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A STUDY ON ROAD WIDENING PROJECT BASED ON TRAFFIC VOLUME AT KARUNAGAPPALLY,KERALA

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Abstract

This work presents the concept of road widening based on the prediction of traffic volume at Karunagappally between Lalaji junction and Pulliman junction. The project deals with traffic and accident reduction. From the traffic survey conducted by PWD in 2013 the traffic volume is increasing 5% every year leading in utilization of roads above capacity thereby reducing level of service. The continuously increasing traffic and congestion on the roadways have become one of the major concerns, increasing the stress levels in daily life. There occurs higher emission of pollutants due to incomplete combustion of fuels .By providing enough space on roads we can achieve fast movement of traffic thereby reducing pollution. For safe and efficient transportation flyover and road are practical solutions. As road widening is more economical than a flyover, to find a good solution we can propose road widening project between Lalaji junction and Pulliman junction. This work includes the study of existing traffic situation for the selected road stretch, observations and results of traffic volume survey of stretch, the study on need of road widening and justification, the design the two lane two way traffic.

Keywords: Level of service, passenger car unit PCU, Congestion, Traffic Volume, Spot Speed Study, Capacity

1. Introduction

National highways form the economic backbone of the country and have often facilitated urban development along the major highways. Although National highways (100,087 km) comprise 1.7% of India's total road network, it carries about 40% of road traffic and most of them have only two lanes. National Highway 66 which connects Panvel (south of Mumbai city) to Kanyakumari commonly referred to as NH 66 (Erstwhile NH-17), is a busy National Highway in India that runs roughly north–south along the western coast of India,

parallel to the Western Ghats passes through the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu. NHAI upgrades highways to a minimum 4-lane, 60-meter-wide, grade-separated highway or a better standard across India. In Kerala, even though National Highways are being upgraded to only 45-meter-wide,now Kerala State Government has requested NHAI to reduce the width of National highways in state to 30-meters, although neighboring Karnataka and Tamil Nadu are upgrading their National Highways as 60- meters or more wider highways, with futuristic provision for 6/8-lane highway. The reason cited by the State Government is the difficulty and disinterest in Land Acquisition, which is the responsibility of the State Government. Most of the National Highways are of good quality and the roads are wider and maintained well, but conditions of roads become worse during monsoon season, due to excessive rainfall in Kerala.

Karunagappally, one of the most important towns in Kollam district has experienced an increase both in population and in vehicular traffic. National highway No. 66 passes through the central part of the town and provides vital connectivity to Kollam and Thiruvananthapuram in the south and Alappuzha and Ernakulam in the Central parts of Kerala. From the records traffic survey conducted by PWD in 2013 the traffic volume is increasing 5% every year. This increase in rate of traffic resulted in hurdles like accidents, speed delay, environmental pollution due to incomplete combustion of fuels, damages in the pavement thus reducing the life of pavement etc. In this current scenario, by providing enough space in roads we can achieve fast movement of traffic thereby reducing pollution. To find a good solution we have proposed road widening project between Lalaji junction and Pulliman junction. thereby reducing traffic conjunction for about 2km. The objective of the project is to provide a safe transportation system. For this a flyover and road widening can be adopted. Road widening is preferred to a flyover as the former is more economical.

2. Study Area

The major road national highway No. 66 is maintained by PWD while the remaining roads are maintained by Karunagappally Municipality. Apart from NH 66, other important roads in the town are

(i) Karunagappally -Sasthamkotta road
(ii) Karunagappally - Alappad road
(iii) Karunagappally - Amrithapuri road
(iv) Karunagappally - Alum Kadavu road

To compile base line data and necessary inputs for the study, various primary surveys were conducted in the study area. For the purpose of carrying out the surveys, major roads in the study area were divided into various homogeneous sections based on road width and traffic characteristics. Details of homogeneous sections identified on major roads in Karunagappally town are given in table.

