ANNUAL REPORT

2018- '19

natpac
KSCSTE - NATPAC

के एस सी एस टी इ – राष्ट्रीय परिवहन योजना एवं अनुसंधान केंद्र

KSCSTE - NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE

കെ എസ് സി എസ് ടി ഇ – ദേശീയ ഗതാഗത ആസൂത്രണ ഗവേഷണ കേന്ദ്രം

(An Institution of Kerala State Council for Science, Technology and Environment)

K. Karunakaran Transpark, Akkulam, Thuruvikkal P.O, Thiruvananthapuram - 695011

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(An Institution of Kerala State Council for Science, Technology and Environment)
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From Director's Desk.....

As the Director of NATPAC it gives me immense pleasure to share with you that this Centre is among the frontrunners and a leading R&D Centre in the field of Traffic and Transportation. The achievements of NATPAC for the period 2018-19 are briefly outlined in this Report.

NATPAC is in the process of developing a traffic growth rate model for the National Highways in Kerala. The Centre is in the process of creating a Road Asset Management System (RAM) for selected network of roads. Recommendations for guidelines on the infrastructural and operational aspects of public bus transport in Kerala especially the bus terminals and allied facilities were formulated by NATPAC. Regional transportation development plan for Ernakulam District in Kerala were prepared by NATPAC

Traffic and transportation improvement measures for Medical College Campus, Thiruvananthapuram was formulated by NATPAC. At the instance of Lulu, the Centre carried out traffic impact studies to address the likely traffic problems due to construction of Lulu Mall by the side of the Mini Bypass near Smashanam Junction in Kozhikode City. The effect of vehicle type in the saturation flow at signalized intersections was observed by the Centre.

NATPAC is in the process of developing a rehabilitation design methodology for the rural roads in Kerala, based on the obtained Dynamic Cone Penetrometer Test values and the laboratory results of pavement layer parameters.

NATPAC investigated the use of waste plastic materials in geotechnical applications and the effects of the shredded plastic fibers on shear strength of soil. A study for determining the optimum plastic content that could be added with different grades of bitumen to arrive at a bituminous mix was undertaken by the Centre. The damage caused by moisture content on various grades of bituminous mixes was studied thereby providing a better solution.

Availability of accurate road data is the most important element for the successful analysis and decision making process for research activities in general and for Geoinformatics analysis in particular. Geoinformatics technology was used by NATPAC to update the road network map for Ernakulam District in the state of Kerala. A study to develop a Web GIS based road crash information system using Geospatial tools for Kerala was undertaken by NATPAC. NATPAC aims to prepare road and traffic database for the roads in Kerala. The study can be further extended to prepare database pertaining to road accidents, pavement management system, Traveller/Tourist Information System etc. for the entire state.

NATPAC is in the process of implementing a safe system which would control the traffic signals so that the emergency services get priority and reach their destination without any delay in time.

At the instance of Public works Department (PWD), Kerala, NATPAC prepared junction improvement design, pavement design and signal design of Kunnamkulam junction. A project report on ring road development for Kunnamkulam town was also prepared by the Centre.

The main priority of our Traffic Safety Division is to reduce motor vehicle and pedestrian accidents through Road Safety Education Programmes. The Centre is continuously monitoring the crash scenario in Kerala by regularly undertaking on-the-spot investigation of accidents in the State and there by suggesting crash counter measures.

Water Transport is an inexpensive non-polluting and energy-efficient means of Transport. This will also give a boost to eco-tourism and commerce. NATPAC is in the process of assessing the accident and safety aspects related to Inland Waterways in Kerala. Creation of a GIS database for inland waterways in Kerala is being done by NATPAC.

The Library of NATPAC is a specialized one which caters not only to the scientific community of the institute but also extends its services to the scientists and research students of various research institutions and universities.

NATPAC is providing facilities to students for their project work and training. During the year several students from reputed academic institutions carried out their project work for B.Tech/M.Tech programmes.

The constant support and encouragement received from the Hon'ble Chief Minister of Kerala, Hon'ble Minister for Transport and Hon'ble Minister for Works are thankfully acknowledged. The continuous support obtained from the Executive Vice President of KSCSTE, Research Council and Management Committee of NATPAC has helped us to discharge our duties for the benefit of the Society. In conclusion, I want to thank the Staff in my Office, for their continued commitment and hard work.

DIRECTOR

SUMMARY OF PROJECTS

1. Development of Traffic Growth Rate Model for National Highways in Kerala

As the rapid growth in the national economy boost the transportation demands, the importance of traffic demand prediction has significantly increased. This in turn helps for providing proper engineering design, evaluation of the economic and financial viability of transport facilities and planning. Accordingly, NATPAC is developing a traffic growth rate model for the National Highways in Kerala as part of the Centre's Research Study.

Tasks carried out

- Establishment of volume count stations;
- Estimation of Average Daily Traffic (ADT) & Annual Average Daily Traffic (AADT) (in terms of total vehicles, total PCU) on the project road;
- Determining the hourly, daily variation and directional split of existing traffic;
- Study of the traffic composition of both passenger and commercial vehicles;
- Establishing relationships between the collected data and socio economic indicators;
- Development of a hybrid model for traffic growth rate.

Methodology

The methodology adopted for the study consisted of periodic data collection at selected locations on the road network to evaluate the existing traffic pattern. The secondary data collected includes vehicle registration data of selected districts, population growth, population density, per capita income, Gross State Domestic Product/Net State Domestic Product etc. The data collected through primary and secondary data collection were analysed under two domains: traffic data analysis and socio-economic data analysis. The various techniques available for developing a model for traffic growth rate were identified. A hybrid method i.e. a combination of Auto Regressive Integrated Moving Average (ARIMA) and Artificial Neural Network (ANN) is utilized for deriving a model for traffic growth rate for the NH in Kerala.

Data collection

Three locations situated in southern Kerala, middle Kerala and northern Kerala were selected for the primary data collection and four sets of 7 day-24 hour classified traffic volume data were collected from each of these locations twice in a year. The locations selected for the data collection are Kalluvathukkal in NH 47 (NH- 66) at Kollam district, Paliyekkara in NH 47

(NH 544) at Thrissur District and Mahe near Vadakara in NH 17(NH 66) at Kozhikode district. All the relevant secondary data were also collected.

Model Development

A hybrid model of ARIMA and Artificial Neural Network were developed by using traffic data collected and socio-economic parameters and the result obtained from the model were quite satisfactory.

2. Road Asset Management for National Highways and State Highways in Kerala

Road Asset Management (RAM) is the process of application of engineering, financial and management practices to optimize the level of service outcome in return for the most cost effective financial input. It offers a discipline for integrating asset data in a way that facilitates its use for decision-making. NATPAC is doing a study to create a Road Asset Management System for the selected network of roads in Kerala to achieve desired level of service with minimum financial cost.

Scope and Objectives

Scope of the work is limited to National Highways, State Highways and Major District Roads (MDR) in the selected district of Kerala. The following tasks are identified for arriving at the targeted objective:

- Identify all the road assets along the study area;
- Detailed inventory of the study roads;
- Collection of baseline data and secondary data;
- Identify the major issues related to the road assets;
- Preparation of baseline report for the study area;
- Creation of a database system that integrates all assets;
- Suggesting appropriate solutions to the identified problems of road assets.

