 BC. The place used to be a continuous area of land spread across Kakkanad and Alangad historians have recorded that it was so up to AD 1341. The town, by then thickly populated, became a holiday resort and a centre of commerce. Mangalappuzha, a branch of Periyar which bifurcates at Aluva was known to be the nerve centre of trade and commerce in this part of South India. Before Indian independence, Aluva was part of the Kingdom of Travancore and was the official summer residence of the royal family. The etymology of the name of the town of Aluva has been the subject of speculation for centuries. One of the more accepted version relates to the story of Hindu god Shiva drinking the Kalakootam poison to save the world. It is said that Shiva with the poison –Alam - in his mouth -Vaa- was made into a deity which was then rested in a temple in Aluva. The Sivarathri festival for which the town is famous for is celebrated in the honour of Shiva. In the twentieth century, when there was a community of Jews in Cochin, some used to have holiday homes in Aluva on the banks of the River Periyar. it also has a name "gate way to east".

1.2 City Profile

Name of Municipality	:	Aluva
District	:	Ernakulam
Thaluk	:	Aluva
Area (in km^2)	:	7.18 km sq
No. of wards	:	26
Population	:	22,428
Male	:	11,031
Female	:	11,397
No. of Households	:	5,641
Density of population	:	3358/sq km
SC Population	:	834
Male Female Ratio	:	1033
Literacy Rate	:	97.90 %

No. of BPL families	:	720
No. of Notified slum	:	0

Provision of drinking water and sanitation facilities has always been a key priority for the state as it is directly related with the health of the community. The state has achieved significant results in terms of improved water supply coverage through Kerala Water Authority. But the sanitation sector could not cope up with the water supply sector.

At present, there are no sewerage/septage treatment plants or sewerage networks exist in Aluva. One existing wastewater treatment plant is used to treat storm water and after the flood in 2018, it is not working and requires revamping.

1.2.1 TOPOGRAPHY

The area of Aluva Municipality lies at 10.1004° N latitude and 76.3570° E longitude. The river Periyar imparted a typical topography to the Aluva area. The river Periyar is the source of drinking water to Aluva Municipality and adjoining Panchayaths and Kochi Corporaton. The height above mean sea level in areas is only 8 metre on an average.

1.2.2 GEOLOGICAL CONDITION

Major portion of the project area lies in low land region. The soil in the low land region is mainly slushy, clayey and water logged. These clayey soil with poor aeration and drainage and are characterized by a deep black colour, extremely high content of organic matter and very high acidity.

1.2.3 WATER RESOURCES

- **SURFACE SOURCE**

Periyar is the major river flowing through the Municipality. The major source of water supply to the Municipality aswell as Kochi Corporation is Periyar river.

- **GROUND AND WATER POTENTIAL**

The seepage from the rivers and accumulation of ground water owing to heavy rains make the district relatively rich in groundwater sources. But the ground water in the low land areas are not suitable for drinking purposes due to salinity.

1.2.4 CLIMATE AND RAINFALL

The district has a tropical humid climate. Four seasonal variations are experienced in the district viz. the south west monsoon season from June to

September; North east monsoon season from October to December, a cool and pleasant climate during January and February and summer season.

1.2.5. DEMOGRAPHY

Aluva is the second biggest town of Greater Cochin City which is also considered as the Industrial and Commercial City of Kochi. Aluva witnessed a rapid population growth during the 30 years up to 1991. But the study during the last decade (1991-2011) shows decrease in growth. Even though the natural growth rate of population does not show an exorbitant increase, the floating population in Aluva is to be considered while earmarking the infrastructural requirements. For computing the future requirements, it has been considered the population in 1991 census as base.

1.2.6 EMERGING ISSUES AND CONCERNS

Even though the natural growth rate of population does not show an exorbitant increase, the floating population in Aluva is to be considered while earmarking the infrastructural requirements. During Mahasivarathri festival, large numbers of people are gathering at Aluva for one month. There is no intensive migration to Aluva Muncipality as Employment opportunities in the city is not sufficient to exert a pulling effect.

It must be noted that the daily commutation adds to the increased number of floating population in the core city. Due to the commuter traffic in Aluva, Koch Metro Rail starts from Aluva. The town is well connected to Kochi and nearby areas by road and rail. The international air port is also located about 15 km away from Kochi city.

1.3 PROPOSED SEWER NETWORK AREA

The population in Aluva Municipality is decreasing from census 1991 and as per 2011 census for the municipality is 22428 and considered as population 22428 for computing sewerage load. Taking water consumption per capita as 150 lpcd and considering UFW, non-domestic consumption and floating population, total water usage is calculated as 5.16 MLD. As per CPHEEO guide lines, 80% of water consumption is returned as sewage produced and the total sewerage load arrived for the entire Municipality as 4.54 MLD incorporating 10 % infiltrations also.

The area lies between the 10.1004° N latitude and 76.3570° E longitude. The area is residential where high raised buildings, hospitals shopping complexes etc.

are also exists. By implementing the sewerage scheme in this area contamination of water bodies can be prevented.

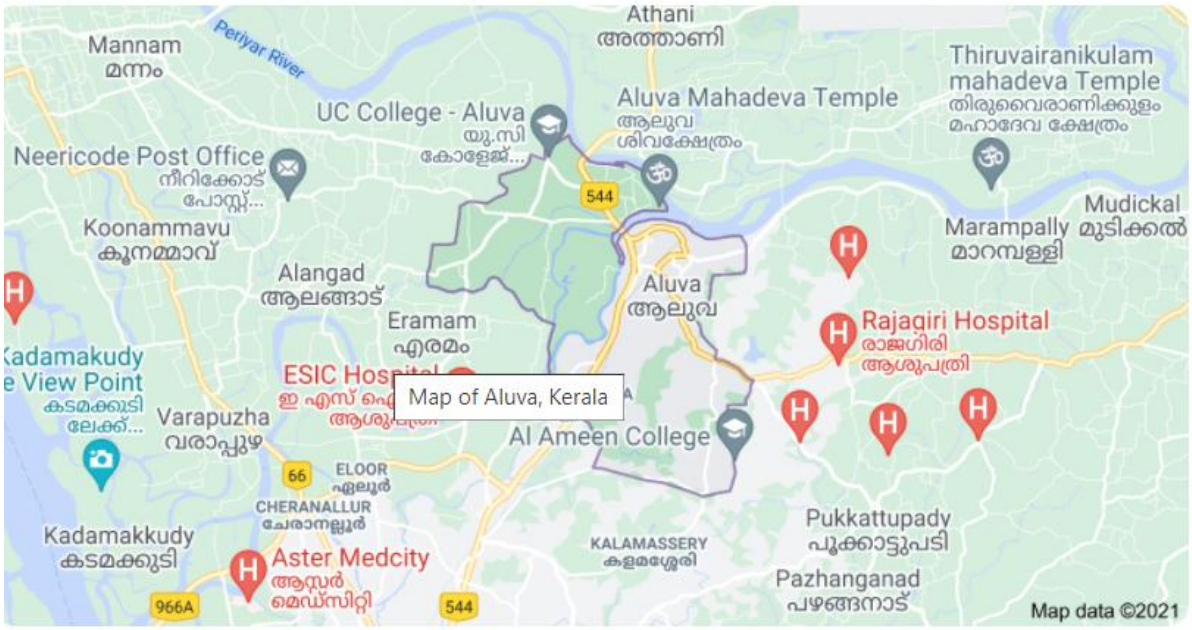


Figure 1.1 Location Map of Network Area

The entire Municipality is divided into 5 zones based on natural and manmade boundaries like river Periyar, Railway line, National Highway and boundaries of adjacent Panchayaths. The zones are Zone-1 Thottakkattukara West, Zone-2 Thottakkattukara East, Zone-3 Market Area, Zone-4 Central Area and Zone-5 Sub Jail Area. As Ist phase the zone 1 and 2 are selected in this DPR. The sewage load generated in the project area is 1.72 MLD. The area covered is 2.43 km^2 , the population is 8522 (as per 2011 census) and population density is 3506. The network is 23457 m with 954 manholes.

CHAPTER 2
SECTOR BACKGROUND, CONTEXT & BRIEF PROJECT RATIONALE

2.1 ALUVA SEWERAGE SCHEME-A REVIEW

Most of the inhabitants or households of Aluva Municipality have their own sewerage treatment facilities such as septic tank etc. But during festival seasons etc. untreated sewage discharges directly to river Periyar which pollutes drinking water source. The augmentation and revamping of the existing wastewater treatment plant near Adwaitha Ashramam (which is used to treat only storm water) remains one of the major projects that has remained in the cold storage for long.. After the flood occurred in the year 2018, the plant has ceased operation and not yet repaired. At present there is no sewerage system in Aluva Municipality.

Fig.2.1 Existing Storm Water Treatment Plant at Aluva

Fig.2.2 Existing Storm Water Treatment Plant at Aluva

2.1.1. NETWORK COVERAGE

As there is no existing sewerage system in Aluva, the whole Municipality has to be considered for implementation of the sewerage project with network and STP. Total area to be covered is 7.18 km^2 with an approximate road length of 150km.

2.2 USER COVERAGE AND ACCESS TO THE USERS

River Periyar is passing through Aluva Municipality which divides the Municipality into two and these areas are well connected with Railway bridge, Marthandavarma Bridge and Rainbow Bridge which exclusively used by pedestrians for reaching Aluva Mahadeva Temple. River Periyar is one of the main source of drinking water to Aluva Municipality as well as to Kochi Corporation. It also feeds drinking water to many Panchayaths and Municipalities located at the up and down stream. Salinity intrusion from Arabian sea with tides was reaching to the upstream side of river which made to stop functioning of water treatment plant at Aluva. In order to prevent salinity intrusion to the upstream of river, regulator cum bridges have been constructed at Pathalam and Purappillikkav. Aluva Municipality comprising an area of 7.18 km^2 out of which 1.32 km^2 is river and remaining land area is 5.84 with a

population of 22,428 as per the 2011 Census. Many number of court cases regarding the pollution of rivers especially river Periyar are still outstanding. Honorable NGT on O.A No. 673/2018 had directed that All States and Union Territories shall prepare action plans within two months for bringing all the polluted river stretches to be fit at least for bathing purposes (i.e BOD less than 3 mg/L and FC less than 500 MPN/100 ml) within six months from the date of finalization of the action plans. Govt. had constituted a District Level Technical Committee for preparing the draft action plan for the rejuvenation of River. To meet the growing demand for waste water management, KWA established a Sewerage Vertical Wing, led by the Chief Engineer, PPD & WASCON. PPD Wing's three circle offices in Thiruvananthapuram, Kochi, and Kozhikode have been designated as Sewage Circle offices in addition to Kochi sewerage circle office. These wings are responsible for the investigation, planning, design, and DER preparation of sewerage projects.

The sewage load of Aluva Municipality is calculated as 4.54 MLD. The population growth from 1991 is negative and as per 2011 census is 22,428 which is taken as the base population for designing sewerage system. The effluent after treatment from STP is proposed to discharge into river Periyar at down streams.

- **KEY ISSUES, IMPORTANCE OF THE PROJECT TO THE SECTOR**

Increasingly rapid urbanization and industrialization are causing more rapid rise in the pollution of water and in many areas of the country, it has resulted in major public health hazards as well as in general deterioration of natural water resources. Drinking water sources are often threatened by increasing concentration of pathogenic organisms, as well as by many of the new toxic chemicals disposed of by industry and agriculture.

In several cases, rivers and lakes have become recipients of putrescible organic substances far exceeding their natural purifying capacities resulting in deterioration of water supplies and far reaching economic and health consequences.

Aluva, the industrial capital of Kerala State is situated in the Deccan peninsular. The general elevation of the city varies from 8m above mean sea level with population density of 3827 per sq.km.

Fig. No.2.3 Wastewater flowing to Periyar River through Existing Drainage Channels

2.3 NEED FOR SEWAGE TREATMENT

The sewerage project in respect of which considerable public and social resources are being used, form a basic infrastructure for the country and an indisputable indicator of civilization and development. The works cover a number of substantial social needs and aim to improve the quality of life and to protect public health and the environment. Some of the benefits and advantages of the sewerage system are as follows:

- **UPGRADING THE QUALITY OF LIFE**

The operation of the sewerage system has relieved these areas to a great extent from previous problems that were caused by the continuous emptying of cesspools. The sewerage system provides a healthier and more appropriate way to manage liquid wastes.

- **PRESERVING NATIONAL ENVIRONMENT**

With the operation of the sewerage system no more pollution of ground water is effected and the discharge of sewage waste in surface water will be significantly reduced. Clogging of drains and weed menace of surface water will be reduced resulting in the rejuvenation of the canals and the back water system.

- **SAVING AND PROCESSING WATERS**

Water is a substantial natural resource for our country and it should be managed in the best possible manner. The tertiary treated effluent at the wastewater treatment plant is reused for agricultural and other purposes thus helping conservation of precious water resources.

- **STANDARD OF LIVING**

Enhanced quality of ground and surface water minimizes water borne diseases. As a result of the above, the sewerage system contributes to further development and increase of the standard of living of the inhabitants. Considering all the above advantages, there is no doubt that if we all cooperate, we and our children will enjoy a better quality of life in the years to come and that we will secure a better environment to the forthcoming generations.

2.4 TYPES OF TREATMENT

The objective of wastewater treatment is to remove pollutants from waste and to bring the quality of effluent to a desired standard. It is therefore necessary to know the characteristics of raw waste water, its mode of use or disposal of effluent to determine the degree of treatment required. Different types of treatment provide different percentage removal of BOD and suspended solids. In general, the treatments are classified as primary, secondary and tertiary. The general yard sticks for evaluating the performance of sewage treatment plants is the degree of reduction in BOD, COD, Suspended solids etc.

2.4.1 PRIMARY TREATMENT

Any material which can possibly enter the sewer lines through the sanitary system in the homes or through manholes on the sewer line or in any other manner will be delivered to the treatment plant. Such materials may include refuse of every type, garbage, rags, pieces of wood, cans and children play things. These materials would injure subsequent equipment, clog piping or wrap around pump impellers and interfere with treatment process. The object of the provision of a primary treatment is to provide protection to the subsequent treatment units and to enhance the efficiency of subsequent treatment processes.

2.4.2 SECONDARY TREATMENT (BIOLOGICAL TREATMENT)

The overall objectives of biological treatment of domestic wastewater are

- To transform (i.e. oxidize) dissolved and particulate biodegradable constituents into acceptable end products.
- Capture and incorporate suspended and non settleable colloidal solids into biological floc or bio film.
- Transform or remove nutrients such as nitrogen and phosphorus.

2.4.3 TERTIARY TREATMENT

Tertiary treatment is the final cleaning process that improves wastewater quality before it is reused, recycled or discharged to the environment. The treatment removes remaining inorganic compounds, and substances, such as the nitrogen and phosphorus.

Tertiary treatment adds a third, more advanced and rigorous level of treatment. Primary and secondary treatment typically gets wastewater only clean enough to discharge safely into the environment. Tertiary treatment, on the other hand, can achieve levels of water purification that make the water safe for reuse in water-intensive processes or even as drinking water. Tertiary treatment is also beneficial when facilities must discharge water into sensitive aquatic ecosystems such as estuaries, sluggish rivers or waters close to coral reefs.

CHAPTER-3
PROJECT DEFINITION, CONCEPT AND SCOPE

3.1 WASTEWATER TREATMENT AND OPERATIONS

The major aim of wastewater treatment is to remove the suspended solids as much as possible before it (called effluent) is discharged back to the environment. If untreated sewage is discharged into rivers or seas, then the water in the rivers or seas would also get contaminated. If this contaminated water is used for drinking, it can cause water born diseases such as cholera, typhoid, dysentery, etc. which may lead to death. Bacteria and other organisms in freshwater use oxygen to metabolize the sewage they accompany. While breaking down the sewage, these micro-organisms can cause hypoxic (oxygen-depleted) dead zones. These dead zones lack oxygen that fish and other native organisms need to survive. As solid material decays, it uses up oxygen, which is needed by the plants and animals living in the water. Sewage treatment removes the contaminants from sewage to produce liquid and solid (sludge) suitable for discharge to the environment or for reuse. It is a form of waste management. Sewage treatment results in sewage sludge which requires sewage sludge treatment before safe disposal or wastewater treatment is to reuse. Four common ways to treat wastewater include physical water treatment, biological water treatment, chemical treatment, and sludge treatment. Let us learn about these processes in detail. In this stage, physical methods are used for cleaning the wastewater. The basic function of speed up the natural processes by which water is purified. There are two basic stages in the treatment of wastewater viz. primary and secondary, which are outlined here. In the primary stage, solids are allowed to settle and removed from wastewater.

Long-term objectives of Sewerage project are to:

- Prevent the spread of diseases, including the limitation of the mosquito population,
- Prevent the prevalence of conditions offensive to sight and smell,
- Control the contamination of water resources
- Prevent and control soil and groundwater pollution.

Specific objectives of the project are to:

- To ensure the whole Municipality area is covered by a well maintained piped sewerage network and treat the sewerage at the proposed STPs located at various locations for disposal of sewage from households.
- Manage the pathogenic risk inherent in wastewater to meet the effluent discharge standards set by the CPHEEO, Ministry of Urban, Government of India and World Health Organization.
- Manage the safe disposal of sludge.

The unit operations involving wastewater treatment are classified generally as given below,

Table 3.1: Unit Operations and Processes.

Sl No.	UNIT	FUNCTION	UNIT OPERATIONS /PHASES
1	Primary	Removal of rags, floating matter, grit, oil and grease etc.	Screening Grit removal Oil and grease trap
2	Secondary	Removal of Bio degradable organic matter and suspended solids	Aerobic suspended growth (Aerobic andanaerobic)Lagoon Chemical oxidation process Nitrate and phosphate removal Chemical oxidation Suspended growth Nitrification/De-nitrification Air stripping Ion exchange Chemical treatment Biological nutrient removal system
		Also include nutrient removal (Nitrate and Phosphate) in advanced technologies	
3	Tertiary	Polishing the effluent for reuse application	<u>Pathogen removal</u> Chlorine compounds O_3,UV Radiation Membrane filtration Filtration variation Carbon Adsorption Iron exchange

The unit operations and process can be further classified as below

Table 3.2: Unit Operations and Processes

Sl. No.	Unit Operation	Functions	Treatment Devices
1	Screening, coarse	Removal of coarse solids such as sticks, rags and other debris in untreated waste water by interception(surface straining)	Bar rack
2	Screening fine	Removal of small particles	Fine screen
3	Screening micro	Removal of fine solids floatable matter and algae	Micro screen
4	Comminution	In stream grinding of coarse solids to reduce size	Comminutor
5	Grinding/ maceration	Grinding of solids removed by bar racks. Side stream grinding of coarse solids	Screenings grinder Macerator
6	Flow equalization	Temporary storage of flow to equalize flow rates and mass loadings of BOD and suspended solids	Equalization tank
7	Mixing	Blending chemicals with waste water and for homogenizing and maintaining solids in suspension	Rapid mixer
8	Flocculation	Promoting the aggregation of small particles into larger particles to enhance their removal by gravity	Flocculator

		sedimentation	
9	Accelerated sedimentation	Removal of grit Removal of grit and coarse solids	Grit chamber Vortex separator
10	Floatation	Removal of finely divided Suspended solids and particles with densities close to that of water also thickens bio- solids Removal of oil and grease	Dissolved air floatation (DAF) Induced air floatation
11	Aeration	Addition of oxygen to biological process Post aeration of treated effluent	Diffused aerator, mechanical aerator,cascade aerator
12	VOC control	Removal of volatile and semi volatile organic compounds from wastewater	Gas stripper Diffused air and mechanical aeration
13	Depth filtration	Removal of suspended solids	Depth filters

3.2 SCOPE OF THE WORK

At present there are no sewerage treatment plants in Aluva Municipality. The project includes the construction of an STP having capacity of 1.72 MLD, for zone 1 and 2 at the land owned by Irrigation department. Provision for treatment of septage is also incorporated with STP.

There whole Municipality has been divided into 5 zones. The zones are finalized according to natural or manmade ridges. The river Periyar, Railway line and National High Way are taken as the boundaries of zones. The five zones are as shown.

Zone-1	Thottakkattukara West	Boundaries are adjacent Panchayaths, River Periyar and NH.
Zone-2	Thottakkattukara East	Boundaries are adjacent Panchayaths, River Periyar and NH.
Zone-3	Market Zone	Boundaries are River, NH and adjacent Panchayaths
Zone-4	Central Zone	Boundaries are River, NH and Railway Line.
Zone-5	Sub Jail Zone	Boundaries are Railway line and adjacent Panchayaths

As a first phase, zone 1 and 2 are considered in this project and the STP is proposed at the land owned by irrigation department in anticipation of getting permission for crossing NH.

Network design has been done with the free domain software EPASWMM. Lifting stations are provided wherever necessary.

The primary treatment system is required for removing large size solid waste, removing oil and grease etc. before undergoing biological treatment and filtering etc. Layout plan shows common pre-treatment units as receiving chamber, screen channel, grit chamber, parshall flume. The technology considered for proposed STPs treatment is MBBR technology and tertiary treatments. The provision for dealing ammoniacal nitrogen is also catered. The necessary filtration and disinfection process is included in the design to meet the desired standards.

The project area (zone-1 and 2 combined) has an area of 2.43 sq.km. and network length is 23.457 km with 954 manholes. The number of collection wells are 3 (one nearby Old Desam Road, another nearby Paravoor Kavala and third well is in the premises of proposed STP and length of pumping main is 2274m.

3.3 LAND

The proposal is to lay sewerage network in the municipal area of zone 1 and 2 and to construct an STP with capacity of 1.72 MLD with modern technologies. Land for the construction of 1.72 MLD STP at zone-1 is the land owned by irrigation department.

3.4 POPULATION FORECASTING

Demographic forecasting is an important topic: population, household and related forecasts from the basis of social and economic planning and are fundamental to many other forecasting exercises. Water supply projects and sewerage projects are designed for 30 years. After 30 years the system needs renovation or to make a new system to accommodate load at that time.

There are several methods developed for forecasting population but none of them are perfect. The population growth may change based on several factors such as attitude of community, social status, onset of pandemic diseases, war etc. which are unpredictable.

The average decadal growth in Aluva Municipality for the thirty years before 1991 shows considerable increase. But the study during the last two decades (1991-2011) shows decrease in growth.

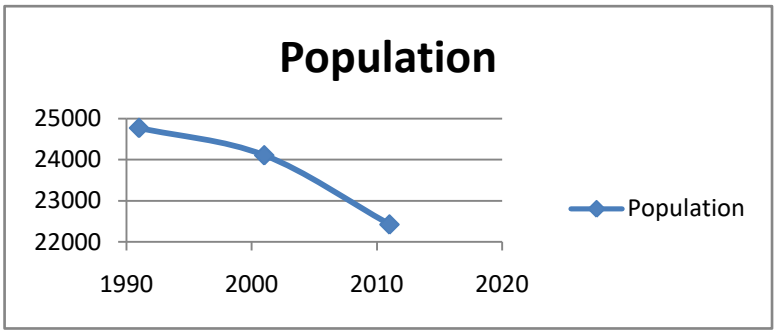


Fig.3.1 Decadal Population growth in Aluva Municipality

Even though the natural growth rate of population does not show an exorbitant increase, the floating population in Aluva is to be considered while earmarking the infrastructural requirements. Even though showing detrimental growth in Aluva Municipality, for computing the future requirements, it has been considered the population of census 2011 as base population and adequate floating population, unaccounted flow of water, infiltration, non-domestic consumption etc. are taken in account while calculating sewerage load.

3.5 DESIGN PERIOD

The design criteria to be followed for design of sewage collection, transportation and treatment system for the project area based on the recommendations

laid down in the CPHEEO Manual of Sewerage and Sewage Treatment (Ministry of Urban Development, Government of India, 2013). Sewerage treatment plant like sewerage scheme is normally designed to meet the future requirement of a stipulated design period of 30 years.

3.6 SEWAGE LOAD

The area selected for the sewage network is the entire Aluva Municipality. The decadal increment of population upto the year 1991 was positive whereas for the two succeeding decades, census data shows that decadal population growth is negative. Hence the population as per census 2011 is taken as base population. Considering the water consumption of 150 lpcd, non-domestic demand , floating population demand and UFW, the total water demand arrived as 5.16 MLD. Considering 80 % return as wastewater , the total sewage load is calculated as 4.54 MLD considering 10 % infiltration demand.

Table-3.3 Sewage Load Calculation

Base population(2011)	22428
Water consumption @150 lpcd	3.36 MLD
Floating population demand, Non Domestic demand, UFW,etc	1.79 MLD
Total Water demand	5.16 MLD
Sewage load @80 % of water demand	4.13 MLD
Infiltration demand	0.41 MLD
Total Load	4.54 MLD

Table-3.4 Detailed Sewerage Load Calculation

Zone No.	Name of Zone	Area (km^2)	Population (2011)	Floating population	Water Consumption @150 lpcd (MLD)	Floating demand @70 lpcd (MLD)	Non-Domestic demand @30% (MLD)
					MLD	MLD	
1	Thottakkattukara West	1.08	3180	1590	0.477	0.1113	0.1431
2	Thottakkattukara East	1.35	5342	2671	0.8013	0.187	0.2404
3	Market	0.33	1309	654.5	0.1964	0.0458	0.0589
4	Central	1.02	3706	1853	0.5559	0.1297	0.1668
5	Sub Jail	2.08	8891	4445.5	1.3337	0.3112	0.4001
	Total	**5.86**	**22428**	**11214**	**3.3642**	**0.785**	**1.0093**

Zone No.	Name of Zone	Total water demand (MLD)	Sewage Generated (MLD)	Infiltration (MLD)	Total Sewarage Load (MLD)
1	Thottakkattukara West	0.731	0.5851	0.0585	0.6436
2	Thottakkattukara East	1.229	0.9829	0.0983	1.0812
3	Market	0.301	0.2409	0.0241	0.2649
4	Central	0.852	0.6819	0.0682	0.7501
5	Sub Jail	2.045	1.6359	0.1636	1.7995
	Total	**5.16**	**4.1268**	**0.4127**	**4.5394**

CHAPTER - 4
PLAN OF SEWERAGE TREATMENT SCHEME

4.1 GENERAL

In this Chapter, general aspects of sewage collection, treatment and disposal for the Aluva Municipality is described. In the entire Municipal area 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. As a Ist phase zone 1 & 2 having population of 8522 (2011 census) is considered in this DPR.

The sewage network system is 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 provided. To reduce depth of cutting, lifting manholes are provided with sewage lifting pumps of smaller capacities. Solar power and diesel generator backup power are 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 if any are included in the septage management plan. Using septage transportation system, sludge from various points is collected and diluted using co-treatment 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 and are to be provided.

The recycled water can be taken for diluting the septage for co treatment, agricultural, other commercial ,industrial purposes and for recharging water bodies and to alleviate any pollution loads.

4.2 PRESENT SEWERAGE SYSTEM- OVERVIEW

Like all other Municipalities in Kerala, Aluva Municipality is also not having a sewerage system. All the residential building, commercial buildings, institutional establishments are having their own septic tanks for collecting sewage from latrines and grey water is either collected in leach pits or directly disposed to drainage system and nearby canals. Most of septic tanks are unscientifically constructed and do not have the facility for treating the effluent resulting in contamination of surroundings and the ground water. Even though Hospitals and other institutions are having their own independent facilities, in most cases partly treated effluent is discharged to nearby

drains or water bodies. Most of dwellings have their own wells as drinking water source and proximity to the septic tanks leads pollution in well water also. Coliform bacteria are detected in 70% of wells in Kerala and emphasizing the need for a well-planned sewerage system.

Fig 4.1: Pollutted area of Periyar near Aluva

4.3 METHODOLOGY FOR PREPARATION OF SEWERAGE MASTER PLAN

The following tasks have been performed during the planning of the proposed sewerage System:

- Data Collection and Field Visits
- Field survey using DGPS
- Social survey
- Population Projection and Sewage Flow Estimation
- Design of Sewage Collection System
- STP site identification, assessing area requirement

- Discussions with Municipality authorities and scheme presentation in the council for land availability
- Phasing of construction of STP
- Capital cost and O & M costs

4.4 FIELD INVESTIGATIONS

General Field investigations like topographic survey, geotechnical investigation, and sewage samples analysis has been conducted to ascertain the topography of the area, population density, the soil classifications and to ascertain its characteristics for designing the type of treatment, which forms the basis for proceeding further in designing the sewerage system.

4.4.1 TOPOGRAPHICAL SURVEY WITH DGPS

Topographical survey forms a very important component in formulating the sewerage project. A detailed topographical survey has been performed covering the area using DGPS and Total Station.

Fig 4.2: DGPS Survey in Aluva Municipality

Topographical survey of the project area was conducted using DGPS and Total station. Ground Levels have been taken along the roads at suitable intervals along straight portions and at all junctions of alignment. Important features and obligatory points like junctions such as culverts, major drains, and public utilities, cross roads, railway line have been captured. Using the topographical survey data and detailed base map showing the features like roads, land marks, public buildings, parks etc. has been developed.

4.4.2 SOCIAL SURVEY

Social Survey was carried out for locating each buildings for arriving the sewer load in manholes. Identifying and arriving possible shock loads from institutions such as hospitals, flats, and other establishments are very important for avoiding overflows in manholes. Identifying the buildings which are not feasible to be connected to network, for arriving septage load /separate pumping arrangements is also carried out in social survey. Moreover the areas likely to be developed in future are to be identified for arriving sewer load to be incorporated in design. Major Non domestic institutions identified are listed below.

1. Thaluk Head Quarters Hospital, Aluva
2. Karothukuzhy Hospital
3. Anwar Memorial Hospital
4. Arogyalayam
5. Lakshmi Hospital
6. Najath Hospital
7. Lakshmi Hospital (Former GTMH)
8. Railway Station and surrounding railway offices
9. KSRTC Bus Stand and office
10. Municipal Private Bus Stand
11. Matha-Madhurya Cinema Theatre
12. Zeenath Cinema Theatre
13. Casino Cinema Theatre
14. Aluva Town Hall
15. Tass Hall
16. Police Acadamy
17. Sub Jail, Police Station
18. Various Flats

19. Govt. Higher Secondary School near Municipal Office
20. Govt. Higher Secondary School for Boys
21. Nirmala School
22. St.Mary's School
23. Govt. LP School
24. St.Xavier's Women's College
25. Women's Hostel
26. Head Post Office
27. Municipal Office

4.5 COMPONENTS OF SEWARAGE NETWORK

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

Table 4.1 Components of sewerage network

Sl. No.	Type of element	Material	Function
1	Chambers	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 in order to limit the depth of cutting. Submersible pump sets installed inside in such manholes.
5	Collection well	Reinforced concrete	Centralised collection point for sewer load from a subzone in the project area.

6	Pumping station	Reinforced concrete	Centralised collection point for sewer load from a subzone in the project area and pumping of sewage to the next well or STP

4.6 DESIGN OF SEWARAGE NETWORK

For the design of sewage network, hydraulic analysis was performed using the software EPASWMM 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 180 mm for main lines along the roads and for carriage from chambers to manholes, 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-cleaning 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.

4.6.1. 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.

4.7 SEPTAGE

Septage or septic tank waste refers to the partially treated matter stored in and pumped out of a septic tank. In other words, fecal sludge from septic tanks is known as Septage, but fecal sludge and Septage are inter-changeably used in India. Septage is a by-product of pretreatment of household wastewater in a septic tank where it accumulates overtime. It is generally pumped out of a septic tank or onsite sanitation system using a vacuum tanker. Septage is the liquid and solid material that is pumped from a septic tank, cesspool, or other such onsite treatment facilities after it has accumulated over a period of time.

Networked sewerage system with STPs is proposed for the entire town area of

Aluva. Furthermore, if there is any portion which are not connected to the sewerage system, septage treatment is proposed for a population of 10000. Septage load from non network area of Aluva Municipality is proposed to be transported to the proposed STP plant where Co treatment facility will be provided.

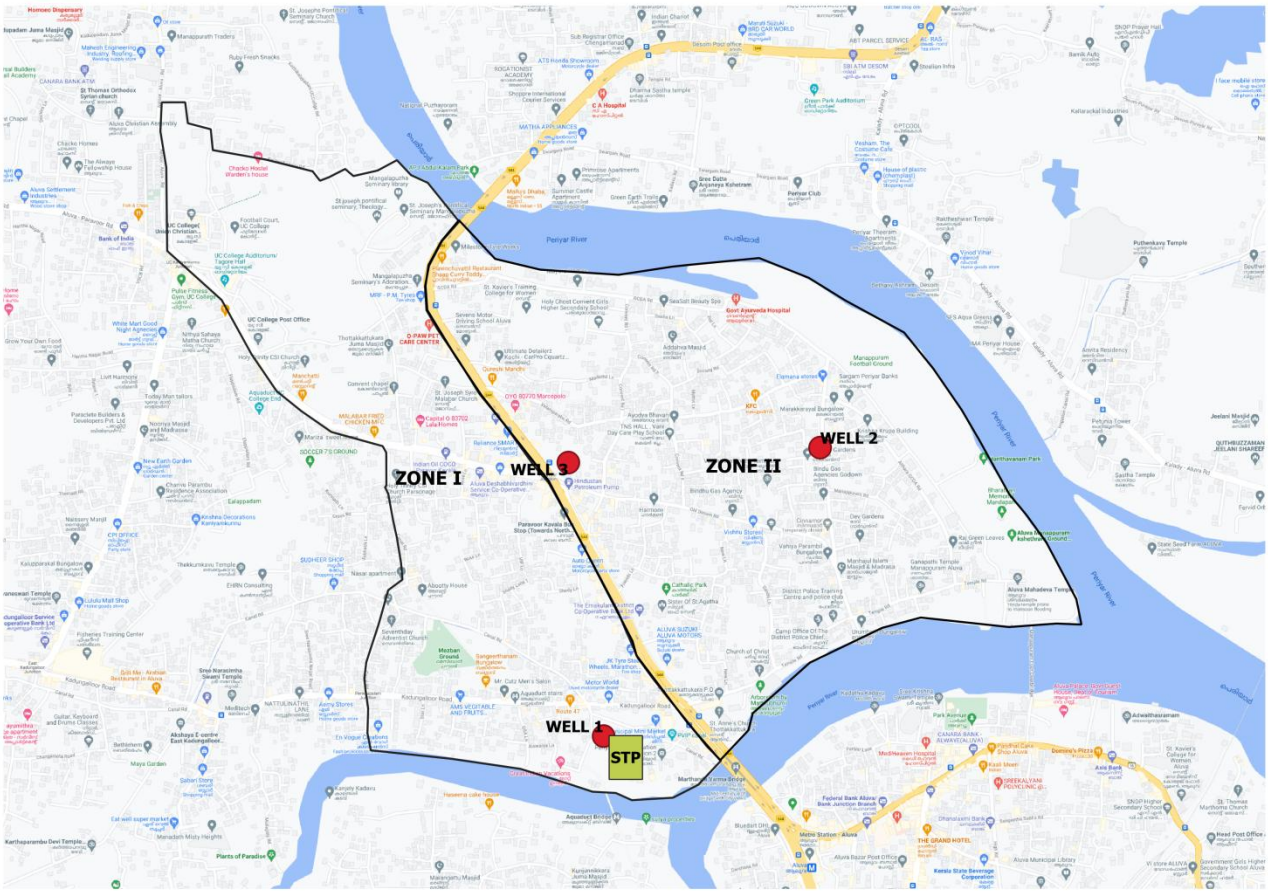


Fig 4.3 Collection well locations

4.8 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 wastewaters 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 is proposed to use as manure for cultivating vegetables and other plant life.

4.9 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. The integrated planning of the projects associated with water resources will contribute effectively for a successful sewerage system.

CHAPTER - 5
DESIGN CRITERIA

5.1 SEWAGE COLLECTION & CONVEYANCE SYSTEM

The sewerage system or storm water carriage system can be separate system or combined system or partially separate system depending on domestic sewage and rain water are drained through two separate set of pipes or through single set of piping. However, the combined system is not quite suitable in tropical Indian conditions as;

i) Heavy and concentrated rainfall occurs during the monsoon period and thus there is a large variation in the quantity of sewage during different months of the year,

ii) Dry weather flow is generally a very small proportion of the total flow and hence sewers are likely to get silted up due to low velocity of flow in lean periods,

iii) Capital funds are limited,

iv) Treatment costs and pumping costs are significantly reduced in separate system due to reduction in quantity.

v) If the system is overdesigned, external flushing to attain the areas where the self-cleansing velocity is not attained which will increase the O&M cost. It affects system efficiency.

The pipes for collection can have:

vi) Zonal pattern in which entire city is divided into suitable zones and a separate interceptor is provided for each zone,

vii) Radial pattern in which sewers are laid radial outwards from the center of the city to dispose sewage at multiple points,

viii) Interceptor pattern in which sewers are intercepted by large size sewers laid along the natural watercourses or,

ix) Fan pattern in which the STP is located at a certain point and the entire sewage flow is directed towards this point.

The collection and conveyance system adopted in this project is exclusively for sewage system

5.2 ESTIMATION OF QUANTITY OF SEWAGE

The quantity of domestic sewage is estimated by quantity of water supply consumption minus evaporation plus sewage flow from personal water sources which are other than those of community water supply and this water reaching to sewers. In

actual practice about 70-80% of the water supplied is reaching to sewers. As such 80% of quantity of water supply can be taken as sewage generation.

5.2.1 INFILTRATION AND LEAKAGE.

Some quantity of ground water or subsoil water may infiltrate into sewers through defective joints, broken pipes etc. This is significant when water table is high and head of ground water is more than the head of sewage in sewers. Some quantity of sewage may leak out from defective joints and defective pipes when head of sewage is more in sewers than head of ground water outside. Infiltration and leakage mainly depends on quality of construction and water table levels. Infiltration can be considered 5000-50000 liters per day per hectare or 500-5000 liters per day per km length of sewers or 250-500 liters per day per manhole for sewers laid below ground water level.

5.3 DESIGN PERIOD

Sewerage projects are normally designed to meet the requirements over a period of 30 years after their completion. However, the period of 30 years may be modified in respect of certain components of the project depending on their useful life or the facility for carrying out extensions when required and rate of interest, so that expenditure far ahead of its utilization is avoided. As such design period for various main components has been taken as indicated in Table below.

Table 5.1: Design Period of Sewerage Components

Sl. No	Design Component	Design Period	Remarks
1	Land Acquisition for STP, SPS, sewers etc.	30 Years	Land acquisition in future difficult
2	Sewer network (laterals, Trunk mains, Outfall etc.)	30 Years	Replacement difficult and costly
3	Pumping mains	30 Years	Cost may be economical
4	Pumping Stations- Civil Work	30 Years	Life of civil structure is 30 years
5	Pumping Machinery	15 Years	Life of pumping machinery is 15 years
6	Sewage Treatment Plants	30 Years	The construction shall be modular in phased manner as actual population less than

			design population and in Indian cities initially flows are much less due to connectivity problems
7	Effluent disposal and utilization	30 Years	Provision of design capacities in the initial stages itself is economical

5.4 VARIATION IN RATE OF FLOW

The rate of flow of sewage varies from season to season (seasonal or monthly variation), from day to day (daily variation) and from hour to hour (hourly variation). For design of sewers maximum or peak flow rates are adopted. The value of peak factor (ratio of maximum flow to average flow) depends on the contributing population and the values recommended in the Manual on Sewerage and Sewage Treatment prepared by CPHEEO are given in Table below

.

Table 5.2: Peak Factor

S.No.	Contributing Population	Peak Factor
1	Up to 20,000	3.00
2	20,000 – 50,000	2.50
3	50,000 – 7,50,000	2.25
4	Above 7,50,000	2.00

The variation between maximum and average rates of flow is large for domestic and lateral sewers because they receive the flow directly from the source. This variation gradually diminishes as the flow reaches the branch or sub main sewers and the main sewers.

Minimum rate of flow: The minimum rate of flow may vary from 0.5 to 0.33 of the average flow.

5.5 HYDRAULIC DESIGN OF SEWERS

The design for sewage collection system presumes flow to be steady and uniform. The unsteady and non-uniform sewage flow characteristics are accounted in the design by proper sizing of manhole. The sewage is mostly liquid containing about 0.1% of solid matter and hence follows same laws of flow as water. However the difference in design for water supply network and sewer network is, i) In order to

avoid clogging of sewers due to settlement of heavier particles of solids, sewers are to be laid at such gradient that self-cleansing velocity is achieved at all values of discharge and that the inner surface of the sewers should be capable of resisting the wear and tear due to abrasive action of solid particles and ii) sewage flows under gravity as open channel flow and as such sewers are laid at continuous downward gradient.

5.5.1 DEPTH OF FLOW

The sewers shall not run full as otherwise the pressure will rise above or fall below the atmospheric pressure and condition of open channel flow will cease to exist. Moreover, from consideration of ventilation, sewers should not be designed to run full. In case of circular sewers, the Manning's formula reveals that:

The velocity at 0.8 depth of flow is 1.14 times the velocity at full depth of flow.

The discharge at 0.8 depth of flow is 0.98 times the discharge at full depth of flow.

Accordingly, the maximum depth of flow in design shall be limited to 0.80 of the diameter at ultimate peak flow.

5.5.2 HYDRAULIC FORMULAE FOR DESIGN OF SEWERS

Manning's formula has been used for design of sewers in case of gravity flow. For pressure flow (Pumping Mains), the Hazen-William's formula has been used. Sewer Network design has been done with the help of Manning's Formulae i.e. Velocity V= [(1/n) x (R2/3 .S1/2)] (in m/s) For Circular Sections V = (1/n) (3.968 x 10-3D2/3S1/2) Q = (1/n) (3.118 x 10-6D8/3S1/2) Where, Q = discharge in lps; S = slope of hydraulic gradient; D =internal dia of pipe line in mm; R = hydraulic radius in m; n = Manning's Coefficient of roughness

5.5.3 PER CAPITA SEWAGE FLOW

The rate of water supply has been adopted 150 LPCD at consumer end throughout the whole design period as water supply schemes are designed with per capita supply of 150lpcd in Kerala. 80 percent of the water supply has been considered as sewage flow into the sewerage system.

5.5.4 MINIMUM VELOCITY OF FLOW

A minimum velocity of 0.6 m/s for present peak flow and 0.8 m/s at design peak flow is recommended for sanitary sewers. Thus the sewers are designed on the assumption that although silting might occur at minimum flow, it would be flushed out during peak flows.

5.5.5 RECOMMENDED SLOPES FOR MINIMUM VELOCITY

For sewers running partially full, for a given flow and slope, velocity is little influenced by pipe diameter. As such for present peak flows up to 30 lps, the slopes given in Table below may be adopted which would ensure minimum velocity of 0.6 m/s in the early years.

Table 5.3: Recommended slope

S.No.	Present Peak Flow in LPS	Slope per 1000
1	2	6.0
2	3	4.0
3	5	3.1
4	10	2.0
5	15	1.3
6	20	1.2
7	30	1.0

5.5.6 EROSION AND MAXIMUM VELOCITY OF FLOW

Erosion of sewers is caused by sand and other gritty material in the sewer and also by excessive velocity. Non-scouring or limiting velocities in sewers of different materials are given in CPHEEO manual. Accordingly maximum velocity for cement concrete pipes is 2.5- 3.00 m/s.

5.5.7 SEWER TRANSITIONS

Sewers shall be designed to ensure that the energy gradient is a continuous smooth line, thus transitions from larger to smaller diameters shall not be made. The crowns of sewers shall be kept continuous. In no case, the hydraulic flow line in the large sewers shall be higher than the incoming sewer. To avoid backing up, the crown of outgoing sewer shall not be higher than the crown of incoming sewer

5.5.8 MINIMUM PIPE DIAMETER

Minimum pipe diameter recommended in CPHEEO manual is 150 mm except that in hilly areas, where extreme slopes are prevalent, 100 mm can be used. Some states and ULBs have started adopting minimum diameter as 200 mm or even 250 mm. The logic is Maintenance of sewer system is generally not good and 150 mm dia sewer will block frequently and remain un-attended for some time, Quality of construction in smaller size RCC main such as 150 mm is not good, The sewerage system is not totally closed one and undesired waste such as solid waste and drains

finds way in sewerage, making smaller size sewer lines more prone to frequent blocking, The cost of pipe line element is only about 15 percent of total project cost and increase in pipe size from minimum of 150 mm to minimum of 200 mm size will increase cost of project by 2 percent whereas flow capacity increases by more than 80 percent.

The minimum diameter may be adopted as 200 mm for cities having present / base year population of over 1 lakh. However, depending on growth potential in certain areas even 150 mm diameter can also be considered. However, in towns having present / base year population of less than 1 lakh, the minimum diameter of 200mm shall be adopted.

The house sewer connection pipe to public sewer shall be (a) minimum 100 mm or higher based on the number of houses / flats connected and (b) subject to the receiving public sewer being of higher diameter. In this project 180 mm diameter has been suggested as minimum diameter in design of sewerage network.

5.6 MATERIAL OF CONSTRUCTION FOR GRAVITY SEWERS

Brickwork is used for large diameters as sewers can be constructed in any shape. However now it is not common. Concrete pipes are commonly used now as can be manufactured to any reasonable strength and laying is easy and jointing is leak proof. However these pipes are subject to corrosion where acid discharges are carried or where velocities are not sufficient to prevent septic conditions or where the soil is highly acidic or contains excessive sulphates. Only high alumina cement concrete should be used when it is exposed to corrosive sewage or industrial wastes. Salt glazed stoneware pipes are mostly manufactured in sizes 80-1000 mm but sizes greater than 380 mm are generally not used due to economic considerations. The length of these pipes is 60 cm75 cm and 90 cm. These pipes are good for corrosion resistance and erosion resistance. However due to less length, more joints, difficulty in jointing, requirement of special bedding and less compressive strength of pipes manufactured in India; use of these pipes is reducing in India.