Table-1 Details of major roads in Karunagappally

NAME OF ROAD & SECTION
National Highway No. 66 (Old NH 47)
Lalaji Jn - KSRTC Jn
KSRTC Jn - Civil Station Jn
Civil Station Jn - High School Jn
High School Jn - Pulliman Jn

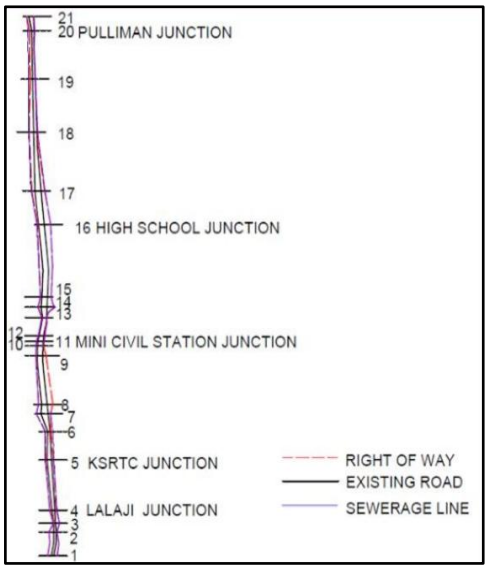


Figure-1 AutoCAD drawing of the selected stretch of road section

2.1 Dimensions of the road stretch

Here in our project we have used handy GPS (Global Positioning System) to obtain the latitudes and longitudes of the points that we have selected, so as to obtain the dimensions of the road stretch. The latitudes and longitudes of 21 points in and between Lalaji junction and Pulliman junction were collected and the length and width of the selected road stretch was calculated.

Table-2 Width of by routes

JUNCTION NAME	BY ROUTES	WIDTH(m)
LALAJI JUNCTION	Old NH	5
	Panickerkadavu	5
KSRTC JUNCTION	Market road	4
MINI CIVIL STATION	Kottarakkara	6
	By route	8
HIGH SCHOOL JUNCTION	Alumkadav	6
PULLIMAN JUNCTION	Railway station road	5
	Pulliman Nagar road	5

Table-3 Latitudes and longitude details obtained from the handy GPS

Poi	P1	P2	P3	P4	P5	P6
1	9.0479,76.53	9.0478,76.53	0	0	9.0478,76.5	9.0479,76.5
2	9.04783,76.5	9.0487,76.53	0	0	9.0487,76.5	9.0487,76.5
3	9.04908,76.5	9.0490,76.53	0	0	9.04903,76.	9.04903,76.
4	9.04950,76.5	9.04950,76.5	0	0	9.04941,76.	9.04944,76.
5	9.05135,76.5	9.05138,76.5	0	0	9.05128,76.	9.0513,76.5
6	9.05248,76.5	9.05245,76.5	0	0	9.05250,76.	9.05247,76.
7	9.0531,76.53	9.0531,76.53	0	0	9.0531,76.5	9.0531,76.5
8	9.05369,76.5	9.05345,76.5	9.5367,76.5	9.05366,7	9.05366,76.	9.05363,76.
9	9.05515,76.5	9.05527,76.5	9.05531,76.	9.05511,7	9.05520,76.	9.05513,76.
10	9.05520,76.5	9.05520,76.5	9.05524,76.	9.05526,7	9.05527,76.	9.05528,76.
11	9.05520,76.5	9.05537,76.5	9.05545,76.	9.05542,7	9.05544,76.	9.0555,76.5
12	9.05559,76.5	9.05625,76.5	9.05568,76.	9.05568,7	9.0556,76.5	9.05557,76.
13	9.05626,76.5	9.05625,76.5	9.05627,76.	9.05631,7	9.05631,76.	9.05631,76.
14	9.05656,76.5	9.05655,76.5	9.05658,76.	9.05662,7	9.05662,76.	9.05660,76.
15	9.05764,76.5	9.05660,76.5	9.05762,76.	9.5761,76.	9.05761,76.	9.05755,76.
16	9.05931,76.5	9.05933,76.5	0	0	9.05926,76.	9.05926,76.
17	9.06112,76.5	9.06104,76.5	0	0	9.06112,76.	9.06107,76.
18	9.06138,76.5	9.06318,76.5	0	0	9.06315,76.	9.06329,76.
19	9.06517,76.5	9.06516,76.5	0	0	9.06514,76.	9.06515,76.
20	9.06697,76.5	9.06697,76.5	0	0	9.06699,76.	9.06701,76.
21	9.06752,76.5	9.06750,76.5	0	0	9.06760,76.	9.06756,76.

