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Design of Sewer and Strom Water Drainage Network for Karaikal

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Abstract – *Sewerage networks and storm water drainage are important infrastructure part of any society. The present project was undertaken to design the efficient sewerage network and storm water drainage system for Karaikal town. As part of the project, assessment of present conditions of the sewerage and drainage system was studied. By using water supply and population data to estimate the quantity of waste water generated from the rainfall data and assume that suitable coefficient of runoff, to estimate the quantity of storm water produced. From the rainfall data and coefficient of runoff, to estimate the quantity of storm water produced. Rational method was used to design storm drain. Then these data were used to draw the sewerage network and storm water drainage map using AutoCAD. Preliminary costing for sewer network was estimated.*

Key Words: Sewerage network, Storm water drain, Rational method, Preliminary cost.

1. INTRODUCTION

Sewage network is an important part of the infrastructure. The main purpose of providing the sewer network is to carry away sanitary waste from a municipal area in such a way that it does not cause any public health related problem. It is known that rural sewage system one the basic infrastructure facilities to transport sanitary waste to sewage treatment plant. storm is a the form of the waste waters from the rain leftover the land without any use that cause many problem to the human like disease and etc.,. So transport the storm water to the sewer is important part of designing sewer.

1.1 Objectives of the study

The following objectives were made for this study:

To assess the current status of sewerage disposal and storm water drainage system

To design and mapping the separate network system

To estimate the preliminary costing of the sewer network system

2. STUDY AREA

Karaikal district is situated in Pondicherry U.T. Its total area is 160 km square. It has a population of 2,00,222 as per the 2011 censes. The town is situated on 11° 23' N latitude and 79° 73' E longitude. It is holly place is located 11km to the south-west of Thirunallar temple, 32 km ton the south-east of Vellankanni, 15 km to the south-east of Nagour Dharka, 2km to the south of Karaikal Ammaiyar temple and 12 km to the to the Karaikal port.