Methodology

The study network consisted of one national highway, three state highways and two MDRs in Thrissur district with a total length of 165 km. Based on Pavement Condition Index, Roughness

and traffic volume, a total of 28 homogeneous sections were identified in the road network. Test sections were demarcated in the homogeneous sections and structural and functional performance evaluation was carried out in each control section. The structural performance of all test sections was measured using Benkelman Beam Deflection technique. To obtain the performance rating of the sections, the Pavement Condition Index (PCI) and International Rough Index (IRI) value of the control sections were compared with the standard values as per the prevailing codes of practice.

The collected data is properly tabulated and stored for further analysis. Soil samples were collected from all the control sections for sub soil investigation. The properties such as, Atterberg limits, gradation of soil, optimum moisture content and California Bearing Ratio (CBR value) are determined through lab tests.

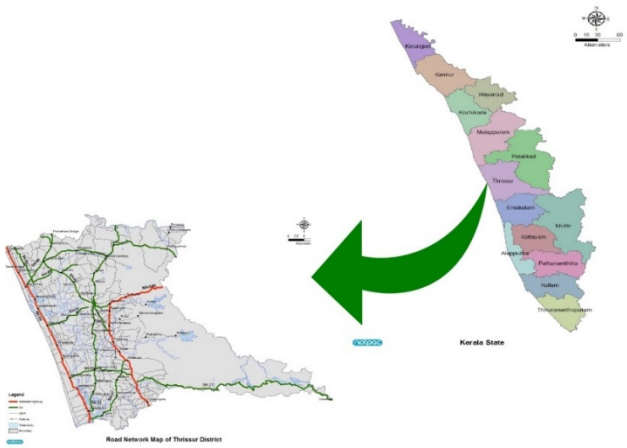


Figure 1: Road Network Map of Thrissur District

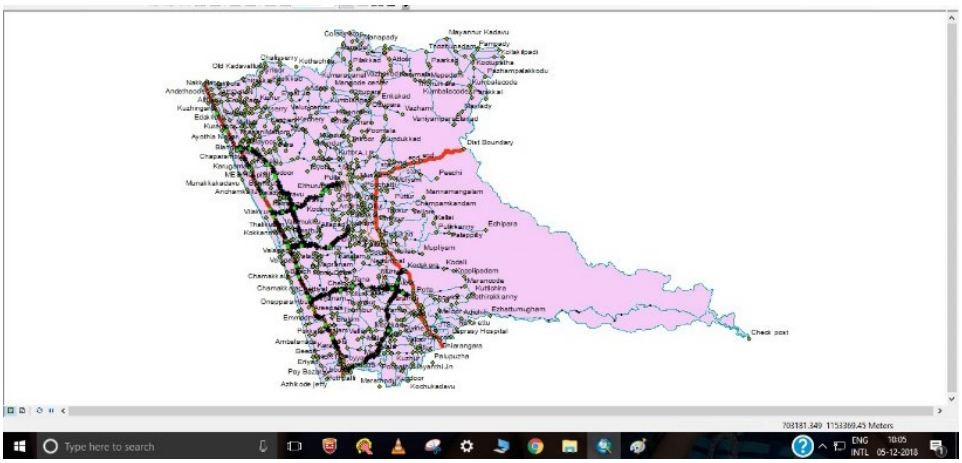


Figure 2: Digitalized Road Network

Interim Conclusions

By comparing the PCI value of sections in 2018 and 2019, it is observed that the rating of most of the sections falls to the next lower level. But some sections shows rise in their rating when

compared the PCI value in 2018. This may be because of the recent improvements in surface layers. When comparing the IRI value, the rating of most of the test sections remains the same.

3. Integrated Designs for Public Transit Terminals in Urban Areas

Buses are the predominant mode of motorized public transport in Kerala. All bus systems combined carry much more passengers than any other mass transit systems. Buses, bus stops, bus terminals and depots are the critical infrastructure components of a bus-based transit system. A well-functioning and sustainable city cannot be achieved without strengthening its public transport system. Infrastructure plays a vital role in the operation of an efficient, convenient and safe transit system. Hence there is a strong need to upgrade the infrastructure and facilities of these spaces into hubs which meet the requirements of both facility users and bus operators.

Scope and Objectives

The scope of the study is limited to the public bus transport scenario of the state of Kerala.

Objectives:

- To conduct surveys to study the arrival and departure rates of buses in service at bus stands;
- To estimate the bus bay requirements for designing the bus stand layouts;
- To evaluate the present levels of integration between Kochi metro rail and bus stands;
- To recommend for facility enhancement measures to integrate the bus stand/terminal with other mass transit facilities;
- To prepare typical design layouts for bus stand/terminal facilities delivering to different capacities with appreciable level of service.

Data Collection and Analysis

The study areas selected are the terminals/depots in the District of Kochi and the KSRTC depots in the urban areas of Thiruvananthapuram.

Bus trip survey, inventory survey and questionnaire surveys of both crew and passengers in the bus stand were conducted. A five-point rating was given for various facility characteristics of the bus stand survey with 5 being very good and 0 being very poor. The performance index for the bus terminals/depots under study are estimated and categorized under the location - Semi urban

and Urban locations. With a view of integrating the bus stands with metro so as to improve the ridership of metro, the questionnaire included queries to estimate a 5 scale rating based on the main reasons for not using metro.

Summary and Results

Table 1: Performance Index (PI) Estimated

Location	Name of Bus Terminal/depot	PI Value
Semi Urban	Thripunithura	1.05
	VikasBhavan	1.65
	Peroorkada	1.60
	Pappanamcode	0.80
Urban	Vytila Mobility hub	2.62
	Ernakulam KSRTC stand	0.995
	Aluva private bus stand	1.075
	Kaloor private bus stand	1.055
	Angamaly KSRTC	1.20
	Perumbavoor Pvt	1.17
	Perumbavoor KSRTC	1.54
	Aluva KSRTC	1.68
	East fort KSRTc	1.53

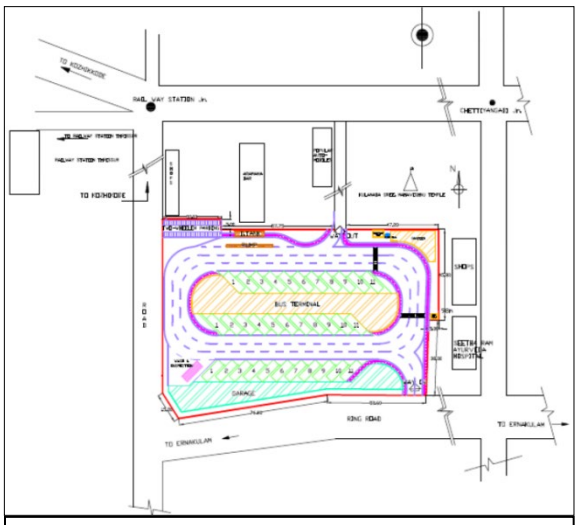
Table 2: Summary of Bus Bay Requirements

Location	Name of Bus Terminal/depot	Peak hour bus trips	No of bus trips in peak hour	No of bus bays required
Semi Urban	Thripunithura	7:30 to 8:30	94	17
	VikasBhavan	12:00 to 13:00	19	4
	Peroorkada	12:30to 13:30	22	4
	Pappanamcode	8:30 to 9:30	59	11
Urban	Vytila Hub	10:30 to 11:30	161	23
	Ernakulam KSRTC	12:00 to 13:00	54	15
	Aluva private bus	9:30 to 10:30	130	23
	Angamaly KSRTC	9:30 to 10:30	86	16
	Perumbavoor Pvt	11:30 to 12:30	56	10
	Perumbavoor KSRTC	11:30 to 12:30	55	10
	Aluva KSRTC	10:30 to 11:30	96	17
	East fort KSRTC	8:00 to 9:00	217	23

Questionnaire survey for determining the proportion of passenger's willingness to shift to metro was carried out. Main reasons for not using metro were sorted out and passenger's opinion on shifting to metro with better conditions was analyzed. Increased accessibility, improved connectivity of metro, integration of bus and metro, reduction in travel cost, introduction of feeder and ATIS, increased parking facility etc were found to be the major factors affecting the willingness to shift.