Table 5.4: Pipe material Comparison

S . N	EVALUATION CRITERIA	RCC PIPES	DI PIPES	HDPE PIPES	DWC HDPE PIPES
1	Type of Joint	Available in both collar and S&S	Tyton joint With rubber gasket	Butt fusion welding process	Simple push fit joints with

		joints.			Elastomeric sealing Ring for online system or with extra couplers.
2	Weight	Heavy	Lighter than R.C.C.	Light	Very Light in Comparison of Other Solid Wall Pipes
3	Corrosion resistance	To prevent corrosion, sulphate resistant cement concrete to be used for pipe manufacture	Protective layers are required to protect corrosion	Highly corrosion resistant	Highly corrosion resistant
4	Remarks on Cost	NP2 is Cheapest among all materials	Costlier than other pipes but cheaper than HDPE pipes	Smaller diameter pipes are cheaper and higher diameter Pipes are costlier	Uses minimal material for equal strength, therefore cost cheaper from other pipes
5	Infiltration	Infiltration is less	Infiltration is very less	Infiltration is very less	Infiltration is very less
6	Workability	due to heavy weight handling to	Good	Light weight for easy	They are user friendly,

		be done with care		handling	very fast and inexpensive in installation
7	Jointing	Jointing is easy in S&S pipes with Rubber ring joints	Jointing is easy in S&S pipes with Rubber ring joints	Jointing is expensive	Joining time is 2-5 minutes per joint
8	Maintenance	Almost nil if proper velocity is maintained	Minimum	Pipe may get damaged due to rodding	Maintenance is low because of non adherence of sewage elements
9	Previous Experience/Performance	It is durable pipe	. Performance is yet to be proven	Recent use started in India. It is durable.	They are maintenance free and therefore, once installed, will lie underground for years
10	Trenchless compatibility	Micro tunneling	Micro tunneling	HDD &Micro tunneling	Not suitable for Trenchless

AC pipes cannot stand high superimposed loads, subject to corrosion from acids in sewage and high sulphate soils, require special bedding and weak against erosion where high velocities are encountered; as such use of AC pipe is not prevalent. Cast iron, DI and steel pipes are not used due to high cost. uPVC pipes are manufactured in sizes 75, 90,110, 140, 160,250,290 and 315 mm outer dia. uPVC

pipes are smooth, light, easy to joint and have leak proof joint. Rates are also low. These days these pipes are used for making connection from house to sewer but not prevalent in street sewers.

GRP pipes are widely used in other countries where corrosion resistant pipes are required at reasonable rates. When using concrete or reinforced concrete, high density sulphur resistant cement should be used. These pipes are made of slag cement that contains fewer calcareous (CaOH2) particles than pipes made of Portland cement. These particles react with the sulphuric acid (created by bacterial dissipation of hydrogen sulphide) in sewers, causing the aforementioned crown corrosion. If this particular cement is not used, lifetime of concrete sewers cannot be expected more than 30 years. A comparative study of characteristics of various pipe options for gravity sewers is presented in table above.

5.6.1 BENEFITS OF HDPE PIPES FOR SEWERS

When compared to other common wastewater piping system materials, such as PVC, ductile iron, or concrete, HDPE pipe offers significant benefits. Some of these include:

- Chemical Resistance. Hydrogen sulfide gas (H2S) corrosion is a serious threat to conventional sewer lines, like concrete and ductile iron, greatly reducing their service life. WL Plastics HDPE pipe is not attacked, corroded or degraded by H2S, ensuring a service life of 100 years.
- Anti-corrosive properties: HDPE piping systems have immunity to the harmful effects of corrosion and tuberculation which are common factors that reduces the operational life of concrete and ductile iron wastewater systems. HDPE also resists other corrosive or harmful agents, including scaling and organics such as fungi, bacteria, and other microbial contaminants.
- Leak-free:. HDPE pipe is joined together via heat fusion, creating a welded, leak-free joint unlike conventional bell and spigot joints. These leak-free joints prevent infiltration and exfiltration making it a truly sanitary piping system.
- Durability. HDPE pipe is resistant to fatigue from water hammer and surge events in sewer force mains. HDPE pipe is also abrasion resistant, ensuring that flowing water and slurries won't damage the pipe throughout its service life.
- Lightweight.: HDPE pipes are much lighter in weight compared with ductile iron or concrete alternatives, which makes transportation and installation significantly easier

and safer.

- Cost-effectiveness. HDPE pipe is cost competitive with other sewer pipe options. HDPE pipe is faster, easier, and safer to install due to longer cut lengths and more linear footage per truck, which significantly reduce the overall project costs. With low maintenance costs and long service life, HDPE pipe is the ideal solution for wastewater systems.

However, HDPE pipes are slightly costlier compare to RCC pipe but as of now most of sewer pipes are laid through Trenchless technology method and because of this, plastic pipes like HDPE/ uPVC are most suitable and easy to use for trenchless as well as open cut trench method for pipe laying. The use of HDPE pipes are more economical and to be considered for smaller diameter pipes upto 110mm where they are available on coils thereby avoiding joints. Hence lesser number of joints thereby reducing leaks and the rates of pipes are reasonable. As a general pipe policy decision for the use of HDPE pipe shall be preferred up to 200mm & occasionally upto 350mm (source- KWA pipe policy, page 19). Therefore, considering the above benefits of HDPE pipe over RCC pipes, HDPE pipes are recommended to use for maximum stretch of network. The pipe policy of KWA also favours adoption of HDPE pipes. However, RCC pipe (HDPE lined) has been recommended for higher diameter pipe (i.e. above 700 mm) as HDPE pipes for higher diameter pipes are not easily available and very costly for large diameter and generally not manufactured.

5.7 MANHOLES

A manhole is an opening constructed on the alignment of a sewer for facilitating a person to access the sewer for the purpose of inspection, testing, cleaning and removal of obstructions from the sewer line.

Manholes will be located at:

- Change of direction
- Change of slope
- Change of pipe diameter
- Change of material
- Ginning of each line at points of branches Manhole Sizes

Table 5.5: Recommended Size of manholes

Man Holes	
CPHEEO Specifications	
Depth (m)	Diameter (mm)
0.9-1.65	900
1.65-2.30	1200
2.30-9.00	1500
9.0-14.0	1800

5.7.1 TYPE OF MANHOLES

5.7.1.1 STRAIGHT – THROUGH MANHOLES

The simplest type of manhole is that built on a straight run of sewer with no side junctions. Where there is change in the size of sewer, the soffit or crown level of the two sewers should be the same, except where special conditions require otherwise.

5.7.1.2 JUNCTION MANHOLES

A manhole is provided at every junction of two or more sewers, and the curved portions of the inverts of tributary sewers have been formed within the manhole. The gradient of the smaller sewer may be steepened from the previous manhole sufficiently to reduce the difference of invert level at the point of junction to a convenient amount.

5.7.1.3 DROP MANHOLES:

As per CPHEEO manual, drop manhole is to be provided when a sewer connects with another sewer, where the difference in level between water lines (peak flow levels) of main line and the invert level of branch line is more than 600mm or a drop of more than 600mm is required to be given in the same line and it is uneconomical or impractical to arrange the connection within 600mm. The drop pipe may be either outside the manhole shaft and encased in concrete or supported on brackets inside the shaft. If the drop pipe is outside the shaft, a continuation of the sewer should be built through the shaft wall to form a rodding and inspection eye, which should be provided with a half blank flange. If the drop pipe inside the shaft, it should be in cast iron/ductile iron and it would be advantageous to provide adequate means for rodding and water cushion of 150mm depth should also be provided. The drop pipe should terminate at its lower end with a plain or duck-foot bend turned so as to discharge its flow at 45 degrees or less to the direction of the flow in the main sewer and the pipe, unless of cast iron, should be surrounded with 150mm concrete.

5.7.1.4 FLUSHING MANHOLES

Where it is not possible to obtain self-cleansing velocities due to flatness of the gradient especially at the starting point of branch sewers which receive very little flow, it is essential that some form of flushing device to be incorporated in the system. Flushing can be very conveniently accomplished using a fire hydrant or tanker and hose pipe. The upper reaches of lateral sewers, the discharges shall be partially full even at the ultimate design flow conditions, because of necessity of adopting the prescribed minimum size of sewer. In such situations, flushing arrangements have to be provided in the initial years.

5.7.2 MATERIAL OF CONSTRUCTION FOR MANHOLE

5.7.2.1 BRICK MASONRY MANHOLES

Bricks used for construction of manholes shall conform to the relevant Indian Standards. They shall be sound, hard and homogeneous in texture, well burnt in kiln without being vitrified, table moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing unground particles and/or which absorb water more than 1/6 th of their weight when soaked in water for twenty-four hours shall be rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 35 kg/sq.cm unless otherwise noted in drawings. The class and quality requirements of bricks shall be as laid down in IS: 1077. The size of the brick shall be 23.0 x 11.5 x 7.5 or unless otherwise specified. Mortar for brick masonry shall be prepared as per IS: 2250. Manholes shall be constructed in brick masonry with cement mortar (1:4), 20 mm thick inside plaster with plasticized water proofing material consisting of 12 mm thick backing coat in CM 1:3 and 8 mm thick finishing coat in CM 1:1 and 15 mm thick outside plaster in CM 1:3. Whenever a pipe enters or leaves a manhole, bricks on edge must be cut to a proper form and laid around the upper end of the pipe so as to form an arch. All around the pipes, there shall be a joint of cement mortar (1:2) 13 mm thick between it and the bricks. The manhole base has been kept as 150mmfor manholes upto1mdepth, and 200mmfor manholes from 1 to 2 m depth and 300 mm for greater depths. In all cases, the thickness shall be counter checked for uplift conditions based on maximum ground water elevations at the site on the soil side by considering empty manhole conditions. The thickness of walls shall be typically one brick up to l.5 m deep manholes, one and

a half brick for depths greater than 1.5 m. The actual thickness in any case shall be verified on the basis of engineering design in difficult soil conditions

5.7.2.2 RCC MANHOLES

The idea of RCC manholes is essentially to quicken the work of construction in the roads by adopting precast sections assembled at site. Thus, the issues related to their construction are more of design itself and quality control in casting. In general, plain and reinforced concrete work for manholes shall be carried out in accordance with the specification given in CPHEEO manual otherwise specified in this specification. Wherever good quality of brick and workmanship of the construction cannot be ensured, it is advisable to go in for RCC manholes. The provisions of IS: 456 and IS3370 Part I, II and IV shall inter alia apply to the design. The entire structure shall at all times be designed to the condition where the ground water is at ground level itself and the inside is empty and there is no superimposed load on the manhole and not considering the skin friction of the manhole side wall with the soil. Now the newly available precast RCC chambers shall be conveniently used for the manholes upto 6.0m or more depth. This will make the construction very easy and faster.

5.7.2.3 HDPE MANHOLES

Polyethylene manholes remain leak-free because there is no chemical attack. The toughness of polyethylene eliminates the chance of cracking during installation. There is no infiltration of external ground water, reducing the amount of treatment required. There is no exfiltration of sewage to the environment.

CHAPTER - 6
PROPOSED SEWERAGE SYSTEM

6.1 POPULATION PROJECTION

Population of the city normally depends on factors such as birth and death rates, migration, industrial development, general environmental conditions etc. Usually the population forecast of a city is made on the basis of methods of population forecast as provided for in section 1.5 of the CPHEEO manual for sewerage and sewerage treatment. The latest available census records are that of 2011.

As far as Kerala is concerned it is quite different from other states on education, health, life expectancy etc. The demographic pattern of the state therefore is quite different and need to take into account all the developmental parameters so as to avoid undue over designs. The anticipation of future growth in any community in terms of population or commercial and industrial expansion forms the basis for preparation of plan for providing the amenities including installation of sewers in the area to be served. The anticipated population, its density and its waste production is generally estimated for a specified planning period. The recommended planning period is 30 years.

Based on topography, population etc the municipality is divided into five zones and zone1 and 2 are included in this DPR.

Table 6.1 Population in Project Area

Name of Zone	Area (km^2)	Population (2011)	Floating population
Thottakkattukara West Zone-1	1.08	3180	1590
Thottakkattukara East Zone-2	1.35	5342	2671

6.2 SEWAGE LOAD OF PROJECT AREA

Sewerage load has been calculated based on the network area design population and water demand of 150 lpcd . Since some water is lost due to evaporation and seepage, only 80% of the average water supply is taken as sewage flow. Non domestic and floating water demand has been considered as 15% and infiltration as 10%. The

Sewage load calculation in the network area is shown in the below table:

Table 6.2 Sewage Load Calculation for Network area

Network area population	8522
Water demand @150 lpcd	1.27
Floating Population	4261
Water demand @70 lpcd	0.2982
Non domestic water demand 15% of water demand	0.1917
Total Water demand	1.96
Seweage Load @80%	1.56
Add Infiltration 10%	0.156
Total Network area Sewage Load	**1.724**

A provision of co treatment unit of capacity 2.60 kLD is also proposed with the STP. The collection system has been designed for ultimate year peak flow. The cumulative flows and the cumulative contributory population are discussed zone wise in the succeeding sections. The design diameter and slope have been finalized based on the minimum flow velocity of 0.60 m/s (present peak flow) with maximum velocity of 3.00 m/sec. The system has been designed using EPASWWM software. Design calculations are shown in Annexure attached. The sewerage system network has been so planned to limit lifting and pumping stations. The Maximum depth of the sewer lines are kept at 5.0 m from the existing ground level.

6.3 COLLECTION SYSTEM

The collection system has been designed for ultimate year peak flow. The cumulative flows and the cumulative contributory population are discussed zone wise in the succeeding sections. The design diameter and slope have been finalized based on the minimum flow velocity of 0.60 m/s (present peak flow) with maximum velocity of 3.00 m/sec. The system has been designed using EPASWWM software. Design calculations are shown in Annexure attached. The sewerage system network has been so planned to limit lifting and pumping stations. The Maximum depth of the sewer lines are kept at 5.0 m from the existing ground level.

6.3.1 SEWERAGE NETWORK AND MANHOLES

The project network area is zone 1 and 2 of Aluva Muncipality and DGPS survey conducted for obtaining the field survey details. Social survey was done to ascertain the living conditions and amenities provided in the households. Reconnaissance survey was also carried out to assess the nature of buildings such as offices, institutions such as schools, colleges, hospitals, lodges, etc.

6.3.2 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 5.0 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 modeling 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 storm water runoff, combined and sanitary sewers, and other drainage systems.

The software EPASWMM was used to design the network owing to the fineness in the results. The EPA Storm Water Management Model (SWMM) is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of sub catchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators. SWMM tracks the quantity and quality of runoff generated within each sub catchment, and the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps. As the sewerage network system is designed by considering it as open channel flow, this software is the most apt for the design of sewer network. Moreover, we can visualize the output in a three

dimensional platform and hence it can be refined to least error.

The manholes are first plotted in the scaled, geo referenced, Auto CAD base map. Using this auto cad base map prepared, a windows metafile format used as back drop in the EPASWMM window. The nodes representing manholes and links representing the conduits are plotted for developing the model in the EPASWMM software, consequently entered the parameters regarding the nodes and links. Based on the population scattered in the area especially taking into consideration, the point load from various non domestic buildings like hospitals, schools/colleges, lodges/hostels etc. located in the selected zone, the sewage load is assessed in each manhole and fed as dry weather flow in the model. The peak factor considered is 3. Flow routing is done correcting the invert levels of manholes by trial and error to the proposed outfalls. By several trials it was refined to successfully run with least error.

The detailed outputs of EPASWMM for the two zones are attached in Annexure-1.

180mm HDPE-PE100, PN8 pipes for 12394.00m, 225mm HDPE-PE100, PN8 pipes for 10813m ,280 mm HDPE-PE100, PN8 pipes for 49.60m and 355mm HDPE-PE100, PN8 pipes for 201.50m are selected for the network for smooth functioning with little maintenance. The inverted level of manholes has been selected by providing the required slope for the movement of sewage with gravity.

The EPASWMM models of two well zones are as follows.

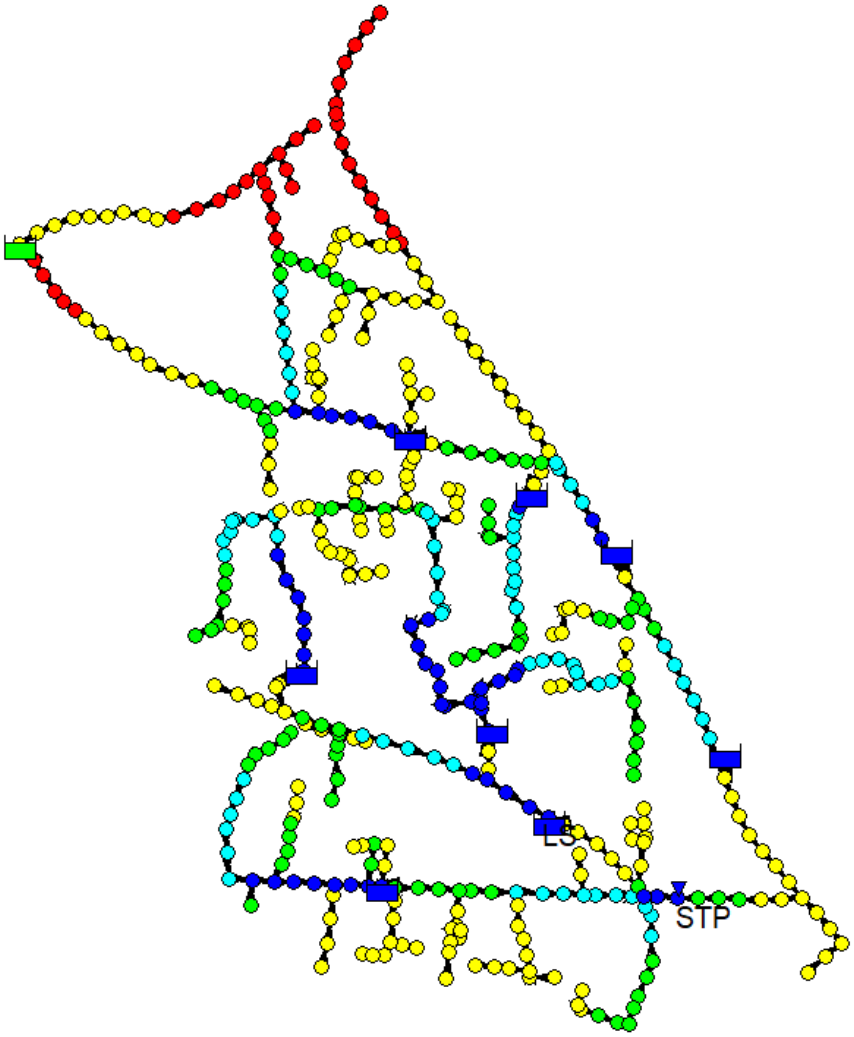


Figure 6.1 : Network Design output of Zone-1 in EPASWMM

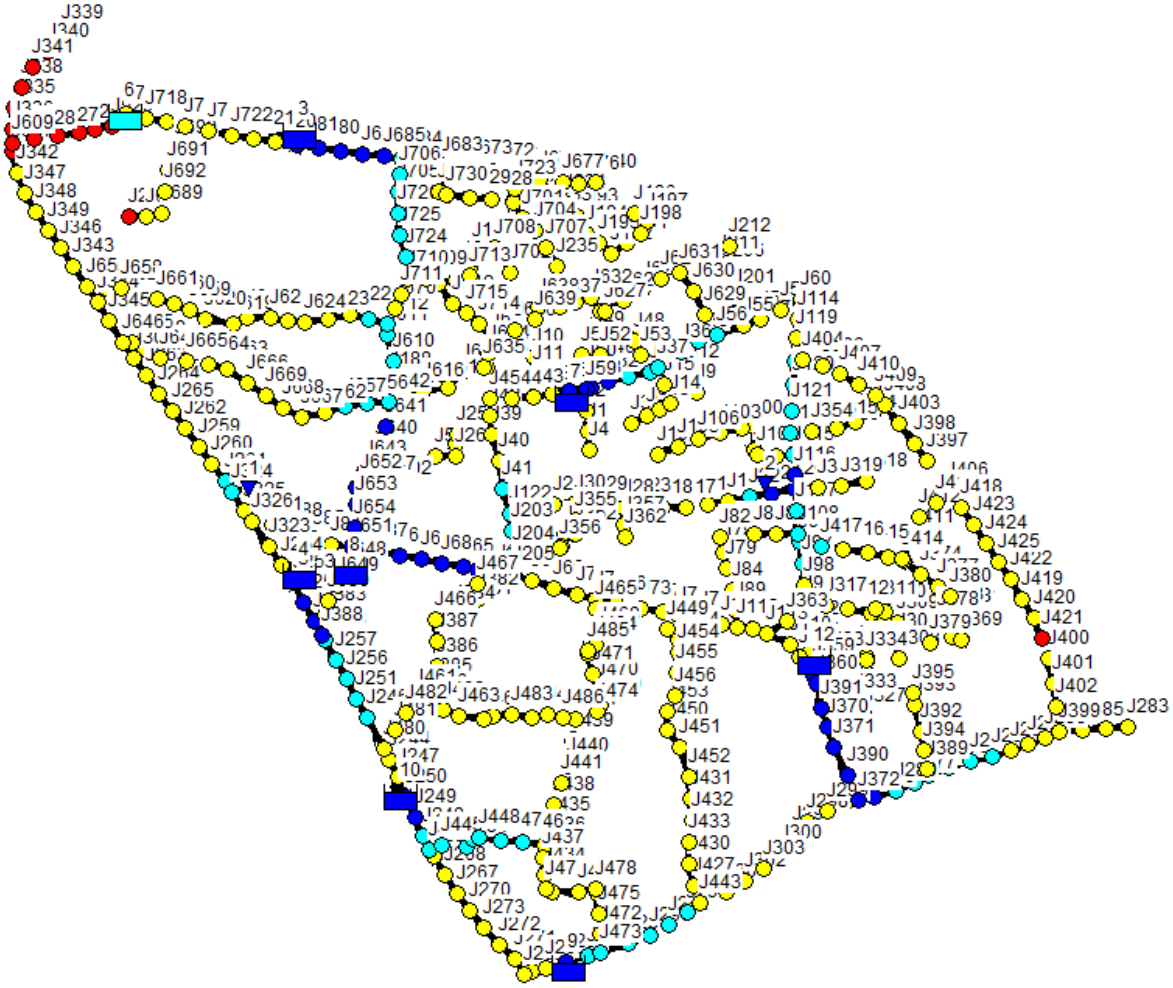


Figure 6.2 : Network Design output of Zone-2 in EPASWMM

6.3.3 DETAILS OF SEWER NETWORK

Abstract of sewer network is furnished below:

Table 6.3: Network Length & Pipe details

NETWORK PIPE -SUMMARY			
Diameter mm (OD)	Type of Pipe	ZONE 1-Length	ZONE 2-Length
180 mm	HDPE-PE100,PN8		12394.14
225 mm	HDPE-PE100,PN8	10411	401.25
280 mm	HDPE-PE100,PN8	49.60	
355 mm	HDPE-PE100,PN8		201.39
TOTAL		10460.60	12996.78

6.3.4 MANHOLES

Total number of manholes comes to 952.

Table 6.4: Details of Manholes Type

MANHOLE TYPE -SUMMARY		
Diameter	ZONE 1	ZONE 2
900mm	201	255
1200mm	65	83
1500mm	173	175
TOTAL	439	513

MANHOLE DEPTH -SUMMARY		
Depth	ZONE 1	ZONE 2
upto1.5m	96	103
1.5-3m	210	272
3-4.5m	89	101
4.5-6m	44	37
TOTAL	439	513

Table 6.5: Details of Manhole Depth

6.4 PUMPING STATION AND RISING MAIN

Pumping or force mains deliver wastewater discharged from a pumping station to its destination, which may be a treatment plant or the final disposal point.

6.4.1 LIFTING STATION /PUMPING STATION

Pump stations are normally required in a sewage collection system to lift the sewage against a gradient or to limit the depth of cutting of the pertinent sewer line. A

simplified form of the pump station, called a Lift Station, is also employed for the same purpose. The primary difference between a pump station and a lift station is that the Pump Station shall handle greater flows with arrangements for removal of floating material and grit prior to pumping through a force main. Lift Stations will have only an enlarged manhole as a wet well with pumps installed and a small control room adjacent to it, for lifting the sewage to ground level. Lift stations are generally used to restrict the depth of cutting and discharging normally to the manhole in a downstream trunk sewer. No screens and grit wells are provided in lift stations. Pumping and lifting stations shall use submersible pumps, such stations have a single well, circular or rectangular, in which pumps are installed. Superstructure requirement is minimum. The pump stations have been designed considering easy removal and reinstallation of the pumps without disturbing the connecting delivery pipe work.

Hydraulic Criteria: According to the existing ground level contour from the topographic survey, the number of pumping stations has been finalized. Lift stations are generally proposed where depth of cutting exceeds 5.0 m . The location of pumping stations is at lower points of the network. Overflow is not allowed.

6.4.2 DETAILS OF COLLECTION WELL/PUMPING STATIONS

In the project there are 3 Nos. of collection wells proposed. Out of this three collection wells, well 1is located in the premises of STP site at Irrigation Department plot (Sy.No. no.39/4,6-9). Well 2 is located near old Desham road and Well 3 is located near Paravoor Kavala.

Table 6.6: Details of Collection well

COLLECTION WELL DETAILS			
Sl.No.	Zone No.	Well No.	Location
1	1	1	At STP Premises
2	2	2	Near Paravoor Kavala
3	2	3	Near Old Desam Road

6.4.3 DETAILS OF LIFTING STATIONS

LIFTING STATIONS							
	Lifting Station No.	From Node	To Node	Maximum DISCHARGE Q in LPS	HEAD H in M	Power of pump set in HP	HDPE PN10 Pumping Main OD mm
ZONE-1							
	LF-1	J817	J536	2.16	6.73	0.5	90
	LF-2	J492	J802	11.76	6.45	3	200
	LF-3	J736	J735	2.16	5.14287	1	90
	LF-4	J134	J131	18.48	6.55466	4	250
	LF-5	J170	J175	20.55	6.38197	4	280
	LF-6	J924	J965	3.99	6.38559	1	110
	LF-7	J581	J580	2.91	6.55724	1	110
	LF-8	J569	J570	17.22	6.46455	4	250
	LF-9	J872	J741	10.95	6.87003	3	200
ZONE-2							
	LF-1	J717	J529	2.61	7.03518	1	110
	LF-2	J681	J720	0.99	6.42038	0.5	63
	LF-3	J58	J38	6.99	6.38409	3	160
	LF-4	J359	J93	9.27	6.43204	3	180
	LF-5	J253	J254	2.43	7.02206	1	90
	LF-6	J250	J247	10.38	6.40318	3	180
	LF-7	J294	J293	8.37	6.32458	3	160
	LF-8	J648	J649	15.93	6.43464	4	225

Table 6.7 Details of Lifting station

6.5 PUMPING MAINS

The pumping main carries sewage from collection well to STP under pressure. From each collection well, separate pumping main is designed to carry sewage to the treatment plant.

The schematic diagram of Pumping main is shown below:

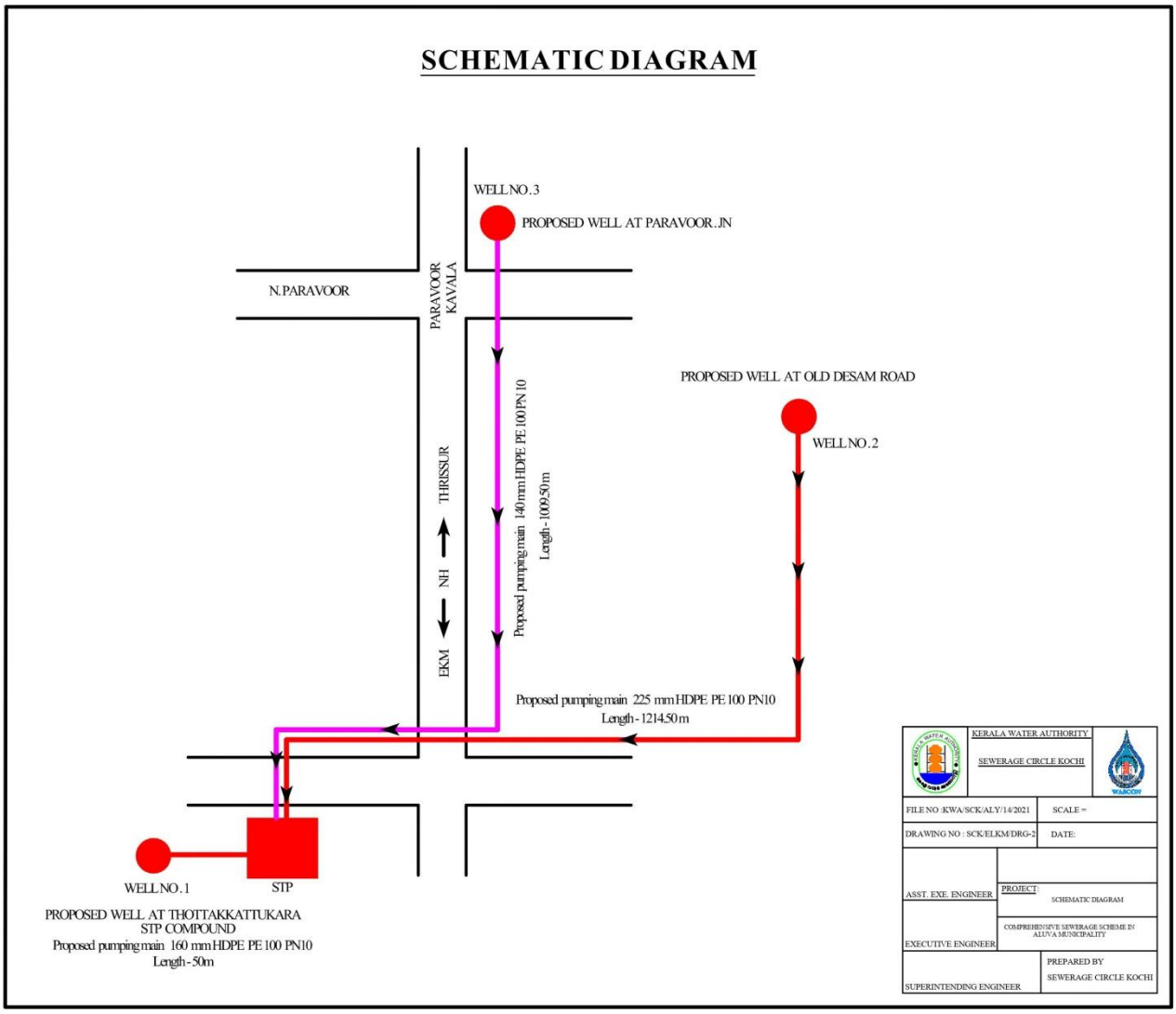
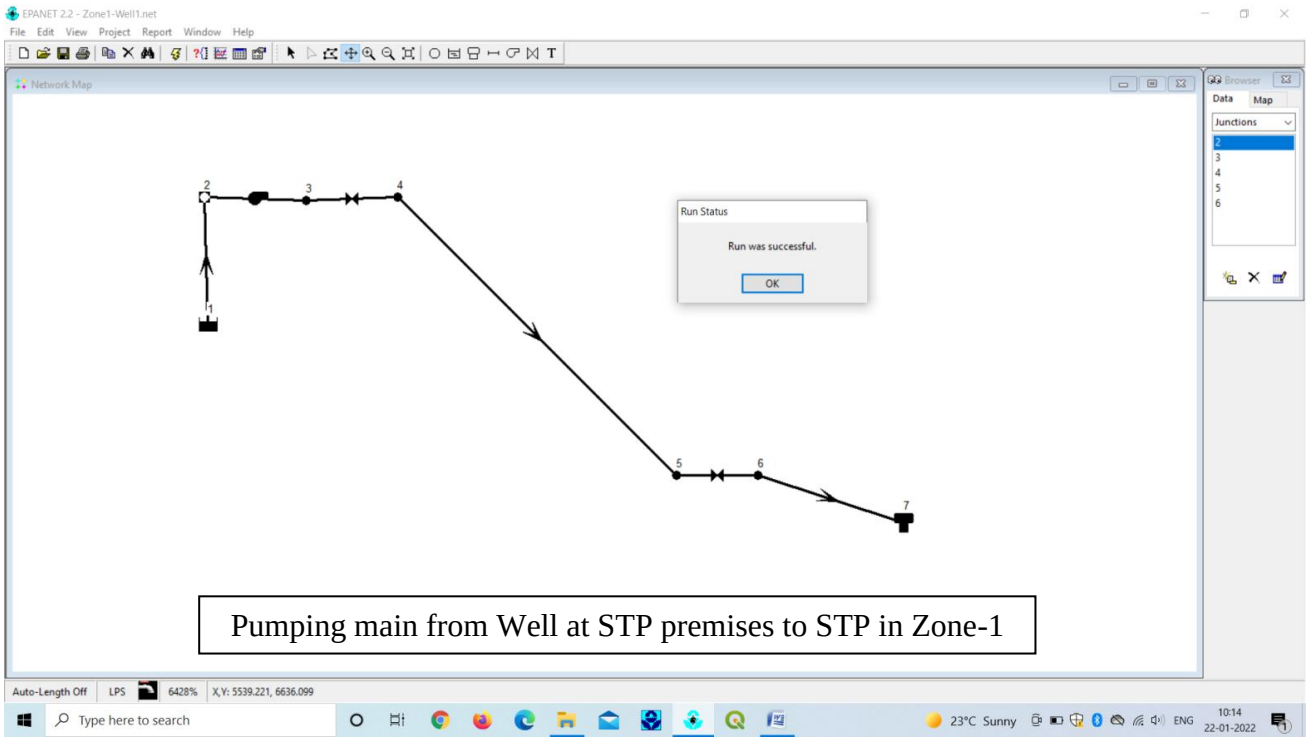
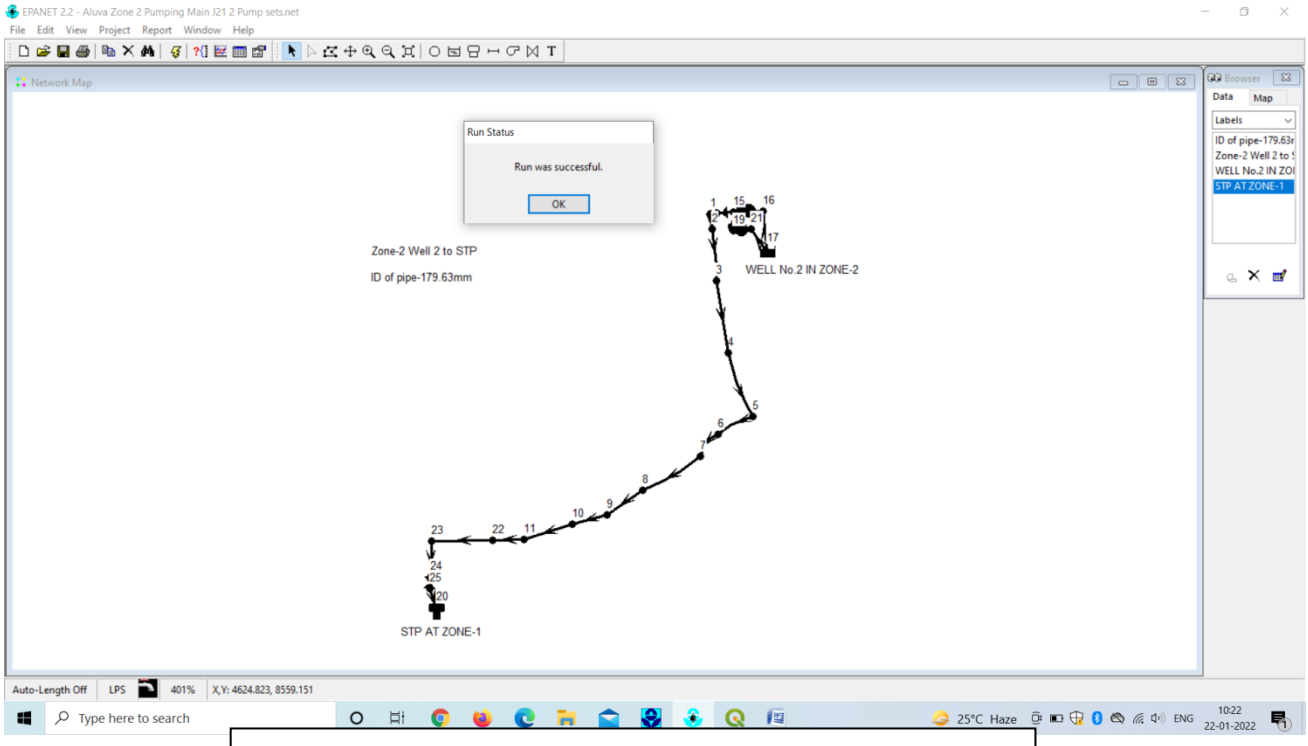


Figure 6.3 : Schematic diagram of Pumping Main

The EPANET model of three pumping main are as shown below.



Pumping main from Well at STP premises to STP in Zone-1



Pumping main from Well-2 at Old Desam Road to STP in

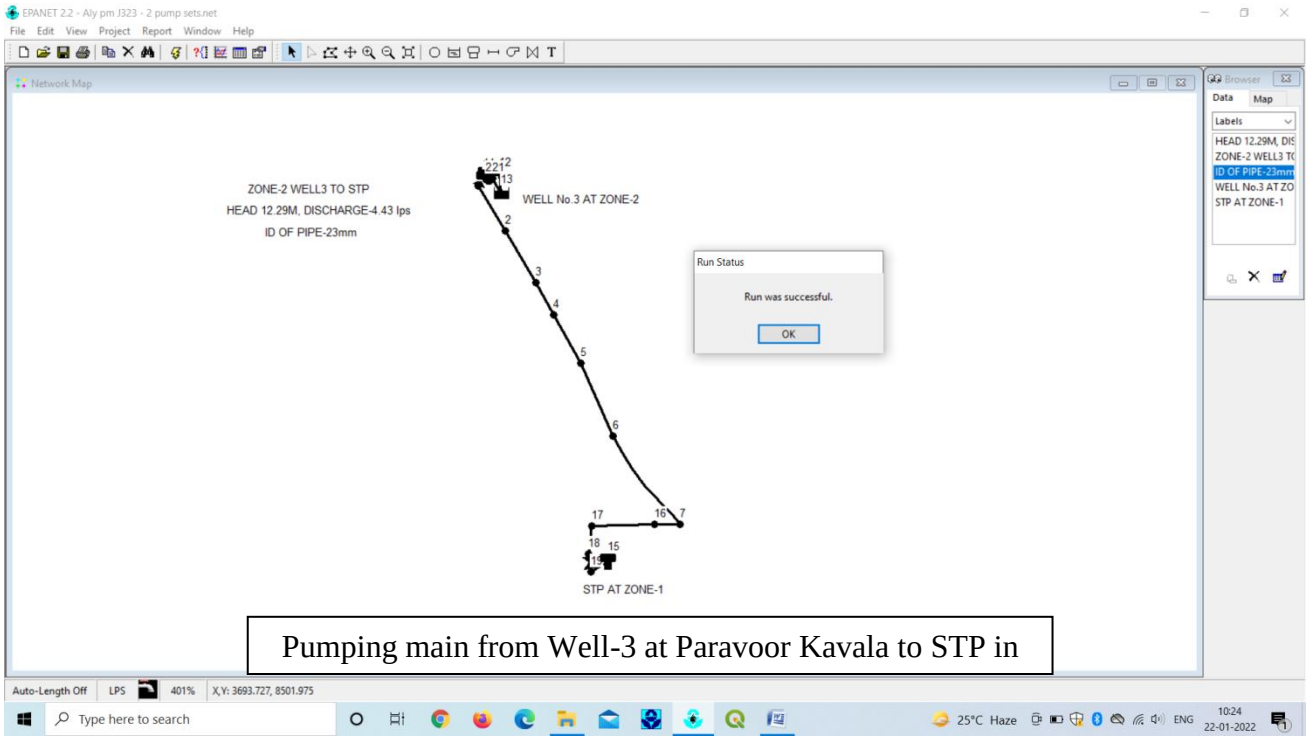


Figure 6.4 : Design of Pumping mains (3 Nos.) in EPANET

PUMPING MAIN DETAILS						
Sl.No.	Zone No.	From Well No.	Pumping to	Diameter (mm)	Length (m)	Type
1	1	1	STP	160	50	HDPE PE100 PN 10
2	2	2		225	1214.50	HDPE PE100 PN 10
3	2	3		140	1009.50	HDPE PE100 PN 10

Table 6.8: Pumping main details

6.6 PUMP AND OPERATION CONTROL

Fluid level activated switches will be provided to start and to stop the pumps depending upon the quantity of sewage available in the pump house. This will ensure that the pumps will not run dry. A sluice valve will be provided on the suction side and a sluice valve and a non return valve will be provided on the delivery side. Flow meter (digital type) will be provided to measure the quantity of sewage flowing out of the pumping station. It will be an integrating type indicating instantaneous flow and the cumulative flow.

6.6.1 DETAILS OF PUMP SETS

DETAILS OF PUMP SET				
Sl.No	Name	No. of Pump Set (Incl.One Standby)	HP	Type of Pump
1	LS-1 of Zone-1, LS-2 of Zone-2	4	0.5	Submersible
2	LS -2, & 9 of Zone-1, LS-3,4,6 & 7 of Zone-2	12	3	Submersible
3	LS-3,6&7 of Zone-1, LS-1&5 of Zone-2	10	1	Submersible
4	LS-4,5,8 of Zone-1, LS-8 of Zone-2	8	4	Submersible

Table 6.9: Pump set details

6.7 ARRANGEMENTS FOR POWER SUPPLY

KSEB will supply power at 11/22KV HT supply or 440 V LT supply for the operation of pumps in the pumping stations and for operation of equipment in the STP. In respect of HT supply, suitable transformers would be provided to step down the voltages to 440V. In case the Horse Power of pump set is less than 75HP, 440V LT supply will be availed. Each pumping station shall have Motor control centre for start-stop and other controls for protection and safety of motors and other auxiliary equipment. Capacitors of suitable capacity would be provided to improve the power factor, so that power consumption can be brought down.

CHAPTER 7
TECHNOLOGY FOR STP

7.1 SEWAGE TREATMENT

Sewage treatment is a type of wastewater treatment which aims to remove contaminants from sewage to produce an effluent that is suitable for discharge to the surrounding environment or an intended reuse application, thereby preventing water pollution from raw sewage discharges. Sewage contains wastewater from households and businesses and possibly pre-treated industrial wastewater. There are various number of sewage treatment processes adopting different technologies from which one suit to existing circumstances can be chosen. These can range from decentralized systems (including on-site treatment systems) to large centralized systems involving a network of pipes and pump stations which convey the sewage to a treatment plant.

Sewage is a type of wastewater that is produced by a community of people. It is typically transported through a sewer system. Sewage consists of wastewater discharged from residences and from commercial, institutional and public facilities that exist in the locality. Sub-types of sewage are grey water (from sinks, bathtubs, showers, dishwashers, and clothes washers) and black water (the water used to flush toilets, combined with the human waste that it flushes away). Sewage also contains soaps and detergents. Food waste may be present from dishwashing. Sewage may contain micro-pollutants and pollutants from industrial wastewater.

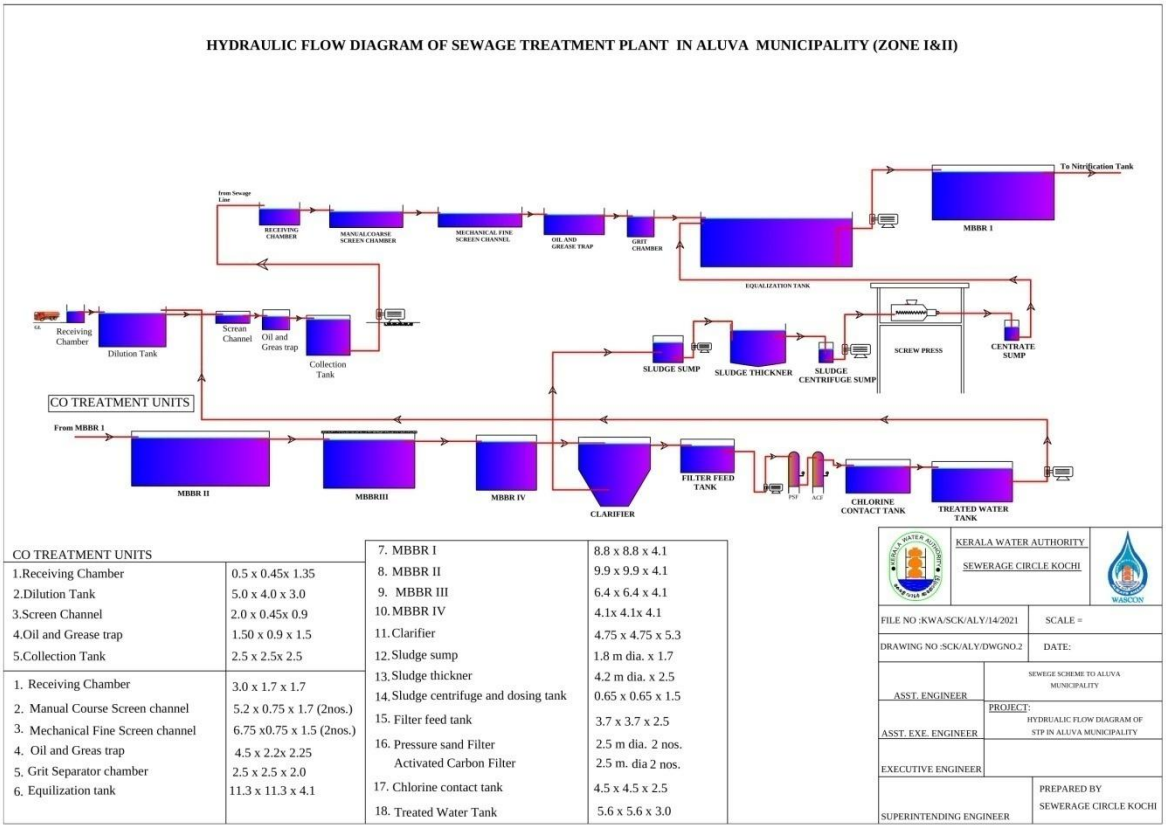
The main parameters in sewage that are measured to assess the sewage strength or quality as well as treatment options include: solids, indicators of organic matter, nitrogen, phosphorus, and indicators of fecal contamination. The following four types of pathogens from fecal matter are found in sewage: bacteria, viruses, protozoa, helminths and their eggs. In order to quantify the organic matter, indirect methods are commonly used: mainly the Biochemical Oxygen Demand (BOD) and the Chemical Oxygen Demand (COD). Typical values for physical–chemical characteristics of raw sewage in developing countries have been published as follows: 180 g/person/d for total solids (1100 mg/L concentration), 50 g/person/d for BOD (300 mg/L), 100 g/person/d for COD (600 mg/L), 8 g/person/d for total nitrogen (45 mg/L), 4.5 g/person/d for ammonia-N (25 mg/L) and 1.0 g/person/d for total phosphorus (7 mg/L).

Sewage can be treated close to where the sewage is created, which may be called a "decentralized" system or even an "on-site" system (on-site sewage facility,

septic tanks, etc.). Alternatively, sewage can be collected and transported by a network of pipes and pump stations to a municipal treatment plant. This is called a "centralized" system. The procedure for removing contaminants from the wastewater basically from the household sewage is called sewage treatment. It has to undergo the chemical, physical and biological procedure to remove these contaminants and give out an environmentally safe treated effluent.