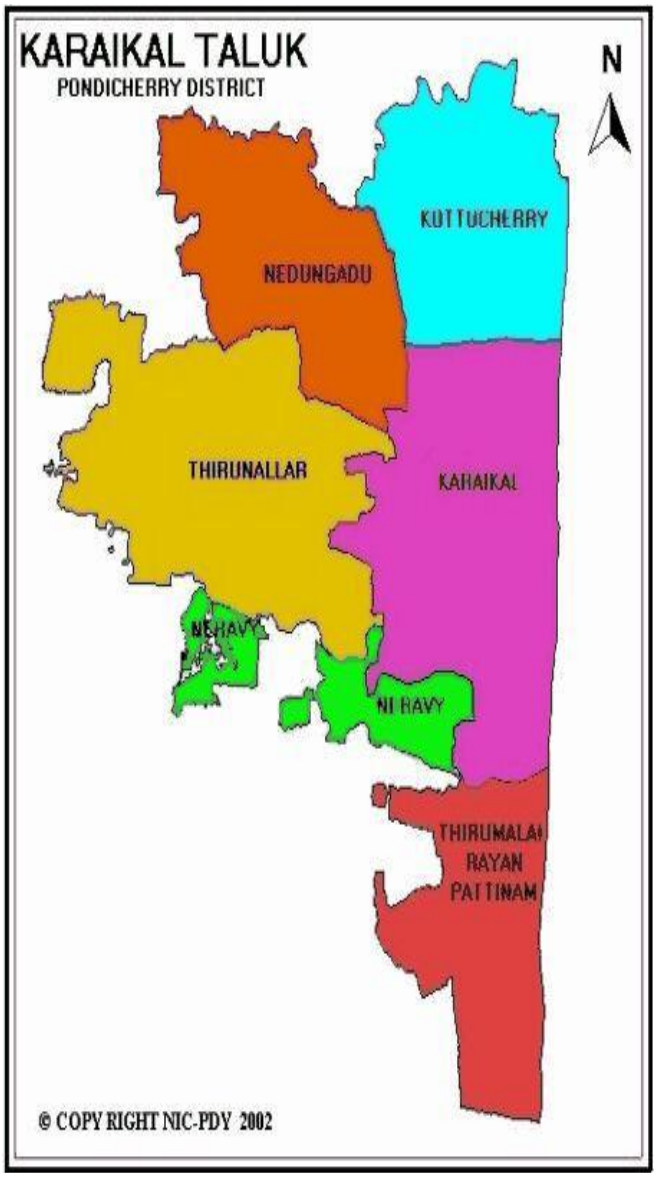

Fig -1: Karaikal, Pondicherry U.T.

3. METHODOLOGY

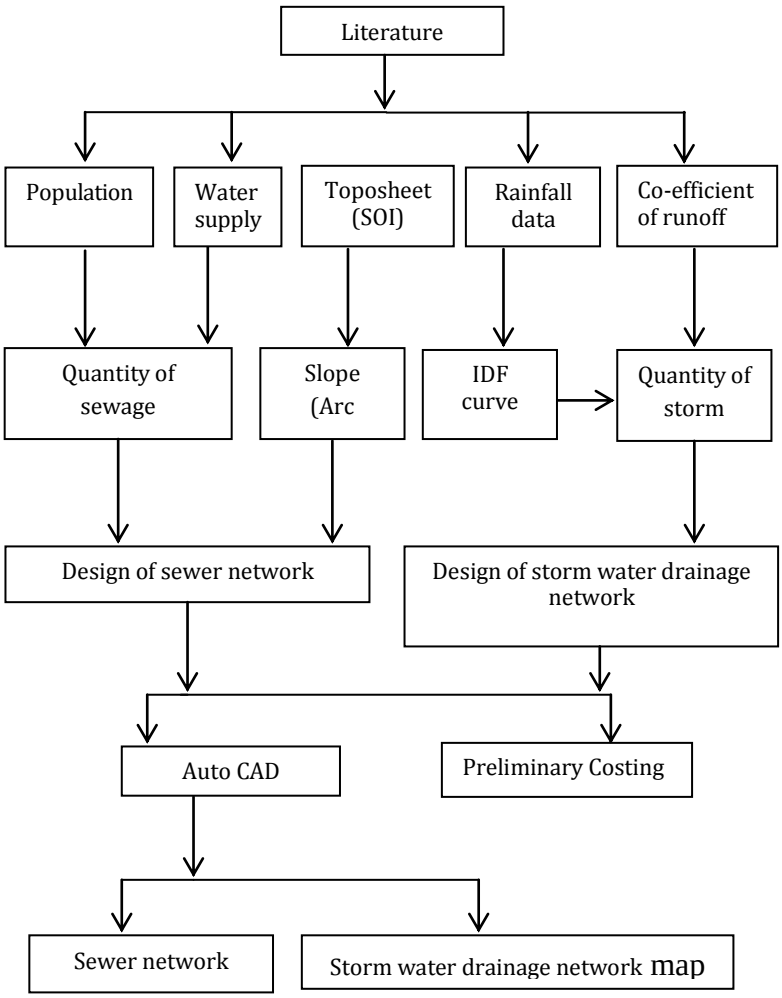

Fig -2: Methodology

4. MATERIALS AND METHODS

In this study Karaikal taluk was selected. Population, rainfall, current water supply scenario were collected and analyzed. Design of sewer and storm water network was done using Manning's formula and rational method.

4.1 Questionnaire survey

A detailed questionnaire survey was conducted to reveal the current sceneries of sewage & drainage in the survey area. From the survey, the existing storm water drainage is not fulfill its function. The maintenance is poor & it is damaged in many areas. Almost 80% of the people said that water stagnation problem.

In Karaikal municipality, there is no separate system for sewage. Most of the area are discharged the sewer into storm water drain. It is also a big issue which is deducted in this survey. So we concluded that, a separate system can be designed to overcome those issues.