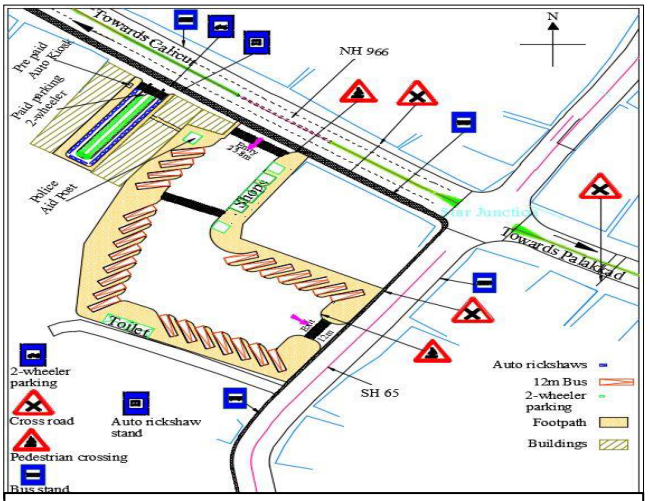
Layout Design

Typical layout designs for a well-equipped public bus stand/terminal are prepared for reference by user agencies which incorporate all the recommended facility components.



Typical layout design of Thrissur KSRTC bus stand

Figure 3



Typical layout design of Kondotty bus stand

Figure 4

The findings of the study led to the formulation of recommendations for guidelines on the infrastructural and operational aspects of public bus transport in Kerala especially the bus terminals and allied facilities. This will finally bring out a broad set of principles or guidelines that can help the stakeholders in addressing public transport policy matters and investment priorities and also serve as a basis of guidelines for reference in related affairs of infrastructure development.

4. Regional Transportation Development Plan for Ernakulam District in Kerala

Ernakulam district is situated on the coast of the Arabian Sea, almost at the middle of Kerala State. As per Census 2011, the total population of Ernakulam District is 3,282,388 covering an area of 3063 sq.km. with a population density of 1072 per sq.km.

Objectives

- To assess the existing road network and to identify the traffic bottlenecks of the region;
- To study the capacity utilization of road network in order to assess the extent of shortfall of the road system;
- To assess the speed and delay characteristics along the identified corridors;
- To assess the existing public transport operations;
- To develop Regional Transportation Indices;
- To formulate transport development proposals.

Methodology

Data required for the study were collected from various secondary and primary sources. Secondary data sources included Census 2011, Census 2001, Census 1991, accident details in the District from 2013 to 2018 from State Crime Records Bureau and Kochi Metro passenger ridership details from Kochi Metro Rail Limited (KMRL).

Primary surveys conducted for the study include Household Survey, Link Volume Survey, Speed and Delay Survey, Public Transport Passenger Opinion Survey and road inventory survey. The present transport scenario in the District was analyzed and major factors affecting the transport sector were identified. Regional Transport Indices were developed for the District based on the major factors identified. From the indices that were developed, deficiencies in road network and major travel corridors of the District were identified. A Transport Development Plan was prepared for the District in order to solve the identified issues associated with transport sector.

Data Analysis

It was observed from the analysis that the road stretches - road section of NH-66 between Kundannoor Junction and Aroor Junction, road stretch of NH-544 between Angamaly and Karukutty, road stretch of NH 66 between North Paravoor and Moothakunnam Junction, road stretch of SH 15 between South Paravoor and Poothotta and the road section of SH 8 between Vazhakkulam and Vengalloor were utilized more than their handling capacity. Speed characteristics and public transport characteristics were also studied.

Transport Related Indices

Five transport related indices were developed for Ernakulam District, namely Education Accessibility Index, Medical Accessibility Index, Road Safety Index, Road Network Accessibility Index and Transport Potential Index.

Regional Transport Development Plan

The mobility goals for Kochi need to be addressed through a multipronged approach. A Regional transport development plan was prepared for the District by considering eight strategies, namely, Land use and transport strategy, Development of Mobility Corridors, Public Transit Improvement Strategy, Non-Motorized Transport Strategy, Freight Management Strategy,

Traffic Engineering Measures, Travel Demand Management Strategy and Technological Strategy.

Ring radial network, Multi modal transit concept and Non-Motorized transport plan were considered in the Regional Transport Development Plan. Public Transport Plan included route rationalization and connecting Fort Kochi to the main land using transit lines. Traffic engineering and management measures included junction improvements, development of traffic management centres and parking policy.

Considering more number of criteria or parameters for development of indices can improve the performance of the indices developed in this study. This approach can be considered as an initial stepping-stone towards developing transport related indices for all the Districts in Kerala.

5. Development of Ring Road for Kunnamkulam Town

Kunnamkulam junction, the central point of Kunnamkulam municipal town is the intersection point of two major roads namely; Chavakkad – Vadakkanchery road (SH 50) and Thrissur - Kuttippuram road (SH 69). It is a four- arm busy intersection handling considerable through and turning movements of traffic. Congestion in vehicular movements at this junction affects the entire road system surrounding the junction. As there are limitations in the scope for road widening, development of ring road around the city is expected to reduce the pressure on the urban streets of the town.

At the instance of Public works Department (PWD), Kerala, National Transportation planning and research centre undertook the task of preparing a project report on ring road development for Kunnamkulam town.

Data Collection and Analysis

From the traffic studies conducted, it was evident that there is a significant percentage of traffic which can be diverted from town centre of Kunnamkulam through the existing peripheral roads. And these exterior but adjacent roads could be selected as the connecting links to form a closed loop for a ring road development for Kunnamkulam town. The total length of the proposed ring road for Kunnamkulam town is about 6.2 km.

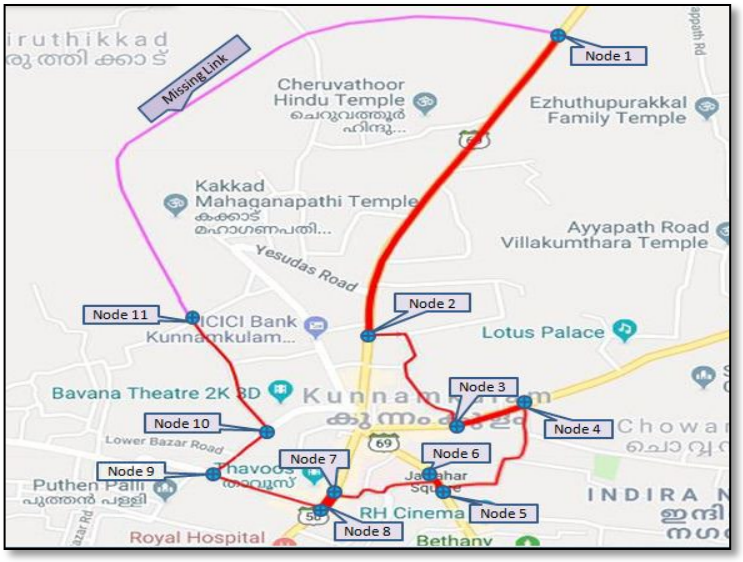


Figure 5: Map showing the alignment of proposed ring road of Kunnamkulam town

Summary and Conclusions

The ring road development is proposed with a ROW of 19.5m for the State Highways, 11m for the different road reaches located in built up area of the town connecting the Highways and either 12m or 25m for the missing link. Two alternatives were suggested for the cross section of missing link which passes through the existing wetland area. The width of the SH stretches in the proposed ring road should be raised to standard cross section. The proposed ring road passes along an alignment in close periphery of the town and is designed making use of the existing road reaches to the maximum extent possible to save the cost incurred in development.