Choosing the most suitable treatment process is complicated and requires expert inputs, often in the form of feasibility studies. This is because the main important factors to be considered when evaluating and selecting sewage treatment processes are numerous: process applicability, applicable flow, acceptable flow variation, influent characteristics, inhibiting or refractory compounds, climatic aspects, process kinetics and reactor hydraulics, performance, treatment residuals, sludge processing, environmental constraints, chemical product requirements, energy requirements, requirements of other resources, personnel requirements, operating and maintenance requirements, ancillary processes, reliability, complexity, compatibility, area availability. With regards to environmental impacts the following aspects are included in the selection process: Odors, vector attraction, sludge transportation, sanitary risks, air contamination, soil and subsoil contamination, surface water pollution or groundwater contamination, devaluation of nearby areas, inconvenience to the nearby population.

The different stages of the treatment process involved for the treatment of sewage is shown in the flow diagram.



CO TREATMENT UNITS	
1.Receiving Chamber	0.5 x 0.45x 1.35
2.Dilution Tank	5.0 x 4.0 x 3.0
3.Screen Channel	2.0 x 0.45x 0.9
4.Oil and Grease trap	1.50 x 0.9 x 1.5
5.Collection Tank	2.5 x 2.5x 2.5
1. Receiving Chamber	3.0 x 1.7 x 1.7
2. Manual Course Screen channel	5.2 x 0.75 x 1.7 (2nos.)
3. Mechanical Fine Screen channel	6.75 x0.75 x 1.5 (2nos.)
4. Oil and Greas trap	4.5 x 2.2x 2.25
5. Grit Separator chamber	2.5 x 2.5 x 2.0
6. Equilization tank	11.3 x 11.3 x 4.1
7. MBBR I	8.8 x 8.8 x 4.1
8. MBBR II	9.9 x 9.9 x 4.1
9. MBBR III	6.4 x 6.4 x 4.1
10. MBBR IV	4.1x 4.1x 4.1
11. Clarifier	4.75 x 4.75 x 5.3
12. Sludge sump	1.8 m dia. x 1.7
13. Sludge thickner	4.2 m dia. x 2.5
14. Sludge centrifuge and dosing tank	0.65 x 0.65 x 1.5
15. Filter feed tank	3.7 x 3.7 x 2.5
16. Pressure sand Filter	2.5 m dia. 2 nos.
Activated Carbon Filter	2.5 m. dia 2 nos.
17. Chlorine contact tank	4.5 x 4.5 x 2.5
18. Treated Water Tank	5.6 x 5.6 x 3.0

Figure-7.1 Hydraulic Flow Diagram

7.2 TREATMENT UNITS

7.2.1 PRE-TREATMENT

Pre-treatment removes all materials that can be easily collected from the raw sewage before they damage or clog the pumps and sewage lines of treatment. Objects commonly removed during pretreatment include trash, tree limbs, and other large objects. The influent in sewage water passes through a bar screen to remove all large objects like cans, rags, sticks, plastic packets, etc. carried in the sewage stream. This is most commonly done with an automated mechanically raked bar screen in modern plants serving large populations, while in smaller or less modern plants, a manually cleaned screen may be used. The raking action of a mechanical bar screen is typically paced according to the accumulation on the bar screens and/or flow rate. The solids are collected and later disposed of in a landfill, or incinerated.

7.2.1.1 GRIT REMOVAL

Grit consists of sand, gravel, cinders, and other heavy materials. Pretreatment may include a sand or grit channel or chamber, where the velocity of the incoming sewage is adjusted to allow the settlement of sand and grit. Grit removal is necessary to

- Reduce formation of heavy deposits in aeration tanks, aerobic digesters, pipelines, channels, and conduits
- Reduce the frequency of digester cleaning caused by excessive accumulations of grit and
- Protect moving mechanical equipment from abrasion and accompanying abnormal wear.

The removal of grit is essential for equipment with closely machined metal surfaces such as comminutors, fine screens, centrifuges, heat exchangers, and high pressure diaphragm pumps. Grit chambers come in 3 types: horizontal grit chambers, aerated grit chambers, and vortex grit chambers. Sand and other particles of specific gravity > 2.65 are settled in the Grit Chamber. Grit removal systems have been designed to remove clean inorganic particles that are greater than 0.210 millimetres, most grit passes through the grit removal flows under normal conditions. During periods of high flow deposited grit is resuspended and the quantity of grit reaching the treatment plant increases substantially. It is, therefore, important that the grit removal system not only operate efficiently during normal flow conditions but also under sustained peak flows when the greatest volume of grit reaches the plant.

7.2.1.2 PARSHALL FLUME

The Parshall flume is an open channel flow metering device that was developed to measure the flow. It is used to measure volumetric flow rate in municipal sewer lines, and influent/effluent flows in wastewater treatment plants. In Parshall flume flow should be measured at a point that is 2/3 the length of the converging wall measured back from the throat. It is important to note that this distance is NOT simply 2/3 of the distance back from the throat, but 2/3 of the length of the side wall. The advantages of the Parshall flume are

- It passes sediment and small trash easily
- It requires only a small head loss, and
- It allows accurate flow measurements even when partially submerged.

A disadvantage of the Parshall flume is that it is not accurate at low flow rates.

Construction of 5 MLD under AMRUTH scheme is in progress. The layout for the construction of this plant is set out with space demarcated for another 5 MLD STP. In the DPR it is pointed out that the pre-treatment units are designed for 10 MLD capacity and the layout also in accordance with this. Hence in this DPR the components receiving chamber, screen channel, grit separator, approach channel for parshall flume are not considered.

7.2.1.3 EQUALIZATION TANK

Flow equalization is used to minimize the variability of water and wastewater flow rates and composition. The main function of the equalization tank is to act as a buffer: to collect the raw incoming sewage that comes at widely fluctuating rates and pass it on to the rest of the sewage treatment plant at a steady flow rate. The tank is rectangular in shape to provide placement of air diffusers for full floor coverage. Each unit operation in a treatment train is designed for specific wastewater characteristics. Improved efficiency and control are possible when all unit operations are carried out at uniform flow conditions. The equalization tanks are provided (i) to balance fluctuating flows or concentrations, (ii) to assist self- neutralization, or (iii) to even out the effect of a periodic "slug" discharge from a batch process. In STP design equalization tank is provided to enable the source to operate at a predetermined rate. Waste water generated does not flow at a constant rate. Even in dry weather, the flow rate varies from hour to hour. Flow equalization is a process of controlling flow velocity and flow composition. It is necessary in many municipal treatment processes to dampen severe variation in inflow and water quality. Providing consistent flow and loading to a biological process is important to maintain optimal treatment. The principal factors considered in the design of equalization tanks are

- Location and configuration,
- Volume
- Tanks geometry,
- Mixing and air requirements,
- Appurtenances (accessories, trappings) and
- Pumping facilities

Considering the variation in hourly flow pattern adopted as shown in appendix, volume of equalization tank is arrived at around 1055 m^3. Thus in order to maintain uniform flow rate the retention time is considered as 5.06 hrs. Due to the additional retention time, aeration and mixing is required to prevent the raw wastewater from becoming septic and to maintain solids in suspension. Homogeneous mixture in Equalization Tank is done via the actions of coarse bubble diffusers, oxygen transfer efficiency of a coarse bubble diffuser is 10%-20% and are capable of delivering 6 - 12 m^3 / hour air , typical diameter of coarse bubble diffuser is 150 mmOther role is to make water homogeneous in nature.

7.2.2 SECONDARY TREATMENT

Secondary treatment removes the soluble organic matter that escapes primary treatment. It also removes more of the suspended solids. Removal is usually accomplished by biological processes in which microbes consume the organic impurities as food, converting them into carbon dioxide, water, and energy.MBBR has been proposed as a secondary treatment option due to the following reasons.

1. MBBR has been in existence sufficiently for a long time, also in India and is a proven technology.
2. Minimum footprint
3. Better stabilized sludge
4. Better Effluent Quality
5. Less sophisticated
6. Spare parts available
7. Lower life cycle cost
8. Nil odour nuisance and other environmental hazards

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 filters or RBC systems. The microorganisms that carry out the treatment are kept suspended in the mixed liquor in the aeration tank.

7.2.2.1 MOVING BED BIO REACTOR (MBBR) TECHNOLOGY

MBBR technology employs thousands of polyethylene biofilm carriers operating in mixed motion within an aerated wastewater treatment basin. Each individual bio- carrier increases productivity through providing protected surface area to support the growth of heterotrophic and autotrophic bacteria within its cells. It is this high-density population of bacteria that achieves high-rate biodegradation within the system, while also offering process reliability and ease of operation.

This technology provides cost-effective treatment with minimal maintenance since MBBR processes self-maintain an optimum level of productive biofilm.

Additionally, the biofilm attached to the mobile bio carriers within the system automatically responds to load fluctuations.

7.2.2.2 PROCESS BENEFITS

- Compact Design: A fraction of the size of conventional systems
- Expandable: Capacity can be easily upgraded by simply increasing the fill fraction of biofilm carriers
- Single Pass Process: No return activated sludge stream required
- Load Responsive: Actively sloughed biofilm automatically responds to load fluctuations
- Minimal Maintenance

No F/M ratios or MLSS levels to maintain MBBR processes are an excellent solution for common wastewater applications including

- BOD Reduction
- Nitrification
- Total Nitrogen Removal

Moving Bed Biofilm Reactor systems deliver a flexible, cost-effective, and easy-to-operate means to address current wastewater requirements and the expandability to meet future loads or more stringent discharge requirements within a compact design.

7.2.2.3 FEATURES OF MBBR

In Fluidized aerobic process a non-clogging biofilm reactor with special grade plastic media having density close to that of water is used. This plastic media has more surface area and biofilm grows on these media which move along with the water in the reactor. This movement within the reactor is generated by providing aeration with the help of diffusers placed at the bottom of the aerobic reactor. The thin biofilm on the elements enables the bacteria to act upon the biodegradable matter in sewage and reduce BOD / COD content in the presence of oxygen present in air. Area requirement for this process is 1/10 of space required for conventional sewage treatment plants. Power requirements are low as recycling of sludge is not done in this method as required in ASP. This can take shock loads and can withstand variation. Expected COD/BOD removal is more than 95%.

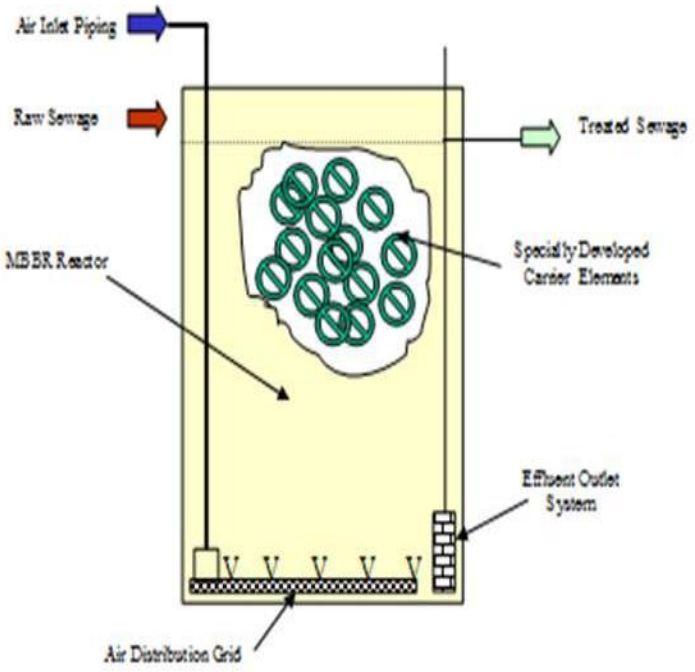


Fig 7.2: Essential Components of MBBR

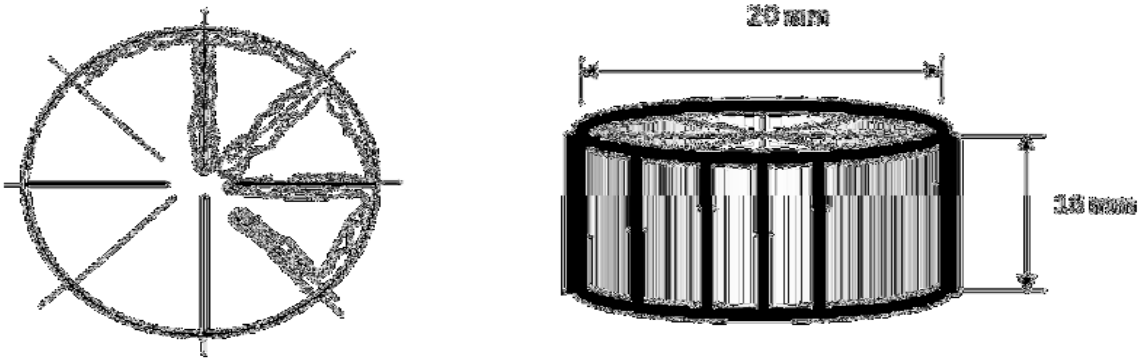


Fig 7.3: MBBR Media

7.2.2.4 MBBR WASTEWATER TREATMENTPROCESS ALTERNATIVES

The MBBR wastewater treatment process is quite flexible and can be used in several different ways. The figure shows the flow diagram of the options adopted for the proposed treatment plant, with single stage BOD removal, nitrification, post anoxic

denitrification with raw sewage feeding for carbon source and thereafter removing low grade BOD in the subsequent reactor.

7.2.2.5 POST ANOXIC DENITRIFICATION ALTERNATIVE

In order to carry out the denitrification of the waste water flow (removal of the Nitrogen from the waste water)**,** it is necessary to first nitrify the waste water, conversion of ammonia nitrogen typically present in the influent wastewater to nitrate. Nitrification will only take place at a reasonable rate in the MBBR reactor 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. Nitrification reactor will always follow the BOD removal reactor because of the need for low BOD level in the nitrification reactor. Denitrification reactor is provided after the nitrification reactor as the post anoxic denitrification.

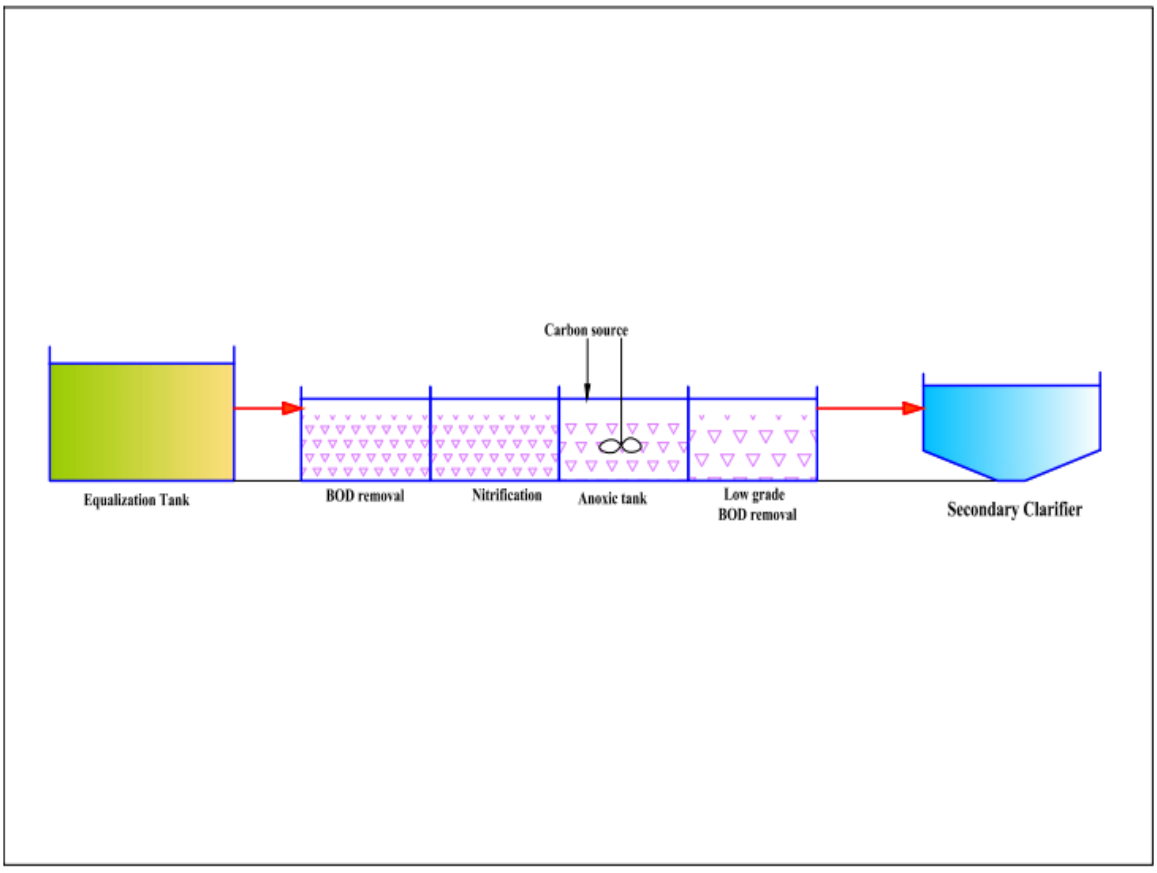


Figure 7.4 Nitrification and Denitrification Reactors

7.2.2.6 NITRIFICATION TANK

Ammonia in wastewater could originate from a variety of sources, including Proteins (meat and blood), urea, amino acid products, casein, corrosion inhibitors, process chemicals and raw materials or cleaning chemicals containing quaternary ammonium compounds. Nitrification is a bio-chemical reaction that occurs inside bacteria. Two species of bacteria are involved in the process – Nitrosomonas and Nitrobacter.

These bacteria are collectively known as nitrifiers and are autotrophic, i.e. they get their carbon source from inorganic carbon (carbonates, bicarbonates) or carbon dioxide.

A healthy and stable population of nitrifiers (Nitrosomonas and Nitrobacter) will not exist without the following conditions:

- **OXYGEN**: Nitrifiers are obligate aerobes, i.e. they require free molecular oxygen and are killed off by anaerobic conditions. Maximum nitrification occurs at a D.O. (Dissolved Oxygen) level of 3.0 mg/l. Significant nitrification occurs at a D.O. level of 2.0 to 2.9 mg/l. Nitrification ceases at D.O. levels of <0.5 mg/l. Approximately 4.6 kg of oxygen are required for every kg of ammonium ions oxidized to nitrate (This compares with a requirement of 1 kg of oxygen to oxidize 1 kg of carbonaceous B.O.D.). An absence of oxygen for <4 hours does not adversely affect nitrifiers when oxygen is restored. To ensure effective nitrification, always maintain a D.O. level of 1.5 mg/l.

- **TEMPERATURE**: Nitrification is temperature sensitive. The optimum temperature for nitrification is generally considered to be 30°C.

TEMPERATURE	EFFECT UPON NITRIFICATION
>45°C	Nitrification ceases
28-32°C	Optimal temperature range
16°C	Approx. 50% of nitrification rate at 30°C
10°C	Significant reduction in nitrification rate – 20% of rate at 30°C
<5°C	Nitrification ceases

- **ALKALINITY AND pH**: Alkalinity is lost in an activated sludge process during nitrification. Nitrifiers use alkalinity as a carbon source, i.e., they use an inorganic

form of carbon. Hydrogen ions (H+) are produced when ammonium ions are oxidized to nitrite:

$$NH_4^{++} + 1.5O_2 \longrightarrow 2H^+ + NO_2^- + 2H_2O.$$

Nitrous acid (HNO_2) is also produced during the oxidation of ammonium ions. This destroys alkalinity:

$$H^+ + NO_2^- \longrightarrow HNO_2^-$$

7.14 mg of alkalinity as CaCO3 are destroyed for every mg of ammonium ions oxidized. If the pH drops below 6.7, there is a significant decrease in nitrification. Therefore, it is important to maintain an adequate alkalinity in the aeration tank to provide pH stability and also to provide inorganic carbon for nitrifiers. After complete nitrification, a residual alkalinity of 50 mg/l in the aeration tank is desirable. If this alkalinity is not present, then alkalinity should be added to the aeration tank. The optimal pH range for nitrification is 7.2 to 8.0. A substantial reduction in nitrification activity occurs at pH levels below 6.7.

- **HIGH MEAN CELL RESIDENCE TIME (SLUDGE AREA) OR LOW F:M**

The necessary MCRT or F: M values are temperature dependent. Nitrifier activity and reproduction are decreased during cold temperatures. Therefore, in winter, an increase in the quantity of nitrifiers (MLVSS) or an increase in MCRT is often required to maintain effective nitrification. Reducing the wasting rate (WAS rate) will increase the MCRT.

INHIBITION/TOXICITY: Inhibition is temporary short-term or long-term loss of enzymatic activity. Toxicity is permanent loss of enzymatic activity or irreversible damage to cellular structure. Small increases in inhibitory wastes can cause a dramatic reduction in nitrification. Nitrifiers grow slowly and only account for a small portion of the bacterial assemblage in an aeration system. Nitrifiers are excellent indicators of toxic shock in an effluent treatment plant. Significant loss of nitrification will occur before loss in efficiency of carbonaceous BOD removal. Nitrifying bacteria are also inhibited by relatively low concentrations of free ammonia (10 mg/l for Nitrosomonas; 0.1 mg/l for Nitrobacter) and free nitrous acid (1.0 mg/l for both Nitrosomonas and Nitrobacter). Free ammonia (NH3) is produced from ammonium ions under a high pH in the aeration tank. Free nitrous acid (NHO2) is produced from nitrite ions under a

low pH in the aeration tank. This type of inhibition is known as substrate inhibition. Substrate inhibition usually occurs at a concentration of 400-500 mg/l ammonium ions or when ammonium ions are converted to nitrite ions at a faster rate than nitrite ions are converted to nitrate ions.

- **BOD:** Soluble and simplistic forms of cBOD can inhibit the activity of nitrifying bacteria. They are able to enter the cells of nitrifying bacteria and inactivate their enzyme systems. This form of cBOD must be degraded significantly or completely by organotrophs in order for nitrifying bacteria to oxidize ammonium and nitrite ions. Nitrifiers are dependent on organotrophs to reduce cBOD to relatively low concentrations (<40-50 mg/l). Excess BOD can cause a significant oxygen demand, which may cause a drop in D.O. that adversely affects nitrifying bacteria. Fluctuations in BOD loading may lead to intermittent nitrification.

7.2.2.7 DENITRIFICATION PROCESS IN THE REACTOR

Denitrification is the process that converts nitrate to nitrogen gas, thus removing bioavailable nitrogen and returning it to the atmosphere. Unlike nitrification, denitrification is an anaerobic process, occurring mostly in soils and sediments and anoxic zones in lakes and oceans. In a biological water treatment, denitrification is generally the next step following nitrification. Here nitrate (NO_3) and nitrite (NO_2) are transformed into nitrogen (N_2). The gaseous nitrogen escapes out of the water into the air. Air exists for 78% out of nitrogen (N_2) and for 21% out of O_2 (oxygen), so N_2 is absolutely not polluting the atmosphere. A large number of aerobic bacteria is able to perform denitrification. When there is no oxygen in the water, these bacteria use nitrate and nitrite as a source of oxygen.

The denitrification reaction requires a carbon source. Hence raw sewage is proposed to dose from the equalization tank to the denitrification tank and BOD in the primary effluent waste water is used as the carbon source for the denitrification. Thereafter a reactor is also proposed for dealing low grade BOD in the effluent.

7.2.2.8 SECONDARY CLARIFIER

Secondary clarifiers are to separate biological floc from the treated liquid waste stream. Plate settlers are also being proposed in the clarifier to get more clarified water.Clarifiers are settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. A clarifier is generally used to remove

solid particulates or suspended solids from liquid for clarification. Necessary coagulants are being added before feeding the clarifier.

7.2.2.9 CLARIFIED WATER COLLECTION TANK

After treatment, the effluent is stored in this tank from where it is taken for further treatment.

7.2.2.10 SLUDGE COLLECTION SUMP

The dead bacteria that dies after consuming BOD and COD are retained in the form of sludge from the bottom of the tank.

7.2.2.11 DEWATERING UNIT

A dewatering unit is required to further dry the sludge. The centrate at the outlet of the dewatering unit is then re-circulated to the system.

7.2.3 TERTIARY TREATMENT

Tertiary treatment refers to secondary treatment followed by a filtration step, such as media filtration, so that the turbidity and TOC concentrations are generally lower, and if coagulation with metal salts is used, then the phosphate concentration will also be reduced.

7.2.3.1 PRESSURE SAND FILTER (PSF)

The treated water which is collected in the filter feed tank shall be pumped into the Pressure Sand Filter using the Filter Feed Pumps. They are the most popular method for removal of turbidity from water. The Pressure Sand Filter consists of a multiple layer of sand with a variety in size and specific gravity. These Filters are designed to remove turbidity and suspended particles present in the feed water with minimum pressure drop. Raw water flows downwards through the filter bed and as the suspended matter, which is treated by addition of a coagulant like alum or poly electrolyte, is retained on the sand surface and between the sand grains immediately below the surface. There is steady rise in the loss of head over a period of time and the flow reduces once the pressure drop across the filter is excessive. The filter is then taken out of service and cleaning of the filter media is affected by flow reversal also called as backwash. To assist in cleaning the bed, the backwash operation is sometimes preceded by air scouring by way of agitation through the under drain system. The air scouring agitates the sand with a scrubbing action, which loosens the intercepted particles.

Fig 7.5 Pressure Sand Filter

7.2.3.2 ACTIVATED CARBON FILTER (ACF)

Filtered wastewater from Pressure sand filter is then passed through the Activated Carbon Filter. They are generally employed in the process of removing organic compounds and/or extracting free chlorine from water, thereby making the water suitable for discharge.

Activated carbon is commonly used for removing organic constituents and residual disinfectants in water supplies. This not only improves taste and minimizes health hazards; it protects other water treatment units such as reverse osmosis membranes and ion exchange resins from possible damage due to oxidation or organic fouling. Activated carbon is a favoured water treatment technique because of its multifunctional nature and the fact that it adds nothing detrimental to the treated water. Most activated carbons are made from raw materials such as nutshells, wood, coal and petroleum.

Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical adsorption. Each particle/granule of carbon provides a large surface area/pore structure, allowing contaminants the maximum possible exposure to the active sites within the filter media.

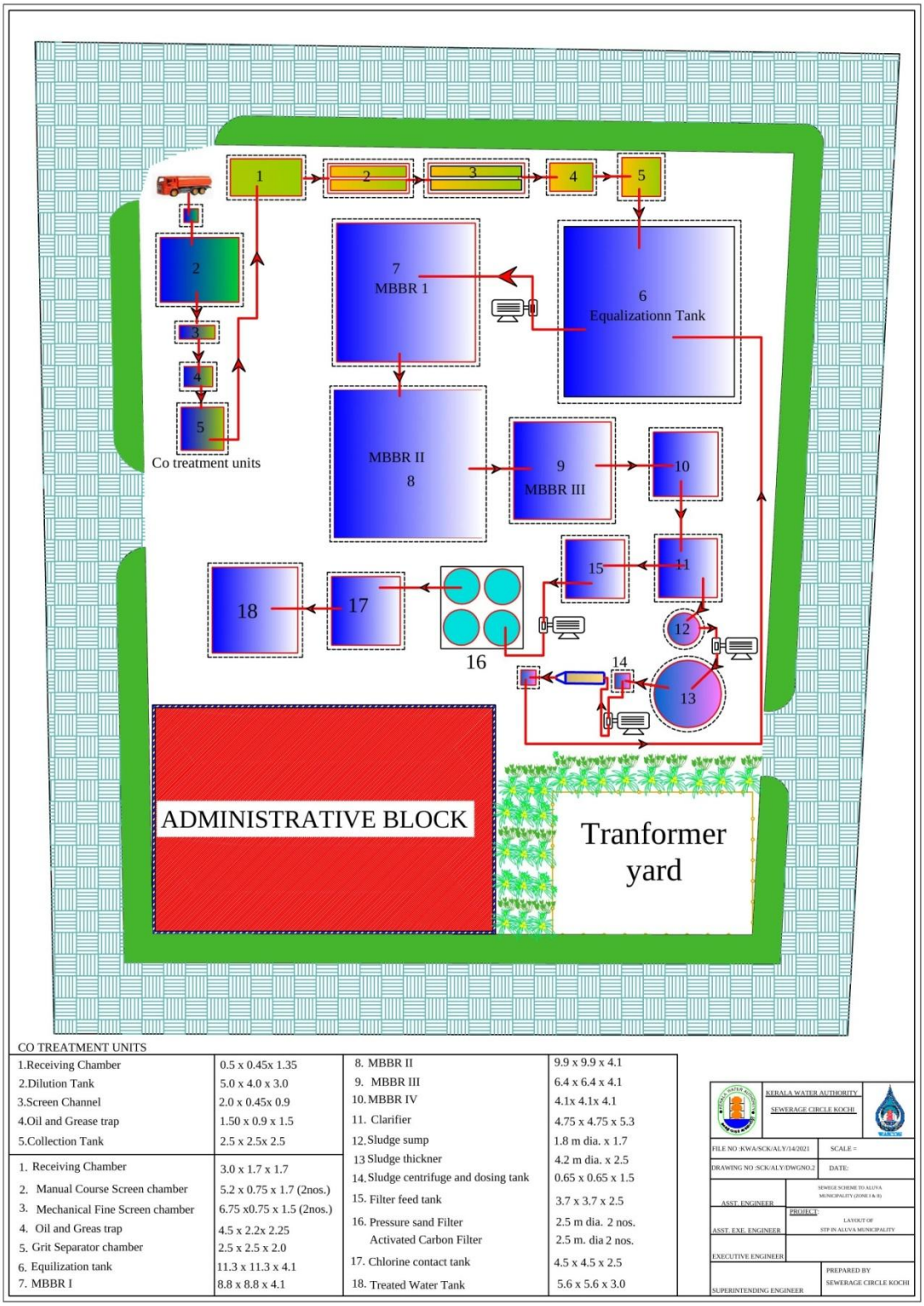
Fig 7.6 Activated Carbon Filter

7.2.3.3 CHLORINE CONTACT TANK

Chlorination is by far the most common method of wastewater disinfection and is used worldwide for the disinfection of pathogens before discharge into receiving streams, rivers or oceans. Chlorine is known to be effective in destroying a variety of bacteria, viruses and protozoa, including Salmonella, Shigella and Vibrio cholera. Disinfection is achieved at this facility through chlorination using chlorine gas. The purpose of the Chlorine Contact Tanks is to allow sufficient time for the chlorine to disinfect the water.

7.2.3.4 TREATED WATER TANK

Treated water is being collected in treated water before being disposed off to river.



CO TREATMENT UNITS

1.Receiving Chamber	0.5 x 0.45x 1.35	8. MBBR II	9.9 x 9.9 x 4.1
2.Dilution Tank	5.0 x 4.0 x 3.0	9. MBBR III	6.4 x 6.4 x 4.1
3.Screen Channel	2.0 x 0.45x 0.9	10. MBBR IV	4.1x 4.1x 4.1
4.Oil and Grease trap	1.50 x 0.9 x 1.5	11. Clarifier	4.75 x 4.75 x 5.3
5.Collection Tank	2.5 x 2.5x 2.5	12. Sludge sump	1.8 m dia. x 1.7
1. Receiving Chamber	3.0 x 1.7 x 1.7	13 Sludge thickner	4.2 m dia. x 2.5
2. Manual Course Screen chamber	5.2 x 0.75 x 1.7 (2nos.)	14. Sludge centrifuge and dosing tank	0.65 x 0.65 x 1.5
3. Mechanical Fine Screen chamber	6.75 x0.75 x 1.5 (2nos.)	15. Filter feed tank	3.7 x 3.7 x 2.5
4. Oil and Greas trap	4.5 x 2.2x 2.25	16. Pressure sand Filter	2.5 m dia. 2 nos.
5. Grit Separator chamber	2.5 x 2.5 x 2.0	Activated Carbon Filter	2.5 m. dia 2 nos.
6. Equilization tank	11.3 x 11.3 x 4.1	17. Chlorine contact tank	4.5 x 4.5 x 2.5
7. MBBR I	8.8 x 8.8 x 4.1	18. Treated Water Tank	5.6 x 5.6 x 3.0

KERALA WATER AUTHORITY
SEWERAGE CIRCLE KOCHI

FILE NO :KWA/SCK/ALY/14/2021 SCALE =
DRAWING NO :SCK/ALY/DWGNO.2 DATE:
ASST. ENGINEER
SEWEGE SCHEME TO ALUVA MUNICIPALITY (ZONE I & II)
PROJECT:
ASST. EXE. ENGINEER
LAYOUT OF STP IN ALUVA MUNICIPALITY
EXECUTIVE ENGINEER
SUPERINTENDING ENGINEER
PREPARED BY
SEWERAGE CIRCLE KOCHI

Figure 7.7 Layout of STP

7.3 SLUDGE MANAGEMENT

The solid particles separated from wastewater are in the form of slurry and known as sludge. The volume of sludge is more as it contains more water. Hence to reduce the volume of sludge, dewatering process is done with the help of centrifuges, sludge thickening units and sludge press. After this process, it is converted in the form of cake. The sludge from sewage is rich with nitrogen, phosphorous, Sulphur and other minerals which are essential for the growth of plants. Hence it can be used as manure. Further researches are going on this field to make this cake as a construction material but are in its infant stage.

CHAPTER 8
DESIGN OF TREATMENT PLANT UNITS AND NETWORK SYSTM

8.1 DESIGN CALCULATIONS FOR TREATMENT PLANT

DESIGN OF STP WITH MOVING BED BIOFILM-REACTOR (MBBR)						
Average flow from network	**1.72**	MLD				
Working hours	**23**					
Flow from septage dilution tank	2.33	m^3/hour	0.06	MLD		
Design flow	**1.85**	MLD	1850719	LPD	1851	m^3/day
			1851	KLD	77.11	m^3/hour
Assumed peak factor	**2.25**					
Peak design flow	4.164	MLD	4164117	LPD	4164	m^3/day
					173.50	m^3/hour
Raw Sewage Characteristics						
Average sewage flow entering the STP	77.11	m^3/hour				
Peak flow entering the STP	173.50	m^3/hour				
COD	**500**	mg/l				
Primary ST/ET effluent BOD	**250**	mg/l				
Thickener overflow return as fraction of plant flow	**0.15**					
Thickener overflow return	0.278	MLD				
Thickener overflow return BOD	**350**	mg/l				
Centrate from sludge dewatering as fraction of plant flow	**0.006**					
Centrate from sludge dewatering return	0.01110	MLD				
Centrate from sludge dewatering return BOD	**280**	mg/l				
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 (after filtration)						
COD	**50**	mg/l				
BOD	**10**	mg/l				
TSS	**20**	mg/l				

Total Nitrogen (As N)	**10**	mg/l				
Total Phosphorous (As P)	**1**	mg/l				
E Coliform	**100**	mpn/100 ml				
pH	**7**					
Oil and Grease Trap						
Average quantity of flow	77.11	m^3/hour				
Peak flow	173.50	m^3/hour				
	0.0482	m^3/sec				
Average Retention Time for peak flow	**300**	sec	offset to wall	**0.15**	m	
Volume of the inlet chamber	14.46	m^3	free board	**0.75**	m	
Assumed depth of flow	**1.5**	m	total height	**2.25**	m	
Area required for inlet chamber	9.64	m^2	wall thickness	**0.25**	m	
Length of the tank	**4.5**	m	slab thickness	**0.3**	m	
Breadth of the tank	2.14	fix	**2.2**	m	area in m^2	**15.9**
Breadth of baffle wall inside	2.2	m				
Receiving Chamber						
Average quantity of flow	77.11	m^3/hour				
Peak flow	173.50	m^3/hour				
	0.0482	m^3/sec				
Average Retention Time for peak flow	**120**	sec	offset to wall	**0.3**	m	
Volume of the inlet chamber	5.78	m^3	free board	**0.5**	m	
Assumed depth of flow	**1.2**	m	total height	**1.7**	m	
Area required for inlet chamber	4.82	m^2	wall thickness	**0.25**	m	
Length of the tank	**3**	m	slab thickness	**0.3**	m	
Breadth of the tank	1.61	fix	**1.7**	m	area in m^2	**11.48**
Manual Coarse Screen Channel						
Peak design flow	0.0482	m^3/sec				
Number of screen	**2**					
Peak flow rate per screen	0.0241	m^3/sec				
Velocity at peak flow	**1**	m/sec	assumed			
Velocity through clean bar screen	**1.10**	m/sec				
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	0.06	m	slab thickness	**0.30**	m	
Area required for screen	0.02	sqm				
Head loss through bar screen	0.02	m	*assuming head loss coefficient = 0.7*			

Assumed depth of flow after inserting bar screen	**0.1**	m	0.08	(control value)		
Width of channel required	0.24	m	fix	**0.75**	m	
Clear bar spacing	**20**	mm	*(20 to 50 mm)*			
Bar thickness	**12**	mm	*(5 to 15 mm)*			
Number of bars	**23**					
Clear bar spacing obtained	22	mm	OK			
Inside width of screen (openings)	0.474	m			area in m^2	**3.85**
Full height of channel	**1.2**	m	fb	**0.5**		
Angle of inclination	**45**	degree	0.79	rad		
Actual velocity at peak flow	0.64	*(between 0.60 m/sec and 0.90 m/sec)*				
Length of channel required D/S	1.20	m	fix	**1.2**	m	
Mechanical Fine Screen Channel						
Peak design flow	0.048	m^3/sec				
Number of screen	**2**					
Peak flow rate per screen	0.024	m^3/sec				
Velocity at peak flow	**0.8**	m/sec	assumed			
Velocity through clean bar screen	**0.85**	m/sec				
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	0.08	m	slab thickness	**0.30**	m	
Area required for screen	0.03	Sq.m				
Head loss through bar screen	0.01	m	*assuming head loss coefficient = 0.7*			
Assumed depth of flow after inserting bar screen	**0.37**	m	0.09	(control value)		
Width of channel required	0.08	m	fix	**0.75**	m	
Clear bar spacing	**6**	mm	*(up to 6 mm)*			
Bar thickness	**10**	mm	*(5 to 15 mm)*			
Number of bars	**47**					
Clear bar spacing obtained	6.1	mm				
Inside width of screen (openings)	0.28	m				
Full height of channel	**1**	m	fb	**0.5**		
Angle of inclination	**70**	degree	1.22	rad		
Actual velocity at peak flow	1.00	*(between 0.60 m/sec and 1.20 m/sec)*				

Length of channel required D/S	2.74	m	fix	**2.75**	m	**5.625**
Daily screening quantity						
Daily sewage quantity	1850.72	m^3/day				
Rate of screening quantity	**0.015**	m^3/1000 m^3				
Daily screening quantity	0.0278	m^3/day				
Grit Separator						
Number of grit units	**1**	SB	**0**			
Peak flow	0.0482	m^3/sec				
Flow in one unit	0.0482	m^3/sec				
Grit particle size	**0.15**	mm				
HRT	**60**	sec	*(45 to 90 sec, typical 60)*			
Volume of grit chamber	2.89	m^3				
SOR	**900**	$m^3/m^2/d$	*(empirical, from observations)*			
	0.010	$m^3/m^2/sec$				
Area required	4.63	m^2	wall thickness	**0.25**	m	
SWD	**1.50**	m	slab thickness	**0.30**	m	
Side of square channel	2.15	m	offset to wall	**0.3**	m	
Fix length	**2.5**	m	freeboard	**0.5**	m	
Fix width	**2.5**	m	area given	6.25	m^2	OK
Shape factor	**0.85**		volume given	9.3750	m^3	OK
Specific gravity of liquid	**2.65**					
Kinematic viscosity	**1E-06**	m^2/sec				
V_p in m/sec	0.020	*let Nr < 1, apply Stoke's law to get terminal velocity vp*				
N_r	3	*apply Newton's equation*				
Assumed velocity in m/sec	**0.0146**					
Nr	2				area in m^2	**12.96**
drag coefficient Cd	15.47					
vp in m/sec	0.014					
Critical displacement velocity, Vc	0.0145	m/sec		R_t	1.67	
Horizontal velocity of flow, Vh	0.0129	m/sec	OK	R_v	1.13	
Equalization Tank						
Average design flow	77.11	m^3/hour				
Volume of tank required	**456.00**	m^3	*from detailed analysis*			
HRT	5.91	hours				
SWD	**3.6**	m				

Area required for equalization tank	126.67	m^2	free board	**0.50**	m	
Number of tanks proposed	**1**		offset to wall	**0.45**	m	
Area required for each tank	126.67	m^2	wall thickness	**0.3**	m	
Diameter of circular tank	12.70	m	fix	**12.7**	m	
Side if square tank	11.25	m	fix length	**11.3**	m	
Thickness of foundation slab	**0.45**	m	fix breadth	**11.3**	m	
Actual capacity provided	456.0	m^3	circular	OK		
	459.684	m^3	rectangular	OK	area in m^2	**163.84**
Sewage pump- for pumping to MBBR tank						
Number of pumps	**1**	SB	**1**			
Type of pump set	submersible centrifugal sewage transfer-non clog					
Average flow	1850.72	m^3/day				
Peak design flow	4164.12	m^3/day				
Working hours	**23**					
Flow capacity of each pump	80.47	m^3/hour				
Peak factor	**1.20**					
Discharge	26.82	LPS	0.0268	m^3/sec		
Head required	**12**	m				
Efficiency	**50%**					
Power required	8.58	HP	fix	**9**	HP	
Energy	147.27	kwh				
Moving Bed Bio-Reactor (MBBR)-Single Stage						
Average design flow	1850.72	m^3/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				
BOD to be removed	253.13	mg/l				
BOD removal % expected	96.20					
Number of tanks proposed	**1**					
BOD loading rate/volume	**4**	kg/m^3/day	*4-7 kg/m^3/day as per M&E*			
Actual BOD loading rate	486.98	kg/day				
Quantity of BOD to be removed per day	468.48	kg/day				
Volume of reactor required	121.75	m^3				
Surface area loading rate (SALR) for BOD removal	**7.50**	g/m^2/day				

Required carrier surface area	64930.98	m^2				
Specific surface area of carrier	**600.00**	m^2/m^3				
Required carrier volume	108.22	m^3				
Volume of media required	**40%**					
	48.70	m^3	depth of base	**0.3**	m	
Volume of tank required-BOD loading rate/volume method	170.44	m^3	slab thickness	**0.35**	m	
Volume of tank required- SALR method	270.55	m^3	offset to wall	**0.45**	m	
Volume of each tank	270.55	m^3	total height	**4.10**	m	
SWD	**3.6**	m	wall thickness	**0.30**	m	
Area of each tank	75.15	m^2	fix dia	**10**	m	
Diameter of circular tank	9.78	m	length	**8.8**	m	
Side of square tank	8.67	m	breadth	**8.8**	m	
Actual capacity provided-circular	282.74	m^3	OK			
Actual capacity provided-rectangular	278.78	m^3	OK			
Fix capacity	**278.78**	m^3				
Actual volume of media obtained	111.51	m^3				
Actual carrier surface area	66907.20	m^2				
Volume of liquid in the tank	234.18	m^3				
Hydraulic Retension Time at design average flow	3.04	hours	182.2	minutes		
Hydraulic Retension Time at peak flow	1.35	hours	81.0	minutes		
SARR for the given SALR	6.94	$g/m^2/day$			area in m^2	**106.09**
Estimated BOD removal rate	464.17	kg/day				
Actual BOD removal rate %	95.32	BOD of effluent		12.33	mg/l	not ok
Moving Bed Bio-Reactor (MBBR)-Single Stage Nitrification						
Average design flow	1850.72	m^3/day				
Number of streams	**1**					
BOD of incoming sewage	**20.00**	mg/l				
NH_4-N of incoming sewage	**40.00**	mg/l				
Alkalinity as $CaCO_3$	**140.00**	mg/l				
Target effluent NH_3-N	**3.30**	mg/l	% removal	91.75		
DL level to be maintained in tank	**2.00**	mg/l				
Design minimum waste water temperature	**20.00**	^oC				
$SARR_{max}$	0.61		SARR temp coefft. Θ		1.058	
Minimum NH_3-N at $SARR_{max}$	0.50		$SARR_T$	0.81	$g/m^2/d$	

					ay	
Design value of SALR	0.88	$g/m^2/day$				
NH_3-N loading rate	74.03	kg/day				
Required carrier surface area	83994.00	m^2/day				
Specific surface area of carrier	**600.00**	m^2/m^3				
Required carrier volume	139.99	m^3/day	depth of base	**0.65**	m	
Volume of media required	**40%**		slab thickness	**0.35**	m	
Volume of tank required- SALR method	349.98	m^3	offset to wall	**0.45**	m	
Volume of each tank	349.98	m^3	total height	**4.10**	m	
SWD	**3.6**	m	wall thickness	**0.30**	m	
Area of each tank	97.22	m^2	fix dia	**11.2**	m	
Diameter of circular tank	11.13	m	length	**9.9**	m	
Side of square tank	9.86	m	breadth	**9.9**	m	
Actual capacity provided-circular	354.67	m^3	OK			
Actual capacity provided-rectangular	352.84	m^2	OK			
Fix capacity	**338.72**	m^3				
Actual volume of media obtained	135.49	m^3				
Actual carrier surface area	81292.80	m^2			area in m^2	**129.96**
Volume of liquid in the tank	284.52	m^3				
Hydraulic Retension Time at design average flow	3.69	hours	221.38	minutes		
Hydraulic Retension Time at peak flow	1.64	hours	98.39	minutes		
BOD SALR	0.46	$g/m^2/day$	*should be < 0.5 to achieve good nitrification*			
Using the equivalent weight of $CaCO_3$ as 50, the equivalent weight of $NaHCO_3$ as 84, the alkalinity use for nitrification as 7.14 g $CaCO_3$/g NH_3-N and the target effluent alkalinity as 80 mg/L as $CaCO_3$, give the calculated alkalinity requirement as 118.5 mg/L as $CaCO_3$.						
Influent alkalinity	**140.00**	mg/l				
Target effluent alkalinity	**80.00**	mg/l				
Alkalinity used for Nitrification	**7.14**	g $CaCO_3$/g NH_3-N				
Alkalinity to be added	202.04	mg/l				
Rate of alkalinity addition needed as $CaCO_3$	373.92	kg/day				
Equiv wt. of $CaCO_3$	50.00	g/equivalent				
Equiv wt. of $NaHCO_3$	84.00	g/equiva				

		lent				
Daily $NaHCO_3$ requirement	628.18	kg/day $NaHCO_3$				
Moving Bed Bio Reactor (MBBR)-post-anoxic denitrification						
Carbon:Nitrogen ratio (C/N)	6.58					
Average design flow	1851	m^3/day				
Number of post-anoxic tanks	**1.00**					
Target effluent NO_3-N concentration	**4.00**	mg/l				
SALR for post-anoxic stage	**2.00**	g NO_3 N /m^2/day				
Estimate of SARR/SALR ratio	0.886	mg/l				
Target % N removal	91.75					
Specific surface area of carrier	**600.00**	m^2/m^3				
NO_3-N daily loading rate	67.92	kg/day				
Required carrier surface area	33960.69	m^2				
Required carrier volume	56.60	m^3				
Volume of media required	**40%**		depth of base	**0.65**	m	
Volume of tank required- SALR method	141.50	m^3	slab thickness	**0.35**	m	
Volume of each tank	141.5	m^3	offset to wall	**0.45**	m	
SWD	**3.6**	m	total height	**4.10**	m	
Area of each tank	39.31	m^2	wall thickness	**0.30**	m	
Diameter of circular tank	7.07	m	fix dia	**7.15**	m	
Side of square tank	6.27	m	length	**6.4**	m	
Actual capacity provided-circular	144.55	m^3	breadth	**6.4**	m	
Actual capacity provided-rectangular	147.46	m^2	OK			
Fix capacity	**147.46**	m^3	OK			
Actual volume of media obtained	58.98	m^3				
Actual carrier surface area	35390.40	m^2				
Volume of liquid in the tank	123.87	m^3			area in m^2	**62.41**
Hydraulic Retension Time at design average flow	1.61	hours	96.38	hours		
Hydraulic Retension Time at peak flow	0.71	hours	42.83	hours		
SARR	1.77	g/m^2/day				
Estimated NO_3-N removal rate	62.72	kg/day				
NO_3-N of effluent	2.81	mg/l				
Alkalinity produced by denitrification	**3.57**	g $CaCO_3$/ g NO_3-N removed				