Fig -3: Damaged storm water drain in Bharatiyar street, Karaikal

4.2 Population forecasting

Ward wise population data has been collected for the decades 1971, 1981, 1991, 2001 from the Karaikal municipality. By using Arithmetic method population is forecasting for next 50 years. This population is used for further studies.

Table -1: Population forecasting

Sl. No.	Year	Population	Arithmetic Increase
1	1971	43338	
2	1981	52399	9061
3	1991	63576	11177
4	2001	74438	10862
5	2011	86836	12398
		Average	10875

4.2.1 Arithmetical increase method

$$P_n = P_{1+n} \times X$$

Where,

P_n = Population nth in present

P_1 = Population in last decades

n = Number of decades

X = Average Arithmetical increase

4.2.2 Sample calculation

P_1 =86836

n =0.6

X =10875

P_{2017} = 86836 + 0.6 × 10875 = 93361

P_{2017} =93361

P_{2021} = 97711

P_{2031} =108586

P_{2041} =119461

P_{2051} =130336

P_{2061} =141211

P_{2067} =148824

4.3 Quantity of sewerage produced

As per IS 1172-1993 recommendation, the minimum water requirement for each person in Karaikal municipality is 150 LPCD, from that total water requirement is calculated, 80% of the above requirement is produced as sewage. Design factor can be assumed as 3 & then maximum sewage discharge can be calculated.

Average Population = 137949
Water Supply = 0.24 m^3/s
Sewage Quantity = 0.192(m^3/s)
Design Sewage Discharge = 3×0.192
= 0.576 m^3/s

4.4 Hydraulic design of sewer

Manning's formula can be used for the design of sewer. By using Arc GIS, the slope of the study area can be calculated. The N value for concrete pipe was taken as 0.015 from the IS 1771-1993. From these data, the diameter of the sewer pipe is calculated. Further it is checked for self-cleansing velocity & dry weather flow (DWF).

Q = 1/N ×A×R (2/3) × S (1/2)

0.576 = (1/0.015) × (3.14×D2/4) ×(D/4)(2/3)×(6×10-3)

D = 0.7 m

4.5 Design of storm water drain

The rational method was used to design the drains in the study area. The quantity of runoff was worked out using the formula

Considering the topography, slope & nature of soil in the study area the value of coefficient of runoff (K) and drainage area (A) was assessed and found to be 1156.

Using the kinematic equation the time of concentration was found out to be 56 min.

By using past 6 years rainfall data & IDF curve of the study area, the intensity of rainfall was found to be 4.9 cm/hr.

Quantity of storm water produced

Q = 1/36 (K × A × P_C) **= 157.3 m^3/s**

4.6 Section of the drain

By using manning's formula, the section of the drain was determined as most economical section.

Ward 6 to 9, depth = 1.2 m
Width = 2.4 m
Ward 10 and 11, depth = 1.15 m
Width = 2.2 m
Ward 12 and 13, depth = 0.65 m
Width = 1.2 m

4.6 Preliminary costing

A feasibilty study is a conducted by calculating preliminary cost, because it is conducted before a project begins. Preliminary costing is based on the typical geometriuc drain sections arrived for primary and major drains. This costing represents the block cost of the storm drains including the cross drainage works, protective works, opertion and maintenance and other miscellaneous works.

Table -2: Quantity estimation of earth work excavation

ITEM NO	DESCRIPTION	NO	DIMENSIONS			QUANTITY
			L	B	W	m^3
1	EARTH WORK EXCAVATION					
	Main sewer	2	1900	0.9	1.5	5130
	Lateral sewer					
	P.k salai 1	2	600	0.5	0.3	180
	P.k salai 2	1	130	0.5	0.3	19.5
	Mariamman kovil street	1	1400	0.3	0.2	84
	Elakara street	8	190	0.5	0.3	228
	Church street	1	1300	0.5	0.3	195
	Thiunallar main road	6	500	0.4	0.3	360
	French teacher street	8	230	0.4	0.3	220.8
	Ambethkar street	1	450	0.4	0.3	54
	Moh road	1	261	0.4	0.3	31.32
				TOTAL QUANTITY		**6502.62**