It is recommended to upgrade the existing roads to form the connecting reaches of the ring with minimal land acquisitions to cater for the future traffic. The design drawings are prepared for the entire stretch of the ring road. The suggested option of model corridor illustrated with schematic drawing is also prepared. The land acquisition required for the project road and the earthwork estimates were worked out. The proposed ring road is expected to divert the through traffic from the local traffic thereby relieving congestion of the urban centre.

6. Geometric Improvement of Kunnamkulam Junction

Kunnamkulam, situated in the Thrissur District is one of the major junction where two state highways, SH 50 and SH 69 intersect. At the instance of Public Works Department (PWD),

Kerala, National Transportation Planning and Research Centre undertook the tasks of junction improvement design, pavement design and signal design of Kunnamkulam junction.

Objectives

The specific objectives of the study are:

- Preparation of junction improvement design for Kunnamkulam;
- Pavement design for Kunnamkulam junction and development of recommendations towards a rehabilitation strategy;
- Traffic signal design for Kunnamkulam Junction.

Data Collection and Analysis

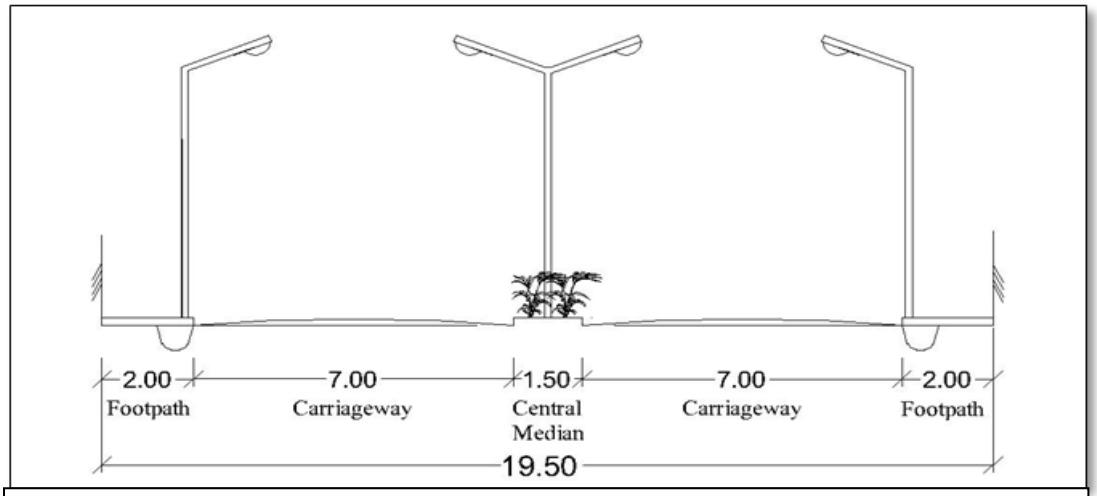
The major surveys carried out for data collection includes detailed reconnaissance and road inventory surveys along the project site, detailed topographical surveys, traffic volume count surveys, detailed pavement condition survey, investigation of pavement subgrade soil and pavement layer details and pavement structural evaluation by Benkelman beam deflection surveys.

Intersection design is carried out as per the guidelines in IRC:SP:41-1994. Kunnamkulam junction is designed as per the detailed warrants for signalised intersection as laid down in IRC:93-1985. It is seen that 62,869 vehicles are passing through the junction among which 8,172 numbers are commercial vehicles.

Summary

The existing roadways in Kunnamkulam have to be widened especially at the corner curves of the intersection for the smooth flow of the traffic. Four lane carriageways with a central median of 1.5m width are proposed for all the arms at the intersection. Paved footpath of 2m width with segregation by railings is proposed to be provided over covered drains. Channelising island is provided on all the arms to allow for the free left movements. An additional two lane roadway is provided to facilitate the continuous and free left turning manoeuvre of traffic exiting from Pattambi arm and destined towards Vadakkancheri direction. The islands and roadside footpaths are interconnected with zebra crossings to facilitate the safe pedestrian movement at this busy

intersection. The bi-directional traffic flow is segregated with continuous median and opening is to be provided wherever required.



Typical cross section proposed for the intersection

Figure 6

Land acquisition and widening of RoW has been suggested wherever the space constraints are detrimental to the safe movement of vehicles due to reasons like sight obstruction and lack of adequate lateral clearance. All the right turn movements from the Vadakkanchery arm have been prohibited by providing a wide area channelizing island. As Kunnamkulam junction is a rich pedestrian transit point because of the utilities present there, paved footpaths with railings are suggested on either side of the roads/ intersecting arms for safe pedestrian movement. In order to facilitate the safe pedestrian movement, zebra crossings are to be provided connecting the islands and footpath. A 50 mm thick overlay is suggested over the existing pavement based on the deflection and layer details collected from the field. Also new pavement is suggested for the development of bell mouths, if any.

7. Traffic Studies and Parking Management for Medical College Campus, Thiruvananthapuram

National Transportation Planning and Research Centre (NATPAC) undertook the task of traffic and transportation improvement measures for Medical College Campus, Thiruvananthapuram.

Objectives

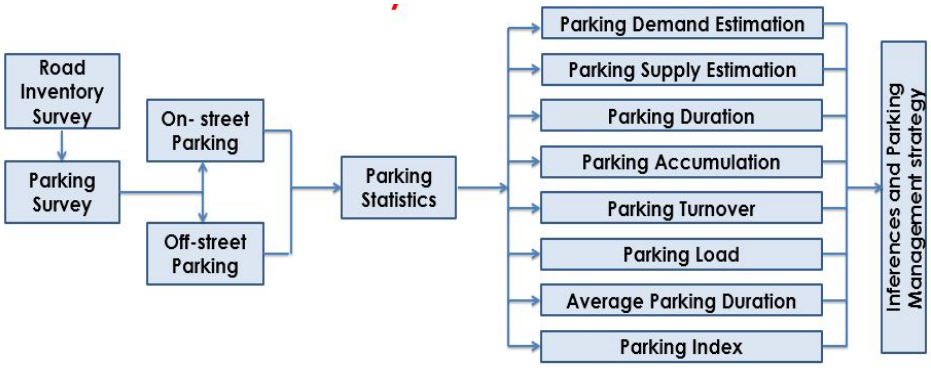
The main objectives of the study were:

- To assess the parking demand and supply characteristics in the Medical College campus as well as the internal roads and to estimate the gap between demand and supply;
- To work out the parking statistics to evaluate the adequacy of parking facilities for meeting the parking demand;
- To identify the appropriate locations for on-street and off-street parking lots;
- To recommend best parking management strategies based on short and long term measures.