Actual alkalinity to be added	81.05	mg/l				
Rate of alkalinity addition needed as $CaCO_3$	150.01	kg/day				
Equiv wt. of $CaCO_3$	50.00	g/equivalent				
Equiv wt. of $NaHCO_3$	84.00	g/equivalent				
Daily $NaHCO_3$ requirement	252.01	kg/day $NaHCO_3$				
4.6 lb COD/lb NO_3-N removed and 1.5 lb COD/lb Methanol. The required methanol dosage is then calculated as: 4.6/1.5 = 3.1 lb methanol /lb NO_3-N removed. The methanol requirement in lb/day is then equal to 3.1 times the previously calculated NO_3-N removal rate						
Methanol requirement in kg/day	210.56	kg/day				
Considering toxicity, economy and safety considerations it is better to adopt retrun activated sludge feed into anoxic tank for carbon source. Alkaline fermentation can be adopted for better results.						
Moving Bed Bio-Reactor (MBBR) chamber after de-nitrification						
Average design flow	1850.72	m^3/day				
Number of streams	**1**					
BOD of incoming sewage	**87.71**	mg/l				
TSS of incoming sewage	**50**	mg/l				
BOD expected after treatment	**7**	mg/l				
BOD to be removed	80.71	mg/l				
BOD removal % expected	92.02					
Number of tanks proposed	**1**					
BOD loading rate/volume	**4**	kg/m^3/day	*4-7 kg/m^3/day as per M&E*			
Actual BOD loading rate	162.33	kg/day				
Quantity of BOD to be removed per day	149.37	kg/day				
Volume of reactor required	40.58	m^3				
Surface area loading rate (SALR) for BOD removal	**15.00**	g/m^2/day				
Required carrier surface area	10821.83	m^2				
Specific surface area of carrier	**500.00**	m^2/m^3				
Required carrier volume	21.64	m^3				
Volume of media required	**40%**					
	16.23	m^3	depth of base	**0.9**	m	
Volume of tank required-BOD loading rate/volume method	56.81	m^3	slab thickness	**0.35**	m	
Volume of tank required- SALR method	54.11	m^3	offset to wall	**0.45**	m	
Volume of each tank	56.81	m^3	total height	**4.10**	m	
SWD	**3.6**	m	wall thickness	**0.30**	m	
Area of each tank	15.78	m^2	fix dia	**4.5**	m	
Diameter of circular tank	4.48	m	length	**4.1**	m	

Side of square tank	3.97	m	breadth	**4.1**	m	
Actual capacity provided-circular	57.26	m^3	OK			
Actual capacity provided-rectangular	60.52	m^3	OK			
Fix capacity	**60.52**	m^3				
Actual volume of media obtained	24.21	m^3				
Actual carrier surface area	12104.00	m^2				
Volume of liquid in the tank	50.84	m^3				
Hydraulic Retension Time at design average flow	0.66	hours	39.6	minute		
Hydraulic Retension Time at peak flow	0.29	hours	17.6	minute		
SARR for the given SALR	13.13	$g/m^2/day$			area in m^2	**31.36**
Estimated BOD removal rate	158.87	kg/day				
Actual BOD removal rate %	97.87	BOD of effluent		1.87	mg/l	ok
Blower air requirement						
BOD loading	649.31	kg/day				
NH_3-N loading rate	74.03	kg/day				
Oxygen uptake ratio-BOD	**1.50**	kg of O_2/kg of BOD				
Oxygen uptake ratio-NH_3-N	**4.57**	kg of O_2/kg of NH_3-N				
Oxygen required for BOD loading	973.96	kg/day				
Oxygen required for NH_3-N loading	338.31	kg/day				
Percentage of O_2 in air	**21.00**					
Weight of air required-BOD loading	4637.93	kg/day				
Weight of air required-NH_3-N loading	1611.01	kg/day				
Density of air	**1.225**	kg/m^3				
Volume of air-BOD loading	3786.06	m^3/day				
Volume of air-NH_3-N loading	1315.11	m^3/day				
Air transfer efficiency of diffuser	**0.075**					
Quantity of air required-BOD loading	50480.84	m^3/day				
Quantity of air required-NH_3-N loading	17534.76	m^3/day				
Factor of saftey	**1.20**					
Volume of air required-BOD loading	2524.04	m^3/hour				
Volume of air required-NH_3-N loading	876.74	m^3/hour				
Volume of equalisation tank	456.00	m^3				
Normal inflow	0.021	m^3/sec				
Air requirement for equalisation tank	**1.25**	$m^3/m^3/h$				

Air requirement for sludge tank	**3.00**	$m^3/m^3/h$ our				
Volume of ET	419.00	m^3				
Volume of air required for ET	523.75	m^3/hour				
Volume of air required for ST	11.01	m^3				
Total air required	3935.54	m^3/hour				
Capacity of blower	3936.00	m^3/hour				
Number of blowers working	**3.00**	SB	**1**			
Air required per blower	1312.00	m^3/hour				
Pressure given	**0.60**	kg/cm^2	5.89	m		
Volumetric efficiency	**50%**					
Power required for blower motor	57.60	HP	42.97	kw		
Fix power of blower motor	**56.00**	HP				
Energy	3007.87	kwh				
Alum solution tank						
number of units	**1**					
dosage of alum	**25**	ppm				
requirement for 8 hours	15.420	kg				
volume of solution at 10% strength/unit	0.14	m^3				
length of tank	**0.6**	m				
breadth of tank	**0.6**	m				
liquid depth	0.39	m				
total depth	**1**	m				
solution flow rate	0.0175	m^3/hour				
Lime solution tank						
number of units	**1**					
dosage of lime	**15**	ppm				
requirement for 8 hours	9.25	kg				
volume of solution at 10% strength/unit	0.09	m3				
length of tank	**0.6**	m				
breadth of tank	**0.6**	m				
liquid depth	0.25	m				
total depth	**1**	m				
solution flow rate	0.01125	m^3/hour				
Secondary Clarifier with Plate/Tube Settler						
Average output required from tube settler in MLD	1.851	77.11	m^3/hour	21.42	LPS	
Number of batteries	**1**					
Average design flow as input in MLD/unit	1.85	77.11	m^3/hour	21.42	LPS	
Width of plates in mm	**900**	space between plates		**20**	mm	23.10
Length of plates adopted in m	**0.75**					

Angle of inclination of tubes adopted in deg.	**60**	1.05	rad			
Relative length of settler (dimensionless) Lr = L/d	37.5		wall thickness	**0.3**	m	
Relative length is changed by L' = 0.058 x [Vo x d/v]			column size	**0.35**	m	
Where Vo is velocity of flow along tube settler			offset to wall	**0.6**	m	
v is kinematic viscosity of water			depth of raft	**0.75**	m	
Effective relative length of tube, L = Lr-[0.058 x Vo x d/v]			slab thickness	**0.35**	m	
Kinematic viscosity of water in m/day	0.087264		r-beam depth	**0.45**	m	
Effective relative length of tube/plate , L	37.5	(-)	0.013	Vo		
	31.85					
desirable value of relative length =	*around 20 but below 40*					
for one unit:			freeboard	**0.5**	m	
Vertical water height in chamber in m	**2.4**		t-beam width	**0.35**	m	
Height of chamber in hopper portion in m	**2.4**		t-beam depth	**0.45**	m	
Side of large square in m	**4.75**		r-beam width	**0.35**	m	
Side of small square in m	**2**		inlet pipe dia	**0.2**	m	
h_3 in m (height of the truncated cone)	1.75					
Angle of inclination of hopper side to vertical	0.520	29.82	degree	60.18	*deg. with hor.*	
Larger inclined length L_i of slanting slab in m	4.78	area in m^2	11.35			
Smaller inclined length l_i of slanting slab in m	2.01	area in m^2	2.01			
Contact area in m^2	37.34					
SOR in m^3/m^2/day for upflow clarifier	**49.56**	<	**50**			
Trial volume in m^3 of one unit	82.71	volume of hopper in m^3			28.56	
Detention time in hours	1.07	in square	0.70	in hopper	0.37	hours
Fix volume	**45.00**	m^3				
Performance parameter of tube settler S = Vs/Vo x [sinθ + L x cosθ]						
For laminar flow regime, critical performance parameter value for complete removal of particle,						
Critical value of performance parameter, Sc =	1.333	circular				
	1.375	square				

	1	parallel plates				
Particle size in mm	**0.025**					
Settling velocity of particle in m/sec, V_s (laminar)	0.0006	m/sec	48.08	m/d		
Reynolds number, Nr	0.014					
Trial value of flow along plate settler V_o in m/day	**424.78**					
Shape of cross section of tubes	**plates**	(square, circular, or plates)				
Critical of performance parameter obtained, Sc	[(Vs/Vo) x (sinθ+Lcosθ)					
	1.90					
Plate entrance area/one unit	4.18	m^2				
Number of modules of plates	**2**					
Number of plates required/module	115.98					
Fix number of plates required/module	**110**					
Length/module of tray holding plates	**2800**	mm				
Thickness of plate	**1.5**	mm				
Number of plates configured in one module	114.82	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	**110**					
Angle of inclination	60	degree to horizontal				
Contact area	148.5	m^2			area in m^2	**42.90**
SOR in m^3/m^2/day for plate settler	**11.94**	<	**40**			
Total plate entrance area	3.96	m^2				
Actual velocity of flow in m/day	447.88	***now correct velocity***				
Sludge Sump						
Average flow	1850.72	m^3/day				
TSS	400	mg/l				
BOD	350.84	mg/l				
Assumed TSS Sludge	**30%**					

Assumed BOD Sludge	**35%**					
Sludge generated-TSS	222.1	kg/day				
Sludge generated-BOD	227.3	kg/day				
Total sludge	449.34	kg/day				
% sludge with 1.02 specific gravity	**10%**					
Sludge volume per day	44.05	m^3/day				
	1.84	m^3/hour				
Assumed HRT	**2**	hours	freeboard	**1.2**	m	
Volume of tank	3.67	m^3	slab thickness	**0.3**	m	
Assumed SWD	**1.5**	m	offset to wall	**0.3**	m	
Area of the tank	2.45	m^2	wall thickness	**0.25**	m	
Diameter of circular tank	1.77	m	fix	**1.8**	m	
Actual capacity provided	3.82	m^3			area in m^2	**2.90**
Pump for Sludge transfer to Thickner						
Number of pumps	**1.00**	W	**1**	SB		
Specific gravity of liquid	**1.03**					
Tipe of pump set	submersible centrifugal sewage transfer-non clog					
Working hours	**5.00**	hours				
Discharge required	8.81	m^3/hour	0.002447	m^3/sec		
Required head	**15.00**	m				
Velocity in sludge transfer pipe adopted	**0.70**	m/sec				
Pipe diameter required	66.72	mm	fix	**90**	mm	
Power required	0.98	HP	fix	**1.00**	HP	Efficiency
Energy	3.65	kwh				
Sludge Thickener						
Number of units	**1**					
Total sludge	449.34	kg/day				
Solids Loading Rate	**40**	$kg/m^2/day$				
Thickening area required	11.23	m^2				
Surface Loading Rate	**12**	$m^3/m^2/day$				
Thickening area required	3.67	m^2	freeboard	**0.5**	m	
Maximum area	11.23	m^2	slab thickness	**0.35**	m	

Area of distribution chamber	**20%**		offset to wall	**0.35**	m	
Total area required	13.48	m^2	wall thickness	**0.3**	m	
Diameter of circular tank	4.14	m	fix	**4.2**	m	
Thickening area available	13.85	m^2				
SWD	**2**	m				
Actual volume provided	27.71	m^3				
Thickened sludge consistency	**3%**	of total sludge volume				
Thickened sludge volume	13.48	m^3/day			area in m^2	**5.50**
Pump for Sludge transfer to Centrifuge						
Type of pump set	Screw pump					
Number of pumps	1.00	W	1	SB		
Volume of thickened sludge to be pumped	13.48	m^3/day				
Working hours of centrifuge	**5.00**	hours				
Discharge required	2.70	m^3/hour	7.5E-04	m^3/sec		
Head required	**15.00**	m				
Efficiency	**50%**					
Power required	0.300	fix	**0.30**	HP		
Energy	1.117	kwh				
Sludge Centrifuge and Dosing Tanks						
Number of centrifuges	**1**	SB	**1**			
Capacity of centrifuge	**0.25**	m^3/hour				
Poly electrolyte dozing for centrifuge & thickener	**10%**					
Sludge volume	449.34	kg/day				
Dose	**2**	kg/1000 kg				
Quantity of Poly Electrolyte	0.90	kg/day				
Concentration	**0.1**					
Volume of tanks @ 24 hour	0.90	m^3				
	898.69	litres				
Volume	37.45	litres/hr				
Volume required for 8 hours	0.30	m^3				
Liquid depth of tank	**1**	m				
Area required	0.30	m^2				
side of square tank	0.55	m	fix	**0.65**	area in m^2	0.845
Chlorine contact tank						
HRT	**30**	minutes	offset to wall	**0.3**	m	

Average flow	77.11	m^3/hour	wall thickness	**0.25**	m	
Volume of tank	38.56	m^3	slab thickness	**0.3**	m	
Assumed liquid depth	**2**	m	freeboard	**0.5**	m	
Area of the tank	19.28	m^2			area in m^2	**31.36**
side of square tank	4.39	m	fix	**4.5**	m	
Filter feed tank						
HRT	**20**	minutes	offset to wall	**0.3**	m	
Average flow	77.11	m^3/hour	wall thickness	**0.25**	m	
Volume of tank	25.70	m^3	slab thickness	**0.3**	m	
Assumed liquid depth	**2**	m	freeboard	**0.5**	m	
Area of the tank	12.85	m^2				
side of square tank	3.58	m	fix length	**3.7**	m	
			fix breadth	**3.7**	m	
Volume provided	27.38	OK			area in m^2	**23.04**
Pressure Sand Filter						
Average flow	1850.72	m^3/day				
Filter operating hours	**20**	hours				
Operating flow	92.54	m^3/hour				
Filter Loading Rate	12	m^3/m^2/hour				
Area of the filter required	7.71	m^2				
Number of filters	**2**					
Area of each filter	3.86	sqm				
Diameter of filter required	2.22	m	fix	**2.5**	m	
Height of the filter	**2.5**	m	offset to wall	**0.5**	m	
Operating pressure	**3.5**	Bar				
Filter media	Sand				area in m^2	**24.50**
Activated Carbon Filter						
Average flow	1850.72	m^3/day				
Filter operating hours	**20**	hours				
Operating flow	92.54	m^3/hour				
Filter Loading Rate	10	m^3/m^2/hour				
Area of the filter required	9.25	m^2				
Number of filters	**2**					
Area of each filter	4.63	sqm				
Diameter of filter required	2.43	m	fix	**2.5**	m	
Height of the filter	**2.5**	m	offset to wall	**0.5**	m	

Operating pressure	**3.5**	Bar				
Filter media	Activated Carbon				area in m^2	**24.50**

Pump for clarified water to PSF and ACF						
Type of pump set	CF					
Number of pumps	**1.00**	W	**1**	SB	**1**	
Discharge of clarified water required	77.11	m^3/hour				
Working hours of pumps	**20.00**	hours				
Discharge required	92.54	m^3/hour	2.6E-02	m^3/sec		
Head required	**35.00**	m				
Efficiency	**50%**					
Power required	23.99	fix	**24.00**	HP		
Energy	357.94	kwh				
Treated Water Tank						
HRT	**60**	minutes	offset to wall	**0.3**	m	
Average flow	77.11	m^3/hour	wall thickness	**0.25**	m	
Volume of the tank	77.1	m^3	slab thickness	**0.3**	m	
Assumed liquid depth	**2.5**	m	freeboard	**0.5**	m	
Area of the tank	30.85	m^2				
Number of tanks	**1**		fix length	**5.6**	m	
Area of one tank	30.85	m^2	fix breadth	**5.6**	m	
Side of square tank	5.55	m				
Volume provided	78.40	m^3	OK		area in m^2	**44.89**
Administrative bldg, lab, chemical store etc(30*25)	750.00					
Transformer yard (12*12)	144.00					
Total area of units	1731.23	m^2				
Movement space factor	**1.6**					
Total area rquired	2769.96	m^2	**0.68**	**Acre**		

DESIGN OF CO-TREATMENT UNIT FOR SEPTAGE WITH MOVING BED BIOFILM-REACTOR (MBBR)						
Design population	**10000**					
Sludge deposit coefficient	**95**	litres/person/year				
Sludge deposit	2.60	KLD				
Average septage flow	**2.6**	KLD				
Working hours	**24**					
Design flow	2.60	KLD	2600	LPD	2.6	m^3/day
Assumed peak factor	**1.5**		3	KLD	0.11	m^3/hour

Peak design flow	3.90	KLD	3900	LPD	4	m^3/day
					0.16	m^3/hour
Number of trips/day	**8**				0.00005	cum/sec
Quantity of septage obtained in single trip with peak factor	0.49	m^3				
Raw Septage Characteristics						
COD	**25000**	mg/l				
BOD	**5000**	mg/l				
TSS	**7000**	mg/l				
Treated Sewage Characteristics (after filtration)						
COD	**50**	mg/l				
BOD	**10**	mg/l				
TSS	**20**	mg/l				
Receiving Chamber						
Average quantity of flow	0.11	m^3/hour				
Peak flow	0.16	m^3/hour				
	0.00005	m^3/sec				
Average Retention Time for peak flow	**600**	sec	offset to wall	**0.3**	m	
Volume of the inlet chember	0.0271	m^3	free board	**0.85**	m	
Assumed depth of flow	**1**	m	total height	**1.35**	m	
Area required for inlet chamber	0.03	m^2	wall thickness	**0.25**	m	
Length of the tank	**0.5**	m	slab thickness	**0.3**	m	
Breadth of the tank	0.05	fix	**0.45**	m	area in m^2	**2.48**
Design of Dilution Chamber from Mass-balance Principle						
Target outflow BOD (actual incoming BOD to STP)	**265**	mg/l				
Target outflow TSS (actual incoming TSS to STP)	**400**	mg/l				
Volume of recycled water used for dilution	**10000**	litres				
Quantity of septage obtained as above	0.49	m^3	ratio of dilution		20.51	
BOD of diluted septage	241.95	mg/l	**ok**			
TSS of diluted septage	344.46	mg/l	**ok**			
Total volume of dilution tank	10.49	m^3				
Liquid depth adopted inside dilution tank	**2.00**	m	side of square tank		2.29	m
Length of dilution tank adopted	**2.50**	m				
Breadth of dilution tank adopted	**2.50**	m	volume	12.50	m^3	ok

Average outflow from dilution tank	2.33	m^3/hour				
Average sewage flow entering the STP with diluted septage	77.11	m^3/hour	% of diluted sepatge to sewage			3.02

Oil and Grease Trap						
Average quantity of flow	2.33	m^3/hour				
Peak flow	3.50	m^3/hour				
	0.00097	m^3/sec				
Average Retention Time for peak flow	**300**	sec	offset to wall	**0.15**	m	
Volume of the inlet chamber	0.29	m^3	free board	**0.5**	m	
Assumed depth of flow	**1**	m	total height	**1.5**	m	
Area required for inlet chamber	0.29	m^2	wall thickness	**0.25**	m	
Length of the tank	**1**	m	slab thickness	**0.3**	m	
Breadth of the tank	0.29	fix	**0.5**	m	area in m^2	**2.34**
Breadth of baffle wall inside	0.5	m				
Manual Coarse Screen Channel						
Peak design flow	0.00097	m^3/sec				
Number of screen	**1**					
Peak flow rate per screen	0.0010	m^3/sec				
Velocity at peak flow	**0.75**	m/sec	assumed			
Velocity through clean bar screen	**0.85**	m/sec				
Length of channel U/S	**1**	m	wall thickness	**0.25**	m	
Width of channel provided	**0.45**	m	offset to wall	**0.25**	m	
Depth of flow	0.0029	m	slab thickness	**0.30**	m	
Area required for screen	0.0013	sqm				
Headloss through bar screen	0.01	m	*assuming head loss coefficient = 0.7*			
Assumed depth of flow after inserting bar screen	**0.1**	m	0.01	(control value)		
Width of channel required	0.01	m	fix	**0.45**	m	
Clear bar spacing	**20**	mm	*(20 to 50*			

			mm)			
Bar thickness	**10**	mm	*(5 to 15 mm)*			
Number of bars	**15**					
Clear bar spacing obtained	21	mm	OK			
Inside width of screen (openings)	0.3	m			area in m^2	**2.9**
Full height of channel	**0.6**	m	fb	**0.3**		
Angle of inclination	**45**	degree	0.79	rad		
Actual velocity at peak flow	0.22	*(between 0.60 m/sec and 0.90 m/sec)*				
Length of channel required D/S	0.60	m	fix	**1**	m	
Sewage pump- for pumping to equalisation tank of STP						
Number of pumps	**1**	SB	**1**			
Type of pump set	submersible centrifugal sewage transfer-non clog					
Average flow	2.33	m^3/hour				
Peak design flow	3.50	m^3/hour				
Working hours	**23**					
Flow capacity of each pump	3.65	m^3/hour				
Peak factor	**1.20**					
Discharge	1.22	LPS	0.0012	m^3/sec		
Head required	**18**	m				
Efficiency	**50%**					
Power required	0.58	HP	fix	**1**	HP	
Energy	10.01	kwh				
Recycled water pump- for pumping to dilution tank						
Number of pumps	**1**	SB	**1**			

Type of pump set	**submersible centrifugal sewage transfer-non clog**					
Average flow	**2.22**	m3/hour				
Peak design flow	**3.33**	m3/hour				

Working hours	**23**					
Flow capacity of each pump	**3.48**	m3/hour				
Peak factor	**1.20**					
Discharge	**1.16**	LPS	**0.0012**	m3/sec		
Head required	**20**	m				
Efficiency	**50%**					
Power required	**0.62**	HP	**fix**	1	HP	
Energy	**10.61**	kwh				

8.1.1 SIZING OF STP UNITS

Sl No	Components	L	B	H	No of units	Type of construction
1	Receiving Chamber STP	3	1.7	1.7	1	RCC
2	Receiving Chamber CTU	0.5	0.45	1.35	1	RCC
3	Oil and Grease trap STP	4.5	2.2	2.25	1	RCC
4	Oil and Grease trap CTU	1	0.5	1.5	1	RCC
5	Manual Coarse Screen Channel STP	5.2	0.75	1.7	2	RCC
6	Manual Coarse Screen Channel CTU	2	0.45	0.9	2	RCC
7	Manual Fine Screen Channel STP	6.75	0.75	1.5	2	RCC
8	Dilution tank for CTU	2.5	2.5	2.5	1	RCC
9	Grit Separator	2.5	2.5	2	1	RCC
10	Equalization Tank	11.3	11.3	4.1	1	RCC
11	Moving Bed Bio Reactor 1	8.8	8.8	4.1	1	RCC
12	Moving Bed Bio Reactor 2	9.9	9.9	4.1	1	RCC
13	Moving Bed Bio Reactor 3	6.4	6.4	4.1	1	RCC
14	Moving Bed Bio Reactor 4	4.1	4.1	4.1	1	RCC
15	Secondary Clarifier with Plate Settler	4.75	4.75	5.3	1	RCC
16	Filter Feed Tank	3.7	3.7	2.5	1	RCC
17	Sludge Sump	Dia	1.8	2.7	1	RCC
18	Sludge Thickener	Dia	4.2	2.5	1	RCC
19	Chlorine Contact Tank	4.5	4.5	2.5	1	RCC
20	Treated Water Tank	5.6	5.6	3	1	RCC
21	Alum Solution Tank	0.6	0.6	1	2	FRP/HDPE

27	Lime Solution Tank	0.6	0.6	1	2	FRP/HDPE
28	Hypo Dosing Tank	0.6	0.6	1	2	FRP/HDPE
29	Administrative Buiding ,Office cum laboratary ,etc	1000		sqm		RCC
ELECTRO-MECHANICAL UNITS						
1	Sewage Transfer pump to MBBR	10	HP		2	Submersible Cntrifugal
2	Manual Coarse Screen- STP	20	mm	Openinng	2	SS 304
3	Manual Coarse Screen- CTU	20	mm	Openinng	1	SS 304
4	Manual Fine Screen- STP	6	mm	Openinng	2	SS 304
5	Air Grid and Diffused aeration system for ET, MBBR Tanks and Sludge Tank			As per Design		PVC
6	MBBR Carrier			As per Design		PVC/HDPE
7	Air Blowers	1253.3	m3/hour		3+1 SB	
8	Plate Settlers			As per Design		SS
9	Sludge transfer pump to thickener	1	HP		2	Submersible Cntrifugal
10	Sludge transfer pump to centrifuge	0.5	HP		2	Screw type pump
11	Sludge Centrifuge	0.25	m3/hour		2	
12	Pump for clarified water to PSF and ACF	24	HP		2	Submersible Cntrifugal
13	Pressure Sand Filter (Dual media)	Dia	2.5	m	2	MS with all specials
14	Activated Carbon Filter	Dia	2.5	m	2	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

8.2 COLLECTION WELLS

DESIGN OF COLLECTION WELL No 1				
Average inflow into well from network	**4.59**	LPS		
Peak inflow into well from network	**13.77**	LPS	PF	3.00
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 well	4.59	LPS		
Total peak inflow into well from network+other well	13.77	LPS		
Retention time	**30**	min		
Number of pumps operated in peak hours	**1**			
Rated outflow during peak hours/pump in parallel	4.59	LPS		
Total rated outflow in peak hours	13.77	LPS		
Storare required for 30 min	24786.00	L		
Volume of sewage to be stored in well	24.79	m^3		
Diameter of collection well-inner	**3.97332**	m	4	Fix
Depth of collection well for storage	**2**	m		
Volume of sewage actually stored in well	25.13	m^3	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	4.9	m		
Freeboard of collection well	0.5	m		
Depth of well	**6.8**	m		

DESIGN OF COLLECTION WELL No 2				
Average inflow into well from network	**8.87**	LPS		
Peak inflow into well from network	**26.61**	LPS	PF	3.00
Average flow into well from other well	**0.00**	LPS		
Peak flow into well from other well	**0**	LPS		
Total average inflow into well from network+other well	8.87	LPS		
Total peak inflow into well from network+other well	26.61	LPS		
Retention time	**30**	min		
Number of pumps operated in peak hours	**1**			
Rated outflow during peak hours/pump in parallel	8.87	LPS		
Total rated outflow in peak hours	26.61	LPS		
Storare required for 30 min	47898.00	L		
Volume of sewage to be stored in well	47.90	m^3		
Diameter of collection well-inner	**4.94031**	m	5	
Depth of collection well for storage	**2.5**	m		
Volume of sewage actually stored in well	49.09	m^3	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	5.9	m		
Freeboard of collection well	0.5	m		
Depth of well	**7.5**	m		

DESIGN OF COLLECTION WELL No 3				
Average inflow into well from network	**3.81**	LPS		
Peak inflow into well from network	**11.43**	LPS	PF	3.00
Average flow into well from other well	**0.00**	LPS		
Peak flow into well from other well	**0**	LPS		
Total average inflow into well from network+other well	3.81	LPS		
Total peak inflow into well from network+other well	11.43	LPS		
Retention time	**30**	min		
Number of pumps operated in peak hours	**1**			
Rated outflow during peak hours/pump in parallel	3.81	LPS		
Total rated outflow in peak hours	11.43	LPS		
Storare required for 30 min	20574.00	L		
Volume of sewage to be stored in well	20.57	m^3		
Diameter of collection well-inner	**3.62001**	m	3.7	Fix
Depth of collection well for storage	**2**	m		
Volume of sewage actually stored in well	21.50	m^3	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	4.6	m		
Freeboard of collection well	0.5	m		
Depth of well	**5.3**	m		

8.3 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. Considering the alluvial nature of Aluva Municipality, provision for pile foundation has been included for all STP units. Soil analysis reports available for the locality have been examined to arrive at a decision. However, during the execution stage, detailed soil investigations can be performed. Cover for the reinforced concrete elements are 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. The detailed structural design has to be carried out after conducting soil investigation test.

CHAPTER-9
PROJECT COST

The estimate for the work has been prepared based on DSR 2018. The detailed structural design has not been considered for the estimate purpose and the same has to be done before execution of the project. Pile foundation has been adopted as per the details collected from works performed nearby area. The detailed estimate and costing have been separately attached.

9.1 LAND DEVELOPMENT

The land required for construction of sewerage treatment plant is 100 cents and the site proposed is property owned by Irrigation department with Sy.No.39/6-9 near Bypass road (Block-58). Municipal council resolution in this regard is obtained and is enclosed as Annexure 3. Total land required for the Collection wells are 18 cents (approximately six cents for each well) and the proposed lands are private lands except one site which is proposed in the proposed STP premises.

9.2 PHYSICAL INFRASTRUCTURE

9.2.1 SEWERAGE NETWORK SYSTEM

The total length of sewer network is 23.457 km in which 12394m of 180mm HDPE PE100 PN8 pipe 49.60m of 280mm HDPE PE100 PN8 pipe, 201.40m of 355mm pipe of HDPE PE100 PN8 and 10812.25m of 225mm HDPE PE100 PN8 pipe are proposed in the project. The network includes 456 Nos. manholes of 900mm diameter, 148 Nos. 1200mm diameter and 348 Nos. 1500mm diameter for a depth varying from 1.5 m to 6m.

Total length of Pumping main is 2274m of HDPE PE100 PN-10 pipes from 3 nos of wells to STP and 510 m of HDPE PE100 PN-10 pipes for lifting stations.

The total cost of this network system and pumping main comes to Rs.3765.90 lakhs as per DSR 2018 rates including GST. Detailed break up of estimate is appended.

Provision for NH crossing by HDD/Push through method incorporated in the estimate of network system. An amount of Rs.351.45 lakhs for effecting sewerage connections for individuals. Provisions for statutory clearance charge has incorporated in the estimate.

9.2.2 COLLECTION WELL CUM PUMP HOUSES

There are 3 Nos. of collection wells and out of which 1 No. is to be constructed in the premises of proposed STP land. The diameter of 2 wells are 7m, and for one well is 6m. The total cost for collection wells, pump houses and grit chamber is Rs.176.72 lakhs including GST. Detailed estimate attached.

9.2.3 ROAD RESTORATION CHARGES

The cost is estimated based on the standard rate for road restoration charges to be remitted to various departments. The total cost is estimated as Rs. 2586 lakhs including GST.

9.2.4 SEWERAGE TREATMENT PLANT UNITS

The total cost for the sewerage treatment plant units with co- treatment units comes to Rs.1125.38 lakhs including buffer zone with green belt, facility for recycling, administration building with compound wall etc. and including GST, detailed estimate is attached.

9.2.5 MECHANICAL ITEMS

The total cost for Mechanical Items comes to Rs.306.35 Lakhs including GST Detailed estimate attached.

9.2.6 ELECTRICAL & INSTRUMENTATION ITEMS

The total cost for Electrical and Instrumentation items comes to Rs.56.16 Lakhs including GST including Generator, IoT based sensor and control units, provision for solar units etc.

9.3 TOTAL ESTIMATED COST

The total Estimated Cost comes to **Rs.118.50 Crores** including 18% for GST. A provision for O&M for 10 years to an amount of Rs.905 Lakhs including GST excluding power charges has also been incorporated in the DPR.

CHAPTER 10
OPERATION AND MAINTENANCE

10.1 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.

10.2 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 flow rate 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 equalization facility will balance most of the issues related with the variability of the influent flow rate 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. Operation and maintenance for 10 years is to be performed by the firm who carries out the construction and commissioning of the STP.

10.3 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.

10.4 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.

10.5 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.

10.6 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 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.

10.7 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.

10.8 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.

10.9 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 analyze 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.

10.10 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.

10.11 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.

10.11.1 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 ±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.

10.12 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.

10.13 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 (H_2S) 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.

10.13.1 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.

10.13.2 CONTROL OF ODOUR BY CHEMICAL ADDITION

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

Table 10.1 Control of odour by chemical addition

Chemical	Effective against
Ozone Oxidisers	Atmospheric hydrogen sulphide only
Hydrogen peroxide	Hydrogen sulphide also act as oxygen sourse
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

10.14 MAINTAINING AN ECO-FRIENDLY SYSTEM

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: The plants like climbing hydrangea creeps 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.

10.15 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.

10.16 COST ANALYSIS - OPERATION & MAINTENANCE COSTS

OPERATION & MAINTENANCE COSTS					
Sl. No.	**Item**		**Unit**		**Expenditure**
1	Power Charges for STP @ Rs.5 for kwh @	106154		kwh/month	₹ 5,30,771
2	Power Charges for network @ Rs.5 for kwh @	15856		kwh/month	₹ 79,281
3	Operators rate/month	25000	9	Nos.	₹ 2,25,000
4	Unskilled Worker	8000	3	Nos.	₹ 24,000
5	Chemist	20000	1	Nos.	₹ 20,000
6	Fuel for generator/month				₹ 6,000
7	Gas Chlorine/month				₹ 3,500
8	Alum and Lime ,polyelectrolyte dosing/month				₹ 57,256
9	Spares and replacements/month				₹ 5,000
10	Network routine inspection, flushing, cleaning including for manholes/month@	0.3% of cost of network/year			₹ 1,00,433
	Total per month				₹ 10,51,242
	Total per month excluding power charges				₹ 4,41,189
	Annual Operation & Maintenance Charge				₹ 1,26,14,898
	Annual Operation & Maintenance Charge excluding power charges				₹ 52,94,268
	Treatment Cost per Day				₹ 34,561
	Unit Cost of Treatment per Kilo Litre				₹ 20
10 YEAR ANNUAL O&M COST CONSIDERING 8% ANNUAL INCREASE EVERY YEAR					
Excluding power charges					
1	1st year				₹ 52,94,268
2	2nd year				₹ 57,17,809
3	3rd year				₹ 61,75,234
4	4th year				₹ 66,69,253
5	5th year				₹ 72,02,793

6	6th year				₹ 77,79,016
7	7th year				₹ 84,01,337
8	8th year				₹ 90,73,444
9	9th year				₹ 97,99,320
10	10th year				₹ 1,05,83,266
	Total O&M cost for 10 years				₹ 7,66,95,740
	GST @ 18%				₹ 1,38,05,233
	Total O&M cost for 10 years including GST				**INR 9,05,00,973**

CHAPTER-11
IMPLIMENTATION OF THE PROJECT

11.1 IMPLEMENTING AGENCY

Kerala Water Authority is the responsible agency in Government sector in the water supply sector and sewerage Sector for implementation of Major Projects under various funding agencies AMRUTH, NABARD, Rebuild Kerala, ADB assistance, and also STATE PLAN Works. Being high value projects Implementation of sewerage projects also requires an agency with expertise and having sufficient human resources.

11.2 STEPS TO BE TAKEN WHILE TENDERING.

Conditions should be incorporated in the NIT that detailed field survey and design of network shall be carried out for ascertaining the levels due to road developments if any and in order to accommodate the fact that sewer network design based on gravity flow and accurate levels with Total Station equipment along both sides of road and centre of road is required. Due to limitation of fund and time DGPS survey along one side of the road is only taken in the present proposal. Additional changes required for satisfactory completion of work additional sewer lines required with additional manholes, lifting stations required due to future developments in the scheme area shall also be included in the scope of work while implementing the project. Better and advanced technology for treatment to be considered for STP while implementing the project. Soil investigation of STP site, well sites not carried out as the lands proposed are private lands. Hence detailed soil investigation is to be carried out and type of foundation of the structures to be changed accordingly.

11.3 INTEGRATION WITH OTHER PROJECTS

Planning and design of sewerage schemes can be combined with other water projects. This is since most of these projects are inter-related and environment sensitive. Hence the location of an STP, collection wells and coverage of sewerage 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. Planning shall also be done for integrating with road development projects in the scheme area so as to execute all road reformation works after laying sewerage system.

11.4 SUPPORT ACTIVITIES

It has been observed that in many cases of the implementation of the sewerage projects, public protests are experienced by the implementing agencies and authorities.

This is because of the unawareness of the local people about the treatment process, disposal of sludge and re-use of treated sewage etc. In this regard, it is essential to educate the consumers to make them aware of the waste management process thereby encouraging them to come up with sewerage connections. The state government is promoting the waste management concept in all the possible ways. More support is needed from the Local Self Government Departments, Suchitwa Mission Kerala, Haritha Keralam Mission Kerala and all the other departments by organizing programmers for motivation public through seminars and awareness classes.

11.5 IMPLIMENTATION SCHEDULE

Sl.No.	Activity ↓ / Month →	Year 2022												Year 2023											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1	Appraisal of Report																								
2	Sanction of the Project																								
3	Tendering and Awarding work																								
4	STP - Civil Work																								
5	STP-Mechanical Works																								

6	STP-Electrical and Instrumentation works																								
7	Sewer Network and Allied works																								
8	Trial Commissioning																								

Table 11.1 : Implementation Schedule

Proposed implementation Schedule is provided above. The project is proposed to complete within a period of two years.

CHAPTER – 12
CONCLUSION AND RECOMMENDATION

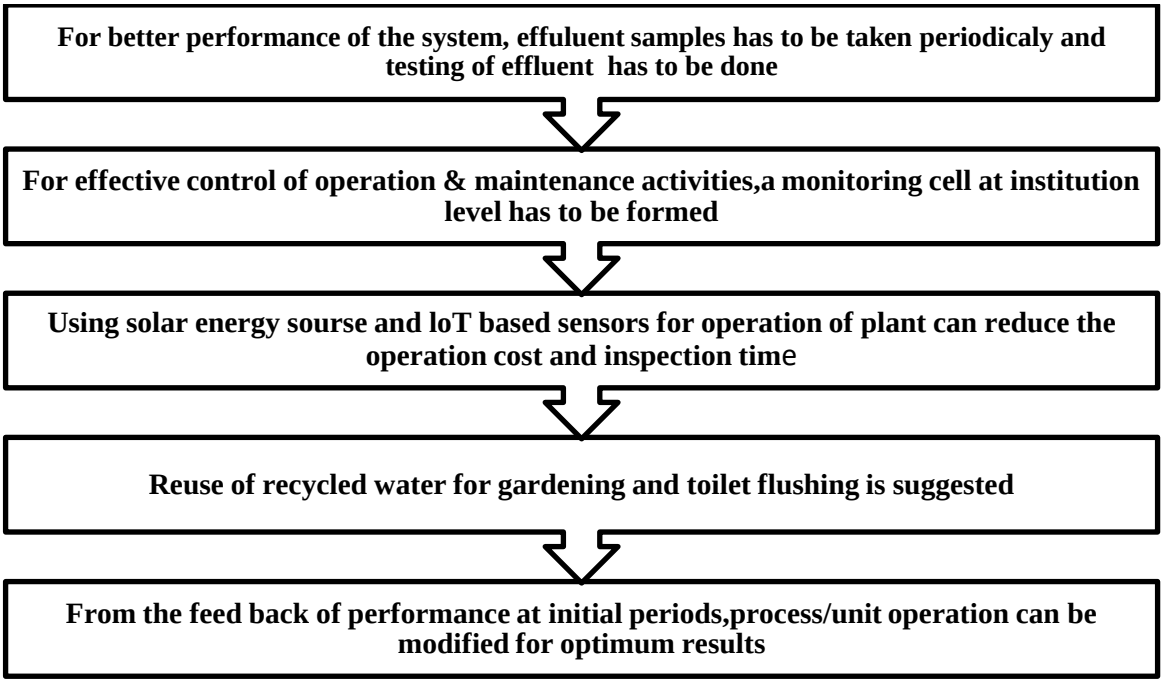
12.1 CONCLUSION

- The responsibility of providing sewerage systems rest with local bodies which can be facilitated by Kerala Water Authority. KWA has recently set up a Sewerage Vertical with four sewerage circles towards this. The idea and vision behind it are to visualize and materialize complete sewerage schemes for the State as it is vital for a safe environment. Moreover, there are directions from the Honourable National Green Tribunal (NGT) for ensuring the installation of Effluent Treatment Plants (ETPs), Common Effluent Treatment Plants (CETPs), Sewage Treatment Plants (STPs) and other pollution control measures. Hon. NGT has also directed to take necessary action to abate discharge of pollution into rivers (OA No. 673 of 2018).
- This proposal includes 1.72 MLD STP with MBBR technology at the land owned by Irrigation Department, Thottakkattukara in Aluva Municipality, a sewer network of 23.457 km, 952 manholes, 2 pumping stations near to NH Paravu Kavala, and near Old Desam Road and 17 lifting stations. Manholes at 30 m intervals and at all intersections are proposed to facilitate maintenance operations. Septage load if any from any area of Aluva Municipality which are not connected by sewer network, is proposed to be transported to the 1.72 MLD STP where Co-treatment facility will be provided.
- The cost estimate of the project is excluding land cost. The fund for land has to be provided by the local bodies /Government, according to the source of funding for the scheme.
- If sufficient funds and lands are made available, the projects can be taken up by KWA and can be completed in 2 years. For efficient control of operation and maintenance a monitoring cell at institutional level is to be formed.
- Soil investigation and sewage sample test has to be performed before implementing the project
- For better performance of the system testing of influent samples, effluent samples after treatment from each unit is to be tested at regular intervals and modifications if any shall be made at the initial stage itself so as to ensure efficiency of individual units and effluent standards as per design.

- Better and advanced technology for treatment to be considered for STP while implementing the project.
- Sludge generated in the STP must be properly disposed of 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.
- 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.