Table -3: Quantity estimation of brick work

ITEM NO	DESCRIPTION	NO	DIMENSIONS			QUANTITY
3	BRICK WOK					
	Brick wok manhole	32	1.2	0.2	1.3	9.984
	Longitudinal cross section	32	0.8	0.2	1.3	6.656
	Deduction					
	Pipe	32	0.502	0.2	1	3.2128
	Inlet	32	0.192	0.2	1	1.2288
				TOTAL QUANTITY		**12.1984**

Table -4: Quantity estimation of cement concrete

ITEM NO	DESCRIPTION	NO	DIMENSIONS			QUANTITY
	CEMENT CONCRETE(1:1.5:3)					
	Main sewer(RCC)	2	1900	0.15	0.9	513
	Trenge((a+b)/2)*2	2	1900	0.31		1191.3
	Deduction(cicula pipe)	2	1900	0.44		839.39
	Rectangula channel	2	600	0.3	0.1	36
	Base concete	1	0.6	0.1	600	36
	P.k salai	1	130	1.2	0.1	15.6
	Maniakovil steet	1	1400	0.9	0.1	126
	Elakan steet	1	190	0.9	0.1	17.1
	Chuch steet	1	1300	1.2	0.1	156
	Thiunalla st	6	500	0.9	0.1	270
	Fench steet	8	230	0.9	0.1	165.6
	Ambethga st	1	450	0.9	0.1	40.5
	Moh road	1	261	0.9	0.1	23.49
2	Slab					0
	Manaian steet1600	1	600	0.7	0.1	42
	Maiappan street	1	1400	0.5	0.7	490
	Elakara street	8	190	0.7	0.1	106.4
	Chruch street	1	1300	0.7	0.1	91
	Thiunalla st	6	500	0.6	0.1	180
	French teacher street	8	230	0.6	0.1	110.4
	Ambeka street	1	450	0.6	0.1	27
	Moh road	1	261	0.6	0.1	15.66
	Manhole					0
	Base concete	32	1.2	0.15	1.2	6.912
	Slab concete	32	1.2	1.2	0.1	4.608
	Slab concrete	32	3.2	0.04	1	4.096
	Phase concrete	32	0.9	0.9	0.8	20.736
	Deduction(circular pipe)	32	0.502	0.1	1	1.6064
	Manhole cover	32	0.504	0.9	1	14.5152
	Slope concrete	32	0.084	0.5	0.9	1.2096
			TOTAL QUANTITY			**2835.1**

Table -5: Analysis rate of earth work

QUANTITY	DESCRIPTION	RATE	PER	AMOUNT	
5	BELDER	400	DAY	2000	
4	MAZDOOR	400	DAY	1600	
3	BELDER	400	DAY	1200	
3	MAZDOOR	400	DAY	1200	
0.5	BHISTRI	300	DAY	150	
				28.3CUMEC	**6150**
	EARTH WORK FOR 1	CUMEC	IS	217.3145	
	EARTH WORK REQUIRED	6502.61	CUMEC	459539.4	
		6502.61	CUMEC	585885S.2	
Total					**1045425**

Table -6: Analysis rate of brick work

QUANTITY	DESCRIPTION	RATE	PER	AMOUNT	
5000	BRICK	8	NOS	40000	
30	CEMENT	400	BAG	12000	
15.9	MAZDORE	400	DAY	6360	
8	MANSON	600	DAY	4800	
1.76	BHISTI	300	DAY	528	
2	SAND	700	CUBMEC	1400	
1	MIXING CHARGE	50	LS	50	
			Total	**65138**	
BRICK WORK FOR CUMEC 6513.8/-					
FOR REQUIRED BRICK WORK IS 79457.94/-					