Data Collection and Analysis

Road Inventory surveys were conducted to collect the potential of existing facility in terms of available space, road characteristics, type of parking etc. As per IRC, the standard dimension of vehicles for e.g. parking space for a car is taken as 5x2.5 meters, and this was suitably applied on the area to arrive at the existing supply of parking spaces.

Methodology

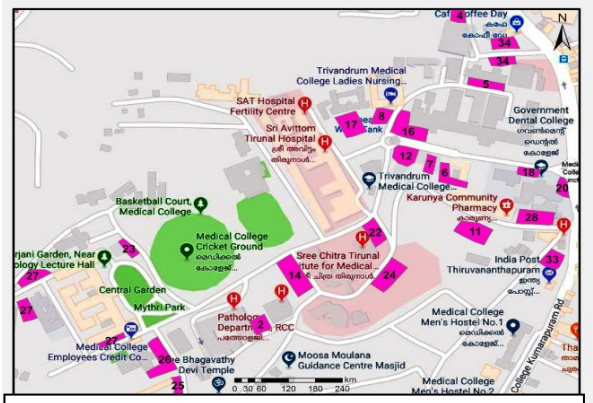


The traffic studies including volume count, general inventory and parking surveys were conducted at the Medical College campus. 34 parking locations including both on street and off street parking, were surveyed. The license plate method of survey was used. Both on-street parking and off-street parking facilities were evaluated.

Summary and Results

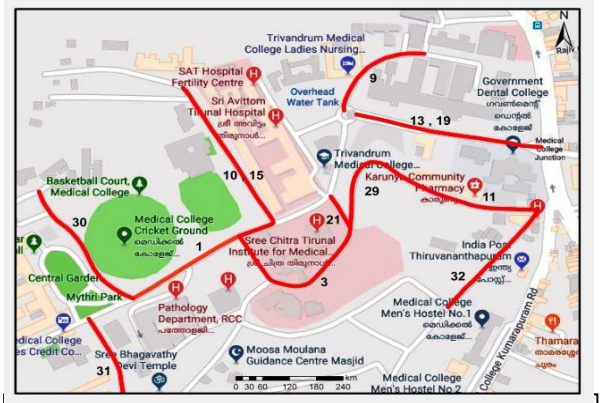
- Average parking duration observed for 70% vehicles is less than 60 minutes;
- Majority of parking spaces are occupied by car and heavy car parking were observed between Sree Avittam Tirunal (SAT) – Child Development Center (CDC) stretch and near SAT round;

- Percentage of three wheeler parking is minimum within the campus. It contributes about 17 -19 % of total parking and observed between New OP to Sree Chitra Tirunal Institute for Medical Sciences and Technology (SCT) second gate;
- Parking Duration indicate total vehicle parked within the campus, which is found to be 5,424 veh-hr;
- Peak hour parking demand for most locations was between 10.00 AM to 12 Noon during OP hours.



Map showing Off street parking locations at Medical College

Figure 7

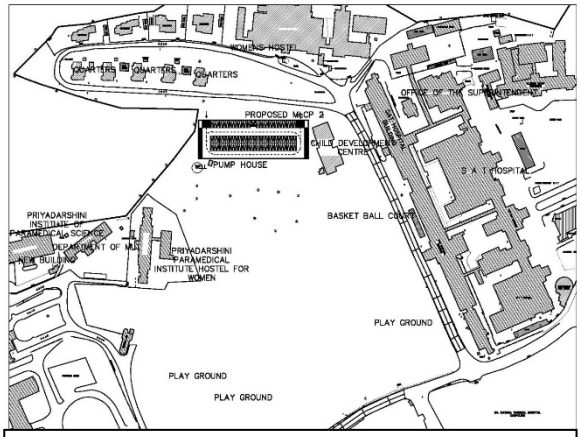


Map showing On street parking locations at Medical College

Figure 8

Application of ITS in Parking Management

Figure 9



Typical Layout of Multi Level Car Parking near OP Building

Figure 10

Parking Management Strategies

Two stage management: - Short term and long term measures

- Short term measures include installation of traffic signs as per IRC guide lines and erection of cameras to check violation of traffic rules
- Long term measures include Multilevel Car Parking, ITS based parking management and advanced parking management system.

Demand assessment studies reveals that Medical College campus has a parking demand of 2,037 Equivalent Car Space (ECS) but supply is only 400 ECS. Remaining demand is currently met by haphazard and unauthorised parking. Short term measures suggested includes demarcating parking lots at on and off street parking locations, sign boards and street light installation. Long term measures include Multi Level Car Parking (MLCP) at two demarcated locations with automation or ramp facility.

8. Assessment of Annual Potential Collection at Proposed Toll Plaza at Ponnarimangalam on NH 966-A

The Office of the Project Director, NHAI Kochi entrusted NATPAC to carry out traffic surveys to assess the annual toll collection potential at the proposed toll plaza at Ponnarimangalam, Ernakulam district.

Data Collection

- Classified volume counts of tollable vehicles at Ponnarimangalam for seven days;
- Previous O-D survey details of tollable vehicles passing through the proposed toll plaza and the frequency of trip for a normal day;
- Sale details of petroleum products from retail outlet in the influence area of the project was taken from previous study;
- Particulars like number of working days, holidays, and hartal/ strike and disturbed days in a year;
- Fee particulars for various categories of vehicle from NHAI.

Estimation of tollable traffic with different toll tickets

To assess the number of tollable vehicles with the type of toll ticket likely to be used by them, a sample number of vehicle users passing through Ponnarimangalam were collected from previous OD survey to obtain the following information:

(i) Type of vehicle (Car/ LCV/ Truck/ Bus);

(ii) Registration number of vehicle;

(iii) Whether the trip maker resides within 20km;

(iv) Whether the trip is a regular daily trip and,

- If no, whether the trip is a one-way trip or a two-way trip with return on the same day.

Tollable volume of vehicles with different toll tickets were estimated for various categories of vehicles with inputs obtained from origin-destination survey (OD) discussed earlier. The following assumptions have been made for the estimation of tollable vehicles.

(i) All the vehicles making non-daily single trips are considered for one-way toll ticket;

(ii) All the vehicles making one non-daily return trip were considered for daily pass;

(iii) All vehicles making daily trips were considered for monthly pass. However, residents within a distance of 20km from the toll plaza were considered as local personal traffic with concessional monthly pass;

(iv) Commercial vehicles registered in Ernakulam district are considered as local vehicles for the consideration of concessional fee.

Toll rates fixed for various categories of vehicles were obtained from National Highway Authority of India, Kochi.

Estimation of annual toll collection

By multiplying the number of vehicles with the toll rate, annual potential collection of toll at Ponnarimangalam was estimated.

9. Traffic Impact Study for Proposed Lulu Complex at Mankavu on Mini Bypass in Kozhikode City

Lulu entrusted KSCSTE-NATPAC to prepare a traffic impact study to address the likely traffic problems due to construction of Lulu Mall by the side of the Mini Bypass near Smashanam Junction in Kozhikode City.