12.2 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:



ANNEXURE

ANNEXURE-1

ALUVA ZONE-1 THOTTAKKATTUKARA WEST EPASWMM REPORT

[JUNCTIONS]

Name	Elevation	Baseline	Name	Elevation	Baseline	Name	Elevation	Baseline
J123	4.303647	0.011975	J157	4.083471	0.011975	J221	3.502412	0.011975
J124	4.48	0.011975	J158	1.562235	0.011975	J222	2.617529	0.011975
J125	1.506765	0.011975	J159	2.85	0.011975	J223	5.103294	0.011975
J126	4.127176	0.011975	J160	2.44	0.011975	J224	11.4	0.011975
J127	3.597765	0.011975	J161	6.874118	0.011975	J225	3.12	0.011975
J128	3.774235	0.011975	J163	7.203235	0.011975	J226	2.12	0.011975
J129	3.950706	0.011975	J164	4.867882	0.011975	J227	3.38	0.011975
J130	1.330412	0.011975	J165	8.1	0.011975	J228	2.864	0.011975
J131	4.53	0.011975	J166	7.39	0.011975	J238	2.136588	0.011975
J132	2.277118	0.011975	J167	2.395882	0.011975	J239	0.877353	0.011975
J133	2.100647	0.011975	J168	1.218471	0.011975	J321	4.700706	0.011975
J134	0.624941	0.011975	J169	1.042	0.011975	J487	6.723647	0.011975
J135	1.153941	0.011975	J170	0.865529	0.011975	J488	0.539353	0.011975
J136	0.977882	0.011975	J171	1.394824	0.00192	J489	0.652294	0.011975
J137	0.801412	0.011975	J172	1.924176	0.011975	J490	0.860059	0.011975
J138	7.37	0.011975	J173	1.747706	0.011975	J491	0.380235	0.011975
J139	6.84	0.011975	J174	1.571235	0.011975	J492	-0.15	0.011975
J140	6.33	0.011975	J175	4.6	0.075309	J493	0.009941	0.011975
J141	7.72	0.011975	J176	3.718941	0.011975	J494	0.216294	0.011975
J142	9.94	0.011975	J177	3.542471	0.011975	J496	3.95	0.011975
J143	9.02	0.011975	J178	3.907118	0.011975	J497	4.36	0.011975
J144	8.11	0.011975	J179	3.895412	0.011975	J498	4.85	0.011975
J145	5.97	0.011975	J180	4.423941	0.011975	J499	3.773529	0.011975
J146	3.068353	0.011975	J181	4.247529	0.011975	J500	2.969059	0.011975
J147	3.244824	0.011975	J182	4.071706	0.011975	J501	3.145529	0.011975
J148	3.421294	0.011975	J183	10.84	0.011975	J502	3.53	0.011975
J149	4.51	0.011975	J199	3.474118	0.011975	J503	1.423353	0.011975
J150	5.67	0.011975	J214	2.584176	0.011975	J504	3.43	0.011975
J151	5.38	0.011975	J215	2.505941	0.011975	J505	3.223941	0.011975
J152	5.203529	0.011975	J216	3.61	0.011975	J506	1.783294	0.011975
J153	3.373647	0.011975	J217	2.794294	0.011975	J507	3.431294	0.011975
J154	5.37	0.011975	J218	3.816529	0.011975	J508	2.513235	0.011975
J155	1.262765	0.011975	J219	3.96	0.011975	J509	2.294059	0.011975
J156	2.579	0.011975	J220	2.98	0.011975	J510	3.047471	0.011975

J511	2.785	0.011975	J556	3.465647	0.011975	J598	3.598235	0.011975
J512	2.996	0.011975	J557	3.87	0.011975	J599	3.432412	0.011975
J513	3.138	0.011975	J558	3.66	0.011975	J600	3.193	0.011975
J514	2.609	0.011975	J559	3.89	0.011975	J601	2.540706	0.011975
J515	2.829529	0.011975	J560	3.8	0.011975	J602	1.078235	0.011975
J516	2.308	0.011975	J561	3.322706	0.011975	J603	0.923882	0.011975
J517	2.432	0.011975	J562	3.487588	0.011975	J604	0.750235	0.011975
J518	4.690118	0.011975	J563	3.67	0.011975	J605	1.638706	0.011975
J519	4.99	0.011975	J564	1.025471	0.011975	J606	2.327176	0.011975
J520	5.19	0.011975	J565	0.827118	0.011975	J607	2.145118	0.343086
J521	4.548588	0.011975	J566	0.639647	0.011975	J608	2.009765	0.011975
J522	7.35	0.011975	J567	3.613765	0.011975	J731	3.248412	0.011975
J523	4.09	0.011975	J568	0.321353	0.011975	J732	2.182	0.011975
J524	4.26	0.011975	J569	0.132353	0.011975	J733	3.45	0.011975
J525	5.88	0.011975	J570	3.95	0.141975	J734	1.053765	0.011975
J530	6.07	0.011975	J571	-0.01012	0.011975	J735	3.37	0.235309
J531	6.21	0.011975	J572	1.392941	0.011975	J736	0.875529	0.011975
J532	6.506882	0.011975	J573	1.216471	0.011975	J737	1.153588	0.011975
J533	3.95	0.011975	J574	1.062471	0.661975	J738	3.367235	0.011975
J534	3.719412	0.011975	J575	1.839235	0.011975	J739	2.773294	0.011975
J535	3.659471	0.011975	J576	-0.15041	0.011975	J740	2.222882	0.011975
J536	7.83	0.011975	J577	2.223765	0.011975	J741	3.64	0.011975
J537	5.91	0.011975	J578	2.047353	0.011975	J742	2.859	0.011975
J538	6.58	0.011975	J579	3.314353	0.011975	J743	3.171059	0.011975
J539	7.39	0.011975	J580	3.73	0.011975	J744	3.130824	0.011975
J540	1.019765	0.011975	J581	-0.17724	0.011975	J745	3.009	0.011975
J541	1.884588	0.011975	J582	3.7	0.011975	J746	0.295059	0.011975
J542	2.184118	0.011975	J583	0.582294	0.011975	J747	0.007706	0.011975
J543	5.23	0.011975	J584	0.146647	0.011975	J748	-0.25024	0.011975
J544	1.708118	0.01008	J585	-0.01988	0.011975	J749	0.410647	0.011975
J545	1.178765	0.011975	J586	-0.00529	0.011975	J750	1.209353	0.011975
J546	1.355176	0.011975	J587	0.891882	0.011975	J751	1.048118	0.011975
J547	1.531647	0.00192	J588	1.053529	0.011975	J752	0.766412	0.011975
J548	3.004882	0.011975	J589	3.201471	0.011975	J753	1.567941	0.011975
J549	2.846882	0.011975	J590	0.675176	0.011975	J754	2.75	0.011975
J550	3.023353	0.011975	J591	0.171176	0.011975	J755	2.485765	0.011975
J551	3.199765	0.011975	J592	0.307176	0.011975	J756	2.456647	0.011975
J552	2.670412	0.011975	J593	0.493529	0.011975	J757	2.603	0.011975
J553	0.65	0.011975	J594	3.62	0.011975	J758	2.134471	0.011975
J554	0.2	0.011975	J595	2.892294	0.011975	J759	1.392176	0.011975
J555	2.493941	0.011975	J597	3.068471	0.011975	J760	1.516471	0.011975

J761	4.63	0.023951	J803	2.934059	0.011975	J844	3.613765	0.011975
J762	3.376765	0.011975	J804	3.58	0.011975	J845	3.92	0.011975
J763	3.65	0.011975	J805	3.45	0.011975	J846	3.841294	0.011975
J764	4.241706	0.011975	J806	2.555941	0.011975	J847	3.17	0.011975
J765	3.689706	0.011975	J807	4.03	0.011975	J848	3.92	0.011975
J766	4.418118	0.011975	J808	4.3	0.011975	J849	3.48	0.011975
J767	-0.14541	0.011975	J809	3.345824	0.011975	J850	3.380294	0.011975
J768	3.51	0.011975	J810	3.859353	0.011975	J851	3.286941	0.011975
J769	3.284471	0.011975	J811	7.627529	0.011975	J852	2.884294	0.011975
J770	3.063882	0.011975	J812	3.743235	0.011975	J853	2.5	0.011975
J771	3.816294	0.011975	J813	3.625588	0.011975	J854	3.6	0.011975
J772	3.449176	0.011975	J814	3.65	0.011975	J855	2.98	0.011975
J773	3.5	0.011975	J815	6.36	0.011975	J856	2.404647	0.011975
J774	3.490824	0.011975	J816	3.93	0.011975	J857	1.907235	0.011975
J775	3.8	0.011975	J817	3.75	0.011975	J858	2.033471	0.011975
J776	1.422529	0.011975	J818	4.406118	0.011975	J859	2.259588	0.011975
J777	1.038118	0.011975	J819	2.84	0.011975	J860	2.734588	0.011975
J778	3.53	0.011975	J820	2.037059	0.011975	J861	3.236353	0.011975
J779	0.545706	0.011975	J821	6.27	0.011975	J862	3.027588	0.011975
J780	-0.38153	0.011975	J822	3.465471	0.011975	J863	0.125176	0.011975
J781	0.717353	0.011975	J823	1.906647	0.011975	J864	3.446294	0.011975
J782	-0.33565	0.011975	J824	3.57	0.011975	J865	3.112176	0.011975
J783	1.601647	0.011975	J825	2.569529	0.011975	J866	2.924941	0.011975
J784	2.383118	0.011975	J826	2.158765	0.011975	J867	2.752588	0.011975
J785	3.494118	0.011975	J827	2.027235	0.011975	J868	3.893	0.011975
J786	1.226412	0.011975	J828	2.72	0.011975	J869	3.8	0.011975
J787	3.57	0.011975	J829	1.685471	0.011975	J870	3.62	0.011975
J788	1.876765	0.011975	J830	2.578824	0.011975	J871	3.480235	0.011975
J789	3.308235	0.011975	J831	1.421294	0.011975	J872	-0.58053	0.011975
J790	2.472824	0.011975	J832	1.949059	0.011975	J873	3.44	0.011975
J791	1.866353	0.011975	J833	2.777706	0.011975	J874	3.227941	0.011975
J792	3.677412	0.011975	J834	1.593176	0.011975	J875	3.05	0.011975
J793	3.832235	0.011975	J835	3.46	0.011975	J876	1.457353	0.011975
J794	3.327	0.011975	J836	3.423059	0.011975	J877	1.590529	0.011975
J795	3.512412	0.011975	J837	3.364353	0.011975	J878	1.731	0.011975
J796	3.333765	0.011975	J838	3.247059	0.011975	J879	1.250412	0.011975
J797	2.673529	0.011975	J839	3.749294	0.011975	J880	2.71	0.011975
J798	2.792588	0.011975	J840	3.54	0.011975	J881	2.59	0.011975
J800	3.543647	0.011975	J841	3.417882	0.011975	J882	2.29	0.011975
J801	3.715647	0.011975	J842	3.591824	0.011975	J883	3.060706	0.011975
J802	3.27	0.011975	J843	3.94	0.011975	J884	2.896529	0.011975

J885	2.731706	0.011975	J927	3.378647	0.011975	J968	1.858941	0.011975
J886	3.274882	0.011975	J928	3.65	0.011975	J969	2.035412	0.011975
J887	1.749765	0.011975	J929	2.572412	0.011975	J970	1.635235	0.011975
J888	3.47	0.011975	J930	4.2	0.011975	J972	3.183765	0.011975
J889	3.295765	0.011975	J931	3.329765	0.011975	J973	0.982294	0.011975
J890	2.084118	0.011975	J932	1.661529	0.011975	J974	3.031706	0.011975
J891	1.054235	0.011975	J933	3.88	0.011975	J975	4.89	0.011975
J892	0.745	0.011975	J934	3.59	0.011975			
J893	0.545824	0.011975	J935	2.706059	0.011975			
J894	1.234941	0.011975	J936	3.88	0.011975			
J895	1.867529	0.011975	J937	3.71	0.011975			
J896	1.691059	0.011975	J938	3.261294	0.011975			
J897	1.467118	0.011975	J939	3.485647	0.011975			
J898	4.045059	0.011975	J940	3.019235	0.011975			
J899	3.918353	0.011975	J941	3.218059	0.011975			
J900	3.673471	0.011975	J942	3.29	0.011975			
J902	3.533176	0.011975	J943	3.1	0.011975			
J903	3.490235	0.011975	J944	2.728765	0.011975			
J904	3.059941	0.011975	J945	2.432176	0.011975			
J905	3.613824	0.011975	J946	2.615	0.011975			
J906	2.278529	0.011975	J947	2.72	0.011975			
J907	2.141824	0.011975	J948	2.187	0.011975			
J908	1.925706	0.011975	J949	2.385706	0.011975			
J909	2.454941	0.011975	J950	2.562176	0.011975			
J910	3.14	0.011975	J951	3.49	0.011975			
J911	2.978941	0.011975	J952	1.154824	0.011975			
J912	2.802471	0.011975	J953	0.925294	0.011975			
J913	0.565235	0.011975	J954	0.864412	0.011975			
J914	3.72	0.011975	J955	1.281471	0.011975			
J915	3.628529	0.011975	J956	2.011118	0.011975			
J916	3.62	0.011975	J957	1.759118	0.011975			
J917	3.016	0.011975	J958	1.496588	0.011975			
J918	3.175176	0.011975	J959	1.73	0.011975			
J919	3.65	0.011975	J960	1.662765	0.011975			
J920	3.56	0.011975	J961	1.486294	0.011975			
J921	3.177	0.011975	J962	2.322588	0.011975			
J922	0.478118	0.011975	J963	2.671647	0.011975			
J923	0.301647	0.011975	J964	2.495176	0.011975			
J924	-0.26959	0.011975	J965	2.867294	0.011975			
J925	2.72	0.011975	J966	0.880118	0.011975			
J926	3.032118	0.011975	J967	1.709706	0.011975			

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CONDUITS

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Name	Node		Length	Roughness	Diameter	Losses		
	From	To			(m)	Kentry	Kexit	Kavg
1	J928	J864	34.63	0.01	0.2	0.5	0.5	0.5
2	J864	J861	35.69	0.01	0.2	0.5	0.5	0.5
3	J861	J862	35.49	0.01	0.2	0.5	0.5	0.5
4	J862	J863	15.32	0.01	0.2	0.5	0.5	0.5
5	J925	J565	36.95	0.01	0.2	0.5	0.5	0.5
6	J926	J965	28.02	0.01	0.2	0.5	0.5	0.5
7	J921	J926	24.63	0.01	0.2	0.5	0.5	0.5
8	J927	J921	34.51	0.01	0.2	0.5	0.5	0.5
9	J902	J927	21.59	0.01	0.2	0.5	0.5	0.5
10	J915	J902	16.21	0.01	0.2	0.5	0.5	0.5
11	J914	J915	15.55	0.01	0.2	0.5	0.5	0.5
12	J903	J927	18.97	0.01	0.2	0.5	0.5	0.5
13	J916	J903	22.06	0.01	0.2	0.5	0.5	0.5
14	J917	J962	30.19	0.01	0.2	0.5	0.5	0.5
16	J904	J917	21	0.01	0.2	0.5	0.5	0.5
15	J918	J904	7.47	0.01	0.2	0.5	0.5	0.5
17	J938	J918	19.59	0.01	0.2	0.5	0.5	0.5
19	J937	J939	38.14	0.01	0.2	0.5	0.5	0.5
18	J939	J938	14.64	0.01	0.2	0.5	0.5	0.5
20	J920	J904	7.98	0.01	0.2	0.5	0.5	0.5
21	J919	J920	11.29	0.01	0.2	0.5	0.5	0.5
22	J974	J575	18.24	0.01	0.2	0.5	0.5	0.5
23	J941	J974	31.68	0.01	0.2	0.5	0.5	0.5
24	J931	J941	18.99	0.01	0.2	0.5	0.5	0.5
25	J199	J931	24.54	0.01	0.2	0.5	0.5	0.5
26	J905	J199	23.1	0.01	0.2	0.5	0.5	0.5
27	J899	J905	29.99	0.01	0.2	0.5	0.5	0.5
28	J898	J899	21.54	0.01	0.2	0.5	0.5	0.5
29	J930	J898	26.34	0.01	0.2	0.5	0.5	0.5
30	J900	J905	10.14	0.01	0.2	0.5	0.5	0.5
31	J936	J900	35.11	0.01	0.2	0.5	0.5	0.5
32	J932	J966	15.49	0.01	0.2	0.5	0.5	0.5
33	J887	J932	15	0.01	0.2	0.5	0.5	0.5
34	J908	J887	29.91	0.01	0.2	0.5	0.5	0.5

35	J907	J908	36.74	0.01	0.2	0.5	0.5	0.5
36	J906	J907	23.24	0.01	0.2	0.5	0.5	0.5
37	J909	J906	29.99	0.01	0.2	0.5	0.5	0.5
38	J929	J909	19.97	0.01	0.2	0.5	0.5	0.5
39	J935	J929	22.72	0.01	0.2	0.5	0.5	0.5
40	J912	J935	16.39	0.01	0.2	0.5	0.5	0.5
41	J911	J912	30	0.01	0.2	0.5	0.5	0.5
42	J910	J911	27.38	0.01	0.2	0.5	0.5	0.5
43	J934	J910	8.14	0.01	0.2	0.5	0.5	0.5
44	J933	J934	21.83	0.01	0.2	0.5	0.5	0.5
45	J766	J764	29.99	0.01	0.2	0.5	0.5	0.5
46	J761	J766	36.02	0.01	0.2	0.5	0.5	0.5
48	J853	J856	16.21	0.01	0.2	0.5	0.5	0.5
49	J856	J859	24.66	0.01	0.2	0.5	0.5	0.5
50	J859	J238	20.91	0.01	0.2	0.5	0.5	0.5
51	J238	J858	17.53	0.01	0.2	0.5	0.5	0.5
52	J858	J857	21.46	0.01	0.2	0.5	0.5	0.5
53	J857	J878	29.96	0.01	0.2	0.5	0.5	0.5
54	J878	J877	23.88	0.01	0.2	0.5	0.5	0.5
55	J877	J876	22.64	0.01	0.2	0.5	0.5	0.5
56	J876	J879	35.18	0.01	0.2	0.5	0.5	0.5
57	J879	J564	38.24	0.01	0.2	0.5	0.5	0.5
58	J564	J565	33.72	0.01	0.2	0.5	0.5	0.5
59	J565	J566	32.64	0.01	0.2	0.5	0.5	0.5
60	J566	J922	27.46	0.01	0.2	0.5	0.5	0.5
61	J922	J923	30	0.01	0.2	0.5	0.5	0.5
62	J923	J863	30	0.01	0.2	0.5	0.5	0.5
63	J863	J571	23	0.01	0.2	0.5	0.5	0.5
64	J571	J576	23.85	0.01	0.2	0.5	0.5	0.5
65	J576	J924	20.26	0.01	0.2	0.5	0.5	0.5
67	J965	J963	33.72	0.01	0.2	0.5	0.5	0.5
68	J963	J964	30	0.01	0.2	0.5	0.5	0.5
69	J964	J962	29.34	0.01	0.2	0.5	0.5	0.5
70	J962	J577	16.8	0.01	0.2	0.5	0.5	0.5
71	J577	J578	29.99	0.01	0.2	0.5	0.5	0.5
72	J578	J575	35.38	0.01	0.2	0.5	0.5	0.5
73	J575	J959	38.68	0.01	0.2	0.5	0.5	0.5
74	J959	J960	30	0.01	0.2	0.5	0.5	0.5
75	J960	J961	30	0.01	0.2	0.5	0.5	0.5
76	J961	J572	15.87	0.01	0.2	0.5	0.5	0.5
77	J572	J573	30	0.01	0.2	0.5	0.5	0.5

79	J574	J966	15.72	0.01	0.2	0.5	0.5	0.5
80	J854	J227	22.68	0.01	0.2	0.5	0.5	0.5
81	J227	J225	23	0.01	0.2	0.5	0.5	0.5
82	J225	J855	8.21	0.01	0.2	0.5	0.5	0.5
83	J855	J228	19.72	0.01	0.2	0.5	0.5	0.5
84	J228	J860	22	0.01	0.2	0.5	0.5	0.5
85	J860	J222	19.9	0.01	0.2	0.5	0.5	0.5
86	J222	J566	27.2	0.01	0.2	0.5	0.5	0.5
87	J942	J865	30.23	0.01	0.2	0.5	0.5	0.5
88	J865	J924	29.76	0.01	0.2	0.5	0.5	0.5
89	J943	J940	13.73	0.01	0.2	0.5	0.5	0.5
90	J940	J866	16.03	0.01	0.2	0.5	0.5	0.5
91	J866	J867	29.3	0.01	0.2	0.5	0.5	0.5
92	J867	J576	32.41	0.01	0.2	0.5	0.5	0.5
94	J888	J889	29.62	0.01	0.2	0.5	0.5	0.5
95	J889	J961	30.27	0.01	0.2	0.5	0.5	0.5
96	J775	J763	21.29	0.01	0.2	0.5	0.5	0.5
97	J763	J773	21.29	0.01	0.2	0.5	0.5	0.5
98	J773	J886	5.17	0.01	0.2	0.5	0.5	0.5
99	J886	J883	35.58	0.01	0.2	0.5	0.5	0.5
100	J883	J852	29.99	0.01	0.2	0.5	0.5	0.5
101	J768	J762	22.65	0.01	0.2	0.5	0.5	0.5
102	J762	J886	17.32	0.01	0.2	0.5	0.5	0.5
103	J852	J966	16.55	0.01	0.2	0.5	0.5	0.5
104	J769	J852	28.08	0.01	0.2	0.5	0.5	0.5
105	J772	J769	28	0.01	0.2	0.5	0.5	0.5
106	J567	J772	27.98	0.01	0.2	0.5	0.5	0.5
107	J771	J567	34.43	0.01	0.2	0.5	0.5	0.5
108	J570	J771	22.73	0.01	0.2	0.5	0.5	0.5
109	J124	J158	19.67	0.01	0.2	0.5	0.5	0.5
110	J568	J569	32.13	0.01	0.2	0.5	0.5	0.5
111	J893	J568	38.87	0.01	0.2	0.5	0.5	0.5
112	J892	J893	33.86	0.01	0.2	0.5	0.5	0.5
113	J239	J892	22.5	0.01	0.2	0.5	0.5	0.5
114	J891	J239	30.07	0.01	0.2	0.5	0.5	0.5
115	J894	J891	30.72	0.01	0.2	0.5	0.5	0.5
116	J897	J894	39.47	0.01	0.2	0.5	0.5	0.5
117	J896	J897	38.07	0.01	0.2	0.5	0.5	0.5
118	J895	J896	30	0.01	0.2	0.5	0.5	0.5
119	J890	J895	36.12	0.01	0.2	0.5	0.5	0.5
120	J885	J890	25.88	0.01	0.2	0.5	0.5	0.5

121	J884	J885	28.02	0.01	0.2	0.5	0.5	0.5
122	J770	J884	28.45	0.01	0.2	0.5	0.5	0.5
123	J972	J770	20.38	0.01	0.2	0.5	0.5	0.5
124	J579	J972	22.2	0.01	0.2	0.5	0.5	0.5
125	J774	J579	30	0.01	0.2	0.5	0.5	0.5
126	J582	J774	35.56	0.01	0.2	0.5	0.5	0.5
127	J226	J890	6.1	0.01	0.2	0.5	0.5	0.5
128	J215	J226	17.97	0.01	0.2	0.5	0.5	0.5
129	J214	J215	13.3	0.01	0.2	0.5	0.5	0.5
130	J217	J214	35.72	0.01	0.2	0.5	0.5	0.5
131	J220	J217	31.57	0.01	0.2	0.5	0.5	0.5
132	J218	J226	24.85	0.01	0.2	0.5	0.5	0.5
133	J219	J218	24.39	0.01	0.2	0.5	0.5	0.5
134	J221	J226	22.89	0.01	0.2	0.5	0.5	0.5
135	J216	J221	18.29	0.01	0.2	0.5	0.5	0.5
136	J765	J770	36.87	0.01	0.2	0.5	0.5	0.5
137	J580	J765	6.85	0.01	0.2	0.5	0.5	0.5
139	J767	J581	5.41	0.01	0.2	0.5	0.5	0.5
140	J586	J767	23.82	0.01	0.2	0.5	0.5	0.5
141	J591	J586	30	0.01	0.2	0.5	0.5	0.5
142	J592	J591	23.12	0.01	0.2	0.5	0.5	0.5
143	J593	J592	31.68	0.01	0.2	0.5	0.5	0.5
144	J590	J593	30.88	0.01	0.2	0.5	0.5	0.5
145	J587	J590	36.84	0.01	0.2	0.5	0.5	0.5
146	J588	J587	27.48	0.01	0.2	0.5	0.5	0.5
147	J786	J588	30	0.01	0.2	0.5	0.5	0.5
148	J503	J786	33.48	0.01	0.2	0.5	0.5	0.5
149	J753	J503	24.58	0.01	0.2	0.5	0.5	0.5
150	J834	J753	4.29	0.01	0.2	0.5	0.5	0.5
151	J829	J834	15.69	0.01	0.2	0.5	0.5	0.5
152	J506	J829	16.63	0.01	0.2	0.5	0.5	0.5
153	J823	J506	20.97	0.01	0.2	0.5	0.5	0.5
154	J827	J823	20.5	0.01	0.2	0.5	0.5	0.5
155	J826	J827	22.36	0.01	0.2	0.5	0.5	0.5
156	J509	J826	23	0.01	0.2	0.5	0.5	0.5
157	J508	J509	37.26	0.01	0.2	0.5	0.5	0.5
158	J825	J508	9.57	0.01	0.2	0.5	0.5	0.5
159	J828	J825	25.58	0.01	0.2	0.5	0.5	0.5
160	J847	J508	21.77	0.01	0.2	0.5	0.5	0.5
161	J507	J847	22.99	0.01	0.2	0.5	0.5	0.5
162	J822	J507	5.81	0.01	0.2	0.5	0.5	0.5

163	J824	J822	17.77	0.01	0.2	0.5	0.5	0.5
164	J785	J892	17	0.01	0.2	0.5	0.5	0.5
165	J741	J785	24.8	0.01	0.2	0.5	0.5	0.5
167	J780	J872	33.83	0.01	0.2	0.5	0.5	0.5
168	J782	J780	7.8	0.01	0.2	0.5	0.5	0.5
169	J748	J782	14.52	0.01	0.2	0.5	0.5	0.5
170	J585	J748	39.16	0.01	0.2	0.5	0.5	0.5
171	J747	J585	4.69	0.01	0.2	0.5	0.5	0.5
172	J584	J747	23.62	0.01	0.2	0.5	0.5	0.5
173	J746	J584	25.23	0.01	0.2	0.5	0.5	0.5
174	J749	J746	19.65	0.01	0.2	0.5	0.5	0.5
175	J583	J749	29.18	0.01	0.2	0.5	0.5	0.5
176	J604	J583	28.55	0.01	0.2	0.5	0.5	0.5
177	J752	J604	2.75	0.01	0.2	0.5	0.5	0.5
178	J603	J752	26.77	0.01	0.2	0.5	0.5	0.5
179	J751	J603	21.12	0.01	0.2	0.5	0.5	0.5
180	J602	J751	5.12	0.01	0.2	0.5	0.5	0.5
181	J750	J602	22.29	0.01	0.2	0.5	0.5	0.5
182	J831	J750	36.03	0.01	0.2	0.5	0.5	0.5
183	J605	J831	36.96	0.01	0.2	0.5	0.5	0.5
184	J791	J605	38.7	0.01	0.2	0.5	0.5	0.5
185	J832	J791	14.06	0.01	0.2	0.5	0.5	0.5
186	J608	J832	10.32	0.01	0.2	0.5	0.5	0.5
187	J607	J608	23.01	0.01	0.2	0.5	0.5	0.5
189	J601	J606	36.3	0.01	0.2	0.5	0.5	0.5
190	J830	J601	6.48	0.01	0.2	0.5	0.5	0.5
191	J833	J830	33.81	0.01	0.2	0.5	0.5	0.5
192	J595	J833	19.09	0.01	0.2	0.5	0.5	0.5
193	J836	J595	15.86	0.01	0.2	0.5	0.5	0.5
194	J594	J836	13.37	0.01	0.2	0.5	0.5	0.5
196	J835	J786	10.82	0.01	0.2	0.5	0.5	0.5
197	J597	J595	29.95	0.01	0.2	0.5	0.5	0.5
198	J600	J597	21.17	0.01	0.2	0.5	0.5	0.5
199	J851	J600	15.97	0.01	0.2	0.5	0.5	0.5
200	J850	J851	15.87	0.01	0.2	0.5	0.5	0.5
201	J599	J850	8.86	0.01	0.2	0.5	0.5	0.5
202	J849	J599	8.09	0.01	0.2	0.5	0.5	0.5
203	J598	J849	20.1	0.01	0.2	0.5	0.5	0.5
204	J844	J598	2.64	0.01	0.2	0.5	0.5	0.5
205	J839	J844	23.04	0.01	0.2	0.5	0.5	0.5
206	J559	J839	23.92	0.01	0.2	0.5	0.5	0.5

207	J560	J601	18.83	0.01	0.2	0.5	0.5	0.5
208	J848	J560	16.24	0.01	0.2	0.5	0.5	0.5
209	J846	J606	16.36	0.01	0.2	0.5	0.5	0.5
210	J845	J846	13.38	0.01	0.2	0.5	0.5	0.5
211	J153	J551	29.56	0.01	0.2	0.5	0.5	0.5
212	J551	J550	29.99	0.01	0.2	0.5	0.5	0.5
213	J550	J549	30	0.01	0.2	0.5	0.5	0.5
214	J549	J552	30	0.01	0.2	0.5	0.5	0.5
215	J552	J555	30	0.01	0.2	0.5	0.5	0.5
216	J555	J554	29.97	0.01	0.2	0.5	0.5	0.5
217	J553	J554	29.99	0.01	0.25	0.5	0.5	0.5
218	J966	J553	19.61	0.01	0.25	0.5	0.5	0.5
219	J790	J784	15.25	0.01	0.2	0.5	0.5	0.5
222	J951	J789	30.9	0.01	0.2	0.5	0.5	0.5
223	J789	J956	18.56	0.01	0.2	0.5	0.5	0.5
224	J956	J788	22.84	0.01	0.2	0.5	0.5	0.5
225	J788	J957	20	0.01	0.2	0.5	0.5	0.5
226	J957	J783	26.77	0.01	0.2	0.5	0.5	0.5
227	J778	J783	27.11	0.01	0.2	0.5	0.5	0.5
228	J787	J778	15.36	0.01	0.2	0.5	0.5	0.5
229	J783	J958	17.86	0.01	0.2	0.5	0.5	0.5
230	J958	J776	12.59	0.01	0.2	0.5	0.5	0.5
231	J776	J955	23.98	0.01	0.2	0.5	0.5	0.5
232	J955	J952	21.53	0.01	0.2	0.5	0.5	0.5
233	J952	J777	19.84	0.01	0.2	0.5	0.5	0.5
234	J777	J953	19.18	0.01	0.2	0.5	0.5	0.5
235	J953	J954	10.35	0.01	0.2	0.5	0.5	0.5
236	J954	J781	25	0.01	0.2	0.5	0.5	0.5
237	J781	J913	25.86	0.01	0.2	0.5	0.5	0.5
238	J913	J779	3.32	0.01	0.2	0.5	0.5	0.5
239	J779	J782	20.05	0.01	0.2	0.5	0.5	0.5
240	J740	J956	36	0.01	0.2	0.5	0.5	0.5
241	J945	J740	35.58	0.01	0.2	0.5	0.5	0.5
242	J156	J945	24.96	0.01	0.2	0.5	0.5	0.5
243	J944	J156	25.46	0.01	0.2	0.5	0.5	0.5
244	J159	J944	20.61	0.01	0.2	0.5	0.5	0.5
245	J178	J153	31.28	0.01	0.2	0.5	0.5	0.5
246	J157	J178	29.98	0.01	0.2	0.5	0.5	0.5
247	J764	J157	26.9	0.01	0.2	0.5	0.5	0.5
248	J177	J153	28.7	0.01	0.2	0.5	0.5	0.5
249	J176	J177	30	0.01	0.2	0.5	0.5	0.5

250	J179	J176	30	0.01	0.2	0.5	0.5	0.5
251	J182	J179	29.67	0.01	0.2	0.5	0.5	0.5
252	J181	J182	30.13	0.01	0.2	0.5	0.5	0.5
253	J180	J181	29.99	0.01	0.2	0.5	0.5	0.5
254	J175	J180	29.93	0.01	0.2	0.5	0.5	0.5
255	J573	J574	24.46	0.01	0.2	0.5	0.5	0.5
256	J169	J170	30	0.01	0.2	0.5	0.5	0.5
257	J168	J169	30	0.01	0.2	0.5	0.5	0.5
258	J171	J168	29.98	0.01	0.2	0.5	0.5	0.5
259	J174	J171	29.99	0.01	0.2	0.5	0.5	0.5
260	J173	J174	30	0.01	0.2	0.5	0.5	0.5
261	J172	J173	30	0.01	0.2	0.5	0.5	0.5
262	J133	J172	30	0.01	0.2	0.5	0.5	0.5
263	J132	J133	30	0.01	0.2	0.5	0.5	0.5
264	J784	J132	17.49	0.01	0.2	0.5	0.5	0.5
265	J739	J946	26.91	0.01	0.2	0.5	0.5	0.5
266	J742	J739	14.57	0.01	0.2	0.5	0.5	0.5
267	J745	J742	25.5	0.01	0.2	0.5	0.5	0.5
268	J744	J745	20.71	0.01	0.2	0.5	0.5	0.5
269	J743	J744	6.84	0.01	0.2	0.5	0.5	0.5
270	J738	J743	33.35	0.01	0.2	0.5	0.5	0.5
272	J131	J784	38.29	0.01	0.2	0.5	0.5	0.5
274	J137	J134	30	0.01	0.2	0.5	0.5	0.5
275	J136	J137	30	0.01	0.2	0.5	0.5	0.5
276	J135	J136	29.93	0.01	0.2	0.5	0.5	0.5
277	J130	J135	30	0.01	0.2	0.5	0.5	0.5
278	J125	J130	29.98	0.01	0.2	0.5	0.5	0.5
279	J756	J155	33.11	0.01	0.2	0.5	0.5	0.5
280	J755	J756	4.95	0.01	0.2	0.5	0.5	0.5
281	J757	J755	19.93	0.01	0.2	0.5	0.5	0.5
282	J754	J757	24.99	0.01	0.2	0.5	0.5	0.5
283	J838	J791	33.31	0.01	0.2	0.5	0.5	0.5
284	J837	J838	19.94	0.01	0.2	0.5	0.5	0.5
285	J556	J837	17.22	0.01	0.2	0.5	0.5	0.5
286	J840	J556	12.64	0.01	0.2	0.5	0.5	0.5
287	J158	J125	9.39	0.01	0.2	0.5	0.5	0.5
289	J124	J123	29.98	0.01	0.2	0.5	0.5	0.5
290	J123	J126	30	0.01	0.2	0.5	0.5	0.5
291	J126	J129	30	0.01	0.2	0.5	0.5	0.5
292	J129	J128	30	0.01	0.2	0.5	0.5	0.5
293	J128	J127	30	0.01	0.2	0.5	0.5	0.5

294	J127	J148	30	0.01	0.2	0.5	0.5	0.5
295	J148	J147	30	0.01	0.2	0.5	0.5	0.5
296	J147	J146	30	0.01	0.2	0.5	0.5	0.5
298	J321	J149	32.55	0.01	0.2	0.5	0.5	0.5
299	J320	J321	32.88	0.01	0.2	0.5	0.5	0.5
300	J223	J320	35.56	0.01	0.2	0.5	0.5	0.5
301	J152	J223	17.04	0.01	0.2	0.5	0.5	0.5
302	J151	J152	30	0.01	0.2	0.5	0.5	0.5
303	J150	J151	30	0.01	0.2	0.5	0.5	0.5
304	J145	J150	30	0.01	0.2	0.5	0.5	0.5
305	J140	J145	30	0.01	0.2	0.5	0.5	0.5
306	J139	J140	29.9	0.01	0.2	0.5	0.5	0.5
307	J138	J139	29.96	0.01	0.2	0.5	0.5	0.5
308	J811	J138	14.17	0.01	0.2	0.5	0.5	0.5
309	J141	J811	15.72	0.01	0.2	0.5	0.5	0.5
310	J144	J141	29.93	0.01	0.2	0.5	0.5	0.5
311	J143	J144	29.95	0.01	0.2	0.5	0.5	0.5
312	J142	J143	29.95	0.01	0.2	0.5	0.5	0.5
313	J183	J142	29.91	0.01	0.2	0.5	0.5	0.5
314	J224	J183	30	0.01	0.2	0.5	0.5	0.5
315	J946	J790	22.07	0.01	0.2	0.5	0.5	0.5
370	J731	J732	13.87	0.01	0.2	0.5	0.5	0.5
371	J735	J731	21.19	0.01	0.2	0.5	0.5	0.5
373	J973	J736	18.15	0.01	0.2	0.5	0.5	0.5
374	J734	J973	12.15	0.01	0.2	0.5	0.5	0.5
375	J737	J734	16.97	0.01	0.2	0.5	0.5	0.5
376	J155	J737	18.56	0.01	0.2	0.5	0.5	0.5
377	J759	J155	22	0.01	0.2	0.5	0.5	0.5
378	J760	J759	21.13	0.01	0.2	0.5	0.5	0.5
379	J970	J760	20.19	0.01	0.2	0.5	0.5	0.5
380	J967	J970	12.66	0.01	0.2	0.5	0.5	0.5
381	J968	J967	25.37	0.01	0.2	0.5	0.5	0.5
382	J969	J968	30	0.01	0.2	0.5	0.5	0.5
383	J758	J969	16.84	0.01	0.2	0.5	0.5	0.5
384	J948	J758	8.93	0.01	0.2	0.5	0.5	0.5
385	J949	J948	33.78	0.01	0.2	0.5	0.5	0.5
386	J950	J949	30	0.01	0.2	0.5	0.5	0.5
387	J947	J950	26.83	0.01	0.2	0.5	0.5	0.5
388	J800	J830	20	0.01	0.2	0.5	0.5	0.5
389	J558	J800	19.78	0.01	0.2	0.5	0.5	0.5
390	J801	J558	3.05	0.01	0.2	0.5	0.5	0.5

391	J557	J801	26.24	0.01	0.2	0.5	0.5	0.5
393	J504	J505	35.03	0.01	0.2	0.5	0.5	0.5
394	J505	J510	30	0.01	0.2	0.5	0.5	0.5
395	J510	J803	19.28	0.01	0.2	0.5	0.5	0.5
396	J803	J515	17.77	0.01	0.2	0.5	0.5	0.5
397	J515	J806	22.86	0.01	0.2	0.5	0.5	0.5
399	J843	J563	25.67	0.01	0.2	0.5	0.5	0.5
400	J563	J842	13.29	0.01	0.2	0.5	0.5	0.5
401	J842	J562	17.72	0.01	0.2	0.5	0.5	0.5
402	J562	J841	11.85	0.01	0.2	0.5	0.5	0.5
403	J841	J561	16.18	0.01	0.2	0.5	0.5	0.5
404	J561	J802	8.33	0.01	0.2	0.5	0.5	0.5
405	J732	J158	19.75	0.01	0.2	0.5	0.5	0.5
406	J516	J732	21.41	0.01	0.2	0.5	0.5	0.5
407	J517	J516	21.13	0.01	0.2	0.5	0.5	0.5
408	J514	J517	30	0.01	0.2	0.5	0.5	0.5
409	J511	J514	30	0.01	0.2	0.5	0.5	0.5
410	J512	J511	35.85	0.01	0.2	0.5	0.5	0.5
411	J513	J512	24.14	0.01	0.2	0.5	0.5	0.5
412	J802	J513	22.4	0.01	0.2	0.5	0.5	0.5
414	J493	J492	26.76	0.01	0.2	0.5	0.5	0.5
415	J494	J493	35.08	0.01	0.2	0.5	0.5	0.5
416	J491	J494	27.87	0.01	0.2	0.5	0.5	0.5
417	J488	J491	27.05	0.01	0.2	0.5	0.5	0.5
418	J489	J488	19.2	0.01	0.2	0.5	0.5	0.5
419	J490	J489	35.31	0.01	0.2	0.5	0.5	0.5
420	J167	J490	28	0.01	0.2	0.5	0.5	0.5
421	J806	J167	27.21	0.01	0.2	0.5	0.5	0.5
422	J797	J806	19.99	0.01	0.2	0.5	0.5	0.5
423	J798	J797	20	0.01	0.2	0.5	0.5	0.5
424	J500	J798	30.24	0.01	0.2	0.5	0.5	0.5
425	J501	J500	30	0.01	0.2	0.5	0.5	0.5
426	J796	J501	32	0.01	0.2	0.5	0.5	0.5
427	J502	J796	33.36	0.01	0.2	0.5	0.5	0.5
428	J499	J502	24.6	0.01	0.2	0.5	0.5	0.5
429	J496	J499	30	0.01	0.2	0.5	0.5	0.5
430	J497	J496	29.98	0.01	0.2	0.5	0.5	0.5
431	J498	J497	29.99	0.01	0.2	0.5	0.5	0.5
432	J154	J498	19.98	0.01	0.2	0.5	0.5	0.5
433	J537	J154	20.27	0.01	0.2	0.5	0.5	0.5
434	J538	J537	19.62	0.01	0.2	0.5	0.5	0.5

435	J539	J538	29.95	0.01	0.2	0.5	0.5	0.5
436	J536	J539	24.49	0.01	0.2	0.5	0.5	0.5
438	J816	J817	30.28	0.01	0.2	0.5	0.5	0.5
439	J523	J816	27.59	0.01	0.2	0.5	0.5	0.5
440	J524	J523	28.74	0.01	0.2	0.5	0.5	0.5
441	J818	J524	24.99	0.01	0.2	0.5	0.5	0.5
442	J521	J818	24.22	0.01	0.2	0.5	0.5	0.5
443	J518	J521	24.06	0.01	0.2	0.5	0.5	0.5
444	J164	J518	30.22	0.01	0.2	0.5	0.5	0.5
445	J519	J164	20.76	0.01	0.2	0.5	0.5	0.5
446	J520	J519	24.18	0.01	0.2	0.5	0.5	0.5
447	J525	J520	35.96	0.01	0.2	0.5	0.5	0.5
448	J530	J525	32.53	0.01	0.2	0.5	0.5	0.5
449	J531	J530	24.61	0.01	0.2	0.5	0.5	0.5
450	J815	J531	25.54	0.01	0.2	0.5	0.5	0.5
451	J532	J815	24.63	0.01	0.2	0.5	0.5	0.5
452	J487	J532	36.23	0.01	0.2	0.5	0.5	0.5
453	J163	J487	33.14	0.01	0.2	0.5	0.5	0.5
454	J166	J163	31.75	0.01	0.2	0.5	0.5	0.5
457	J165	J522	20.99	0.01	0.2	0.5	0.5	0.5
458	J522	J821	30.98	0.01	0.2	0.5	0.5	0.5
459	J821	J543	30	0.01	0.2	0.5	0.5	0.5
460	J543	J542	26.93	0.01	0.2	0.5	0.5	0.5
461	J542	J820	25	0.01	0.2	0.5	0.5	0.5
462	J820	J541	25.92	0.01	0.2	0.5	0.5	0.5
463	J541	J544	30	0.01	0.2	0.5	0.5	0.5
464	J544	J547	30	0.01	0.2	0.5	0.5	0.5
465	J547	J546	30	0.01	0.2	0.5	0.5	0.5
466	J546	J545	29.99	0.01	0.2	0.5	0.5	0.5
467	J545	J540	27.03	0.01	0.2	0.5	0.5	0.5
468	J540	J490	27.15	0.01	0.2	0.5	0.5	0.5
469	J795	J489	24.08	0.01	0.2	0.5	0.5	0.5
470	J535	J795	25	0.01	0.2	0.5	0.5	0.5
471	J792	J535	3.05	0.01	0.2	0.5	0.5	0.5
472	J534	J792	7.14	0.01	0.2	0.5	0.5	0.5
473	J793	J534	19.18	0.01	0.2	0.5	0.5	0.5
474	J533	J793	20.02	0.01	0.2	0.5	0.5	0.5
475	J548	J492	29.99	0.01	0.2	0.5	0.5	0.5
476	J589	J548	33.42	0.01	0.2	0.5	0.5	0.5
477	J794	J589	21.34	0.01	0.2	0.5	0.5	0.5
478	J805	J794	20.91	0.01	0.2	0.5	0.5	0.5

479	J804	J589	22.49	0.01	0.2	0.5	0.5	0.5
480	J149	J869	32.72	0.01	0.2	0.5	0.5	0.5
481	J869	J870	30	0.01	0.2	0.5	0.5	0.5
482	J870	J875	32.64	0.01	0.2	0.5	0.5	0.5
483	J875	J819	35.21	0.01	0.2	0.5	0.5	0.5
484	J819	J880	22	0.01	0.2	0.5	0.5	0.5
485	J880	J881	21.49	0.01	0.2	0.5	0.5	0.5
486	J881	J160	25	0.01	0.2	0.5	0.5	0.5
487	J160	J882	25.4	0.01	0.2	0.5	0.5	0.5
488	J882	J542	18.1	0.01	0.2	0.5	0.5	0.5
489	J813	J881	17.5	0.01	0.2	0.5	0.5	0.5
490	J812	J813	20	0.01	0.2	0.5	0.5	0.5
491	J810	J812	19.74	0.01	0.2	0.5	0.5	0.5
492	J868	J810	5.72	0.01	0.2	0.5	0.5	0.5
493	J807	J868	23.29	0.01	0.2	0.5	0.5	0.5
494	J808	J807	32.19	0.01	0.2	0.5	0.5	0.5
495	J975	J808	19.1	0.01	0.2	0.5	0.5	0.5
497	J809	J819	24.73	0.01	0.2	0.5	0.5	0.5
498	J871	J809	22.85	0.01	0.2	0.5	0.5	0.5
499	J814	J871	28.86	0.01	0.2	0.5	0.5	0.5
500	J874	J875	29.99	0.01	0.2	0.5	0.5	0.5
501	J873	J874	36.05	0.01	0.2	0.5	0.5	0.5
502	J161	J487	25.58	0.01	0.2	0.5	0.5	0.5
503	J162	J161	26.5	0.01	0.2	0.5	0.5	0.5
316	J817	1	8.88	0.01	0.2	0.5	0.5	0.5
319	J872	5	5.67	0.01	0.2	0.5	0.5	0.5
320	J581	6	2	0.01	0.2	0.5	0.5	0.5
321	J569	8	11.98	0.01	0.2	0.5	0.5	0.5
322	J924	9	8.56	0.01	0.2	0.5	0.5	0.5
220	J736	7	3.08	0.01	0.2	0.5	0.5	0.5
47	J554	2	11.66	0.01	0.2	0.5	0.5	0.5
297	J606	J607	30.95	0.01	0.2			
66	J492	10	5.84	0.01	1			
271	J733	J738	14.07	0.01	0.2			
93	J134	12	2	0.01	1			
138	J170	13	2	0.01	1			

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[JUNCTIONS]

Name	Elevation	Baseline	Name	Elevation	Baseline	Name	Elevation	Baseline
J1	4.087706	0.019893	J39	2.384471	0.019893	J77	3.282	0.019893
J2	3.918294	0.019893	J40	2.157235	0.019893	J78	3.542647	0.019893
J3	4.41	0.019893	J41	1.927059	0.019893	J79	3.67	0.019893
J4	4.23	0.019893	J42	3.724706	0.019893	J80	3.141059	0.019893
J5	2.99	0.019893	J43	4.205471	0.019893	J81	4.19	0.019893
J6	2.736235	0.019893	J44	4.030765	0.019893	J82	3.412882	0.019893
J7	2.528882	0.019893	J45	3.853706	0.019893	J83	2.964647	0.019893
J8	4.271765	0.019893	J46	3.701941	0.019893	J84	3.57	0.019893
J9	4.41	0.019893	J47	2.92	0.019893	J85	3.423529	0.019893
J10	4.75	0.019893	J48	2.885471	0.019893	J86	3.274824	0.019893
J11	4.41	0.019893	J49	3.94	0.019893	J87	0.109765	0.019893
J12	4.233941	0.019893	J50	4.23	0.019893	J88	3.6	0.019893
J13	3.6	0.019893	J51	4.83	0.019893	J89	3.393647	0.019893
J14	3.501706	0.019893	J52	3.807824	0.019893	J90	3.134765	0.019893
J15	3.344882	0.019893	J53	2.760647	0.019893	J91	4.06	0.019893
J16	3.63	0.019893	J54	3.29	0.019893	J92	3.323529	0.019893
J17	4.58	0.019893	J55	3.138765	0.019893	J93	3.5	0.019893
J18	4.403529	0.019893	J56	1.889	0.019893	J94	2.629882	0.019893
J19	2.5	0.019893	J57	2.81	0.019893	J95	2.454176	0.019893
J20	0.802824	0.019893	J58	0.616412	0.019893	J96	1.732059	0.019893
J21	0.23	0.019893	J59	0.750647	0.019893	J97	1.924294	0.019893
J22	1.37	0.019893	J60	2.33	0.019893	J98	2.099706	0.019893
J23	4.227059	0.019893	J61	2.263765	0.019893	J99	2.663	0.019893
J24	3.345059	0.177778	J62	0.930235	0.019893	J100	2.737235	0.019893
J25	2.664941	0.019893	J63	1.083765	0.019893	J101	2.448294	0.019893
J26	2.829588	0.019893	J64	2.270529	0.019893	J102	2.405	0.019893
J27	3.521471	0.019893	J65	0.815176	0.455556	J103	2.913706	0.019893
J28	4.080294	0.019893	J66	0.286059	0.019893	J104	4.45	0.019893
J29	3.874176	0.019893	J67	0.462353	0.019893	J105	3.62	0.019893
J30	3.701235	0.019893	J68	0.638706	0.019893	J106	3.09	0.019893
J31	1.107	0.019893	J69	2.461	0.019893	J107	3.6	0.019893
J32	0.935647	0.019893	J70	3.356059	0.019893	J108	1.666882	0.019893
J33	0.790294	0.019893	J71	3.477118	0.019893	J109	1.837118	0.019893
J34	1.277294	0.019893	J72	3.653529	0.019893	J110	2.97	0.019893
J35	1.740294	0.019893	J73	3.171294	0.019893	J111	3.83	0.019893
J36	1.575882	0.019893	J74	2.650765	0.019893	J112	3.262176	0.019893
J37	1.353882	0.019893	J75	2.811118	0.019893	J113	2.841529	0.019893
J38	4.35	0.019893	J76	2.972059	0.019893	J114	2.170647	0.019893