Table-4 Width of the road and right of way at the 21 points

POINT	WIDTH (m)		EXTRA WIDENING	
POINTS(P)	PAVEMENT WIDTH	DIVIDER (IF ANY)	LEFT	RIGHT
P1	11	0	16	16
P2	11	0	3	22
P3	7	0	19	1
P4	14	0	7	9
P5	22	0	9	7
P6	7	0	5	11
P7	33	0	11	22
P8	25	2	27	7
P9	25	9	14	8
P10	23	7	3	8
P11	25	6	3	7
P12	22	13	5	4
P13	18	8	1	3
P14	28	4	37	13
P15	26	3	18	6
P16	23	0	3	4
P17	28	0	17	15
P18	5	0	4	21
P19	12	0	1	11
P20	11	0	3	11
P21	21	0	2	9

Table-5 Length of the road on either side

POINT NUMBER	LENGTH (m)		POINT NUMBER	LENGTH (m)	
POINTS(P)	LEFT	RIGHT	POINTS(P)	LEFT	RIGHT
P1-P2	101	100	P11-P12	24	18
P2-P3	35	40	P12-P13	76	83
P3-P4	56	43	P13-P14	44	39
P4-P5	211	212	P14-P15	43	113
P5-P6	126	136	P15-P16	305	186
P6-P7	73	83	P16-P17	190	211
P7-P8	40	64	P17-P18	246	229
P8-P9	205	172	P18-P19	222	224
P9-P10	39	24	P19-P20	203	207
P10-P11	20	21	P20-P21	59	68

3. Data Collection and Analysis

3.1 Traffic volume surveying

A traffic count is a count of vehicular or pedestrian traffic, which is conducted along a particular road, path, or intersection. It provides the source data used to calculate the Annual Average Daily Traffic (AADT), which is the common indicator used to represent traffic volume.

Table-6 Traffic count towards Kollam direction from each junction during peak and off peak hours

JUNCTION NAME	TIME	CYCLE	MOTOR CYCLE	AUTO	CAR	BUS	HEAVY VEHICLE
LALAJI JUNCTION	(8:00-10:00)AM (12:30-2:30)PM (3:00-5:00)PM	25 5 8	1839 674 1966	275 179 296	1834 419 1152	253 104 288	129 73 120
KSRTC BUS JUNCTION	(8:00-10:00)AM (12:30-2:30)PM (3:00-5:00)PM	180 178 186	3989 4137 3347	784 828 648	1384 3887 1845	547 1648 760	845 1384 836
CIVIL STATION JUNCTION	(8:00-10:00)AM (12:30-2:30)PM (3:00-	129 142 24	2316 3785 3912	470 568 1080	1061 1546 2289	190 187 169	212 225 125
HIGH SCHOOL JUNCTION	(8:00-10:00)AM (12:30-2:30)PM (3:00-5:00)PM	53 44 36	2042 2152 1388	452 308 243	894 592 997	124 44 204	91 24 100

PULLIMAN JUNCTION	(8:00-10:00)AM (12:30-2:30)PM (3:00-5:00)PM	6 14 12	2088 2032 2810	168 254 231	874 943 1800	48 59 78	50 57 54

Table-7 Traffic count towards Alappuzha direction from each junction during peak and off peak hours

JUNCTION NAME	TIME	CYCLE	MOTOR CYCLE	AUTO	CAR	BUS	HEAVY VEHICLE
LALAJI JUNCTION	(8:00-10:00)AM (12:30-2:30)PM	15 6 12	1386 867 1174	317 221 354	926 534 945	168 147 261	175 101 266
KSRTC BUS JUNCTION	(8:00-10:00)AM (12:30-2:30)PM (3:00-5:00)PM	138 84 37	3842 2475 3943	1532 1786 735	1974 3485 2835	786 1548 384	945 1490 370
CIVIL STATION JUNCTION	(8:00-10:00)AM (12:30-2:30)PM (3:00-5:00)PM	32 40 12	3112 3924 4248	1123 1128 1104	1468 1672 1537	236 259 210	157 143 179
HIGH SCHOOL JUNCTION	(8:00-10:00)AM (12:30-2:30)PM	96 109 118	1859 1028 1584	311 252 408	1100 1596 855	118 176 198	100 184 150
PULLIMAN JUNCTION	(8:00-10:00)AM (12:30-2:30)PM (3:00-5:00)PM	3 11 6	2880 1398 1564	230 246 320	384 945 1178	72 64 84	24 22 27