The only access to the development is through the Mini Bypass road passing in front of the site. There are three entry/ exit access points to/ from the proposed development. The circulation plan for the Mall is shown in **Figure 11.**

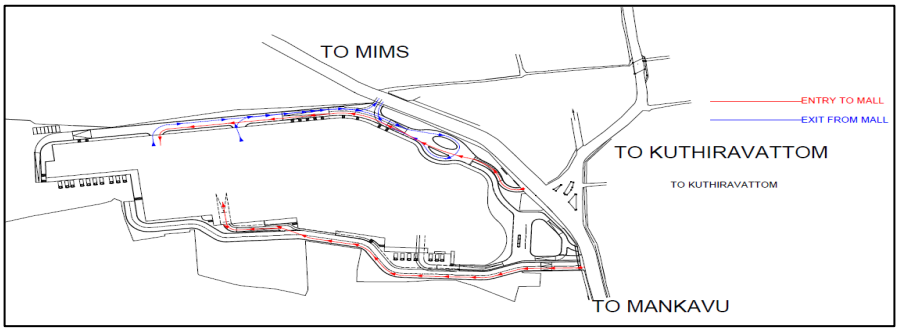


Figure 11: Circulation Plan for Mall

The total traffic generation estimated for the entire development is given in **Table 3.**

Table 3: Estimated Peak hour Traffic Generated by Lulu Complex Kozhikode

Time	Car/Taxi	Auto	TW	Trucks	Goods Auto	Total Vehicles	Total PCU
Weekday AM							
In	170	44	124	2	2	341	314
Out	77	34	44	2	6	163	159
TOTAL	**247**	**78**	**168**	**4**	**8**	**504**	**473**
Weekday PM							
In	138	25	84	2	1	250	233
Out	113	25	36	1	1	176	170
TOTAL	**251**	**50**	**120**	**3**	**2**	**427**	**403**
Weekend AM							
In	237	66	186	2	3	494	454
Out	99	52	65	3	9	227	221
Total	**336**	**118**	**251**	**5**	**12**	**721**	**675**
Weekend PM							
In	189	38	126	2	2	357	331
Out	153	38	54	2	2	248	239
Total	**343**	**75**	**180**	**4**	**3**	**606**	**571**

Walk Trips Generated

The walk trips generated by LuLu Kozhikode are estimated by using the walk trip generation rates obtained from the survey at LuLu Ernakulam. The walk trip generation rates (in persons per sq m of built up area) are multiplied by the proposed built up area of LuLu Kozhikode to estimate the walk trips to/ from this development. The walk trips estimated for LuLu Kozhikode is given in **Table 4**. Walk trips in weekend is estimated by applying an appreciation factor of 10% to the weekday walk trips.

Table 4: Walk trips estimated for LuLu Mall Kozhikode

Time	In	Out	Total	In	Out	Total
	Weekday			Weekend		
10.00 - 11.00	359	107	467	395	118	513
11.00 - 12.00	322	176	498	354	194	548
12.00 - 13.00	332	222	554	365	245	610
13.00 - 14.00	289	266	555	318	293	611
14.00 - 15.00	388	409	797	427	450	877
15.00 - 16.00	254	487	741	279	536	815
16.00 - 17.00	350	523	873	385	575	960
17.00 - 18.00	322	568	890	355	625	979
18.00 - 19.00	474	718	1,192	522	790	1,312
19.00 - 20.00	388	795	1,183	426	875	1,301
TOTAL	3,478	4,272	7,750	3,826	4,699	8,525

Future Background Traffic

The Future Background Traffic would consist of the base year background traffic applied with appropriate annual growth rate.

Growth Rate

The background traffic plying on the bypass road is expected to increase at an annual growth rate of 5%. The weekend traffic is considered as 75% of the weekday traffic. The estimated peak hour future background traffic is given in **Table 5.**

Table 5: Peak Hour Future Background Traffic in 2022-23

Peak period	Mankavu side	MIMS side	Kuthiravattom side	Total	
				Vehicles	PCUs
Weekday AM	2597	1380	823	4555	4800
Weekday PM	2648	1407	839	4720	4894
Weekend AM	1948	1035	617	3417	3600
Weekend PM	1986	1055	629	3540	3670

Assignment of Development Traffic

The directional distribution of development traffic is assumed to be in the ratio of 54% from/to MIMS side, 35% from/to Mankavu side and the remaining11% from/ to Kuthiravattom side. This assumption is based on the city population residing on either side.

Design Traffic Flow

Link Volume on Mini Bypass

The design traffic flow in 2022-23 is obtained by the summation of development traffic and future background traffic. The design traffic is shown in **Table 6.**

Table 6: Peak Hour Design Traffic in 2022-23

Peak period	Mankavu side	MIMS side	Kuthiravattom side	Total	
				Vehicles	PCUs
Weekday AM	2763	1635	875	5059	5273
Weekday PM	2789	1624	883	5147	5297
Weekend AM	2184	1399	691	4138	4275
Weekend PM	2186	1363	692	4146	4241

Remedial Measures

Remedial measures for mitigating the adverse traffic impact of the proposed Mall consists of widening of roads, improving the geometry of the intersections in the influence area of the Mall, provision for public transport facilities, intermediate public transport and non-motorized modes of transport etc.

To help reduce traffic congestion, the concept plans for two options have been developed.

1. Signalization of Smashanam Junction with junction improvement
2. Signalization of Smashanam junction along with Flyover along Mini bypass.

Two options have been conceptualized based on the field conditions, traffic surveys and circulation plan to be adopted within the LuLu site. As all the accesses are coming in close proximity to one another and also dependent on the same road - mini bypass, it has made the situation complex to handle. The mini bypass itself is a congested road and the addition of traffic due to the LuLu complex on this road would add to the traffic woes and chaos unless proper remedial measures are undertaken. It is hoped that the options formulated will help to reduce the traffic issues likely to be faced in future.

10. Traffic Improvement Plan for Koyilandy Junction

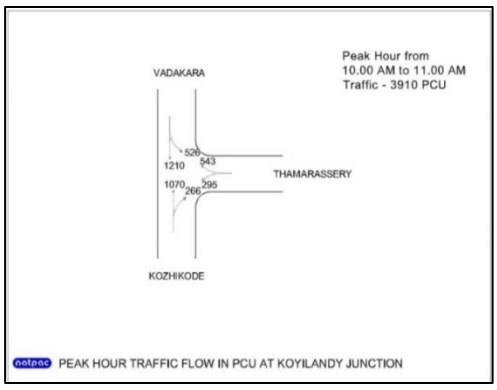
In order to ease the traffic congestion and related issues in Koyilandy junction area in NH 66, NATPAC was assigned with the task of preparation of improvement plan.

Koyilandy junction is a T-junction situated on NH 66 and is the intersection between NH 66 and SH 34 (Koyilandy-Edavanna road). Two-lane roads from Kozhikode, Vadakara and Thamarassery intersect at this junction. The junction is an unsignalised intersection and at times is controlled manually by police. Koyilandy old bus stand/bus bay is located very near to this junction, which is also highlighted by the presence of a number of commercial activities. Public transport buses going in and coming out from this bus bay, halting a minute on an average, inducts huge impact on the smooth flow of traffic in this junction. Due to the presence of commercial area and bus bay near to the junction, pedestrian movement is also very high in the premises. There is no proper pedestrian facility available in lateral as well as cross directions. As the commercial activities are taking place in this junction, the vehicles are often parked on the road side which increases the congestion.

About 30 autorikshaws are parked at a time in the bus bay auto-stand, of which were facing towards Kozhikode direction and the rest facing Vadakara direction. A petrol pump is also situated adjacent to the old bus stand.