J115	1.076176	0.019893	J236	4.6	0.019893	J284	1.445824	0.019893
J116	0.915118	0.019893	J240	4.04	0.019893	J285	2.761176	0.019893
J117	1.479471	0.019893	J241	5.05	0.019893	J286	2.149647	0.019893
J118	1.252647	0.019893	J242	6.8	0.019893	J287	2.305412	0.019893
J119	2.025353	0.019893	J243	3.115235	0.019893	J288	2.446353	0.1111
J120	1.642765	0.019893	J244	4.263588	0.019893	J289	1.383412	0.019893
J121	1.428882	0.019893	J246	1.729235	0.019893	J290	1.568882	0.019893
J122	1.722824	0.019893	J247	4.44	0.019893	J291	1.745059	0.019893
J184	4.184	0.019893	J248	1.037765	0.019893	J292	4.363588	0.019893
J185	3.908118	0.019893	J249	0.861294	0.019893	J293	4.54	0.019893
J186	2.298706	0.019893	J250	0.684824	0.019893	J294	0.863118	0.019893
J187	4.048529	0.019893	J251	1.552765	0.019893	J295	1.039588	0.2
J188	1.345235	0.019893	J252	0.670412	0.019893	J296	1.921529	0.019893
J189	4.264176	0.019893	J253	0.493941	0.019893	J297	3.743588	0.019893
J190	4.228	0.019893	J254	4.87	0.019893	J298	3.897765	0.019893
J191	3.704118	0.019893	J255	0.846882	0.019893	J299	4.074235	0.019893
J192	3.553118	0.019893	J256	1.376294	0.019893	J300	3.561059	0.019893
J193	3.141471	0.019893	J257	1.199824	0.019893	J301	3.021412	0.019893
J194	3.294706	0.019893	J258	1.023353	0.019893	J302	3.197706	0.019893
J195	3.423765	0.019893	J259	2.319706	0.019893	J303	3.373529	0.019893
J196	4.07	0.019893	J260	2.143235	0.019893	J304	3.202	0.019893
J197	3.953412	0.019893	J261	1.966765	0.019893	J305	3.224353	0.019893
J198	3.842	0.019893	J262	2.496176	0.019893	J306	2.979706	0.019893
J200	0.427824	0.019893	J263	3.025588	0.019893	J307	2.794471	0.019893
J201	3.568647	0.019893	J264	2.849118	0.019893	J308	3.37	0.019893
J202	3.78	0.019893	J265	2.672647	0.019893	J309	3.081235	0.019893
J203	1.583882	0.019893	J266	4.433941	0.019893	J310	2.912882	0.019893
J204	1.397294	0.019893	J267	3.515824	0.019893	J311	2.843647	0.019893
J205	1.223412	0.019893	J268	3.339353	0.019893	J312	2.602588	0.019893
J206	3.8	0.019893	J269	3.162941	0.019893	J313	2.974882	0.019893
J207	3.8	0.019893	J270	3.692235	0.019893	J314	2.799	0.019893
J208	3.154294	0.019893	J271	4.221412	0.019893	J315	2.639706	0.019893
J209	3.6	0.019893	J272	4.045	0.019893	J316	3.76	0.019893
J210	3.2	0.019893	J273	3.868588	0.019893	J317	2.426118	0.019893
J211	3.91	0.019893	J274	1.468118	0.019893	J318	4.31	0.019893
J212	4.12	0.066667	J275	1.640294	0.019893	J319	4.112353	0.019893
J213	2.507471	0.019893	J276	1.816765	0.019893	J322	3.215235	0.019893
J229	3.496235	0.019893	J277	1.330471	0.019893	J323	4.693529	0.019893
J230	2.625588	0.019893	J278	4.25	0.019893	J324	1.868882	0.019893
J231	3.884	0.019893	J279	0.992235	0.019893	J325	4.340588	0.019893
J232	3.515	0.019893	J280	1.176824	0.019893	J326	4.450294	0.019893
J233	3.97	0.019893	J281	1.993	0.019893	J327	3.37	0.019893
J234	2.990941	0.019893	J282	2.945	0.019893	J328	3.317412	0.019893
J235	4.17	0.019893	J283	3.12	0.019893	J329	3.241412	0.019893

J330	3.065235	0.019893	J376	2.456412	0.019893	J421	5.02	0.019893
J331	3.340412	0.019893	J377	2.943529	0.019893	J422	4.353529	0.019893
J332	3.241706	0.019893	J378	3.275765	0.019893	J423	3.756647	0.019893
J333	3.37	0.019893	J379	3.47	0.019893	J424	4.000588	0.019893
J334	3.37	0.019893	J380	3.063471	0.019893	J425	4.177059	0.019893
J335	7.02	0.019893	J381	3.548176	0.019893	J426	2.591471	0.019893
J336	6.36	0.019893	J382	3.458647	0.019893	J427	2.205176	0.167
J337	5.140941	0.019893	J383	3.273471	0.019893	J428	3.806235	0.019893
J338	7.79	0.019893	J384	3.69	0.019893	J429	3.420412	0.019893
J339	8.71	0.019893	J385	3.136706	0.019893	J430	2.381118	0.019893
J340	8.47	0.019893	J386	3.305941	0.019893	J431	2.910294	0.167
J341	8.25	0.019893	J387	3.5	0.019893	J432	2.733824	0.019893
J342	4.964706	0.019893	J388	0.972706	0.019893	J433	2.557529	0.019893
J343	4.084353	0.019893	J389	3.650118	0.019893	J434	3.247	0.019893
J344	3.731412	0.019893	J390	0.646588	0.019893	J435	2.264588	0.019893
J345	3.554941	0.019893	J391	0.066882	0.019893	J436	2.104941	0.019893
J346	4.260824	0.019893	J392	3.955235	0.1111	J437	3.112647	0.019893
J347	4.789765	0.019893	J393	4.181	0.019893	J438	2.441059	0.019893
J348	4.613765	0.019893	J394	3.799529	0.019893	J439	2.995412	0.019893
J349	4.437294	0.019893	J395	4.28	0.1	J440	2.793882	0.019893
J350	4.185588	0.019893	J396	3.742412	0.019893	J441	2.617412	0.019893
J351	4.116118	0.019893	J397	4.23	0.019893	J442	1.146706	0.019893
J352	4.098235	0.019893	J398	4.053529	0.019893	J443	2.053706	0.019893
J353	4.285647	0.019893	J399	2.569235	0.019893	J444	4.233882	0.019893
J354	2.446353	0.019893	J400	4.94	0.1833	J445	1.249353	0.019893
J355	3.984824	0.019893	J401	4.737765	0.019893	J446	1.928706	0.019893
J356	4.31	0.019893	J402	4.552706	0.1222	J447	1.752235	0.019893
J357	4.61	0.019893	J403	3.847	0.019893	J448	1.581706	0.019893
J358	-0.20571	0.019893	J404	3.579059	0.019893	J449	4.36	0.019893
J359	-0.28424	0.019893	J406	3.403706	0.019893	J450	3.500118	0.019893
J360	-0.13447	0.019893	J407	3.890059	0.33	J451	3.325647	0.019893
J362	4.71	0.055556	J408	3.07	0.019893	J452	3.086529	0.019893
J363	2.652882	0.019893	J409	4.23	0.019893	J453	3.645647	0.019893
J365	1.524471	0.019893	J410	4.072	0.019893	J454	4.138529	0.019893
J366	3.584294	0.019893	J411	2.914294	0.019893	J455	3.968471	0.019893
J367	3.444	0.019893	J412	3.083059	0.019893	J456	3.792	0.019893
J368	3.416235	0.019893	J413	3.266	0.019893	J457	3.166294	0.019893
J369	3.67	0.019893	J414	2.568824	0.019893	J458	3.468412	0.019893
J370	0.216529	0.019893	J415	2.288588	0.019893	J459	3.603353	0.019893
J371	0.394706	0.019893	J416	2.084647	0.019893	J460	3.080412	0.019893
J372	0.865471	0.019893	J417	1.908176	0.019893	J461	2.496	0.019893
J373	3.220353	0.019893	J418	3.580176	0.019893	J462	2.746765	0.019893
J374	2.767647	0.019893	J419	4.53	0.019893	J463	2.884059	0.019893
J375	2.591353	0.019893	J420	4.844	0.2111	J464	3.171882	0.019893

J465	4.24	0.019893	J627	3.162471	0.019893	J671	2.453647	0.019893
J466	3.81	0.019893	J628	2.647353	0.019893	J672	2.266412	0.019893
J467	3.333235	0.019893	J629	2.082824	0.019893	J673	2.089941	0.019893
J468	4.025941	0.019893	J630	2.286529	0.019893	J674	2.639941	0.019893
J469	3.407529	0.019893	J631	2.474059	0.019893	J676	3.908706	0.019893
J470	3.545294	0.019893	J632	3.43	0.019893	J677	2.827647	0.019893
J471	3.673	0.019893	J633	2.924765	0.019893	J678	1.681706	0.019893
J472	4.13	0.019893	J634	3.035706	0.019893	J679	0.592765	0.019893
J473	1.153235	0.019893	J635	3.179647	0.019893	J680	0.416294	0.019893
J474	3.355294	0.019893	J636	4.42	0.019893	J681	0.239824	0.116667
J475	3.977882	0.019893	J637	3.95	0.019893	J682	0.769235	0.019893
J476	3.367765	0.019893	J638	4.15	0.019893	J683	1.847706	0.019893
J477	3.629412	0.019893	J639	4.39	0.019893	J684	1.076824	0.019893
J478	3.767353	0.078	J640	0.780706	0.019893	J685	0.945706	0.019893
J479	3.833235	0.019893	J641	0.977059	0.019893	J686	4.88	0.019893
J480	2.017471	0.019893	J642	1.178882	0.019893	J689	4.749941	0.019893
J481	2.196588	0.019893	J643	0.604294	0.019893	J690	4.09	0.019893
J482	2.354647	0.019893	J644	3.451235	0.019893	J691	4.397824	0.019893
J483	3.312824	0.019893	J645	4.18	0.019893	J692	4.584353	0.019893
J484	3.939647	0.019893	J646	3.348941	0.019893	J701	3.658	0.019893
J485	3.867	0.019893	J647	3.648824	0.019893	J702	4.66	0.019893
J486	3.73	0.019893	J648	-0.24194	0.019893	J703	4.47	0.019893
J526	6.41	0.019893	J649	3.54	0.019893	J704	3.803235	0.019893
J527	5.9	0.019893	J650	3.392	0.019893	J705	1.338765	0.019893
J528	5.39	0.019893	J651	-0.04235	0.019893	J706	1.204353	0.019893
J529	7.16	0.019893	J652	3.539941	0.019893	J707	3.994353	0.019893
J609	5.205412	0.019893	J653	0.284412	0.019893	J708	4.405647	0.019893
J610	1.504706	0.019893	J654	0.108353	0.019893	J709	2.197294	0.019893
J611	1.722235	0.019893	J655	3.880529	0.019893	J710	2.043471	0.019893
J612	1.812294	0.019893	J656	1.648941	0.019893	J711	3.946824	0.019893
J613	3.87	0.019893	J657	1.825059	0.019893	J712	2.501059	0.019893
J614	3.358647	0.019893	J658	4.02	0.019893	J713	4.025471	0.019893
J615	3.529235	0.019893	J659	3.448294	0.019893	J714	2.761353	0.019893
J616	3.729588	0.019893	J660	3.583824	0.019893	J715	2.632824	0.019893
J617	1.968	0.019893	J661	3.726529	0.019893	J716	3.269176	0.019893
J618	2.949529	0.019893	J662	2.001471	0.019893	J717	2.774824	0.019893
J619	3.072294	0.019893	J663	2.899765	0.019893	J718	2.956176	0.019893
J620	3.298412	0.019893	J664	3.058059	0.019893	J719	3.461353	0.019893
J621	2.765824	0.019893	J665	3.234529	0.019893	J720	4.01	0.019893
J622	2.113471	0.019893	J666	2.705706	0.019893	J721	3.833529	0.019893
J623	2.302824	0.019893	J667	2.187765	0.019893	J722	3.657118	0.019893
J624	2.489412	0.019893	J668	2.352765	0.019893	J723	3.394529	0.019893
J625	2.815235	0.019893	J669	2.529235	0.019893	J724	1.869353	0.019893
J626	2.991706	0.019893	J670	4.08	0.019893	J725	1.691176	0.019893

J726	1.514941	0.019893
J727	3.540882	0.019893
J728	3.98	0.019893
J729	3.802	0.019893
J730	3.612941	0.019893

CONDUITS

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Conduit ID	Node From	Node To	Length (m)	Roughness	Diameter (m)	Losses K_{entry}	Losses K_{exit}	Losses K_{avg}
315	J292	J271	24.17	0.01	0.15	0.5	0.5	0.5
316	J271	J272	29.99	0.01	0.15	0.5	0.5	0.5
317	J272	J273	29.99	0.01	0.15	0.5	0.5	0.5
318	J273	J270	29.98	0.01	0.15	0.5	0.5	0.5
319	J270	J267	29.99	0.01	0.15	0.5	0.5	0.5
320	J267	J268	30	0.01	0.15	0.5	0.5	0.5
321	J268	J269	29.99	0.01	0.15	0.5	0.5	0.5
322	J269	J442	10.91	0.01	0.15	0.5	0.5	0.5
323	J442	J248	19.08	0.01	0.15	0.5	0.5	0.5
324	J248	J249	30	0.01	0.15	0.5	0.5	0.5
325	J249	J250	30	0.01	0.15	0.5	0.5	0.5
327	J247	J244	29.99	0.01	0.2	0.5	0.5	0.5
328	J244	J480	10.57	0.01	0.2	0.5	0.5	0.5
331	J246	J251	30	0.01	0.2	0.5	0.5	0.5
332	J251	J256	30	0.01	0.2	0.5	0.5	0.5
333	J256	J257	30	0.01	0.2	0.5	0.5	0.5
334	J257	J258	30	0.01	0.2	0.5	0.5	0.5
335	J258	J388	8.61	0.01	0.2	0.5	0.5	0.5
336	J388	J255	21.39	0.01	0.3	0.5	0.5	0.5
337	J255	J252	30	0.01	0.3	0.5	0.5	0.5
338	J252	J253	30	0.01	0.3	0.5	0.5	0.5
340	J254	J323	30	0.01	0.3	0.5	0.5	0.5
341	J323	J326	41.35	0.01	0.3	0.5	0.5	0.5
342	J326	J325	18.65	0.01	0.3	0.5	0.5	0.5
343	J325	J324	30	0.01	0.3	0.5	0.5	0.5
344	J261	J324	16.64	0.01	0.15	0.5	0.5	0.5
345	J260	J261	30	0.01	0.15	0.5	0.5	0.5
346	J259	J260	30	0.01	0.15	0.5	0.5	0.5
347	J262	J259	30	0.01	0.15	0.5	0.5	0.5
348	J265	J262	30	0.01	0.15	0.5	0.5	0.5
349	J264	J265	30	0.01	0.15	0.5	0.5	0.5
350	J263	J264	30	0.01	0.15	0.5	0.5	0.5
351	J304	J263	29.99	0.01	0.15	0.5	0.5	0.5
352	J646	J304	24.98	0.01	0.15	0.5	0.5	0.5
353	J345	J646	35.02	0.01	0.15	0.5	0.5	0.5
354	J344	J345	30	0.01	0.15	0.5	0.5	0.5
355	J655	J344	25.35	0.01	0.15	0.5	0.5	0.5
356	J343	J655	34.65	0.01	0.15	0.5	0.5	0.5
357	J346	J343	30	0.01	0.15	0.5	0.5	0.5
358	J349	J346	30	0.01	0.15	0.5	0.5	0.5
359	J348	J349	30	0.01	0.15	0.5	0.5	0.5
360	J347	J348	29.92	0.01	0.15	0.5	0.5	0.5
361	J342	J347	29.74	0.01	0.15	0.5	0.5	0.5
362	J337	J342	29.96	0.01	0.15	0.5	0.5	0.5
363	J609	J337	10.96	0.01	0.15	0.5	0.5	0.5

364	J336	J609	18.75	0.01	0.15	0.5	0.5	0.5
365	J335	J336	29.94	0.01	0.15	0.5	0.5	0.5
366	J338	J335	29.86	0.01	0.15	0.5	0.5	0.5
367	J341	J338	29.9	0.01	0.15	0.5	0.5	0.5
368	J340	J341	29.92	0.01	0.15	0.5	0.5	0.5
369	J339	J340	32.17	0.01	0.15	0.5	0.5	0.5
504	J528	J609	31.38	0.01	0.15	0.5	0.5	0.5
505	J527	J528	30.95	0.01	0.15	0.5	0.5	0.5
506	J526	J527	30.11	0.01	0.15	0.5	0.5	0.5
507	J242	J526	23.25	0.01	0.15	0.5	0.5	0.5
508	J529	J242	21.85	0.01	0.15	0.5	0.5	0.5
510	J718	J717	30.83	0.01	0.15	0.5	0.5	0.5
511	J243	J718	27.04	0.01	0.15	0.5	0.5	0.5
512	J716	J243	26.17	0.01	0.15	0.5	0.5	0.5
513	J719	J716	32.67	0.01	0.15	0.5	0.5	0.5
514	J722	J719	33.28	0.01	0.15	0.5	0.5	0.5
515	J721	J722	29.99	0.01	0.15	0.5	0.5	0.5
516	J720	J721	30	0.01	0.15	0.5	0.5	0.5
518	J680	J681	30	0.01	0.2	0.5	0.5	0.5
519	J679	J680	30	0.01	0.2	0.5	0.5	0.5
520	J682	J679	30	0.01	0.2	0.5	0.5	0.5
521	J685	J682	30	0.01	0.2	0.5	0.5	0.5
522	J684	J685	22.83	0.01	0.2	0.5	0.5	0.5
523	J678	J684	27.77	0.01	0.15	0.5	0.5	0.5
524	J683	J678	28.22	0.01	0.15	0.5	0.5	0.5
525	J673	J683	41.18	0.01	0.15	0.5	0.5	0.5
526	J672	J673	30	0.01	0.15	0.5	0.5	0.5
527	J671	J672	31.83	0.01	0.15	0.5	0.5	0.5
528	J674	J671	31.67	0.01	0.15	0.5	0.5	0.5
529	J677	J674	32.31	0.01	0.15	0.5	0.5	0.5
530	J676	J677	21.72	0.01	0.15	0.5	0.5	0.5
531	J240	J676	22.32	0.01	0.15	0.5	0.5	0.5
546	J60	J114	27.09	0.01	0.15	0.5	0.5	0.5
547	J114	J119	24.7	0.01	0.15	0.5	0.5	0.5
548	J119	J109	32	0.01	0.15	0.5	0.5	0.5
549	J109	J120	33.04	0.01	0.15	0.5	0.5	0.5
550	J120	J121	36.36	0.01	0.15	0.5	0.5	0.5
551	J121	J118	29.96	0.01	0.15	0.5	0.5	0.5
552	J118	J115	30	0.01	0.15	0.5	0.5	0.5
553	J115	J116	27.38	0.01	0.15	0.5	0.5	0.5
554	J116	J20	19.09	0.01	0.15	0.5	0.5	0.5
555	J117	J20	29.59	0.01	0.15	0.5	0.5	0.5
556	J108	J117	31.86	0.01	0.15	0.5	0.5	0.5
557	J96	J108	10.73	0.01	0.15	0.5	0.5	0.5
558	J97	J96	30.62	0.01	0.15	0.5	0.5	0.5
559	J98	J97	29.82	0.01	0.15	0.5	0.5	0.5
560	J95	J98	25.55	0.01	0.15	0.5	0.5	0.5
561	J92	J95	33.93	0.01	0.15	0.5	0.5	0.5
562	J93	J92	30	0.01	0.15	0.5	0.5	0.5
564	J358	J359	13.35	0.01	0.15	0.5	0.5	0.5

565	J360	J358	12.11	0.01	0.15	0.5	0.5	0.5
566	J391	J360	34.23	0.01	0.15	0.5	0.5	0.5
567	J370	J391	25.44	0.01	0.15	0.5	0.5	0.5
568	J371	J370	30.29	0.01	0.15	0.5	0.5	0.5
569	J390	J371	42.82	0.01	0.15	0.5	0.5	0.5
570	J372	J390	37.21	0.01	0.15	0.5	0.5	0.5
571	J283	J282	29.75	0.01	0.15	0.5	0.5	0.5
572	J282	J285	31.25	0.01	0.15	0.5	0.5	0.5
573	J285	J399	32.63	0.01	0.15	0.5	0.5	0.5
574	J399	J288	20.89	0.01	0.15	0.5	0.5	0.5
575	J288	J287	23.96	0.01	0.15	0.5	0.5	0.5
576	J287	J286	26.48	0.01	0.15	0.5	0.5	0.5
577	J286	J281	26.63	0.01	0.15	0.5	0.5	0.5
578	J281	J276	29.96	0.01	0.15	0.5	0.5	0.5
579	J276	J275	30	0.01	0.15	0.5	0.5	0.5
580	J275	J274	29.27	0.01	0.15	0.5	0.5	0.5
581	J274	J277	23.4	0.01	0.15	0.5	0.5	0.5
582	J277	J280	26.12	0.01	0.15	0.5	0.5	0.5
583	J280	J279	31.38	0.01	0.15	0.5	0.5	0.5
584	J279	J372	21.55	0.01	0.15	0.5	0.5	0.5
586	J278	J299	29.88	0.01	0.15	0.5	0.5	0.5
587	J299	J298	30	0.01	0.15	0.5	0.5	0.5
588	J298	J297	26.21	0.01	0.15	0.5	0.5	0.5
589	J297	J300	31.03	0.01	0.15	0.5	0.5	0.5
590	J300	J303	31.88	0.01	0.15	0.5	0.5	0.5
591	J303	J302	29.89	0.01	0.15	0.5	0.5	0.5
592	J302	J301	29.97	0.01	0.15	0.5	0.5	0.5
593	J301	J443	38.16	0.01	0.15	0.5	0.5	0.5
594	J443	J296	21.84	0.01	0.15	0.5	0.5	0.5
595	J296	J291	30	0.01	0.15	0.5	0.5	0.5
596	J291	J290	29.95	0.01	0.15	0.5	0.5	0.5
597	J290	J289	31.53	0.01	0.15	0.5	0.5	0.5
598	J289	J473	39.13	0.01	0.15	0.5	0.5	0.5
599	J473	J295	19.32	0.01	0.15	0.5	0.5	0.5
600	J295	J294	30	0.01	0.15	0.5	0.5	0.5
602	J293	J266	18.03	0.01	0.15	0.5	0.5	0.5
603	J266	J292	11.96	0.01	0.15	0.5	0.5	0.5
604	J404	J109	12.65	0.01	0.15	0.5	0.5	0.5
605	J396	J404	27.77	0.01	0.15	0.5	0.5	0.5
606	J407	J396	25.1	0.01	0.15	0.5	0.5	0.5
607	J410	J407	30.93	0.01	0.15	0.5	0.5	0.5
608	J409	J410	26.86	0.01	0.15	0.5	0.5	0.5
610	J403	J408	31.54	0.01	0.15	0.5	0.5	0.5
611	J398	J403	35.11	0.01	0.15	0.5	0.5	0.5
612	J397	J398	30	0.01	0.15	0.5	0.5	0.5
613	J424	J423	41.47	0.01	1	0.5	0.5	0.5
614	J81	J406	6.78	0.01	0.15	0.5	0.5	0.5
615	J418	J406	30	0.01	0.15	0.5	0.5	0.5
616	J423	J418	30	0.01	0.15	0.5	0.5	0.5
618	J425	J424	30	0.01	0.15	0.5	0.5	0.5

619	J422	J425	30	0.01	0.15	0.5	0.5	0.5
620	J419	J422	30	0.01	0.15	0.5	0.5	0.5
621	J420	J419	29.99	0.01	0.15	0.5	0.5	0.5
622	J421	J420	29.92	0.01	0.15	0.5	0.5	0.5
624	J400	J401	34.38	0.01	0.15	0.5	0.5	0.5
625	J401	J402	31.46	0.01	0.15	0.5	0.5	0.5
626	J402	J399	34.82	0.01	0.15	0.5	0.5	0.5
627	J354	J118	30	0.01	0.15	0.5	0.5	0.5
628	J315	J354	32.87	0.01	0.15	0.5	0.5	0.5
629	J314	J315	27.08	0.01	0.15	0.5	0.5	0.5
630	J313	J314	29.9	0.01	0.15	0.5	0.5	0.5
631	J408	J313	16.17	0.01	0.15	0.5	0.5	0.5
632	J316	J20	30.57	0.01	0.15	0.5	0.5	0.5
633	J319	J316	32.45	0.01	0.15	0.5	0.5	0.5
634	J318	J319	33.6	0.01	0.15	0.5	0.5	0.5
635	J417	J96	29.94	0.01	0.15	0.5	0.5	0.5
636	J416	J417	30	0.01	0.15	0.5	0.5	0.5
637	J415	J416	34.67	0.01	0.15	0.5	0.5	0.5
638	J376	J415	28.53	0.01	0.15	0.5	0.5	0.5
639	J414	J376	19.31	0.01	0.15	0.5	0.5	0.5
640	J411	J414	32.03	0.01	0.15	0.5	0.5	0.5
641	J412	J411	28.69	0.01	0.15	0.5	0.5	0.5
642	J413	J412	31.1	0.01	0.15	0.5	0.5	0.5
643	J406	J413	23.41	0.01	0.15	0.5	0.5	0.5
644	J375	J414	3.83	0.01	0.15	0.5	0.5	0.5
645	J374	J375	29.97	0.01	0.15	0.5	0.5	0.5
646	J377	J374	29.9	0.01	0.15	0.5	0.5	0.5
647	J380	J377	20.39	0.01	0.15	0.5	0.5	0.5
648	J373	J380	26.67	0.01	0.15	0.5	0.5	0.5
649	J378	J373	9.42	0.01	0.15	0.5	0.5	0.5
650	J379	J378	33.02	0.01	0.15	0.5	0.5	0.5
651	J368	J373	11.65	0.01	0.15	0.5	0.5	0.5
652	J367	J368	4.72	0.01	0.15	0.5	0.5	0.5
653	J366	J367	23.85	0.01	0.15	0.5	0.5	0.5
654	J369	J366	14.57	0.01	0.15	0.5	0.5	0.5
655	J317	J95	29.93	0.01	0.15	0.5	0.5	0.5
656	J312	J317	30	0.01	0.15	0.5	0.5	0.5
657	J307	J312	32.62	0.01	0.15	0.5	0.5	0.5
658	J311	J307	8.36	0.01	0.15	0.5	0.5	0.5
659	J310	J311	11.77	0.01	0.15	0.5	0.5	0.5
660	J306	J310	11.36	0.01	0.15	0.5	0.5	0.5
661	J309	J306	17.26	0.01	0.15	0.5	0.5	0.5
662	J305	J309	24.33	0.01	0.15	0.5	0.5	0.5
663	J308	J305	24.76	0.01	0.15	0.5	0.5	0.5
664	J330	J359	29.79	0.01	0.15	0.5	0.5	0.5
665	J329	J330	29.95	0.01	0.15	0.5	0.5	0.5
666	J328	J329	12.92	0.01	0.15	0.5	0.5	0.5
667	J331	J328	3.91	0.01	0.15	0.5	0.5	0.5
668	J334	J331	5.03	0.01	0.15	0.5	0.5	0.5
669	J332	J391	25.24	0.01	0.15	0.5	0.5	0.5

670	J333	J332	21.81	0.01	0.15	0.5	0.5	0.5
671	J322	J370	26.07	0.01	0.15	0.5	0.5	0.5
672	J327	J322	26.31	0.01	0.15	0.5	0.5	0.5
673	J389	J274	8.13	0.01	0.15	0.5	0.5	0.5
674	J394	J389	25.4	0.01	0.15	0.5	0.5	0.5
675	J392	J394	26.47	0.01	0.15	0.5	0.5	0.5
676	J393	J392	38.38	0.01	0.15	0.5	0.5	0.5
677	J395	J393	16.83	0.01	0.15	0.5	0.5	0.5
679	J91	J88	29.99	0.01	0.15	0.5	0.5	0.5
680	J88	J85	30	0.01	0.15	0.5	0.5	0.5
681	J85	J86	25.28	0.01	0.15	0.5	0.5	0.5
682	J86	J651	28.78	0.01	0.15	0.5	0.5	0.5
683	J87	J651	35.52	0.01	0.15	0.5	0.5	0.5
684	J66	J87	29.97	0.01	0.15	0.5	0.5	0.5
685	J67	J66	29.97	0.01	0.15	0.5	0.5	0.5
686	J68	J67	29.98	0.01	0.15	0.5	0.5	0.5
687	J65	J68	30	0.01	0.15	0.5	0.5	0.5
688	J62	J65	19.56	0.01	0.15	0.5	0.5	0.5
689	J63	J62	26.1	0.01	0.15	0.5	0.5	0.5
690	J205	J63	23.16	0.01	0.15	0.5	0.5	0.5
691	J64	J205	25.93	0.01	0.15	0.5	0.5	0.5
692	J69	J64	32.38	0.01	0.15	0.5	0.5	0.5
693	J74	J69	32.26	0.01	0.15	0.5	0.5	0.5
694	J75	J74	27.26	0.01	0.15	0.5	0.5	0.5
695	J76	J75	27.36	0.01	0.15	0.5	0.5	0.5
696	J73	J76	33.87	0.01	0.15	0.5	0.5	0.5
697	J70	J73	31.41	0.01	0.15	0.5	0.5	0.5
698	J71	J70	20.58	0.01	0.15	0.5	0.5	0.5
699	J72	J71	29.99	0.01	0.15	0.5	0.5	0.5
700	J111	J72	30	0.01	0.15	0.5	0.5	0.5
702	J112	J90	21.66	0.01	0.15	0.5	0.5	0.5
703	J90	J113	19.94	0.01	0.15	0.5	0.5	0.5
705	J110	J113	21.84	0.01	0.15	0.5	0.5	0.5
706	J107	J359	21.76	0.01	0.15	0.5	0.5	0.5
707	J113	J363	31.81	0.01	0.15	0.5	0.5	0.5
708	J363	J95	33.78	0.01	0.15	0.5	0.5	0.5
710	J449	J444	21.44	0.01	0.15	0.5	0.5	0.5
711	J444	J454	16.21	0.01	0.15	0.5	0.5	0.5
712	J454	J455	28.91	0.01	0.15	0.5	0.5	0.5
713	J455	J456	30	0.01	0.15	0.5	0.5	0.5
714	J456	J453	24.88	0.01	0.15	0.5	0.5	0.5
715	J453	J450	24.74	0.01	0.15	0.5	0.5	0.5
716	J450	J451	29.66	0.01	0.15	0.5	0.5	0.5
717	J451	J452	40.65	0.01	0.15	0.5	0.5	0.5
718	J452	J431	29.96	0.01	0.15	0.5	0.5	0.5
719	J431	J432	30	0.01	0.15	0.5	0.5	0.5
720	J432	J433	29.97	0.01	0.15	0.5	0.5	0.5
721	J433	J430	29.99	0.01	0.15	0.5	0.5	0.5
722	J430	J427	29.91	0.01	0.15	0.5	0.5	0.5
723	J427	J443	25.75	0.01	0.15	0.5	0.5	0.5

725	J472	J475	25.86	0.01	0.15	0.5	0.5	0.5
726	J475	J428	29.18	0.01	0.15	0.5	0.5	0.5
727	J428	J478	6.61	0.01	0.15	0.5	0.5	0.5
728	J478	J477	23.45	0.01	0.15	0.5	0.5	0.5
729	J477	J429	35.53	0.01	0.15	0.5	0.5	0.5
730	J429	J476	8.95	0.01	0.15	0.5	0.5	0.5
731	J476	J434	20.53	0.01	0.15	0.5	0.5	0.5
732	J434	J437	22.84	0.01	0.15	0.5	0.5	0.5
733	J437	J436	17.4	0.01	0.15	0.5	0.5	0.5
734	J435	J436	27.14	0.01	0.15	0.5	0.5	0.5
735	J438	J435	30	0.01	0.15	0.5	0.5	0.5
736	J441	J438	29.98	0.01	0.15	0.5	0.5	0.5
738	J439	J440	34.26	0.01	0.15	0.5	0.5	0.5
739	J464	J439	30	0.01	0.15	0.5	0.5	0.5
737	J440	J441	30	0.01	0.15	0.5	0.5	0.5
740	J474	J464	31.18	0.01	0.15	0.5	0.5	0.5
741	J469	J474	8.88	0.01	0.15	0.5	0.5	0.5
742	J470	J469	23.42	0.01	0.15	0.5	0.5	0.5
743	J471	J470	21.71	0.01	0.15	0.5	0.5	0.5
744	J479	J471	27.24	0.01	0.15	0.5	0.5	0.5
745	J485	J479	5.74	0.01	0.15	0.5	0.5	0.5
746	J484	J485	12.35	0.01	0.15	0.5	0.5	0.5
747	J468	J484	14.67	0.01	0.15	0.5	0.5	0.5
748	J465	J468	36.39	0.01	0.15	0.5	0.5	0.5
750	J481	J480	30.45	0.01	0.15	0.5	0.5	0.5
751	J482	J481	26.87	0.01	0.15	0.5	0.5	0.5
752	J461	J482	24.03	0.01	0.15	0.5	0.5	0.5
753	J426	J461	16.23	0.01	0.15	0.5	0.5	0.5
754	J385	J426	22.42	0.01	0.15	0.5	0.5	0.5
755	J386	J385	28.77	0.01	0.15	0.5	0.5	0.5
756	J387	J386	32.99	0.01	0.15	0.5	0.5	0.5
757	J466	J387	30.33	0.01	0.15	0.5	0.5	0.5
759	J384	J381	24.11	0.01	0.15	0.5	0.5	0.5
760	J381	J382	15.22	0.01	0.15	0.5	0.5	0.5
761	J382	J467	21.32	0.01	0.15	0.5	0.5	0.5
762	J467	J62	18.5	0.01	0.15	0.5	0.5	0.5
763	J462	J426	26.4	0.01	0.15	0.5	0.5	0.5
764	J463	J462	23.34	0.01	0.15	0.5	0.5	0.5
765	J460	J463	33.38	0.01	0.15	0.5	0.5	0.5
766	J457	J460	14.6	0.01	0.15	0.5	0.5	0.5
767	J483	J457	24.91	0.01	0.15	0.5	0.5	0.5
768	J458	J483	26.45	0.01	0.15	0.5	0.5	0.5
769	J459	J458	22.94	0.01	0.15	0.5	0.5	0.5
770	J486	J459	21.53	0.01	0.15	0.5	0.5	0.5
772	J445	J442	17.45	0.01	0.15	0.5	0.5	0.5
773	J284	J445	33.4	0.01	0.15	0.5	0.5	0.5
774	J365	J284	13.37	0.01	0.15	0.5	0.5	0.5
775	J448	J365	9.73	0.01	0.15	0.5	0.5	0.5
776	J447	J448	28.99	0.01	0.15	0.5	0.5	0.5
777	J446	J447	30	0.01	0.15	0.5	0.5	0.5

778	J436	J446	29.96	0.01	0.15	0.5	0.5	0.5
780	J650	J383	20.15	0.01	0.2	0.5	0.5	0.5
781	J649	J650	25.16	0.01	0.2	0.5	0.5	0.5
784	J654	J651	25.62	0.01	0.15	0.5	0.5	0.5
785	J653	J654	29.93	0.01	0.15	0.5	0.5	0.5
786	J200	J653	24.38	0.01	0.15	0.5	0.5	0.5
789	J640	J643	29.99	0.01	0.15	0.5	0.5	0.5
790	J641	J640	33.38	0.01	0.15	0.5	0.5	0.5
791	J642	J641	34.31	0.01	0.15	0.5	0.5	0.5
792	J188	J642	28.28	0.01	0.15	0.5	0.5	0.5
793	J610	J188	27.11	0.01	0.15	0.5	0.5	0.5
794	J611	J610	36.98	0.01	0.15	0.5	0.5	0.5
795	J612	J611	15.31	0.01	0.15	0.5	0.5	0.5
797	J670	J711	22.64	0.01	0.15	0.5	0.5	0.5
798	J711	J710	22.97	0.01	0.15	0.5	0.5	0.5
799	J710	J724	29.6	0.01	0.2	0.5	0.5	0.5
779	J383	J388	29.6	0.01	0.2	0.5	0.5	0.5
800	J724	J725	30.29	0.01	0.2	0.5	0.5	0.5
801	J725	J726	29.96	0.01	0.2	0.5	0.5	0.5
802	J726	J705	29.95	0.01	0.2	0.5	0.5	0.5
803	J705	J706	22.85	0.01	0.2	0.5	0.5	0.5
804	J706	J684	21.68	0.01	0.2	0.5	0.5	0.5
805	J727	J683	36.16	0.01	0.15	0.5	0.5	0.5
806	J730	J727	12.25	0.01	0.15	0.5	0.5	0.5
807	J729	J730	32.14	0.01	0.15	0.5	0.5	0.5
808	J728	J729	30.26	0.01	0.15	0.5	0.5	0.5
810	J723	J671	17.52	0.01	0.15	0.5	0.5	0.5
811	J229	J723	17.29	0.01	0.15	0.5	0.5	0.5
812	J232	J229	3.19	0.01	0.15	0.5	0.5	0.5
813	J701	J232	24.31	0.01	0.15	0.5	0.5	0.5
814	J704	J701	24.14	0.01	0.15	0.5	0.5	0.5
815	J707	J704	28.04	0.01	0.15	0.5	0.5	0.5
816	J235	J707	29.86	0.01	0.15	0.5	0.5	0.5
817	J233	J704	28.35	0.01	0.15	0.5	0.5	0.5
819	J234	J677	27.76	0.01	0.15	0.5	0.5	0.5
820	J193	J234	25.59	0.01	0.15	0.5	0.5	0.5
821	J194	J193	26.05	0.01	0.15	0.5	0.5	0.5
822	J195	J194	21.94	0.01	0.15	0.5	0.5	0.5
823	J192	J195	21.99	0.01	0.15	0.5	0.5	0.5
824	J191	J192	25.67	0.01	0.15	0.5	0.5	0.5
825	J198	J191	23.44	0.01	0.15	0.5	0.5	0.5
826	J197	J198	18.94	0.01	0.15	0.5	0.5	0.5
827	J196	J197	19.82	0.01	0.15	0.5	0.5	0.5
828	J709	J710	26.15	0.01	0.15	0.5	0.5	0.5
829	J186	J709	17.24	0.01	0.15	0.5	0.5	0.5
830	J712	J186	34.4	0.01	0.15	0.5	0.5	0.5
831	J715	J712	22.4	0.01	0.15	0.5	0.5	0.5
832	J714	J715	21.85	0.01	0.15	0.5	0.5	0.5
833	J633	J714	27.78	0.01	0.15	0.5	0.5	0.5
834	J634	J633	18.86	0.01	0.15	0.5	0.5	0.5

835	J208	J634	20.16	0.01	0.15	0.5	0.5	0.5
837	J45	J42	21.93	0.01	0.15	0.5	0.5	0.5
838	J42	J39	25.45	0.01	0.15	0.5	0.5	0.5
839	J39	J40	37.87	0.01	0.15	0.5	0.5	0.5
840	J40	J41	39.13	0.01	0.15	0.5	0.5	0.5
841	J41	J122	34.72	0.01	0.15	0.5	0.5	0.5
842	J122	J203	23.62	0.01	0.15	0.5	0.5	0.5
843	J203	J204	31.72	0.01	0.15	0.5	0.5	0.5
844	J204	J205	29.56	0.01	0.15	0.5	0.5	0.5
845	J24	J122	29.85	0.01	0.15	0.5	0.5	0.5
846	J27	J24	29.99	0.01	0.15	0.5	0.5	0.5
847	J30	J27	30.56	0.01	0.15	0.5	0.5	0.5
848	J29	J30	29.4	0.01	0.15	0.5	0.5	0.5
849	J28	J29	35.04	0.01	0.15	0.5	0.5	0.5
850	J23	J28	24.95	0.01	0.15	0.5	0.5	0.5
851	J18	J23	30	0.01	0.15	0.5	0.5	0.5
852	J17	J18	30	0.01	0.15	0.5	0.5	0.5
854	J16	J19	29.98	0.01	0.15	0.5	0.5	0.5
855	J19	J22	29.98	0.01	0.15	0.5	0.5	0.5
856	J22	J21	29.98	0.01	0.15	0.5	0.5	0.5
857	J20	J21	32.33	0.01	0.15	0.5	0.5	0.5
858	J355	J30	21.85	0.01	0.15	0.5	0.5	0.5
859	J352	J355	19.28	0.01	0.15	0.5	0.5	0.5
860	J351	J352	3.04	0.01	0.15	0.5	0.5	0.5
861	J350	J351	11.81	0.01	0.15	0.5	0.5	0.5
862	J353	J350	17.01	0.01	0.15	0.5	0.5	0.5
863	J356	J353	4.14	0.01	0.15	0.5	0.5	0.5
864	J357	J28	24.42	0.01	0.15	0.5	0.5	0.5
865	J362	J357	16.6	0.01	0.15	0.5	0.5	0.5
866	J89	J112	22.35	0.01	0.15	0.5	0.5	0.5
867	J84	J89	29.98	0.01	0.15	0.5	0.5	0.5
869	J79	J78	21.65	0.01	0.15	0.5	0.5	0.5
870	J78	J82	22.06	0.01	0.15	0.5	0.5	0.5
871	J82	J77	22.25	0.01	0.15	0.5	0.5	0.5
872	J77	J80	23.96	0.01	0.15	0.5	0.5	0.5
873	J80	J83	29.99	0.01	0.15	0.5	0.5	0.5
874	J83	J108	29.87	0.01	0.15	0.5	0.5	0.5
876	J645	J209	18.69	0.01	0.15	0.5	0.5	0.5
877	J209	J644	25.29	0.01	0.15	0.5	0.5	0.5
878	J644	J665	36.84	0.01	0.15	0.5	0.5	0.5
879	J665	J664	30	0.01	0.15	0.5	0.5	0.5
880	J664	J663	26.91	0.01	0.15	0.5	0.5	0.5
881	J663	J666	32.99	0.01	0.15	0.5	0.5	0.5
882	J666	J669	30	0.01	0.15	0.5	0.5	0.5
883	J669	J668	30	0.01	0.15	0.5	0.5	0.5
884	J668	J667	28.05	0.01	0.15	0.5	0.5	0.5
885	J667	J662	31.67	0.01	0.15	0.5	0.5	0.5
886	J662	J657	29.99	0.01	0.15	0.5	0.5	0.5
887	J657	J656	29.94	0.01	0.15	0.5	0.5	0.5
888	J656	J642	29.78	0.01	0.15	0.5	0.5	0.5

889	J613	J616	23.87	0.01	0.15	0.5	0.5	0.5
891	J616	J615	34.06	0.01	0.15	0.5	0.5	0.5
892	J615	J614	29	0.01	0.15	0.5	0.5	0.5
893	J614	J635	30.43	0.01	0.15	0.5	0.5	0.5
894	J635	J208	4.31	0.01	0.15	0.5	0.5	0.5
895	J44	J45	30.1	0.01	0.15	0.5	0.5	0.5
896	J43	J44	29.7	0.01	0.15	0.5	0.5	0.5
897	J38	J43	24.57	0.01	0.15	0.5	0.5	0.5
899	J59	J58	22.82	0.01	0.15	0.5	0.5	0.5
900	J33	J59	6.74	0.01	0.15	0.5	0.5	0.5
901	J32	J33	24.71	0.01	0.15	0.5	0.5	0.5
902	J31	J32	29.13	0.01	0.15	0.5	0.5	0.5
903	J34	J31	28.95	0.01	0.15	0.5	0.5	0.5
904	J37	J34	13.02	0.01	0.15	0.5	0.5	0.5
905	J36	J37	37.74	0.01	0.15	0.5	0.5	0.5
906	J35	J36	27.95	0.01	0.15	0.5	0.5	0.5
907	J56	J35	25.45	0.01	0.15	0.5	0.5	0.5
908	J55	J56	38.83	0.01	0.15	0.5	0.5	0.5
909	J54	J55	25.71	0.01	0.15	0.5	0.5	0.5
911	J57	J60	30.88	0.01	0.15	0.5	0.5	0.5
912	J636	J633	35.41	0.01	0.15	0.5	0.5	0.5
914	J639	J638	17.75	0.01	0.15	0.5	0.5	0.5
915	J638	J637	30.44	0.01	0.15	0.5	0.5	0.5
916	J637	J207	22.04	0.01	0.15	0.5	0.5	0.5
917	J207	J632	21.97	0.01	0.15	0.5	0.5	0.5
918	J632	J210	22.04	0.01	0.15	0.5	0.5	0.5
919	J210	J627	6.38	0.01	0.15	0.5	0.5	0.5
920	J627	J626	29.03	0.01	0.15	0.5	0.5	0.5
921	J626	J625	30	0.01	0.15	0.5	0.5	0.5
922	J625	J628	28.54	0.01	0.15	0.5	0.5	0.5
923	J628	J213	23.78	0.01	0.15	0.5	0.5	0.5
924	J213	J631	5.68	0.01	0.15	0.5	0.5	0.5
925	J631	J630	31.88	0.01	0.15	0.5	0.5	0.5
926	J630	J629	34.63	0.01	0.15	0.5	0.5	0.5
927	J629	J56	32.95	0.01	0.15	0.5	0.5	0.5
928	J201	J55	38.93	0.01	0.15	0.5	0.5	0.5
929	J206	J201	39.33	0.01	0.15	0.5	0.5	0.5
930	J211	J206	13.89	0.01	0.15	0.5	0.5	0.5
931	J212	J211	27.49	0.01	0.15	0.5	0.5	0.5
932	J53	J34	24.23	0.01	0.15	0.5	0.5	0.5
933	J48	J53	21.22	0.01	0.15	0.5	0.5	0.5
934	J47	J48	5.87	0.01	0.15	0.5	0.5	0.5
935	J46	J32	20.64	0.01	0.15	0.5	0.5	0.5
936	J52	J46	18	0.01	0.15	0.5	0.5	0.5
937	J49	J52	22.47	0.01	0.15	0.5	0.5	0.5
938	J50	J33	24.52	0.01	0.15	0.5	0.5	0.5
939	J51	J50	21.38	0.01	0.15	0.5	0.5	0.5
940	J11	J43	30.33	0.01	0.15	0.5	0.5	0.5
941	J10	J11	23.59	0.01	0.15	0.5	0.5	0.5
942	J2	J59	30.21	0.01	0.15	0.5	0.5	0.5