Table -7: Analysis rate of cement concrete

QUANTITY	DESCRIPTION	RATE	PER	AMOUNT	
60	CEMENT	400	BAG	24000	
2.73	SAND	700	CUMEC	1911	
5.45	AGGREGATE	1500	CUMEC	8175	
1.766	MANSON	600	DAY	1059.6	
2.65	BHISTRI	300	DAY	795	
10.6	MAZDOOR	400	DAY	4240	
7.06	BELDAR	400	DAY	2824	
1	MIXING CHARGE	50	LS	50	
Total				**43054.6/ 10 m³**	
CEMENT CONCRETE FOR 1 CUMEC 4305.46/-					

Table -8: Analysis rate of cement concrete

QUANTITY	DESCRIPTION	RATE	PER	AMOUNT
640	SEWER PIPE	1500	NOS	960000
300	INLET PIPE	1000	NOS	300000
1655.137	CEMENT CONCRETE	4305.46	CUME C	7126126
Total				**8386126/-**
TOTAL AMOUNT FOR SEWER IS **9711009/-**				

4. RESULTS

The design and mapping of sewer and storm water drainage network for Karaikal was worked out.

Table -9: Street wise sewerage discharge and detail of sewer

STORM WATER NAME	QUANTITY OF STORM (m^3/s)	DIA/SEC OF THE STORM (m)	LENGTH OF STORM (m)	SLOPE OF STORM
MS	0.576	0.7	1900	1:158
MS 1	0.576	0.7	1900	1:158
LS 1	0.01952	0.2	600	1:1200
LS 1	0.01952	0.2	500	1:1200
LS 2	0.025	0.3	1400	1:1200
LS 1	0.01952	0.2	450	1:1200
LS 2	0.025	0.3	1300	1:1200
LS 3	0.0191	0.27	230	1:1200
LS 3	0.0191	0.27	261	1:1200
LS 1	0.01952	0.2	190	1:1200