Data Collection and Analysis

It was observed that, in Koyilandy junction, maximum traffic flow occurred between 10.00 AM to 11.00 AM. About 3910 PCU of traffic were plying at this junction during the peak hour. The traffic flow from Vadakara to Kozhikode direction is higher, followed by



Kozhikode to Vadakara direction, while compared to other directions.

Formulation of Improvement Proposal

Considering the existing scenarios and traffic at the junction, improvement proposals are prepared for Koyilandy junction so as to smoothen the traffic flow. Two options were suggested.

Option I

It is proposed to widen the existing carriageway of NH 66 to four lane of width of 14 m with footpath of 2 m on either sides of the carriageway. The carriageway of SH 34 is proposed to be maintained as a two lane road and footpath of width 2 m is provided on either sides. The diameter of the central circular island of the proposed roundabout is 16 m. A circulating lane width of 8m is provided throughout the roundabout and it caters two lane traffic movements.

Option II

Some modifications have been introduced in Option I in consideration with the upcoming Municipal Shopping Complex adjacent to the old bus stand, which will have a huge impact on the traffic movement at Koyilandy town area once it becomes operational. In lieu of the reduced land availability, the diameter of the central island of the proposed roundabout is reduced to 15 m. The circulating lane width of 8m is provided throughout the roundabout so as to cater two lane traffic movements. The bus bay in the junction is proposed to be converted into a single lane bus bay with a width of 4 m.

Keeping in view of the present scenario and existing traffic characteristics, two improvement proposals for the Koyilandy junction has been prepared adhering to relevant IRC standards.

11. Traffic Safety Improvement Plan for Ottapalam Municipal Bus Stand

Joint Regional Transport Officer, Ottapalam requested NATPAC to conduct a study on Ottapalam Municipal Bus Stand, located in Palakkad-Shornur Road and to suggest remedial measures to improve safety inside the bus stand. On an average around 380 bus schedules are operated daily from this terminal.

Amenities around Bus Stand

The bus stand is surrounded by municipal shopping complex and some private buildings. An autorickshaw stand is there inside the bus stand and is located nearer to the exit. Both long route and short route buses have access to this bus stand. Long route buses are halted at the far end of the bus stand whereas short route buses are halted near to the entry. Presently there are no traffic calming measures provided inside the bus stand. Most of the buses do not use the bus bays for alighting the passengers. There is no regulation for the movement of buses inside the bus stand. Hence bus to bus and bus to passenger conflicts are considerable.

Plate 1: Autorickshaw Stand near exit of Bus Stand

Plate 2: Bus to Bus Conflict inside the Bus Stand

Plate 3: Pedestrian Zigzag movement inside the Bus Stand

Safety Improvement Proposals

After identifying the existing safety issues inside Ottapalam Municipal Bus Stand, two improvement proposals are recommended. It has been ensured that a segregated pedestrian walkway is possible so as to have a proper pedestrian circulation around the bus stand; that too with minimum vehicular conflict.

Proposal I

The major change proposed is the interchange of present bus exit and entry. The current entry for the buses has been converted to the exit and vice versa. Proper channelizers have been introduced to segregate the bus traffic and pedestrian traffic. A semi – circular traffic island is introduced between the entry and exit of the bus stand. An opening is proposed in this island for pedestrian passage. A footpath cum raised passenger shelter is proposed between the existing autorickshaw stand and bus stand. It is proposed that the long route buses should be halted in the bus bays near the proposed exit and short route buses should be halted at the far end of the bus stand.

Proposal II

In Proposal II, the existing entry and exit of the bus stand remains unchanged. A semi – circular traffic island is introduced between the entry and exit of the bus stand similarly as in Proposal I. A footpath cum raised passenger shelter is proposed between the existing autorickshaw stand and bus stand as per Proposal I.

Summary

Two proposals have been made to improve the traffic safety as well as the traffic flow in Ottappalam bus stand. Along with the proper circulation plan, traffic calming measures, road markings and suitable channelizers have also been incorporated to obtain a safer movement for both the pedestrians and vehicles.

12. Influence of Vehicle type on Saturation Flow Rate at Signalized Intersection

Saturation flow rate (s) for a lane group is the maximum number of vehicles from that lane group that can pass through the intersection during one hour of continuous green under the prevailing traffic and roadway conditions. The saturation flow is used as the basis for the determination of traffic signal timing and evaluation of intersection performance. NATPAC observed the effect of vehicle type in the saturation flow at signalized intersections.

The major steps involved in the study are:

(i) Collection of data including intersection geometric details, signal cycle details, approach volume data and measured saturation flow;

(ii) Calculation of measured saturation flow using the Indo HCM model. Also, the correlation between the measured saturation flow and type of vehicle and approach volume is calculated;

(iii) A liner regression relationship is formulated for the effect of each vehicle type on the saturation flow;

(iv) Estimation of capacity against category of vehicles to find out variation in capacity with respect to category of vehicles;

(v) Development of model for proportion of two-wheelers and auto with approach width and volume with various scenarios.

Study Area

Vettu road intersection is three-legged intersection at Thiruvananthapuram **(Figure 12)** is selected as the study location. The surface condition of the road was good during the time of study, hence good platoon speed is observed. The highest traffic flow is observed from Kollam towards Thiruvananthapuram.

Figure 12: Vettu Road Intersection Layout

Results and Discussion

(i) The analysis of saturation flow for various approaches shows that it is not just based on the approach width;

(ii) From the correlation coefficient computed between saturation flow and type of vehicles, it is observed that the highest correlation of 0.94 is observed with auto, and the correlation of other category vehicles also found to be above 0.8 which clearly shows that saturation flow is very sensitive to all category of vehicles in this intersection;

(iii) The effect of auto on saturation flow is found to be strong as compared with other type of vehicles. The result shows that the higher the percentage of auto at an approach, the higher the saturation flow with a regression coefficient of 0.893 indicating that 89% of all the variation in the saturation flow rate could be explained by the model parameters;

(iv) Linear regression model is formulated for proportion of two-wheelers and auto with approach width and volume with various scenarios.

13. Development of Pavement Rehabilitation Design Method for Rural Roads Using Dynamic Cone Penetrometer Test

Dynamic Cone Penetrometer Test (DCPT) is the most versatile, rapid evaluation method currently available for use in determining subgrade properties and is the best suited alternative method for California Bearing Ratio (CBR) test. It is a Non-Destructive testing method for evaluation of the structural strength of pavement layers. Adopting DCPT method can reduce efforts and cost for evaluation of pavement and subgrade soils. NATPAC is developing a rehabilitation design methodology for the rural roads in Kerala, based on the obtained DCPT values and the laboratory results of pavement layer parameters.

Need for the Study

The increasing demand for ensuring the desired level of serviceability of road infrastructure facilities emphasize the need for addressing road maintenance and rehabilitation problems in the existing road network. The existing methods for structural evaluation of pavements are time consuming and demands significant effort. By adopting DCPT method, the strength of each layer of pavement can be obtained easily with less effort. NATPAC intends to do the rehabilitation study for the appraisal of the low volume roads in Kerala using DCPT values. Successful completion of this study will allow road construction engineers to assess pavement layer adequacy with a relatively quick, easy-to-perform test procedure and avoiding time-consuming testing.