943	J1	J2	28.8	0.01	0.15	0.5	0.5	0.5
944	J4	J1	24.19	0.01	0.15	0.5	0.5	0.5
945	J15	J37	24.77	0.01	0.15	0.5	0.5	0.5
946	J14	J15	26.66	0.01	0.15	0.5	0.5	0.5
947	J13	J14	16.71	0.01	0.15	0.5	0.5	0.5
948	J8	J13	19.74	0.01	0.15	0.5	0.5	0.5
949	J3	J8	23.5	0.01	0.15	0.5	0.5	0.5
950	J12	J36	28.83	0.01	0.15	0.5	0.5	0.5
951	J9	J12	29.93	0.01	0.15	0.5	0.5	0.5
952	J61	J115	23.04	0.01	0.15	0.5	0.5	0.5
953	J102	J61	24.01	0.01	0.15	0.5	0.5	0.5
954	J101	J102	7.36	0.01	0.15	0.5	0.5	0.5
955	J94	J101	30.87	0.01	0.15	0.5	0.5	0.5
956	J99	J94	5.63	0.01	0.15	0.5	0.5	0.5
957	J100	J99	12.62	0.01	0.15	0.5	0.5	0.5
958	J103	J100	30	0.01	0.15	0.5	0.5	0.5
959	J106	J103	29.97	0.01	0.15	0.5	0.5	0.5
960	J105	J106	29.99	0.01	0.15	0.5	0.5	0.5
961	J104	J105	29.99	0.01	0.15	0.5	0.5	0.5
962	J7	J39	24.55	0.01	0.15	0.5	0.5	0.5
963	J25	J7	23.13	0.01	0.15	0.5	0.5	0.5
964	J6	J25	12.12	0.01	0.15	0.5	0.5	0.5
965	J26	J6	15.87	0.01	0.15	0.5	0.5	0.5
966	J5	J26	27.27	0.01	0.15	0.5	0.5	0.5
967	J643	J200	30	0.01	0.15	0.5	0.5	0.5
968	J652	J200	10.02	0.01	0.15	0.5	0.5	0.5
969	J647	J652	18.51	0.01	0.15	0.5	0.5	0.5
970	J202	J647	22.3	0.01	0.15	0.5	0.5	0.5
971	J185	J186	24.43	0.01	0.15	0.5	0.5	0.5
972	J713	J185	19.95	0.01	0.15	0.5	0.5	0.5
973	J187	J713	3.92	0.01	0.15	0.5	0.5	0.5
974	J184	J187	23.03	0.01	0.15	0.5	0.5	0.5
975	J190	J184	7.48	0.01	0.15	0.5	0.5	0.5
976	J189	J190	6.15	0.01	0.15	0.5	0.5	0.5
977	J708	J189	24.05	0.01	0.15	0.5	0.5	0.5
978	J703	J708	10.94	0.01	0.15	0.5	0.5	0.5
979	J702	J703	30.19	0.01	0.15	0.5	0.5	0.5
980	J690	J716	32.43	0.01	0.15	0.5	0.5	0.5
981	J691	J690	30.8	0.01	0.15	0.5	0.5	0.5
982	J692	J691	31.71	0.01	0.15	0.5	0.5	0.5
983	J689	J692	28.15	0.01	0.15	0.5	0.5	0.5
984	J686	J689	22.11	0.01	0.15	0.5	0.5	0.5
985	J241	J686	23.87	0.01	0.15	0.5	0.5	0.5
987	J236	J658	23.2	0.01	0.15	0.5	0.5	0.5
988	J658	J231	23.12	0.01	0.15	0.5	0.5	0.5
989	J231	J661	26.77	0.01	0.15	0.5	0.5	0.5
990	J661	J660	24.26	0.01	0.15	0.5	0.5	0.5
991	J660	J659	23.04	0.01	0.15	0.5	0.5	0.5
992	J659	J620	25.48	0.01	0.15	0.5	0.5	0.5
993	J620	J619	38.44	0.01	0.15	0.5	0.5	0.5

994	J619	J618	20.87	0.01	0.15	0.5	0.5	0.5
995	J618	J621	31.23	0.01	0.15	0.5	0.5	0.5
996	J621	J230	23.84	0.01	0.15	0.5	0.5	0.5
997	J230	J624	23.15	0.01	0.15	0.5	0.5	0.5
998	J624	J623	31.72	0.01	0.15	0.5	0.5	0.5
999	J623	J622	32.19	0.01	0.15	0.5	0.5	0.5
1000	J622	J617	24.73	0.01	0.15	0.5	0.5	0.5
1001	J617	J612	26.47	0.01	0.15	0.5	0.5	0.5
1	J324	1	24.93	0.01	0.3	0.5	0.5	0.5
2	J21	2	15.48	0.01	0.15	0.5	0.5	0.5
9	J717	6	7.97	0.01	1	0.5	0.5	0.5
10	J651	J648	34.33	0.01	0.15	0.5	0.5	0.5
11	J58	7	14.05	0.01	1	0.5	0.5	0.5
12	J648	8	9.17	0.01	1	0.5	0.5	0.5
13	J294	9	11.91	0.01	1	0.5	0.5	0.5
14	J480	J246	49.43	0.01	0.2	0.5	0.5	0.5
15	J250	10	10.36	0.01	1	0.5	0.5	0.5
17	J359	12	7.43	0.01	1	0.5	0.5	0.5
3	J681	3	400	0.01	1	0.5	0.5	0.5
4	J253	4	400	0.01	1	0.5	0.5	0.5

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ANNEXURE-2

ALUVA ZONE-1 NETWORK SYSTEM


ALUVA ZONE-2 NETWORK SYSTEM

ANNEXURE-3

ആലുവ നഗരസഭ

17.11.2021-ലെ 13-ാം നമ്പർ കൗൺസിൽ തീരുമാനം

അജണ്ട

ഇ.1-7391/2021

ജലസ്രോതസ്സ് മലിനീകരണ നിയന്ത്രണം എന്ന ലക്ഷ്യവുമായി കേരള വാട്ടർ അതോറിറ്റിയുടെ നേതൃത്വത്തിൽ മലിനജല സംസ്കരണ നിലയം സ്ഥാപിക്കുന്നതിനും കളക്ഷൻ വെല്ലുകൾ എന്നിവയ്ക്കായി സ്ഥലം കണ്ടെത്തുന്നതിനായി അസിസ്റ്റന്റ് എക്സിക്യൂട്ടീവ് എഞ്ചിനീയർ, കേരള വാട്ടർ അതോറിറ്റി കൊച്ചി കാര്യാലയത്തിൽ നിന്നും കത്ത് അയച്ചിട്ടുള്ളതും, ആയതു പ്രകാരം വാട്ടർ അതോറിറ്റി അധികൃതരും, ചെയർമാൻ, സെക്രട്ടറി, അസിസ്റ്റന്റ് എഞ്ചിനീയർ എന്നിവർ 12.10.2021 ന് സംയുക്ത പരിശോധന നടത്തുകയും, ആലുവ മാർക്കറ്റ് (ഫിഷ് മാർക്കറ്റിനടുത്തുള്ള സ്ഥലം), ഇറിഗേഷൻ ഓഫീസ് കോംമ്പൗണ്ട് (പെരിയാറിനോട് ചേർന്നുള്ള സ്ഥലം) പറവൂർ കവലക്കും, സെമിനാരിപ്പടിയ്ക്കും ഇടയിൽ ഡ്രൈവിംഗ് ടെസ്റ്റ് നടത്തുന്ന ഗ്രൗണ്ടിനോട് ചേർന്ന് കിടക്കുന്ന സ്ഥലം, പറവൂർ കവല ബസ് സ്റ്റോപ്പിനു പുറകുവശം, വെറ്റിനറി ഹോസ്പിറ്റൽ കോംമ്പൗണ്ട് എന്നി സ്ഥലങ്ങൾ കണ്ടെത്തുകയും ചെയ്തിട്ടുള്ളതാണ്. കൂടാതെ വാട്ടർ അതോറിറ്റിയിൽ നിന്നും സ്ഥലങ്ങൾ ശുപാർശ ചെയ്തു കൊണ്ട് കത്ത് ലഭിച്ചതു പ്രകാരം മൂന്ന് സ്ഥലങ്ങൾ ശുപാർശ ചെയ്തിട്ടുണ്ട്. ആയത് താഴെ പറയും പ്രകാരമാണ്.

Zone 1 തോട്ടയ്ക്കാട്ടുകര വെസ്റ്റ്

1. മാലിന്യ സംസ്കരണശാല (1.58 എം.എൽ.ഡി) തോട്ടയ്ക്കാട്ടുകരയിൽ ഇറിഗേഷൻ ഡിപ്പാർട്ട്മെന്റിന്റെ കൈവശമുള്ള ഭൂമിയിൽ സർവ്വെ നമ്പർ 28/54 നിന്നു 100 സെന്റ് സ്ഥലം

Zone 3 മാർക്കറ്റ് ഭാഗം

2. മാലിന്യ സംസ്കരണശാല (0.24 എം.എൽ.ഡി) മാർക്കറ്റിൽ മുനിസിപ്പാലിറ്റിയുടെ കൈവശമുള്ള ഭൂമിയിൽ നിന്നും 50 സെന്റ് സ്ഥലം.
3. സോൺ 3 സബ് ജയിൽ ഭാഗം, മൃഗാശുപത്രിയ്ക്കടുത്ത് (സർവ്വെ നമ്പർ 64/4) നിന്നും 100 സെന്റ് സ്ഥലം എന്നിങ്ങനെയാണ്.

മേൽ വിഷയം ബഹു:കൗൺസിലിന്റെ തീരുമാനത്തിനായി.

തീരുമാനം

വാട്ടർ അതോറിറ്റിയിൽ നിന്നും ശുപാർശ ചെയ്തത് പ്രകാരമുള്ള

1. സോൺ 1 തോട്ടയ്ക്കാട്ടുകര വെസ്റ്റ്-മാലിന്യ സംസ്കരണശാല (1.58 എം.എൽ.ഡി) തോട്ടയ്ക്കാട്ടുകരയിൽ ഇറിഗേഷൻ ഡിപ്പാർട്ട്മെന്റിന്റെ കൈവശമുള്ള ഭൂമിയിൽ സർവ്വെ നമ്പർ 28/54 നിന്നു 100 സെന്റ്

സ്ഥലത്ത് പദ്ധതി നടപ്പിലാക്കുന്നതിന് അനുവാദം നൽകണമെന്ന് ഇറിഗേഷൻ ഡിപ്പാർട്ട്മെന്റിനോട് അഭ്യർത്ഥിക്കുന്നതിന് തീരുമാനിച്ചു.

2. സോൺ 3 മാർക്കറ്റ് ഭാഗം- മാലിന്യ സംസ്കരണശാല (0.24 എം.എൽ.ഡി) മാർക്കറ്റിൽ മുനിസിപ്പാലിറ്റിയുടെ കൈവശമുള്ള ഭൂമിയിൽ നിന്നും 50 സെന്റ് സ്ഥലം മാർക്കറ്റിൽ ഇപ്പോൾ നടക്കുന്ന വികസന പ്രവർത്തനങ്ങൾക്ക് തടസ്സമില്ലാത്ത തരത്തിൽ നൽകുന്നതിന് തീരുമാനിച്ചു.

3. സോൺ 3 സബ് ജയിൽ ഭാഗം- മൃഗാശുപത്രിയ്ക്കടുത്ത് (സർവ്വെ നമ്പർ 64/4) നിന്നും 100 സെന്റ് സ്ഥലത്ത് പദ്ധതി നടപ്പിലാക്കുന്നതിന് അനുവാദം നൽകണമെന്ന് വെറ്റ്നറി ഡിപ്പാർട്ട്മെന്റിനോട് അഭ്യർത്ഥിക്കുന്നതിന് തീരുമാനിച്ചു.

ഈ മൂന്ന് സ്ഥലങ്ങളിലും മലിനജല സംസ്കരണ നിലയം സ്ഥാപിക്കുന്നതിന് കേരള വാട്ടർ അതോറിറ്റിയെ അനുവദിച്ചുകൊണ്ട് കൗൺസിൽ ഏകകണ്ഠമായി തീരുമാനിച്ചു.

(ഒപ്പ്)
ചെയർമാൻ

MUNICIPAL OFFICE ALUVA

/// ശരിപകർപ്പ് ///

സെക്രട്ടറി

2

ABSTRACT OF COST		
Sl.No.	**Item Specification**	**Amount (INR)**
I	**Sewerage Treatment Plant**	
	Civil Works	57348622
	Mechanical Items	22271799
	Electrical Items and electrical works	3265893
	STP allied works and components	18938929
III	**Sewer Network**	
	Network, Manholes, Pumping Mains of Sewer Netwok	411734522
	Mechanical Items	8362955
	Electrical Items and electrical works	2350000
	Effecting Household Sewer Connections	35145000
	Provision for NH crossing for laying pumping main	7500000
	Charges for utility shifting	2500000
	Side Protection works	1000000
IV	**Road restoration charges**	258581348
V	**O&M Charges**	76694915
	GST @18%	163024917
	Centage Charges @10% (I,II,III,IV &V)	90569398
	DPR Preparation Charge @2.5% (I,II,III,&IV)	20724977
	Contigencies including statutory clearances	4986726
	Grant Total	1185000000

GENERAL ABSTRACT

Others-Comprehensive Sewerage Scheme in Aluva Municipality-DPR Preparation of Comprehensive Sewerage Scheme in Aluva Municipality- Zone -1 & 2-DPR Preparation Work

Sl No	Head Description		Amount
1	Network, Manholes, Pumping Mains of Sewer Netwok		394062716.36
2	Road restoration charges		258581348.01
3	Effecting household sewer connections		35145000.00
4	Provision for NH crossing for laying pumping main		7500000.00
5	Charges for utility shifting		2500000.00
6	Side Protection works		1000000.00
	Total Estimation PAC		698789064.37
C	**Extra Charges**		
C.001	Provision for GST		
	698789064.37	18.00%	125782031.59
	Grand Total		0.00
	Round off		0.00
	Rounded Total(Rs)		824571095.96
	Rupees Eighty Two Crore Forty Five Lakh Seventy One Thousand Ninety Five		

ABSTRACT ESTIMATE

Others-Comprehensive Sewerage Scheme in Aluva Municipality-DPR Preparation of Comprehensive Sewerage Scheme in Aluva Municipality- Zone -1 & 2-DPR Preparation Work

Sl No	Specification	Quantity	Rate	Amount
1	**Network, Manholes, Pumping Mains of Sewer Netwok**			
1.001	16.83			
	Taking out existing CC interlocking paver blocks from footpath/ central verge, including removal of rubbish etc., disposal of unserviceable material to the dumping ground, for which payment shall be made separately and stacking of serviceable material within 50 metre lead as per direction of Engineer-in-Charge.			
	Net Total	4691.538sqm	@110.70/sqm	519353.26
1.002	15.3			
	Demolishing R.C.C. work manually / by mechanical means including stacking of steel bars and disposal of unserviceable material with in 50 metres lead as per direction of Engineer -in-Charge.			
	Net Total	351.865cum	@2983.62/cum	1049831.45
1.003	15.43.2			
	Dismantling manually / by mechanical means including stacking of serviceable material and disposal of unserviceable material within 50 metres lead as per direction of Engineer -in-Charge:Bituminous road			
	Net Total	16420.383sqm	@360.93/sqm	5926608.84
1.004	100.1.1			
	Excavating trenches of required width for pipes, cables, etc., including excavation for sockets, and dressing of sides, ramming of bottoms, depth up to 1.5m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth, including consolidating each deposited layer by ramming, watering, etc., and disposing of surplus excavated soil as directed, within a lead of 50m, in all kinds of soil.			
	Net Total	54956.708cum	@555.54/cum	30530649.56
1.005	100.1.2			
	Excavating trenches of required width for pipes, cables, etc., including excavation for sockets, and dressing of sides, ramming of bottoms, depth exceeding 1.5m but not exceeding 3m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth, including consolidating each deposited layer by ramming, watering, etc., and disposing of surplus excavated soil as directed, within a lead of 50m, in all kinds of soil.			
	Net Total	17145.591cum	@661.92/cum	11349009.59

Sl No	Specification	Quantity	Rate	Amount
1.006	100.1.3			
	Excavating trenches of required width for pipes, cables, etc., including excavation for sockets, and dressing of sides, ramming of bottoms, depth exceeding 3m but not exceeding 4.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc., and disposing of surplus excavated soil as directed, within a lead of 50m, in all kinds of soil.			
	Net Total	5751.112cum	@768.31/cum	4418636.86
1.007	100.1.4			
	Excavating trenches of required width for pipes, cables, etc., including excavation for sockets, and dressing of sides, ramming of bottoms, depth exceeding 4.5m but not exceeding 6m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20cm in depth, including consolidating each deposited layer by ramming, watering, etc., and disposing of surplus excavated soil as directed, within a lead of 50m, in all kinds of soil.			
	Net Total	852.886cum	@874.68/cum	746002.33
1.008	100.8.1			
	Fencing one side of trenches, 1.50m height with two rows of 10cm plastic caution tape in vertical casuarina pole (girth 15cm to 24cm) fixed at 2m intervals.			
	Net Total	18788.800metre	@28.03/metre	526650.06
1.009	100.8.2			
	Fencing 1.50m high with two rows of casuarina poles (girth 15cm to 24cm) tied with coir yarn on vertical casuarina pole (girth 15cm to 24cm) fixed at 1.5m intervals.			
	Net Total	28183.200metre	@96.32/metre	2714605.82
1.010	2.16.1			
	Close timbering in trenches including strutting, shoring and packing cavities (wherever required) complete (Measurements to be taken of the face area timbered).Depth not exceeding 1.5m			
	Net Total	31539.931sqm	@152.97/sqm	4824663.25
1.011	2.16.2			
	Close timbering in trenches including strutting, shoring and packing cavities (wherever required) complete (Measurements to be taken of the face area timbered).Depth exceeding 1.5 m but not exceeding 3 m			
	Net Total	27699.130sqm	@166.19/sqm	4603318.41
1.012	2.16.3			
	Close timbering in trenches including strutting, shoring and packing cavities (wherever required) complete (Measurements to be taken of the face area timbered).Depth exceeding 3 m but not exceeding 4.5 m			
	Net Total	7638.029sqm	@196.02/sqm	1497206.44

Sl No	Specification	Quantity	Rate	Amount
1.013	100.98.139			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 8kg, 180mm Outer Dia.			
	Net Total	49550.247metre	@865.31/metre	42876324.23
1.014	100.98.141			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 8kg, 225mm Outer Dia.			
	Net Total	10834.788metre	@1349.57/metre	14622304.84
1.015	100.98.143			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 8kg, 280mm Outer Dia.			
	Net Total	52.080metre	@2087.37/metre	108710.23
1.016	100.98.145			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 8kg, 355mm Outer Dia.			
	Net Total	211.460metre	@3475.43/metre	734914.43
1.017	100.98.154			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 90mm Outer Dia.			
	Net Total	252.000metre	@264.59/metre	66676.68
1.018	100.98.155			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 110mm Outer Dia.			
	Net Total	189.000metre	@385.56/metre	72870.84
1.019	100.98.157			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 140mm Outer Dia.			
	Net Total	1059.975metre	@642.15/metre	680662.95
1.020	100.98.158			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 160mm Outer Dia.			
	Net Total	178.500metre	@841.02/metre	150122.07
1.021	100.98.159			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 180mm Outer Dia.			
	Net Total	121.200metre	@1064.18/metre	128978.62
1.022	100.98.160			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 200mm Outer Dia.			
	Net Total	1401.225metre	@1308.59/metre	1833629.02
1.023	100.98.161			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 225mm Outer Dia.			
	Net Total	63.000metre	@1659.27/metre	104534.01
1.024	100.98.162			

Sl No	Specification	Quantity	Rate	Amount
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 250mm Outer Dia.			
	Net Total	126.000metre	@2038.78/metre	256886.28
1.025	100.98.163			
	Supply of HDPE Pipe PE 100 (IS 4984/1995), 10kg, 280mm Outer Dia.			
	Net Total	63.000metre	@2561.00/metre	161343.00
1.026	100.10.6			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 180mm Nominal Outside Diameter Pipes.			
	Net Total	37266.140metre	@265.58/metre	9897141.46
1.027	100.10.8			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 225mm Nominal Outside Diameter Pipes.			
	Net Total	10354.160metre	@377.32/metre	3906831.65
1.028	100.10.10			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 280mm Nominal Outside Diameter Pipes.			
	Net Total	109.600metre	@519.76/metre	56965.70
1.029	100.10.1			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 90mm Nominal Outer Diameter pipes.			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	240.000metre	@93.29/metre	22389.60
1.030	100.10.2			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 110mm Nominal Outer Diameter Pipes.			
	Net Total	180.000metre	@126.52/metre	22773.60
1.031	100.10.4			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 140mm Nominal Outside Diameter Pipes.			
	Net Total	1009.500metre	@180.21/metre	181922.00
1.032	100.10.5			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 160mm Nominal Outside Diameter Pipes.			
	Net Total	170.000metre	@215.19/metre	36582.30
1.033	100.10.7			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 200mm Nominal Outside Diameter Pipes.			
	Net Total	1334.500metre	@319.87/metre	426866.52
1.034	100.10.12			
	Laying HDPE pipes (IS : 4984) on land portion including conveying within initial lead and aligning the pipes, electro-fusion welding using automatic or semi-automatic			

Sl No	Specification	Quantity	Rate	Amount
	electrofusion machines, testing the pipeline thus fabricated to suit the hydraulic 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 levelling the trenches including all labour charge, hire for appliances etc., complete but excluding cost of pipe and fittings: 355mm Nominal Outside Diameter Pipes.			
	Net Total	201.390metre	@655.56/metre	132023.23
1.035	100.98.457			
	Supply of CI Double Flanged Sluice Valve Conforming to IS 14846 - 2000, Sluice Valve with Cap PN 1.6, Size 80mm.			
	Net Total	8.000no	@6624.03/no	52992.24
1.036	100.98.458			
	Supply of CI Double Flanged Sluice Valve Conforming to IS 14846 - 2000, Sluice Valve with Cap PN 1.6, Size 100mm.			
	Net Total	6.000no	@9003.95/no	54023.70
1.037	100.98.459			
	Supply of CI Double Flanged Sluice Valve Conforming to IS 14846 - 2000, Sluice Valve with Cap PN 1.6, Size 125mm.			
	Net Total	2.000no	@11066.77/no	22133.54
1.038	100.98.460			
	Supply of CI Double Flanged Sluice Valve Conforming to IS 14846 - 2000, Sluice Valve with Cap PN 1.6, Size 150mm.			
	Net Total	10.000no	@13396.74/no	133967.40
1.039	100.98.461			
	Supply of CI Double Flanged Sluice Valve Conforming to IS 14846 - 2000, Sluice Valve with Cap PN 1.6, Size 200mm.			
	Net Total	8.000no	@23723.64/no	189789.12
1.040	100.98.462			
	Supply of CI Double Flanged Sluice Valve Conforming to IS 14846 - 2000, Sluice Valve with Cap PN 1.6, Size 250mm.			
	Net Total	6.000no	@34361.82/no	206170.92
1.041	100.31.2.1			
	Conveying and fixing C.I. sluice valves (with cap) by providing bolts, nuts, rubber insertions etc., complete, but excluding the cost of the valve (tail pieces, if required, will be paid separately): 80mm diameter, Class II.			
	Net Total	8.000no	@625.35/no	5002.80
1.042	100.31.2.2			
	Conveying and fixing C.I. sluice valves (with cap) by providing bolts, nuts, rubber insertions etc., complete, but excluding the cost of the valve (tail pieces, if required, will be paid separately): 100mm diameter, Class II.			
	Net Total	6.000no	@957.70/no	5746.20

Sl No	Specification	Quantity	Rate	Amount
1.043	100.31.2.3			
	Conveying and fixing C.I. sluice valves (with cap) by providing bolts, nuts, rubber insertions etc., complete, but excluding the cost of the valve (tail pieces, if required, will be paid separately): 125mm diameter, Class II.			
	Net Total	2.000no	@1060.35/no	2120.70
1.044	100.31.2.4			
	Conveying and fixing C.I. sluice valves (with cap) by providing bolts, nuts, rubber insertions etc., complete, but excluding the cost of the valve (tail pieces, if required, will be paid separately): 150mm diameter, Class II.			
	Net Total	10.000no	@1283.82/no	12838.20
1.045	100.31.2.5			
	Conveying and fixing C.I. sluice valves (with cap) by providing bolts, nuts, rubber insertions etc., complete, but excluding the cost of the valve (tail pieces, if required, will be paid separately): 200mm diameter, Class II.			
	Net Total	8.000no	@1729.45/no	13835.60
1.046	100.31.2.6			
	Conveying and fixing C.I. sluice valves (with cap) by providing bolts, nuts, rubber insertions etc., complete, but excluding the cost of the valve (tail pieces, if required, will be paid separately): 250mm diameter, Class II.			
	Net Total	6.000no	@2504.62/no	15027.72
1.047	100.7.1			
	Bailing out water with 5HP engine and pump set including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	50131.200Kwh	@36.93/Kwh	1851345.22
1.048	100.7.2			
	Bailing out water with engine and pump set above 5HP up to 10HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	39388.800Kwh	@18.48/Kwh	727905.02
1.049	100.7.3			
	Bailing out water with engine and pump set above 10HP up to 20HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	65648.000Kwh	@9.23/Kwh	605931.04
1.050	100.98.1008			
	Engaging Coolie.			
	Net Total	630.000no	@878.79/no	553637.70
1.051	2.6.1			

Sl No	Specification	Quantity	Rate	Amount
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	11359.640cum	@214.03/cum	2431303.75
1.052	OD17350/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 1.5 to 3 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soil.			
	Net Total	4948.198cum	@403.35/cum	1995855.66
1.053	OD17564/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 3 to 4.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soil.			
	Net Total	2190.340cum	@509.75/cum	1116525.82
1.054	OD17348/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 4.5 to 6 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soil.			
	Net Total	760.951cum	@616.12/cum	468837.13
1.055	100.6.1			
	Providing steel sheet shoring to the sides of the trenches to depths of above 4.00 m but not exceeding 6.00m using 6 mm M.S. sheet 0.50 M wide stiffen on edges with 50 mm x 50mm x 6 mm M.S. angles driving down vertically on either side one after another in lines and levels with suitable pile driving equipments and accessories to a maximum depth of 0.50 M below the bottom of the proposed excavation 0.5 M above ground level suitably braced by horizontal walling pieces at 75 x 150 mm x 8 mm angles on either side at intervals not exceeding 1.50M and horizontal screw jack type struts at 1.50M intervals and maintaining the shoring till the pipes are laid and works are completed, dismantling, cleaning and restacking for reuse including all labour, hire charges and conveyance for equipments, tools and plants and sundries etc. complete.			
	Net Total	20895.056sqm	@749.09/sqm	15652277.50
1.056	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	1046.426cum	@7211.14/cum	7545924.39
1.057	5.37.1			
	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.All wiork upto plinth level			
	Net Total	3187.634cum	@9886.00/cum	31512949.72
1.058	OD17344/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	3187.634cum	@1916.04/cum	6107634.25
1.059	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	3187.634cum	@82.09/cum	261672.88
1.060	4.1.3			
	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:2:4 (cement : 2 coarse sand (zone-III) : 4 graded stone aggregate 20 mm nominal size)			
	Net Total	190.948cum	@7990.85/cum	1525836.83
1.061	5.7			
	Reinforced cement concrete work in well - steining excluding the cost of centering, shuttering, finishing and reinforcement, with 1:1.5:3 (1 cement : 1.5 coarse sand (Zone - III) : 3 graded stone aggregate 20 mm nominal size)			
	Net Total	3290.510cum	@8557.78/cum	28159460.67
1.062	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	800290.560kilogram	@98.30/kilogram	78668562.05
1.063	OD17346/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	800290.560kg	@2.62/kg	2096761.27
1.064	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	2267491.280kg	@1.34/kg	3038438.32
1.065	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	4821.920sqm	@335.31/sqm	1616838.00
1.066	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	31522.529sqm	@717.20/sqm	22607957.80
1.067	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	12322.625sqm	@570.26/sqm	7027100.13
1.068	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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			

Sl No	Specification	Quantity	Rate	Amount
	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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	1630.496sqm	@439.54/sqm	716668.21
1.069	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	16649.713sqm	@401.22/sqm	6680197.85
1.070	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	2856.000each	@1561.12/each	4458558.72
1.071	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	4335.000each	@545.03/each	2362705.05
1.072	OD17347/2022-2023			
	Taking connections for manholes and chamber			
	Net Total	5762.000no	@777.36/no	4479148.32
1.073	OD17345/2022-2023			
	Removal of excess earth by lorry for minimum mechanical conveyance, labour including loading, unloading and stacking for lead less than 0.50 km and less cost of erath			
	Net Total	79172.116cum	@169.89/cum	13450550.79
1.074	100.41.40			
	Supply, stacking, spreading and consolidating of Red earth in the trench of pipe line for cushion including carriage, loading, unloading & stacking up to any lead.			
	Net Total	500.000cum	@355.16/cum	177580.00
1.075	50.2.25.1			
	Filling with contractor's own earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20 cm in depth, consolidating each deposited			

Sl No	Specification	Quantity	Rate	Amount
	layer by ramming and watering, lead up to 50 m and lift up to 1.5 m as per direction of site Engineer-in-charge			
	Net Total	500.000cum	@525.83/cum	262915.00
			Heading Total(Rs)	394062716.36
2	**Road restoration charges**			
2.001	OD29101/2022-2023			
	Road cutting-Restoration charge- As per order No.GO(Ms)No.59/2020/PWD dated 13/07/2020 Tvpm PW(H)D, Excluding GST			
	Net Total	0.000sqm	@1366.76/sqm	0.00
2.002	OD29474/2022-2023			
	Road cutting-Restoration charge-As per order No.GO(Ms)No.59/2020/PWD dated 30/07/2020 Tvpm PW(H)D,Excluding GST			
	Net Total	0sqm	@3086.88/sqm	3086.88
2.003	OD29475/2022-2023			
	Road cutting-Restoration charge-As per Order No.GO(Ms)No.59/2020/PWD dated 30/07/2020 Tvpm PW(H)D,Excluding GST			
	Net Total	0sqm	@4886.99/sqm	4886.99
2.004	OD29476/2022-2023			
	Road cutting-Restoration charge-As per Order No.GO(Ms)No.59/2020/PWD dated 30/07/2020 Tvpm PW(H)D,Excluding GST			
	Net Total	0sqm	@5676.25/sqm	5676.25
2.005	OD29477/2022-2023			
	Road cutting-Restoration charge- As per order No.GO(Ms)No.59/2020/PWD dated 13/07/2020 Tvpm PW(H)D, Excluding GST			
	Net Total	01 sqm	@1587.49/1 sqm	1587.49
2.006	OD29478/2022-2023			
	Restoration charge - As per order No.GO(Ms)No.59/2020/PWD Dtd.30-07-2020 Tvpm PW(H)D			
	Net Total	2303.840sqm	@1347.09/sqm	3103479.83
2.007	OD29479/2022-2023			
	Shoulder cutting			
	Net Total	0sqm	@1317.42/sqm	1317.42
2.008	OD29480/2022-2023			
	BM & BC road surface restoration charge			
	Net Total	21112.200sqm	@3553.29/sqm	75017769.14
2.009	OD29483/2022-2023			
	Concrete Road Surface			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	21112.200sqm	@4816.63/sqm	101689655.89
2.010	OD29481/2022-2023			
	Tar road cut restoration charge			
	Net Total	28149.600sqm	@2797.56/sqm	78750194.98
2.011	OD29482/2022-2023			
	100mm thick interlocking tiled road surface			
	Net Total	0sqm	@3693.14/sqm	3693.14
			Heading Total(Rs)	258581348.01
3	**Effecting household sewer connections**			
3.001	OD29375/2022-2023			
	Household Sewer connection charges			
	Net Total	2130.000no	@16500.00/no	35145000.00
			Heading Total(Rs)	35145000.00
4	**Provision for NH crossing for laying pumping main**			
4.001	OD29382/2022-2023			
	Provision for NH crossing for laying pumping main			
	Net Total	1.000no	@7500000.00/no	7500000.00
			Heading Total(Rs)	7500000.00
5	**Charges for utility shifting**			
5.001	OD29433/2022-2023			
	Charges for utility shifting while implementing the sewerage scheme in Aluva Municipality zone 1 &2			
	Net Total	1.000no	@2500000.00/no	2500000.00
			Heading Total(Rs)	2500000.00
6	**Side Protection works**			
6.001	OD29468/2022-2023			
	Provision for side protection work in case where there is chances for landslide and damage to nearby compound walls and buildings			
	Net Total	1.000no	@1000000.00/no	1000000.00
			Heading Total(Rs)	1000000.00
			Total Estimation PAC	698789064.37
8	**Extra Charges**			

Sl No	Specification	Quantity	Rate	Amount
7.001	Provision for GST			
		698789064.37	18.00%	125782031.59
			Grand Total	0.00
			Round off	0.00
			Rounded Total(Rs)	824571095.96
	Rupees Eighty Two Crore Forty Five Lakh Seventy One Thousand Ninety Five			

DRAFT
e-PLATFORM FOR THE MANAGEMENT OF PUBLIC WORKS

GENERAL ABSTRACT

Others-Comprehensive Sewerage Scheme in Aluva Municipality-Detailed Estimate of Construction of Collection Well and Grit Chamber at Aluva Municipality Zone 1 & 2-DPR Preparation Work

Sl No	Head Description		Amount
1	COLLECTION WELL1		3639958.07
2	COLLECTION WELL 2		4640075.90
3	COLLECTION WELL 3		2944101.06
4	GRIT CHAMBER		2447670.66
5	Pump house building		4000000.04
	Total Estimation PAC		17671805.73
C	**Extra Charges**		
C.001	Provision for GST		
	17671805.73	18.00%	3180925.03
	Grand Total		0.00
	Round off		0.00
	Rounded Total(Rs)		20852730.76
	Rupees Two Crore Eight Lakh Fifty Two Thousand Seven Hundred and Thirty		

ABSTRACT ESTIMATE

Others-Comprehensive Sewerage Scheme in Aluva Municipality-Detailed Estimate of Construction of Collection Well and Grit Chamber at Aluva Municipality Zone 1 & 2-DPR Preparation Work

Sl No	Specification	Quantity	Rate	Amount
1	**COLLECTION WELL1**			
1.001	OD22704/2022-2023			
	Fabricating MS Kerb of size using 8 mm thick MS plate including cost of MS plate and 10mm dia anger bar welded to the kerb and conveyance charges of MS plate, all fabrication charges, charges of painting outer side of the steel work with two or more coat deluxe multi surface paint to give an even shade over an under coat of primer erection tying anger bar with reinforcement placing in position etc. complete.			
	Net Total	16.328metre	@11196.57/metre	182817.59
1.002	100.3.5.1			
	Earthwork in open well excavation (above water) for wells of diameter above 3.5m and up to 6.0m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift up to 1.5m including neat banking.			
	Net Total	52.215cum	@470.16/cum	24549.40
1.003	OD25796/2022-2023			
	Sinking Wells of dia 7.78m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 1.5 to 3m			
	Net Total	1.500metre	@51367.91/metre	77051.87
1.004	OD25065/2022-2023			
	Sinking Wells of dia 7.78m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 3 to 4.5m			
	Net Total	1.500metre	@54860.80/metre	82291.20
1.005	OD25084/2022-2023			
	Sinking Wells of dia 7.78m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 4.5 to 6m			
	Net Total	1.500metre	@56553.84/metre	84830.76
1.006	OD25091/2022-2023			

Sl No	Specification	Quantity	Rate	Amount
	Sinking Wells of dia 7.78m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 6 to 7.5m			
	Net Total	1.280metre	@60045.30/metre	76857.98
1.007	5.9.12			
	Centering and shuttering including strutting, etc. and removal of form for:Well steining			
	Net Total	231.426sqm	@290.01/sqm	67115.85
1.008	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	231.426sqm	@335.31/sqm	77599.45
1.009	5.37.1			
	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.All wiork upto plinth level			
	Net Total	58.403cum	@9886.00/cum	577372.06
1.010	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	58.403cum	@82.09/cum	4794.30
1.011	5.37.2			
	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.All work above			

Sl No	Specification	Quantity	Rate	Amount
	plinth level upto floor V level			
	Net Total	13.561cum	@11538.11/cum	156468.31
1.012	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	8635.800kilogram	@98.30/kilogram	848899.14
1.013	OD25092/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	8635.800kg	@2.32/kg	20035.06
1.014	OD25097/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	71.965cum	@1916.04/cum	137887.82
1.015	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	24468.100kg	@1.34/kg	32787.25
1.016	4.1.8			
	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)			
	Net Total	5.655cum	@6814.88/cum	38538.15
1.017	4.1.3			
	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:2:4 (cement : 2 coarse sand (zone-III) : 4 graded stone aggregate 20 mm nominal size)			
	Net Total	3.770cum	@7990.85/cum	30125.50
1.018	5.1.2			
	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size			
	Net Total	9.425cum	@9085.13/cum	85627.35
1.019	4.15			
	Extra for laying concrete in or under water and or liquid mud including cost of pumping or bailing out water and removing slush etc. complete. Note for item No. 4.15 : - The quantity will be calculated by multiplying the depth measured from the sub-soil water level upto centre of gravity of concrete under sub-soil water level with quantity of concrete in cum executed under the sub-soil water. The depth of centre of gravity shall be reconed correct to 0.10 m 0.05 m or more shall be taken as 0.10 m and less than 0.05 m ignored.			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	9.426cum	@935.37/cum	8816.80
1.020	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	29.128sqm	@815.75/sqm	23761.17
1.021	5.9.5			
	Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers			
	Net Total	9.800sqm	@649.80/sqm	6368.04
1.022	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	19.000each	@545.03/each	10355.57
1.023	14.72			
	Providing and fixing double scaffolding system (cup lock type) on the exterior side, upto seven story hight made with 40 mm dia. M.S. tube 1.5 m centre to centre, horizontal & vertical tubes joining with cup & lock system with M.S. tubes, M.S. tube challies, M.S. clamps and M.S. staricase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for the required duration as approved and removing it there after. The scaffolding system shall be stiffened with bracings, runners, connection with the building etc wherever required for inspection of work at required location with essential safety features for the workmen etc. complete as per directions and approval of Engineer- in Charge. The elevational area of the scaffolding shall be measured for payment purpose. The payment will be made once irrespective of duration of scaffolding. Note:- This item to be used for maintenance work judicially, necessary deduction for scaffolding in the existing item to be done .			
	Net Total	127.396sqm	@303.64/sqm	38682.52
1.024	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	134.337sqm	@401.22/sqm	53898.69
1.025	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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			

Sl No	Specification	Quantity	Rate	Amount
	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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	65.940sqm	@570.26/sqm	37602.94
1.026	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	18.850sqm	@439.54/sqm	8285.33
1.027	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	134.337sqm	@222.94/sqm	29949.09
1.028	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	20.000cum	@258.56/cum	5171.20
1.029	OD25104/2022-2023			
	Removal of excess earth by lorry for minimum mechanical conveyance, labour including loading, unloading and stacking for lead less than 0.50 km and less cost of erath			
	Net Total	144.029cum	@169.73/cum	24446.04

Sl No	Specification	Quantity	Rate	Amount
1.030	100.7.1			
	Bailing out water with 5HP engine and pump set including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	8392.500Kwh	@36.93/Kwh	309935.03
1.031	100.7.2			
	Bailing out water with engine and pump set above 5HP up to 10HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	10071.000Kwh	@18.48/Kwh	186112.08
1.032	100.7.3			
	Bailing out water with engine and pump set above 10HP up to 20HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	20142.000Kwh	@9.23/Kwh	185910.66
1.033	100.98.1008			
	Engaging Coolie.			
	Net Total	50.000no	@878.79/no	43939.50
1.034	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	4.000each	@1561.12/each	6244.48
1.035	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	242.972kg	@186.00/kg	45192.79
1.036	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	2.314sqm	@148.10/sqm	342.70
1.037	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	50.240Kilo	@185.00/Kilo	9294.40

Sl No	Specification	Quantity	Rate	Amount
		litre	litre	
			Heading Total(Rs)	3639958.07
2	**COLLECTION WELL 2**			
2.001	OD23914/2022-2023			
	Fabricating MS Kerb of size using 8 mm thick MS plate including cost of MS plate and 10mm dia anger bar welded to the kerb and conveyance charges of MS plate, all fabrication charges, charges of painting outer side of the steel work with two or more coat deluxe multi surface paint to give an even shade over an under coat of primer erection tying anger bar with reinforcement placing in position etc. complete.			
	Net Total	19.170metre	@11196.57/metre	214638.25
2.002	100.3.5.1			
	Earthwork in open well excavation (above water) for wells of diameter above 3.5m and up to 6.0m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift up to 1.5m including neat banking.			
	Net Total	63.375cum	@470.16/cum	29796.39
2.003	OD24729/2022-2023			
	Sinking Wells of dia 8.5m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 1.5 to 3m			
	Net Total	1.500metre	@57884.92/metre	86827.38
2.004	OD24792/2022-2023			
	Sinking Wells of dia 8.5m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 3 to 4.5m			
	Net Total	1.500metre	@61967.24/metre	92950.86
2.005	OD24802/2022-2023			
	Sinking Wells of dia 8.5m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 4.5 to 6m			
	Net Total	1.500metre	@66051.75/metre	99077.63
2.006	OD24811/2022-2023			
	Sinking Wells of dia 8.5m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 6 to 7.5m			
	Net Total	1.500metre	@70132.40/metr	105198.60

Sl No	Specification	Quantity	Rate	Amount
			e	
2.007	OD24815/2022-2023			
	Sinking Wells of dia 8.5m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 7.5 to 9m			
	Net Total	0.500metre	@74213.58/metre	37106.79
2.008	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	290.955sqm	@335.31/sqm	97560.12
2.009	5.37.1			
	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.All wiork upto plinth level			
	Net Total	84.528cum	@9886.00/cum	835643.81
2.010	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	84.528cum	@82.09/cum	6938.90
2.011	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	16.072cum	@11538.11/cum	185440.50

Sl No	Specification	Quantity	Rate	Amount
2.012	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	11750.560kilogram	@98.30/kilogram	1155080.05
2.013	OD24825/2022-2023			
	Extra for providing epoxy coating for reinforcement bars			
	Net Total	11750.560kilogram	@2.32/kilogram	27261.30
2.014	OD24845/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	100.600cum	@1916.04/cum	192753.62
2.015	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	34043.280kg	@1.34/kg	45618.00
2.016	4.1.8			
	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)			
	Net Total	8.763cum	@6814.88/cum	59718.79
2.017	4.1.3			
	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:2:4 (cement : 2 coarse sand (zone-III) : 4 graded stone aggregate 20 mm nominal size)			
	Net Total	5.842cum	@7990.85/cum	46682.55
2.018	5.1.2			
	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size			
	Net Total	13.663cum	@9085.13/cum	124130.13
2.019	4.15			
	Extra for laying concrete in or under water and or liquid mud including cost of pumping or bailing out water and removing slush etc. complete. Note for item No. 4.15 : - The quantity will be calculated by multiplying the depth measured from the sub-soil water level upto centre of gravity of concrete under sub-soil water level with quantity of concrete in cum executed under the sub-soil water. The depth of centre of gravity shall be reconed correct to 0.10 m 0.05 m or more shall be taken as 0.10 m and less than 0.05 m ignored.			
	Net Total	14.606cum	@935.37/cum	13662.01

Sl No	Specification	Quantity	Rate	Amount
2.020	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	40.570sqm	@815.75/sqm	33094.98
2.021	5.9.5			
	Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers			
	Net Total	15.800sqm	@649.80/sqm	10266.84
2.022	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	21.000each	@545.03/each	11445.63
2.023	14.72			
	Providing and fixing double scaffolding system (cup lock type) on the exterior side, upto seven story hight made with 40 mm dia. M.S. tube 1.5 m centre to centre, horizontal & vertical tubes joining with cup & lock system with M.S. tubes, M.S. tube challies, M.S. clamps and M.S. staricase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for the required duration as approved and removing it there after. The scaffolding system shall be stiffened with bracings, runners, connection with the building etc wherever required for inspection of work at required location with essential safety features for the workmen etc. complete as per directions and approval of Engineer- in Charge. The elevational area of the scaffolding shall be measured for payment purpose. The payment will be made once irrespective of duration of scaffolding. Note:- This item to be used for maintenance work judicially, necessary deduction for scaffolding in the existing item to be done .			
	Net Total	140.672sqm	@303.64/sqm	42713.65
2.024	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	196.000sqm	@401.22/sqm	78639.12
2.025	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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			

Sl No	Specification	Quantity	Rate	Amount
	integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	186.830sqm	@570.26/sqm	106541.68
2.026	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	27.330sqm	@439.54/sqm	12012.63
2.027	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	196.000sqm	@222.94/sqm	43696.24
2.028	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	50.000cum	@258.56/cum	12928.00
2.029	OD24849/2022-2023			
	Removal of excess earth by lorry for minimum mechanical conveyance, labour including loading, unloading and stacking for lead less than 0.50 km and less cost of erath			
	Net Total	144.029cum	@169.70/cum	24441.72
2.030	100.7.1			

Sl No	Specification	Quantity	Rate	Amount
	Bailing out water with 5HP engine and pump set including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	8392.500Kwh	@36.93/Kwh	309935.03
2.031	100.7.2			
	Bailing out water with engine and pump set above 5HP up to 10HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	10071.000Kwh	@18.48/Kwh	186112.08
2.032	100.7.3			
	Bailing out water with engine and pump set above 10HP up to 20HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	20142.000Kwh	@9.23/Kwh	185910.66
2.033	100.98.1008			
	Engaging Coolie.			
	Net Total	50.000no	@878.79/no	43939.50
2.034	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	4.000each	@1561.12/each	6244.48
2.035	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	284.486kg	@186.00/kg	52914.40
2.036	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	2.710sqm	@148.10/sqm	401.35
2.037	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	122.985Kilo litre	@185.00/Kilo litre	22752.23

Sl No	Specification	Quantity	Rate	Amount
			Heading Total(Rs)	4640075.90
3	**COLLECTION WELL 3**			
3.001	OD24860/2022-2023			
	Fabricating MS Kerb of size using 8 mm thick MS plate including cost of MS plate and 10mm dia anger bar welded to the kerb and conveyance charges of MS plate, all fabrication charges, charges of painting outer side of the steel work with two or more coat deluxe multi surface paint to give an even shade over an under coat of primer erection tying anger bar with reinforcement placing in position etc. complete.			
	Net Total	15.390metre	@10405.66/metre	160143.11
3.002	100.3.5.1			
	Earthwork in open well excavation (above water) for wells of diameter above 3.5m and up to 6.0m in all kinds of soil and conveying and depositing the spoil within initial lead of 50m and lift up to 1.5m including neat banking.			
	Net Total	40.560cum	@470.16/cum	19069.69
3.003	OD24863/2022-2023			
	Sinking Wells of dia 6.27m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 1.5 to 3m			
	Net Total	1.500metre	@34228.94/metre	51343.41
3.004	OD24894/2022-2023			
	:Sinking Wells of dia 6.27m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 3 to 4.5m			
	Net Total	1.500metre	@36634.53/metre	54951.80
3.005	OD24900/2022-2023			
	Sinking Wells of dia 6.27m inside, all kinds of soil to lines and levels and plub by scooping out earth from inside and below the steining using necessary appliances including hire and label for the same including dumping the soil beyond the initial lead of 50m etc. complete total depth 4.5 to 6m			
	Net Total	1.270metre	@39042.41/metre	49583.86
3.006	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	163.396sqm	@335.31/sqm	54788.31
3.007	5.37.1			
	Providing and laying in position ready mixed M-25 grade concrete for reinforced cement concrete work, using cement content as per approved design mix,			