In our project, a handy camera was placed at suitable positions, so that, we can cover the entire roads in the selected junction in our camera. Thereby, the traffic count was collected at two peak time and an off peak time of a day, at a junction. By this method we collected the traffic count of both NH 66 road and that through the by routes present in each junction, for a period of time. By this method we collected the traffic count of both NH 66 road and that through the by routes present in each junction, for a period of time. The following tables given below show the traffic

count of the five junctions naming Lalaji junction, KSRTC bus junction, Mini civil station junction, High school junction and Pulliman junction towards Kollam and Alappuzha side separately and also the counts of vehicles entering and leaving NH 66, to and from by routes.

Table: 8 Traffic count to and from NH 66 and the by routes

TIME	NAME	CYCLE	MOTOR CYCLE	AUTO	CAR	BUS	HEAVY VEHICLE
At Lalaji junction, Karunagappally							
(8:00 – 10:00)AM	To Old NH From Old NH	4 8	112 143	51 34	32 53	11 8	6 3
(12:30 – 2:30)PM	To Old NH From Old NH	5 7	95 107	45 28	31 47	7 9	1 6
(3:00 – 5:00)PM	To Old NH From Old NH	6 5	104 133	43 36	26 41	11 5	3 1
(8:00 – 10:00)AM	To Panickerkadavu road From	9 6	329 372	136 185	245 164	7 6	4 7
(12:30 – 2:30)PM	To Panickerkadavu road From	6 9	373 458	133 129	263 306	5 3	2 4
(3:00 – 5:00)PM	To Panickerkadavu road From	5 8	481 427	108 156	414 144	14 5	9 7
At Mini Civil Station junction, Karunagappally							
(8:00– 10:00)AM	To Kottarakkara From Kottarakkara	12 26	1876 2132	239 321	574 425	10 8	3 4
(12:30 – 2:30)PM	To Kottarakkara From Kottarakkara	20 8	2412 1923	853 353	745 540	20 36	10 12
(3:00 – 5:00)PM	To Kottarakkara From Kottarakkara	45 26	2736 2184	1035 366	784 589	48 12	16 23
(8:00 – 10:00)AM	To kallummotil kadav From kallummotil kadav	6 25	845 917	128 125	236 313	7 13	3 6
(12:30 – 2:30)PM	To kallummotil kadav From kallummotil kadav	8 30	1140 984	320 173	540 745	8 12	10 7

(3:00 – 5:00)PM	To kallummotil kadav From kallummotil kadav	12 35	1345 1056	264 312	312 696	13 6	12 10

Table: 9. Traffic count to and from NH 66 and the by routes

TIME	NAME	CYCLE	MOTOR CYCLE	AUTO	CAR	BUS	HEAVY VEHICLE
Pulliman junction, Karunagappally							
(8:00 – 10:00)AM	To RS road From RS road	3 2	274 120	34 12	10 1	6 3	3 2
(12:30 – 2:30)PM	To RS road From RS road	3 5	247 152	20 16	53 18	5 3	6 7
(3:00 – 5:00)PM	To RS road From RS road	7 3	228 254	18 27	84 89	8 2	10 5
(8:00 – 10:00)AM	To Pulliman nagar From Pulliman nagar	3 2	35 42	9 15	12 7	Nil Nil	2 Nil
(12:30 –	To Pulliman nagar From Pulliman nagar	Nil Nil	40 27	8 5	10 6	1 Nil	3 Nil
(3:00 –	To Pulliman nagar From Pulliman nagar	15 4	72 38	7 4	35 18	2 1	Nil Nil
KSRTC junction, Karunagappally							
(8:00 – 10:00)AM	To market road From market road	25 78	1834 1741	389 318	57 8	349 234	118 157
(12:30 – 2:30)PM	To market road From market road	24 35	1383 1741	389 318	57 8	352 584	184 216
(3:00 – 5:00)PM	To market road From market road	30 67	1344 1843	168 278	19 2	120 354	89 128
High School junction, Karunagappally							
(8:00 – 10:00)AM	To Alumkadav From Alumkadav	82 127	745 967	176 123	24 0	50 41	9 6
(12:30 – 2:30)PM	To Alumkadav From Alumkadav	60 120	768 616	140 120	18 5	44 12	4 8
(3:00 – 5:00)PM	To Alumkadav From Alumkadav	137 50	854 765	154 180	11 5	32 53	7 6