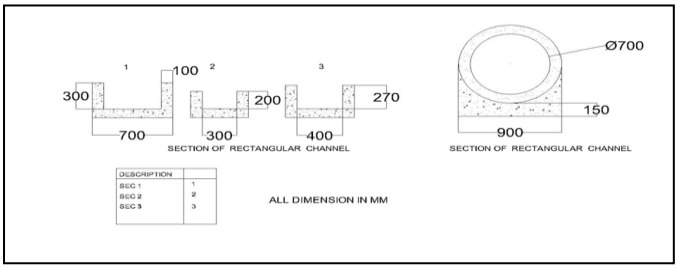

Fig -4: Cross section of main and lateral sewer

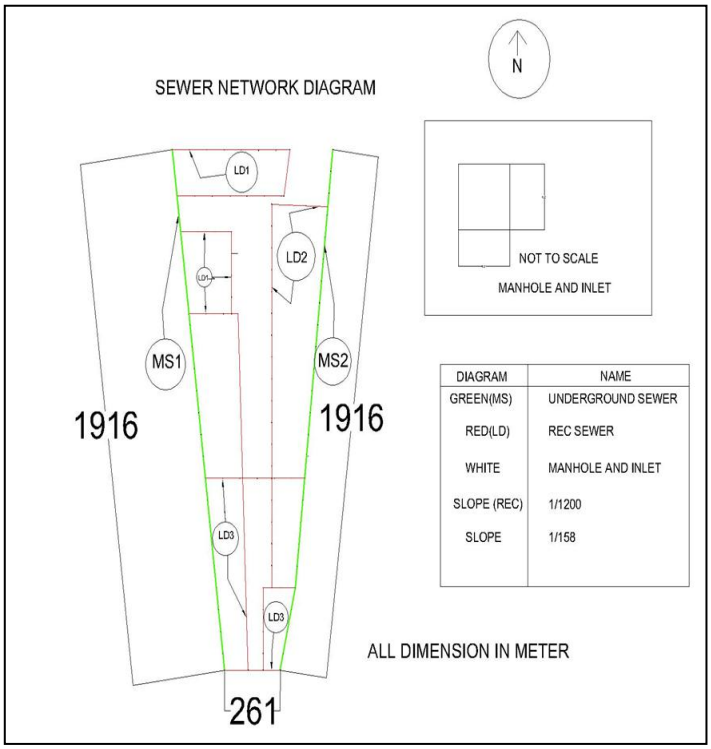

Fig -5: Sewer network map

Table -10: Street wise storm water discharge and detail of drain

SEWER NAME	QUANTITY OF SEWER	DIA/SEC OF THE SEWER	LENGTH OF SEWER	SLOPE OF SEWER
DS	4.08	0.7	1900	1:158
DS 1	4.08	0.7	1900	1:158
DS 1	4.08	0.2	600	1:1200
DLS 1	4.08	0.2	500	1:1200
DLS 2	3.13	0.3	1400	1:1200
DLS 1	4.08	0.2	450	1:1200
DLS 2	3.13	0.3	1300	1:1200
DLS 3	0.167	0.27	230	1:1200
DLS 3	0.167	0.27x	261	1:1200
DLS 1	4.08	0.2	190	1:1200

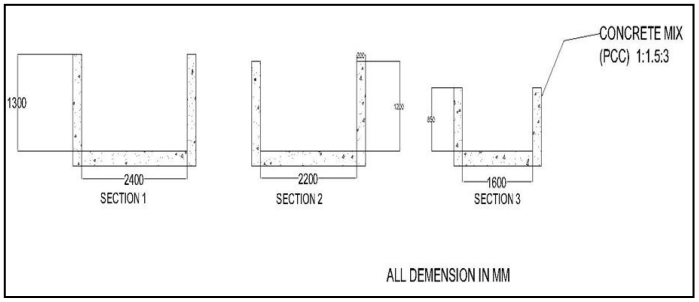

Fig -6: Cross section of drain

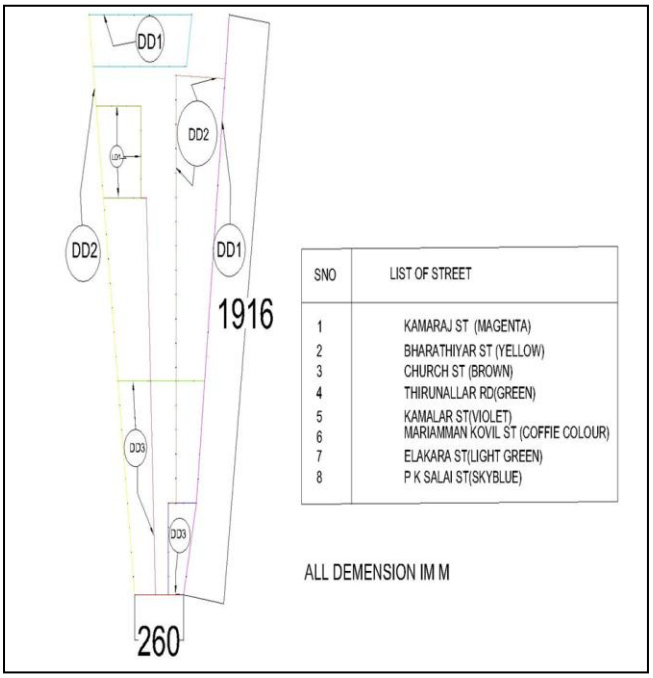

Fig -7: Drain network map

5. CONCLUSIONS

Karaikal, the rapidly urbanizing town has exerted greater stress in dispensing the sewage distribution and storm water drainage.

Questionnaire survey shows that 92 % of study area has covered by open drainage network and 80 % of study area has comes under water stagnation due to improper maintenance.

Calculated total length of sewer line is 8731 m and the diameter of 700 mm and also calculated discharge quantity of waste water produced in study area is 0.576 m^3/s. The distribution factor for the study area is 650, which is greater than 500. Therefore the wastewater is directly poured into the Arasalar river. Sewerage and storm water drainage network system of Karaikal map was drawn.

Preliminary costing was worked out for the sewer network system and it was estimated us around rupees one crore.

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