Sl No	Specification	Quantity	Rate	Amount
	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.All wiork upto plinth level			
	Net Total	46.558cum	@9886.00/cum	460272.39
3.008	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	46.558cum	@82.09/cum	3821.95
3.009	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	11.429cum	@11538.11/cum	131869.06
3.010	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	6729.980kilo gram	@98.30/kilogram	661557.03
3.011	OD24907/2022-2023			
	Extra for providing epoxy coating for reinforcement bars			
	Net Total	6729.980kg	@2.32/kg	15613.55
3.012	OD24977/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	57.988cum	@1916.04/cum	111107.33
3.013	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in			

Sl No	Specification	Quantity	Rate	Amount
	doses by weight of cement as per manufacturer's specification .			
	Net Total	19601.630kg	@1.34/kg	26266.18
3.014	4.1.8			
	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:4:8 (1 cement : 4 coarse sand : 8 graded stone aggregate 40 nominal size)			
	Net Total	4.983cum	@6814.88/cum	33958.55
3.015	4.1.3			
	Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level:1:2:4 (cement : 2 coarse sand (zone-III) : 4 graded stone aggregate 20 mm nominal size)			
	Net Total	3.322cum	@7990.85/cum	26545.60
3.016	5.1.2			
	Providing and laying in position specified grade of reinforced cement concrete, excluding the cost of centering, shuttering, finishing and reinforcement - All work up to plinth level:1:1:5:3 (1 cement 1.5 coarse sand :3 graded stone aggregate 20 mm nominal size			
	Net Total	8.305cum	@9085.13/cum	75452.00
3.017	4.15			
	Extra for laying concrete in or under water and or liquid mud including cost of pumping or bailing out water and removing slush etc. complete. Note for item No. 4.15 : - The quantity will be calculated by multiplying the depth measured from the sub-soil water level upto centre of gravity of concrete under sub-soil water level with quantity of concrete in cum executed under the sub-soil water. The depth of centre of gravity shall be reconed correct to 0.10 m 0.05 m or more shall be taken as 0.10 m and less than 0.05 m ignored.			
	Net Total	18.300cum	@935.37/cum	17117.27
3.018	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	27.204sqm	@815.75/sqm	22191.66
3.019	5.9.5			
	Centering and shuttering including strutting, etc. and removal of form for:Lintels, beams, plinth beams, girders bressumers and cantilevers			
	Net Total	9.200sqm	@649.80/sqm	5978.16
3.020	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having			

Sl No	Specification	Quantity	Rate	Amount
	manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	20.000each	@545.03/each	10900.60
3.021	14.72			
	Providing and fixing double scaffolding system (cup lock type) on the exterior side, upto seven story hight made with 40 mm dia. M.S. tube 1.5 m centre to centre, horizontal & vertical tubes joining with cup & lock system with M.S. tubes, M.S. tube challies, M.S. clamps and M.S. staricase system in the scaffolding for working platform etc. and maintaining it in a serviceable condition for the required duration as approved and removing it there after. The scaffolding system shall be stiffened with bracings, runners, connection with the building etc wherever required for inspection of work at required location with essential safety features for the workmen etc. complete as per directions and approval of Engineer- in Charge. The elevational area of the scaffolding shall be measured for payment purpose. The payment will be made once irrespective of duration of scaffolding. Note:- This item to be used for maintenance work judicially, necessary deduction for scaffolding in the existing item to be done .			
	Net Total	21.980sqm	@303.64/sqm	6674.01
3.022	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	106.265sqm	@401.22/sqm	42635.64
3.023	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	73.234sqm	@570.26/sqm	41762.42
3.024	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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			

Sl No	Specification	Quantity	Rate	Amount
	integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	10.750sqm	@439.54/sqm	4725.06
3.025	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	106.270sqm	@222.94/sqm	23691.83
3.026	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	50.000cum	@258.56/cum	12928.00
3.027	OD24985/2022-2023			
	Removal of excess earth by lorry for minimum mechanical conveyance, labour including loading, unloading and stacking for lead less than 0.50 km and less cost of erath			
	Net Total	87.535cum	@169.70/cum	14854.69
3.028	100.7.1			
	Bailing out water with 5HP engine and pump set including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	8392.500Kwh	@36.93/Kwh	309935.03
3.029	100.7.2			
	Bailing out water with engine and pump set above 5HP up to 10HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	10071.000Kwh	@18.48/Kwh	186112.08
3.030	100.7.3			
	Bailing out water with engine and pump set above 10HP up to 20HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	20142.000Kwh	@9.23/Kwh	185910.66

Sl No	Specification	Quantity	Rate	Amount
3.031	100.98.1008			
	Engaging Coolie.			
	Net Total	50.000no	@878.79/no	43939.50
3.032	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	4.000each	@1561.12/each	6244.48
3.033	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	284.486kg	@186.00/kg	52914.40
3.034	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	2.710sqm	@148.10/sqm	401.35
3.035	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	101.840Kilo litre	@185.00/Kilo litre	18840.40
			Heading Total(Rs)	2944101.06
4	**GRIT CHAMBER**			
4.001	100.98.1000			
	Engaging Bandhani.			
	Net Total	6.000no	@971.71/no	5830.26
4.002	2.8.1			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up to 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.All kinds of soil			
	Net Total	39.668cum	@296.98/cum	11780.60
4.003	OD25151/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 1.5 to 3 m, including			

Sl No	Specification	Quantity	Rate	Amount
	getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soi			
	Net Total	48.375cum	@403.35/cum	19512.06
4.004	OD25153/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 3 to 4.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soil			
	Net Total	35.153cum	@509.75/cum	17919.24
4.005	OD25155/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 4.5 to 6 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soil			
	Net Total	8.385cum	@616.12/cum	5166.17
4.006	100.6.1			
	Providing steel sheet shoring to the sides of the trenches to depths of above 4.00 m but not exceeding 6.00m using 6 mm M.S. sheet 0.50 M wide stiffen on edges with 50 mm x 50mm x 6 mm M.S. angles driving down vertically on either side one after another in lines and levels with suitable pile driving equipments and accessories to a maximum depth of 0.50 M below the bottom of the proposed excavation 0.5 M above ground level suitably braced by horizontal walling pieces at 75 x 150 mm x 8 mm angles on either side at intervals not exceeding 1.50M and horizontal screw jack type struts at 1.50M intervals and maintaining the shoring till the pipes are laid and works are completed, dismantling, cleaning and restacking for reuse including all labour, hire charges and conveyance for equipments, tools and plants and sundries etc. complete.			
	Net Total	165.735sqm	@749.09/sqm	124150.43
4.007	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	5.289cum	@7211.14/cum	38139.72
4.008	5.37.1			
	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			

Sl No	Specification	Quantity	Rate	Amount
	/less cement used as per design mix is payable/recoverable separately.All wiork upto plinth level			
	Net Total	5.676cum	@9886.00/cum	56112.94
4.009	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	5.676cum	@82.09/cum	465.94
4.010	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	40.378cum	@11538.11/cum	465885.81
4.011	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	4719.220kilogram	@98.30/kilogram	463899.33
4.012	OD25158/2022-2023			
	Extra for providing epoxy coating for reinforcement bars			
	Net Total	4719.220kg	@2.32/kg	10948.59
4.013	OD25161/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level			
	Net Total	46.057cum	@1916.04/cum	88247.05
4.014	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	15255.570kg	@1.34/kg	20442.46
4.015	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	7.140sqm	@335.31/sqm	2394.11

Sl No	Specification	Quantity	Rate	Amount
4.016	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	311.370sqm	@717.20/sqm	223314.56
4.017	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	219.720sqm	@401.22/sqm	88156.06
4.018	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	3.000each	@1561.12/each	4683.36
4.019	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	219.720sqm	@222.94/sqm	48984.38
4.020	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	40.000each	@545.03/each	21801.20
4.021	100.31.2.5			
	Conveying and fixing C.I. sluice valves (with cap) by providing bolts, nuts, rubber insertions etc., complete, but excluding the cost of the valve (tail pieces, if required, will be paid separately): 200mm diameter, Class II.			
	Net Total	3.000no	@1729.45/no	5188.35
4.022	OD25179/2022-2023			
	Supplying Conveying and fixing C.I. sluice valves (with cap) by providing complete with bolts, nuts, rubber insertions etc. excluding the cost of valve (the tail pieces if required will be paid separately)			
	Net Total	3.0001 nos	@13729.46/1 nos	41188.38
4.023	100.41.33			
	Supplying and fixing 500mm dia C.I. manhole cover with frame (medium duty) charges including all cost, labour charges etc., complete.			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	3.000no	@7507.05/no	22521.15
4.024	100.7.1			
	Bailing out water with 5HP engine and pump set including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	8392.500Kwh	@36.93/Kwh	309935.03
4.025	100.7.2			
	Bailing out water with engine and pump set above 5HP up to 10HP including conveyance to the site, erecting, dismantling and taking back of engine and pump, cost of fuel lubricating oil and other stores pay of staff etc., complete.			
	Net Total	10071.000Kwh	@18.48/Kwh	186112.08
4.026	100.98.1008			
	Engaging Coolie.			
	Net Total	60.000no	@878.79/no	52727.40
4.027	100.52.S.1			
	Sub Data for providing Earth filled cement bags including cutting of the Earth, filling, conveying and placing in position.			
	Net Total	1200.000each	@93.47/each	112164.00
			Heading Total(Rs)	2447670.66
5	**Pump house building**			
5.001	OD29508/2022-2023			
	Pump house building above wells for sewerage scheme in Aluva Municipality zone1 &2- For 3 Nos amount in Ls			
	Net Total	1.000no	@3300000.00/no	3300000.00
5.002	OD29532/2022-2023			
	Compound wall for well cum pumping stations(Aluva Municipal sewerage scheme zone 1&2)2 Nos			
	Net Total	1.000no	@700000.04/no	700000.04
			Heading Total(Rs)	4000000.04
			Total Estimation PAC	17671805.73
7	**Extra Charges**			
6.001	Provision for GST			
	17671805.73		18.00%	3180925.03
			Grand Total	0.00
			Round off	0.00
			Rounded Total(Rs)	20852730.76
	Rupees Two Crore Eight Lakh Fifty Two Thousand Seven Hundred and Thirty			

GENERAL ABSTRACT

Others-Comprehensive Sewerage Scheme in Aluva Municipality-Detailed Estimate of Construction of Sewerage Treatment Plant, Co-Treatment Units of Septage-DPR Preparation Work

Sl No	Head Description		Amount
1	RECEIVING CHAMBER		1154295.60
2	OIL AND GREASE TRAP		2250986.69
3	GRIT SEPERATOR AND SCREEN CHANNEL		5094801.63
4	EQUALIZATION TANK		11264134.65
5	DILUTION TANK FOR CO-TREATMENT-RECTANGULAR SHAPE		1305337.54
6	COLLECTION TANK FOR COTREATMENT		246243.59
7	MOVING BED BIOFILM REACTOR		22162759.27
8	SECONDARY CLARIFIER WITH PLATE SETTLER		4105597.30
9	SLUDGE SUMP		903930.95
10	SLUDGE THICKENER		1775045.44
11	CHLORINE CONTACT TANK- Rectangular		1803430.74
12	FILTER FEED TANK		1987645.40
13	TREATED WATER TANK		3294413.00
14	Mechanical Items		30634754.00
15	Electrical Items		5615892.85
16	Eco Friendly Units & STP allied components		18938928.56
	Total Estimation PAC		112538197.21
C	**Extra Charges**		
C.001	Provision for GST		
	112538197.21	18.00%	20256875.50
	Grand Total		0.00
	Round off		0.00
	Rounded Total(Rs)		132795072.71
	Rupees Thirteen Crore Twenty Seven Lakh Ninety Five Thousand Seventy Two		

ABSTRACT ESTIMATE

Others-Comprehensive Sewerage Scheme in Aluva Municipality-Detailed Estimate of Construction of Sewerage Treatment Plant, Co-Treatment Units of Septage-DPR Preparation Work

Sl No	Specification	Quantity	Rate	Amount
1	**RECEIVING CHAMBER**			
1.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	100.000metre	@4343.34/metre	434334.00
1.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
1.003	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	4156.230kilogram	@98.30/kilogram	408557.41
1.004	OD17004/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	4156.230kg	@2.32/kg	9642.45
1.005	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	13.655cum	@214.03/cum	2922.58
1.006	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	2.048cum	@7211.14/cum	14768.41
1.007	5.37.1			
	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.All wiork upto plinth level			
	Net Total	9.331cum	@9886.00/cum	92246.27
1.008	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	33.331cum	@82.09/cum	2736.14
1.009	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	1.265cum	@11538.11/cum	14595.71
1.010	OD17003/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	10.600cum	@1509.09/cum	15996.35
1.011	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	3615.945kg	@1.34/kg	4845.37
1.012	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	5.670sqm	@335.31/sqm	1901.21
1.013	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	43.428sqm	@717.20/sqm	31146.56
1.014	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	7.620sqm	@815.75/sqm	6216.02
1.015	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	6.405cum	@258.56/cum	1656.08
1.016	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	18.545sqm	@570.26/sqm	10575.47
1.017	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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			

Sl No	Specification	Quantity	Rate	Amount
	engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	25.148sqm	@439.54/sqm	11053.55
1.018	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	29.150sqm	@401.22/sqm	11695.56
1.019	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	2.000each	@1561.12/each	3122.24
1.020	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	7.000each	@545.03/each	3815.21
1.021	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	8.646Kilo litre	@185.00/Kilo litre	1599.51
			Heading Total(Rs)	1154295.60
2	**OIL AND GREASE TRAP**			
2.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	200.000metre	@4343.34/metre	868668.00
2.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test			

Sl No	Specification	Quantity	Rate	Amount
	cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
2.003	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	8482.260kilo gram	@98.30/kilogram	833806.16
2.004	OD12477/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	8482.261kg	@2.32/kg	19678.85
2.005	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	25.320cum	@214.03/cum	5419.24
2.006	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	3.798cum	@7211.14/cum	27387.91
2.007	5.37.1			
	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.All wiork upto plinth level			
	Net Total	20.721cum	@9886.00/cum	204847.81
2.008	5.37.2			
	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			

Sl No	Specification	Quantity	Rate	Amount
	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.All work above plinth level upto floor V level			
	Net Total	2.472cum	@11538.11/cum	28522.21
2.009	OD21817/2022-2023			
	Extra for providing Sulphate resistant cement for the concrete structures			
	Net Total	23.190cum	@1509.09/cum	34995.80
2.010	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	68.213cum	@82.09/cum	5599.61
2.011	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	7887.630kg	@1.34/kg	10569.42
2.012	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	9.330sqm	@335.31/sqm	3128.44
2.013	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	82.200sqm	@717.20/sqm	58953.84
2.014	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	14.520sqm	@815.75/sqm	11844.69
2.015	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	10.000cum	@258.56/cum	2585.60
2.016	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels			

Sl No	Specification	Quantity	Rate	Amount
	/ 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	34.650sqm	@570.26/sqm	19759.51
2.017	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	10.400sqm	@439.54/sqm	4571.22
2.018	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	67.310sqm	@401.22/sqm	27006.12
2.019	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	2.000each	@1561.12/each	3122.24
2.020	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with			

Sl No	Specification	Quantity	Rate	Amount
	stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	9.000each	@545.03/each	4905.27
2.021	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	25.650Kilo litre	@185.00/Kilo litre	4745.25
			Heading Total(Rs)	2250986.69
3	**GRIT SEPERATOR AND SCREEN CHANNEL**			
3.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	375.000metre	@4343.34/metre	1628752.50
3.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
3.003	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	23822.288kilogram	@98.30/kilogram	2341730.91
3.004	OD12989/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	23822.290kg	@2.32/kg	55267.71
3.005	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	33.939cum	@214.03/cum	7263.96

Sl No	Specification	Quantity	Rate	Amount
3.006	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	8.991cum	@7211.14/cum	64835.36
3.007	5.37.1			
	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.All wiork upto plinth level			
	Net Total	11.330cum	@9886.00/cum	112008.38
3.008	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	38.775cum	@11538.11/cum	447390.22
3.009	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	198.519cum	@82.09/cum	16296.42
3.010	OD12988/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	50.150cum	@1509.09/cum	75680.86
3.011	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	17037.400kg	@1.34/kg	22830.12
3.012	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	27.210sqm	@335.31/sqm	9123.79
3.013	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	139.560sqm	@717.20/sqm	100092.43
3.014	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	26.491sqm	@815.75/sqm	21610.03
3.015	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	62.730sqm	@570.26/sqm	35772.41
3.016	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin-			

Sl No	Specification	Quantity	Rate	Amount
	charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	24.478sqm	@439.54/sqm	10759.06
3.017	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	141.286sqm	@401.22/sqm	56686.77
3.018	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	14.000cum	@258.56/cum	3619.84
3.019	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	2.000each	@1561.12/each	3122.24
3.020	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	11.000each	@545.03/each	5995.33
3.021	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	27.534Kilo litre	@185.00/Kilo litre	5093.79
			Heading Total(Rs)	5094801.63
4	**EQUALIZATION TANK**			
4.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	625.000metre	@4343.34/metre	2714587.50

Sl No	Specification	Quantity	Rate	Amount
4.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
4.003	OD13361/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	43166.290kg	@2.32/kg	100145.79
4.004	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	254.500cum	@214.03/cum	54470.64
4.005	OD13363/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 1.5 to 3 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soil.			
	Net Total	254.500cum	@403.35/cum	102652.58
4.006	OD13362/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 3 to 4.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soil.			
	Net Total	220.700cum	@509.75/cum	112501.83
4.007	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	25.350cum	@7211.14/cum	182802.40
4.008	5.37.1			
	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			

Sl No	Specification	Quantity	Rate	Amount
	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.All wiork upto plinth level			
	Net Total	152.100cum	@9886.00/cum	1503660.60
4.009	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	59.205cum	@11538.11/cum	683113.80
4.010	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	359.310cum	@82.09/cum	29495.76
4.011	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	43166.288kilogram	@98.30/kilogram	4243246.11
4.012	OD13360/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	211.310cum	@1509.09/cum	318885.81
4.013	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	71842.000kg	@1.34/kg	96268.28
4.014	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	23.040sqm	@335.31/sqm	7725.54
4.015	5.9.2			

Sl No	Specification	Quantity	Rate	Amount
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	380.480sqm	@717.20/sqm	272880.26
4.016	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	25.700sqm	@815.75/sqm	20964.78
4.017	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	20.000cum	@258.56/cum	5171.20
4.018	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	185.320sqm	@570.26/sqm	105680.58
4.019	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	127.690sqm	@439.54/sqm	56124.86
4.020	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	557.570sqm	@401.22/sqm	223708.24
4.021	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	12.000each	@545.03/each	6540.36
4.022	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	523.529Kilo litre	@185.00/Kilo litre	96852.87
4.023	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	690.444kg	@186.00/kg	128422.58
4.024	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	20.649sqm	@148.10/sqm	3058.12
4.025	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	557.570sqm	@222.94/sqm	124304.66
	Heading Total(Rs)			11264134.65

Sl No	Specification	Quantity	Rate	Amount
5	**DILUTION TANK FOR CO-TREATMENT-RECTANGULAR SHAPE**			
5.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	100.000metre	@4343.34/metre	434334.00
5.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
5.003	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	17.854cum	@214.03/cum	3821.29
5.004	OD14561/2022-2023			
	Earth work in excavation by mechanical means (Hydraulic excavator) /manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift up 1.5 to 3 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. - All kinds of soil.			
	Net Total	14.283cum	@403.35/cum	5761.05
5.005	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	6.160cum	@7211.14/cum	44420.62
5.006	5.37.1			
	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			

Sl No	Specification	Quantity	Rate	Amount
	- 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.All wiork upto plinth level			
	Net Total	12.231cum	@9886.00/cum	120915.67
5.007	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	1.667cum	@11538.11/cum	19234.03
5.008	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	13.899cum	@82.09/cum	1140.97
5.009	OD14559/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	13.897cum	@1509.09/cum	20971.82
5.010	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	4725.660kg	@1.34/kg	6332.38
5.011	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	4517.430kilogram	@98.30/kilogram	444063.37
5.012	OD14560/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	4517.430kg	@2.32/kg	10480.44
5.013	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	5.805sqm	@335.31/sqm	1946.47
5.014	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	55.000sqm	@717.20/sqm	39446.00
5.015	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	15.010sqm	@815.75/sqm	12244.41
5.016	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	25.000sqm	@570.26/sqm	14256.50
5.017	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	6.250sqm	@439.54/sqm	2747.13
5.018	13.7.1			

Sl No	Specification	Quantity	Rate	Amount
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	41.250sqm	@401.22/sqm	16550.33
5.019	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	10.000cum	@258.56/cum	2585.60
5.020	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	9.000each	@545.03/each	4905.27
5.021	19.18.1			
	Supplying and fixing C.I with out frame for manholes:455 x 610 mm rectangular C.I cover (light duty) the weight of the cover to be no less than 23 kg			
	Net Total	1.000each	@1561.12/each	1561.12
5.022	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	60.000Kilo litre	@185.00/Kilo litre	11100.00
5.023	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	37.500kg	@186.00/kg	6975.00
5.024	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	4.004sqm	@148.10/sqm	592.99
5.025	13.52.2			

Sl No	Specification	Quantity	Rate	Amount
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	36.250sqm	@222.94/sqm	8081.58
			Heading Total(Rs)	1305337.54
6	**COLLECTION TANK FOR COTREATMENT**			
6.001	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	13.225cum	@214.03/cum	2830.55
6.002	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	0.794cum	@7211.14/cum	5725.65
6.003	7.1.1			
	Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)			
	Net Total	2.381cum	@7204.75/cum	17154.51
6.004	5.37.1			
	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.All wiork upto plinth level			
	Net Total	5.300cum	@9886.00/cum	52395.80
6.005	5.37.2			
	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			

Sl No	Specification	Quantity	Rate	Amount
	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.All work above plinth level upto floor V level			
	Net Total	0.221cum	@11538.11/cum	2549.92
6.006	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	5.521cum	@82.09/cum	453.22
6.007	OD15219/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	6.400cum	@1509.09/cum	9658.18
6.008	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	662.520kilogram	@98.30/kilogram	65125.72
6.009	OD15220/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	662.520kg	@2.62/kg	1735.80
6.010	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	2174.640kg	@1.34/kg	2914.02
6.011	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	11.580sqm	@335.31/sqm	3882.89
6.012	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	32.000sqm	@717.20/sqm	22950.40
6.013	5.9.3			
	Centering and shuttering including strutting, etc. and removal of form for:Suspended floors, roofs, landings, balconies and access platform			
	Net Total	4.900sqm	@815.75/sqm	3997.18
6.014	22.23.1			

Sl No	Specification	Quantity	Rate	Amount
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	15.000sqm	@570.26/sqm	8553.90
6.015	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	2.250sqm	@439.54/sqm	988.97
6.016	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	28.050sqm	@401.22/sqm	11254.22
6.017	2.25			
	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.			
	Net Total	10.000cum	@258.56/cum	2585.60
6.018	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum			

Sl No	Specification	Quantity	Rate	Amount
	cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	3.000each	@545.03/each	1635.09
6.019	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	3.375Kilo litre	@185.00/Kilo litre	624.38
6.020	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	131.973kg	@186.00/kg	24546.98
6.021	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	4.132sqm	@148.10/sqm	611.95
6.022	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	18.250sqm	@222.94/sqm	4068.66
			Heading Total(Rs)	246243.59
7	**MOVING BED BIOFILM REACTOR**			
7.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	1150.000metre	@4343.34/metre	4994841.00

Sl No	Specification	Quantity	Rate	Amount
7.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	4.000per test	@70869.50/per test	283478.00
7.003	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	269.546cum	@214.03/cum	57690.93
7.004	7.1.1			
	Random rubble masonry with hard stone in foundation and plinth including levelling up with cement concrete 1:6:12 (1 cement : 6 coarse sand : 12 graded stone aggregate 20 mm nominal size) up to plinth level with:Cement mortar 1:6 (1 cement : 6 coarse sand)			
	Net Total	0.000cum	@7204.75/cum	0.00
7.005	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	50.716cum	@7211.14/cum	365720.18
7.006	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	711.783cum	@82.09/cum	58430.27
7.007	5.37.1			
	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.All wiork upto plinth level			
	Net Total	299.943cum	@9886.00/cum	2965236.50

Sl No	Specification	Quantity	Rate	Amount
7.008	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	138.832cum	@11538.11/cum	1601858.89
7.009	OD15528/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	438.790cum	@1509.09/cum	662173.60
7.010	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	149188.600kg	@1.34/kg	199912.72
7.011	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	85192.560kilogram	@98.30/kilogram	8374428.65
7.012	OD16062/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	85192.561kg	@2.62/kg	223204.51
7.013	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	95.520sqm	@335.31/sqm	32028.81
7.014	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	1003.140sqm	@717.20/sqm	719452.01
7.015	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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			

Sl No	Specification	Quantity	Rate	Amount
	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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	393.600sqm	@570.26/sqm	224454.34
7.016	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	231.620sqm	@439.54/sqm	101806.25
7.017	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	1464.980sqm	@401.22/sqm	587779.28
7.018	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	48.000each	@545.03/each	26161.44
7.019	100.36.1			

Sl No	Specification	Quantity	Rate	Amount
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	833.832Kilo litre	@185.00/Kilo litre	154258.92
7.020	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	1810.766kg	@186.00/kg	336802.48
7.021	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	56.699sqm	@148.10/sqm	8397.12
7.022	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	828.220sqm	@222.94/sqm	184643.37
	Heading Total(Rs)			22162759.27
8	**SECONDARY CLARIFIER WITH PLATE SETTLER**			
8.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	300.000metre	@4343.34/metre	1303002.00
8.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
8.003	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means			

Sl No	Specification	Quantity	Rate	Amount
	over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	64.354cum	@214.03/cum	13773.69
8.004	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	6.435cum	@7211.14/cum	46403.69
8.005	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	132.577cum	@82.09/cum	10883.25
8.006	5.37.1			
	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.All wiork upto plinth level			
	Net Total	24.601cum	@9886.00/cum	243205.49
8.007	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	36.735cum	@11538.11/cum	423852.47
8.008	OD15596/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	61.340cum	@1509.09/cum	92567.58
8.009	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	20855.600kg	@1.34/kg	27946.50
8.010	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	15909.210kilogram	@98.30/kilogram	1563875.34
8.011	OD15597/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	15909.212kg	@2.62/kg	41682.14
8.012	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	38.770sqm	@335.31/sqm	12999.97
8.013	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	92.550sqm	@570.26/sqm	52777.56
8.014	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e by reducing			

Sl No	Specification	Quantity	Rate	Amount
	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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	4.000sqm	@439.54/sqm	1758.16
8.015	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	226.014sqm	@401.22/sqm	90681.34
8.016	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	16.000each	@545.03/each	8720.48
8.017	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	108.300Kilo litre	@185.00/Kilo litre	20035.50
8.018	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	309.815kg	@186.00/kg	57625.59
8.019	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	9.701sqm	@148.10/sqm	1436.72
8.020	13.52.2			

Sl No	Specification	Quantity	Rate	Amount
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	96.440sqm	@222.94/sqm	21500.33
			Heading Total(Rs)	4105597.30
9	**SLUDGE SUMP**			
9.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	75.000metre	@4343.34/metre	325750.50
9.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
9.003	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	3033.000kilogram	@98.30/kilogram	298143.90
9.004	OD16055/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	3032.910kg	@2.62/kg	7946.22
9.005	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	7.300cum	@214.03/cum	1562.42
9.006	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	1.095cum	@7211.14/cum	7896.20
9.007	5.34.1			

Sl No	Specification	Quantity	Rate	Amount
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	25.084cum	@82.09/cum	2059.15
9.008	5.37.1			
	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.All wiork upto plinth level			
	Net Total	2.575cum	@9886.00/cum	25456.45
9.009	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	4.700cum	@11538.11/cum	54229.12
9.010	OD16057/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	7.280cum	@1509.09/cum	10986.18
9.011	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	3010.763kg	@1.34/kg	4034.42
9.012	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	28.680sqm	@335.31/sqm	9616.69
9.013	5.9.2			

Sl No	Specification	Quantity	Rate	Amount
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	38.989sqm	@717.20/sqm	27962.91
9.014	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin-charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	15.255sqm	@570.26/sqm	8699.32
9.015	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin-charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	2.540sqm	@439.54/sqm	1116.43
9.016	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	47.292sqm	@401.22/sqm	18974.50
9.017	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as			

Sl No	Specification	Quantity	Rate	Amount
	165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	3.000each	@545.03/each	1635.09
9.018	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	3.810Kilo litre	@185.00/Kilo litre	704.85
9.019	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	117.064kg	@186.00/kg	21773.90
9.020	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	3.664sqm	@148.10/sqm	542.64
9.021	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	17.810sqm	@222.94/sqm	3970.56
			Heading Total(Rs)	903930.95
10	**SLUDGE THICKENER**			
10.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	100.000metre	@4343.34/metre	434334.00
10.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including			

Sl No	Specification	Quantity	Rate	Amount
	installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
10.003	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	6520.440kilo gram	@98.30/kilogram	640959.25
10.004	OD16223/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	6520.440kg	@2.62/kg	17083.55
10.005	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	11.520cum	@214.03/cum	2465.63
10.006	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	3.456cum	@7211.14/cum	24921.70
10.007	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	54.103cum	@82.09/cum	4441.32
10.008	5.37.1			
	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.All wiork upto plinth level			
	Net Total	18.644cum	@9886.00/cum	184314.58

Sl No	Specification	Quantity	Rate	Amount
10.009	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	11.692cum	@11538.11/cum	134903.58
10.010	OD16227/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	30.340cum	@1509.09/cum	45785.79
10.011	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	10314.580kg	@1.34/kg	13821.54
10.012	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	27.450sqm	@335.31/sqm	9204.26
10.013	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	89.230sqm	@717.20/sqm	63995.76
10.014	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any			

Sl No	Specification	Quantity	Rate	Amount
	leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	37.000sqm	@570.26/sqm	21099.62
10.015	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	13.690sqm	@439.54/sqm	6017.30
10.016	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	74.210sqm	@401.22/sqm	29774.54
10.017	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	4.000each	@545.03/each	2180.12
10.018	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	27.380Kilo litre	@185.00/Kilo litre	5065.30
10.019	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat			

Sl No	Specification	Quantity	Rate	Amount
	of approves steel primer.G.I. pipes			
	Net Total	275.432kg	@186.00/kg	51230.35
10.020	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	8.622sqm	@148.10/sqm	1276.92
10.021	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	50.690sqm	@222.94/sqm	11300.83
			Heading Total(Rs)	1775045.44
11	**CHLORINE CONTACT TANK- Rectangular**			
11.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	100.000metre	@4343.34/metre	434334.00
11.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
11.003	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	6293.400kilogram	@98.30/kilogram	618641.22
11.004	OD16828/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	6294.600kg	@2.62/kg	16491.85
11.005	2.6.1			

Sl No	Specification	Quantity	Rate	Amount
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	83.104cum	@214.03/cum	17786.75
11.006	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	4.704cum	@7211.14/cum	33921.20
11.007	5.37.1			
	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.All wiork upto plinth level			
	Net Total	15.680cum	@9886.00/cum	155012.48
11.008	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	12.775cum	@11538.11/cum	147399.36
11.009	OD16831/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	28.460cum	@1509.09/cum	42948.70
11.010	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			

Sl No	Specification	Quantity	Rate	Amount
	Net Total	52.201cum	@82.09/cum	4285.18
11.011	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	6264.750kg	@1.34/kg	8394.77
11.012	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	11.200sqm	@335.31/sqm	3755.47
11.013	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	107.980sqm	@717.20/sqm	77443.26
11.014	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	45.000sqm	@570.26/sqm	25661.70
11.015	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin-			

Sl No	Specification	Quantity	Rate	Amount
	charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	20.250sqm	@439.54/sqm	8900.69
11.016	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	141.550sqm	@401.22/sqm	56792.69
11.017	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	4.000each	@545.03/each	2180.12
11.018	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	40.500Kilo litre	@185.00/Kilo litre	7492.50
11.019	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	317.496kg	@186.00/kg	59054.26
11.020	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	9.940sqm	@148.10/sqm	1472.11
11.021	13.51.2			
	Painting with silicon & acrylic emulsion based water thinnable sealer of approved brand and manufacture on wet or patchy portion of plastered surfaces:Two coats			
	Net Total	69.750sqm	@151.87/sqm	10592.93
			Heading Total(Rs)	1803430.74

Sl No	Specification	Quantity	Rate	Amount
12	**FILTER FEED TANK**			
12.001	20.2.3			
	Boring, providing and installing bored cast-in-situ reinforced cement concrete piles of grade M-25 of specified diameter and length below the pile cap to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring, with bentonite solution and temporary casing of appropriate length for setting out and removal of same and the length of the pile to be embedded in the pile cap etc. all complete, including removal of excavated earth with all lifts and leads (Length of pile for payment shall be measured upto bottom of pile cap).450 mm dia piles			
	Net Total	100.000metre	@2126.00/metre	212600.00
12.002	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the bottom of pile cap):550 mm dia piles			
	Net Total	100.000metre	@4343.34/metre	434334.00
12.003	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
12.004	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	6520.440kilo gram	@98.30/kilogram	640959.25
12.005	OD16892/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	6520.440kg	@2.62/kg	17083.55
12.006	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	11.520cum	@214.03/cum	2465.63
12.007	4.1.6			
	Providing and laying in position cement concrete of specified grade excluding the			

Sl No	Specification	Quantity	Rate	Amount
	cost of centering and shuttering - All work up to plinth level:1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	3.456cum	@7211.14/cum	24921.70
12.008	5.37.1			
	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.All wiork upto plinth level			
	Net Total	18.644cum	@9886.00/cum	184314.58
12.009	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	11.692cum	@11538.11/cum	134903.58
12.010	OD16891/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	30.340cum	@1509.09/cum	45785.79
12.011	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	54.086cum	@82.09/cum	4439.92
12.012	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	10315.600kg	@1.34/kg	13822.90
12.013	5.9.1			

Sl No	Specification	Quantity	Rate	Amount
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	27.450sqm	@335.31/sqm	9204.26
12.014	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	89.230sqm	@717.20/sqm	63995.76
12.015	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin-charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	37.000sqm	@570.26/sqm	21099.62
12.016	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin-charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	13.690sqm	@439.54/sqm	6017.30
12.017	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	74.210sqm	@401.22/sqm	29774.54

Sl No	Specification	Quantity	Rate	Amount
12.018	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	4.000each	@545.03/each	2180.12
12.019	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	27.380Kilo litre	@185.00/Kilo litre	5065.30
12.020	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	275.432kg	@186.00/kg	51230.35
12.021	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	8.622sqm	@148.10/sqm	1276.92
12.022	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	50.690sqm	@222.94/sqm	11300.83
			Heading Total(Rs)	1987645.40
13	**TREATED WATER TANK**			
13.001	20.3.4			
	Boring, providing and installing cast in situ single under reamed piles of specified diameter and length below pile cap in M -25 cement concrete, to carry a safe working load not less than specified, excluding the cost of steel reinforcement but including the cost of boring with bentonite solution and the length of the pile to be embedded in pile cap etc. all complete. (Length of pile for payment shall be measured upto to the			

Sl No	Specification	Quantity	Rate	Amount
	bottom of pile cap):550 mm dia piles			
	Net Total	225.000metre	@4343.34/metre	977251.50
13.002	20.6.2.1			
	Vertical load testing of piles in accordance with IS 2911(Part IV) including installation of loading platform and preparation of pile head or construction of test cap and dismantling of test cap after test etc. complete as per specification & the direction of engineer -in-Charge. Single pile above 50 tonne and upto 100 tonne capacityInitial test			
	Net Total	1.000per test	@70869.50/per test	70869.50
13.003	5.22.6			
	Steel reinforcement for R.C.C work including straightening, cutting, bending, placing in position and binding all complete upto plinth levelThermo - Mechanically Treated bars of grade Fe-500D or more			
	Net Total	12225.600kilogram	@98.30/kilogram	1201776.48
13.004	OD17259/2022-2023			
	Extra for providing epoxy coating for reinforcement bars.			
	Net Total	12225.600kg	@2.62/kg	32031.07
13.005	2.6.1			
	Earth work in excavation by mechanical means (Hydraulic excavator)/manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including disposal of excavated earth, lead up to 50 m and lift up to 1.5 m, disposed earth to be levelled and neatly dressed.All kinds of soil			
	Net Total	55.191cum	@214.03/cum	11812.53
13.006	4.1.6			
	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 : 6 graded stone aggregate 40 mm nominal size)			
	Net Total	7.884cum	@7211.14/cum	56852.63
13.007	5.37.1			
	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.All wiork upto plinth level			
	Net Total	28.982cum	@9886.00/cum	286516.05

Sl No	Specification	Quantity	Rate	Amount
13.008	5.37.2			
	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.All work above plinth level upto floor V level			
	Net Total	18.897cum	@11538.11/cum	218035.66
13.009	OD17307/2022-2023			
	Extra for providing sulphate resistant cement for the structures above plinth level.			
	Net Total	47.880cum	@1509.09/cum	72255.23
13.010	5.34.1			
	Extra for providing richer mixes at all floor levels. Note:- Excess/less cement over the specified cement content used is payable/ recoverable separately.Providing M-30 grade concrete instead of M-25 grade BMC/RMC. (Note:- Cement content considered in M-30 is @ 340 kg/cum).			
	Net Total	101.309cum	@82.09/cum	8316.46
13.011	4.12			
	Extra for providing and mixing water proofing material in cement concrete work in doses by weight of cement as per manufacturer's specification .			
	Net Total	16279.200kg	@1.34/kg	21814.13
13.012	5.9.1			
	Centering and shuttering including strutting, etc. and removal of form for:Foundations, footings, bases of columns, etc for mass concrete			
	Net Total	17.040sqm	@335.31/sqm	5713.68
13.013	5.9.2			
	Centering and shuttering including strutting, etc. and removal of form for:Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.			
	Net Total	117.858sqm	@717.20/sqm	84527.76
13.014	22.23.1			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e by reducing			

Sl No	Specification	Quantity	Rate	Amount
	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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For vertical surface two coats @0.70 kg per sqm			
	Net Total	67.200sqm	@570.26/sqm	38321.47
13.015	22.23.2			
	Providing and applying integral crystalline slurry of hydrophilic in nature for 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 fiber brush. The material shall meet the requirements as specified in ACI-212-3R-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 engineerin- charge. The product performance shall carry guarantee for 10 years against any leakage.For horizontal surface one coat @1.10 kg per sqm.			
	Net Total	31.360sqm	@439.54/sqm	13783.97
13.016	13.7.1			
	12 mm cement plaster finished with a floating coat of neat cement of mix:1:3 (1 cement : 3 fine sand)			
	Net Total	203.160sqm	@401.22/sqm	81511.86
13.017	19.16			
	Providing orange colour safety foot rest of minimum 6 mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steeel bar conforming to IS:1786, having minimum cross section as 23 mm x 25 mm and over all minimum length 263 mm and width as 165 mm with minimum 112 mm space between protruded legs having 2 mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to with stand the bend test and chemical resistance test as per specifications and having manufactures permanent identification mark to be visible even after fixing including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1cement: 3 coarse sand: 6 graded stone aggregate 20 mm nominal size) Complete as per design			
	Net Total	8.000each	@545.03/each	4360.24
13.018	100.36.1			
	Filling water with 5000 litre tankers fited in lorry and conveying water from a distance of 5 km (average) to the reservoir site and pumping the water into the reservoir of height not less than 3 m using 5 HP diesel engine pump set , hire for			

Sl No	Specification	Quantity	Rate	Amount
	tanker lorry, tools and other appliences and cost of water etc. complete.			
	Net Total	78.400Kilo litre	@185.00/Kilo litre	14504.00
13.019	10.26.3			
	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approves steel primer.G.I. pipes			
	Net Total	378.654kg	@186.00/kg	70429.64
13.020	13.48.3			
	Finishing with Deluxe Multi surface paint system for interiors and exteriors using primer as per manufacturers specifications:Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved brand and manufacture			
	Net Total	11.858sqm	@148.10/sqm	1756.17
13.021	13.52.2			
	Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.On concrete work			
	Net Total	98.560sqm	@222.94/sqm	21972.97
			Heading Total(Rs)	3294413.00
14	**Mechanical Items**			
14.001	OD17749/2022-2023			
	Piping, initial channel arrangements, bypass arrangements, steel ladder, framework and fire fighting arrangements			
	Net Total	1.000each	@349999.99/each	349999.99
14.002	OD17758/2022-2023			
	Supply and installation of centrifuge			
	Net Total	2.000each	@200000.00/each	400000.00
14.003	OD17773/2022-2023			
	Mechanical arrangement for oil and grease trap			
	Net Total	1.000each	@25000.00/each	25000.00
14.004	OD17778/2022-2023			
	Odour control unit for co-treatment unit and STP			
	Net Total	2.000each	@30000.00/each	60000.00
14.005	OD17785/2022-2023			
	Hypo Dosing System			
	Net Total	2.000each	@30000.00/each	60000.00

Sl No	Specification	Quantity	Rate	Amount
14.006	OD17789/2022-2023			
	Alum and Lime Dosing System			
	Net Total	2.000each	@25000.00/each	50000.00
14.007	OD17795/2022-2023			
	Carbon Filter			
	Net Total	2.000each	@1583332.49/each	3166664.98
14.008	OD17813/2022-2023			
	Pressure Sand Filter			
	Net Total	2.000each	@1527777.51/each	3055555.02
14.009	OD17830/2022-2023			
	Electromagnetic Flow meter,pressure and quality sensors			
	Net Total	4.000each	@48642.86/each	194571.44
14.010	OD17838/2022-2023			
	Tube settler media			
	Net Total	1.000each	@66964.28/each	66964.28
14.011	OD17845/2022-2023			
	Air Grid Pipe Supply and installation of air pipes			
	Net Total	4.000each	@44642.86/each	178571.44
14.012	OD17850/2022-2023			
	Bubble Diffuser for MBBR			
	Net Total	4.000each	@31250.00/each	125000.00
14.013	OD18082/2022-2023			
	Air Blower Supply,erection, testing and commissioning of twin lobe air blower(Power of motor 56 HP)			
	Net Total	5.000each	@840000.01/each	4200000.05
14.014	OD18720/2022-2023			
	MBBR media			
	Net Total	330.190sqm	@24553.58/sqm	8107346.58
14.015	OD18719/2022-2023			
	Bar Screen-fine-			
	Net Total	2.000each	@25000.00/each	50000.00
14.016	OD18742/2022-2023			
	bar screen			
	Net Total	44.000each	@25000.00/each	1100000.00
14.017	OD18736/2022-2023			

Sl No	Specification	Quantity	Rate	Amount
	Up to 10 to 20Hp, Head up to 20m As per KWA/HO/SP-333/2014 Dtd.18-03-2016 of The Managing Director			
	Net Total	30.000HP (Horse power)	@22798.00/HP (Horse power)	683940.00
14.018	OD18994/2022-2023			
	Up to 10HP, Head up to 20m As per KWA/HO/SP-333/2014 Dtd.18-03-2016 of The Managing Director			
	Net Total	122.750HP (Horse power)	@27406.80/HP (Horse power)	3364184.70
14.019	OD17983/2022-2023			
	Provision for mechanical arrangements for flushing, cleaning manholes and collection of septage			
	Net Total	1.000L.S	@4000000.00/L.S	4000000.00
14.020	OD30407/2022-2023			
	Filter feed pump - Supply, Installation, Commissioning, testing and trial run of submersible filtered water handling type pump, with specified discharge and head and of reputed make.			
	Net Total	2.000each	@422026.56/each	844053.12
14.021	OD30414/2022-2023			
	Raw Effluent Transfer pump - Supply, Installation, Commissioning, testing and trial run of submersible sewage handling type pump, with specified discharge and head and of reputed make.			
	Net Total	2.000each	@276451.20/each	552902.40
			Heading Total(Rs)	30634754.00
15	**Electrical Items**			
15.001	OD18212/2022-2023			
	Interconnecting piping system			
	Net Total	1.000each	@200892.87/each	200892.87
15.002	OD18215/2022-2023			
	ELECTRICAL & INSTRUMENTATION			
	Net Total	1.000each	@625000.00/each	625000.00
15.003	OD18220/2022-2023			
	Supply, installation and commissioning of diesel generator			
	Net Total	5.000each	@120000.00/eac	600000.00

Sl No	Specification	Quantity	Rate	Amount
			h	
15.004	OD18222/2022-2023			
	Supply and installation of accessories for electrical connection and control units for lifting stations and collection wells including foundations			
	Net Total	20.000each	@75000.00/each	1500000.00
15.005	OD18224/2022-2023			
	Supply, installation and commissioning of solar units for collection wells			
	Net Total	3.000each	@50000.00/each	150000.00
15.006	OD18243/2022-2023			
	Supply, installation and commissioning of solar units for lifting stations			
	Net Total	17.000each	@20000.00/each	340000.00
15.007	OD18247/2022-2023			
	Supply, installation and commissioning of solar units for STP			
	Net Total	1.000each	@1000000.00/each	1000000.00
15.008	OD18250/2022-2023			
	Transformer unit of 315 KVA			
	Net Total	2.000each	@599999.99/each	1199999.98
			Heading Total(Rs)	5615892.85
16	**Eco Friendly Units & STP allied components**			
16.001	OD29232/2022-2023			
	Green Belt,special exterior wall, garden and landscaping, three layer buffer vegetation in the outer periphery with provision for landscape and internal roads			
	Net Total	1.000no	@1155000.00/no	1155000.00
16.002	OD29251/2022-2023			
	Facility for Recycling Purposes			
	Net Total	1.000no	@150000.00/no	150000.00
16.003	OD29282/2022-2023			
	Compound wall at STP site			
	Net Total	1.000no	@1499999.99/no	1499999.99
16.004	OD29309/2022-2023			
	Equipment, Laboratory items, Furniture and Computer system for CIPS of iot			
	Net Total	1.000no	@133928.57/no	133928.57
16.005	OD29324/2022-2023			
	Construction of administration cum laboratary building			
	Net Total	1.000no	@16000000.00/no	16000000.00

Sl No	Specification	Quantity	Rate	Amount
			Heading Total(Rs)	18938928.56
			Total Estimation PAC	112538197.21
18	**Extra Charges**			
17.001	Provision for GST			
		112538197.21	18.00%	20256875.50
			Grand Total	0.00
			Round off	0.00
			Rounded Total(Rs)	132795072.71
	Rupees Thirteen Crore Twenty Seven Lakh Ninety Five Thousand Seventy Two			

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