3.2 Speed and delay study

As part of the study, speed survey was carried out on the selected road stretches. For calculating the time from a video surveying, we adopted Start to Finish Method (Start timing when the front of the object reaches a "start line" and stop timing when the front of the object reaches the "finish line"). For this a starting and finishing point was marked in the screen of the device in which the video is being played. From this, the distance and the time the vehicle had taken to reach the finishing point from the starting point was obtained.

Table: 10. Speed of different vehicles at different junctions

` Junction Name	Cycle (Km/Hr)	Motor Cycle (Km/Hr)	Auto (Km/Hr)	Car (Km/Hr)	Bus (Km/Hr)	Heavy Vehicles (Km/Hr)	Average (Km/Hr)
LALAJI	7.8	13.8	4.54	10	4.7	8.3	8.19
KSRTC	9	29.1	17.4	17.1	12	13.5	16.3
MINI CIVIL STATION	7	34.2	32.4	25.8	15	18.6	26.6
HIGH SCHOOL JUNCTION	12	24.6	21	22.2	18.12	12.4	19.6
PULLIMAN JUNCTION	7.2	24.6	21.8	26.4	15.6	16.2	20.92
TOTAL AVERAGE (km/hr)							18.322

After getting both distance and time the speed was calculated. By this method the speed of each category of vehicle was calculated and we obtained the average speed of vehicles in the selected road stretch i.e., between Lalaji junction and Pulliman junction.

3.2 Passenger Car Equivalent (PCE)

Passenger Car Equivalent (PCE) or Passenger Car Unit (PCU) is a metric used in Transportation Engineering, to assess traffic-flow rate on a highway. A Passenger Car Equivalent is essentially the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car. For example, typical values of PCE (or PCU) are:

Table: 11 Typical values of PCU

Car	1
Bicycle	0.2
Motor cycle	0.5
3-wheeler	0.8
Bus ,Truck	3.5

PCU values derived from the density method are based on underlying homogeneous traffic concepts such as strict lane discipline, car following and a vehicle fleet that does not vary greatly in width.

Table: 12 Table showing PCU for 2 hours towards Alappuzha direction during peak and off peak time

JUNCTION NAME	TOWARDS ALAPPUZHA		TOWARDS KOLLAM	
	PEAK PCU	OFF PEAK PCU	PEAK PCU	OFF PEAK PCU

LALAJI JUNCTION	3371	2015	4289	1521
MINI CIVIL STATION JUNCTION	5307	5953	5085	5363
KSRTC BUS JUNCTION	9146	17162	9289	16343
PULLIMAN JUNCTION	2476	2235	6470	4930
HIGH SCHOOL JUNCTION	3140	3594	3000	2162

Table 13 Capacity utilization of major road sections in Karunagappally town

SL NO:	NAME OF JUNCTION	2013 TOTAL VOLUME IN PCU	PRESENT TOTAL VOLUME IN PCU
1	LALAJI JUNCTION	45,631	82,152
2	KSRTC JUNCTION	47,481	1,51,956
3	CIVIL STATION JUNCTION	52,439	3,63,580
4	HIGH SCHOOL JUNCTION	49,493	1,12,784
5	PULLIMAN JUNCTION	45,857	83,272

By comparing the PCU value of the year 2013 and the present PCU value (2017) we could find that there is a drastic increase in the vehicular population. This increased the traffic congestion at Karunagappally.

3.3 Results and Discussions

As part of the study, speed survey was carried out on the selected road stretches. There are two methods for calculating the time from a video surveying. The speed of each category of vehicle was calculated and we obtained the average speed of vehicles in the selected road stretch i.e., between Lalaji junction and Pulliman junction approximately 25 km/hr.

Passenger Car Equivalent (PCE) or Passenger Car Unit (PCU) is a metric used in Transportation Engineering, to assess traffic-flow rate on a highway. Highway capacity is measured in PCU/hour daily a common method used in the US is the density method. However, the PCU values derived from the density method are based on underlying homogeneous traffic concepts such as strict lane discipline, car following and a vehicle fleet that does not vary greatly in width. On the other hand, highways in India carry heterogeneous traffic, where road space is shared among many traffic modes with different physical dimensions. By comparing the PCU value of the year 2013 and the present PCU value (2017) we could find that there is a drastic increase in the vehicular population. This increased the traffic congestion at Karunagappally.

Table -14 Capacity utilization of major road sections in Karunagappally town

Sl No	Junction Name	2013 Volume in PCU	2017 Volume in PCU
1	Lalaji	45,631	82,152
2	KSRTC	47,481	1,51,956
3	Civil Station	52,439	3,63,580
4	High School	49,493	1,12,784
5	Puliman	45,857	83,272

The quality of the soil on site plays a key role in construction projects. Soil inspection or say geotechnical inspection was conducted to done to explore the sub surface and surface characteristics of soil. Compaction of soil is required for the construction of earth dams, canal embankments, highways, runways, and much other structure. California Bearing Ratio test is conducted in laboratory. This test provides the load penetration resistance of soil and is used for the evaluation of sub grade strength of roads and pavements. Various other tests like proctor compaction, specific gravity are conducted to determine the elastic properties of the soil.Specific Gravity of 2.5 and 2.8 were obtained at Lalaji junction and Puliman junction respectively.

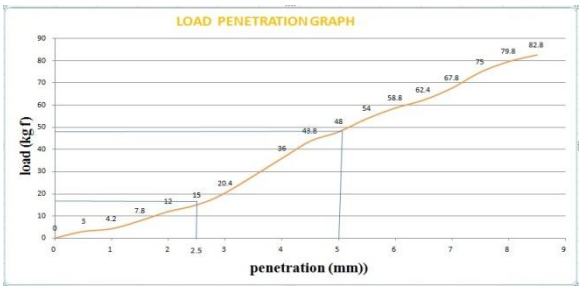


Fig-2 Dry Density Vs Water Content at Lalaji Jn.

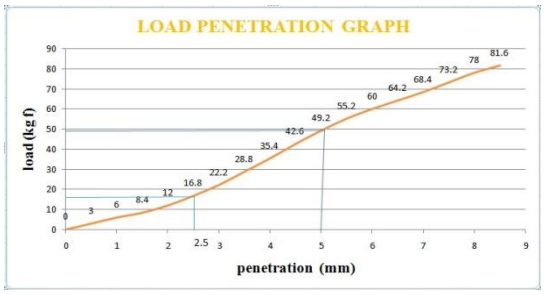
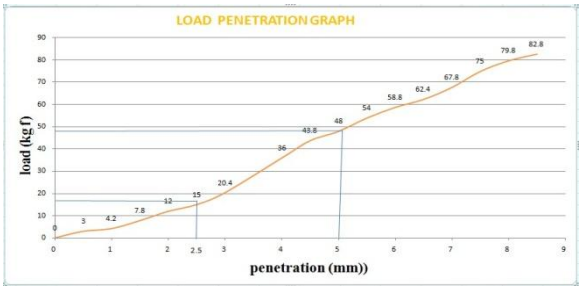


Fig-3 Dry DensityVs Water Content at Puliman Jn.



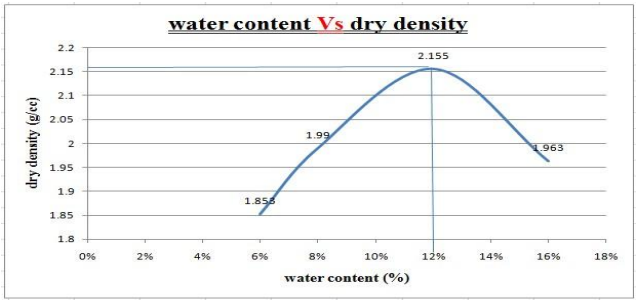
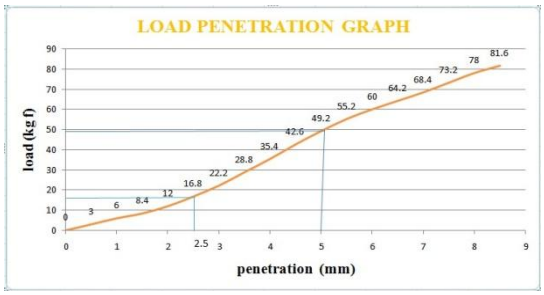


Fig-4 Load Penetration Graph at Lalaji Jn



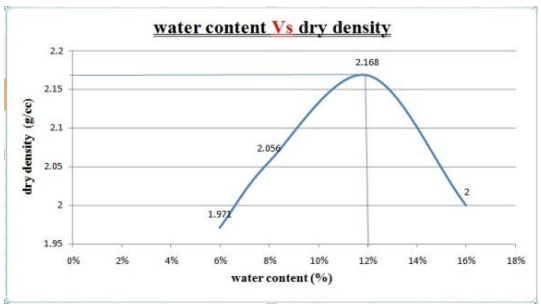


Fig-5 Load Penetration Graph at Puliman Jn

Therefore from the graph the CBR value for 2.5mm penetration and 5mm penetration is 1.185% and 1.92%, respectively.

2.2 Design Concept

Using the elastic properties the various pavement layers were designed using IRC method.

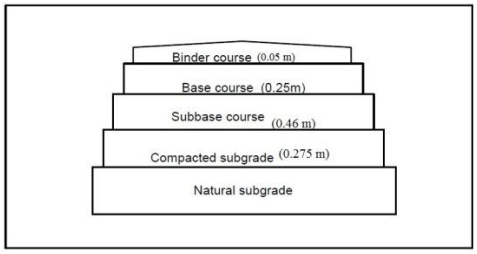


Fig-6 Designed Layers of Pavement

Extra width is provided at the curved section of the road, as there is a tendency to move away from the edge of the carriageway while driving on a curve and also additional width is required for a vehicle taking a horizontal curve. So provide an extra widening of 0.9 m at horizontal curve at Lalaji junction. cambers of slope 2 to 3% are provided. On straight sections of roads, shoulders are provided with higher cross fall than that of the carriageway by 0.5%. Composite camber of 2%-3% is provided.

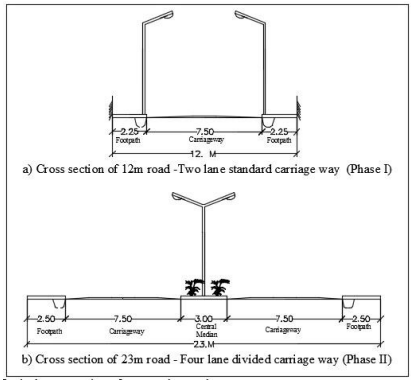


Fig-6 Comparison of Existing and Designed Pavement

2Km road stretch was designed from Lalaji Junction to Puliman Junction having a width of 23m.

4. Conclusions

Based on detailed studies, data pertaining to traffic and transportation system for Karunagappally town has been compiled. The base line data contains traffic volume and utilization on major roads, calculation of passenger car unit at each junction. Traffic on main junctions has been carried out for various horizon periods considering the growth potentials of the study area. The NH road stretch, where KSRTC station is located, faces acute traffic congestion because of movements of buses to and from the KSRTC station, parking of large of vehicles on the road side and pedestrian criss-cross movements. Civil station junction and High school junctions are the other problematic locations in the NH road corridor. The Sasthamkotta road also faces traffic congestion due to presence of market and the inadequate road width. On comparing with previous year data the increase in traffic volume can be analyzed and need of increase in road space shows its relevance.

To provide enough road space a flyover or road widening can be adopted. As a road widening project is more cost effective than a flyover, it is more suitable for solving traffic problems at Karunagappally. Based on traffic projection, a long term Transportation Development Plan has been formulated integrating road, rail, and water transport system.

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