Scope and Objectives

The scope of the study is confined to the development of rehabilitation design using DCPT results, layer parameters and traffic data. The study involved the following tasks:

- Evaluation of structural strength of pavement layers using DCPT;
- Assessment of pavement layer properties for which the DCP tests are performed;
- Conduct of traffic studies;
- Laboratory preparation of pavement layers for identifying the blows required for penetrating standard layers;
- Preparation of rehabilitation design curves based on DCPT values and traffic.

The study stretch includes selected low volume roads in Thiruvananthapuram and Alappuzha districts of Kerala.

Methodology

Methodology adopted for the study consisted of collection of baseline data, conducting laboratory tests for determination of soil properties and CBR values, traffic studies, structural evaluation of the pavements, functional evaluation of the pavements and preparation of rehabilitation design charts based on DCPT values and traffic characteristics.

Study Roads

- Village roads in Thiruvananthapuram district namely Adimalthura – Chowvara and Anjuthengu -Kadinamkulam.
- Low volume Roads in Thiruvananthapuram namely Koliyakode – Kuthirakulam, Kalingu jn – Pathekkar, Netajipuram – Puliveedu, Kaduvakuzhy – Alarakonam, Madavurpara – Temple jn, Chanthavila – Punnatunada, Melethonnakal – Sasthavattom, Parakkal – Kappikunnu, Mylakuzhi – Korandivila, Ambalamukku – Kottukunnu and Chitturkonam - chittazha roads.
- Village roads in Alappuzha Disrtict namely Payikulangara, Kidangara-Kannadi, Edathua-Champakulam, Champakulam-Poopalli, Kainakary – Poopally and Mankompu-Champakulam roads.

Interim Summary

Road inventory and condition survey of the roads were done for the structural and functional evaluation of the pavement. Traffic volume count was also conducted. The study area stretches were selected on the basis of geographical and traffic parameters.

Laboratory tests were conducted to find out the properties of pavement layers mainly gradation and specific gravity of the corresponding samples. The results obtained from these tests are quite satisfactory while comparing it with the data obtained from road condition. Overlay thickness design is done using DCP nomogram available in the literature. The obtained thickness is compared with the overlay thickness obtained from traditional CBR method/ BBD method. From the results it is found that, none of these methods are comparable.

Preparation of laboratory samples is under progress for conducting the DCP test for understanding the number of blows required for penetrating a layer prepared under standard conditions and also estimating the difference in number of blows/ depth of penetration in an inferior /superior pavement layer.

14. Evaluation of Warm Mix Asphalt Mixes with the addition of Reclaimed Asphalt Pavement

The recycled material such as reclaimed asphalt pavement (RAP) is being used in pavement construction which enhances economic savings and environmental benefits. The introduction of Warm Mix Asphalt (WMA) makes the pavement construction a lot more efficient, with both financial and environmental benefits. This technique allows the production and placement of asphalt mixtures at lower temperatures than the typical HMA temperatures. The objective of the study is to evaluate the addition of reclaimed asphalt pavement (RAP) in WMA and compare it to the conventional HMA with RAP.

Need for the Study

RAP is a valid alternative because it reduces the use of virgin aggregates and the amount of virgin asphalt binder required in the production of asphalt mixes. The use of RAP also conserves energy, lowers transportation costs required to obtain quality virgin aggregates, and preserves resources. Hence the use of RAP along with WMA techniques in asphalt pavements may lead to

economic savings and environmental benefits and needs investigation. This study also evaluates the performance of WMA mixes with varying amounts of recycled asphalt pavements (RAP).

Scope and Objectives

The scope of the study is limited to laboratory evaluation of two WMA technologies namely Sasobit and Evotherm by carrying out the Marshall method of mix design for Bituminous concrete mix of grading II.

The following were the objectives of this study:

- To study the performance of asphalt mixtures prepared with two WMA technologies, Evotherm and Sasobit in comparison with a control HMA mixture by conducting indirect tensile strength test, boil test and moisture susceptibility test;
- To study whether the WMA additives enable the production of high RAP content (upto 30%) mixtures with comparable performance to Hot Mix Asphalt (HMA) mixes;
- To predict the performance of pavements using the asphalt mixtures prepared in this study by the MEPDG software (KENPAVE) using the test data acquired from laboratory testing.

Progress of the work and interim findings

The VG 30 bitumen and aggregates were collected and characterised. Two warm mix additives Evotherm and Sasobit were obtained from their manufactures. Marshall method of mix design for HMA using VG 30 was carried out to obtain optimum binder content as 5.4% at 4% air voids. Warm mix additive - Evotherm and Sasobit, both at 1% and 1.5% were used to prepare WMA mixes at 5.4% Optimum Binder Content (OBC). The performance of HMA and WMA mixes were evaluated by carrying out indirect tensile strength and moisture susceptibility tests. Moisture susceptibility of the mixes was evaluated from retained Marshall stability, boil test and tensile strength ratio.

Based on the laboratory tests, the following conclusions were drawn.

- The indirect tensile strengths and Marshall stability increased with increase in percentage of warm mix additive for both types of the additives;
- The Marshall Stability and retained stability values showed slight reduction but the values were well above the specified values of 12 kN in MORTH;

- The ITSdry for the 1.5% Sasobit mix, 1.5% Evotherm mix and control HMA mix were 1133 kPa, 1045 kPa and 988 kPa respectively while the ITSwet values were 903 kPa, 875 kPa and and 905 kPa respectively against the recommended minimum values of 225 kPa and 100 kPa respectively for ITSdry and ITSwet mixes;
- The retained stability ratio and tensile strength ratio was lower for WMA mixes compared to HMA mix showing that they are more susceptible to moisture and may require hydrated lime to reduce the moisture susceptibility. But the stability ratio and Tensile Strength Ratio (TSR) were well within the acceptable range of 75% and 80% respectively.

From the laboratory tests it can be understood that the performance of WMA mixes with 1.5% of warm mix additive Sasobit was comparable to control HMA mix. Since the mixing and compacting temperature can be reduced by 30^{o} C in case of WMA mixes, their use instead of HMA mixes will lead to large reduction in emissions and savings in energy. Therefore, the use of WMA mix can be considered in Kerala where a huge amount of money and resources are spent for maintenance of the roadways.

Further laboratory investigations need to be conducted to study more dosages of WMA additives and also to see if they enable the production mixes of high RAP content (upto 30%) mixtures which are comparable to the performance of HMA mixes.

15. Influence of Randomly Distributed Shredded Waste Plastic on Shear Strength and Hydraulic Conductivity of Cohesive Soil

NATPAC investigated the use of waste plastic materials in geotechnical applications and to evaluate the effects of the shredded plastic fibers on shear strength of soil by carrying out direct shear tests, unconfined compression tests and triaxial shear tests on soil samples. The study also examined the effect of intrusion of shredded waste plastic on the hydraulic conductivity of the soil. The results obtained will be compared for the two samples and inferences will be drawn towards the usability of waste plastic as a stabilizer for soil. This is a solution to plastic waste disposal and can be cost effective as well as sustainable.

Need for the Study

Use of plastic products is increasing day by day. Using shredded plastic waste as a soil stabilizer is an economical and gainful utilization since there is scarcity of good quality soil for embankments and fills. As an alternative method of disposal of plastic waste, we can add shredded plastic to the soil which will help in the improvement of the shear strength of poor soil.

Objectives

The aim of the study is to find the feasibility of utilizing the shredded waste plastic in improving the properties of weak soil and to reduce the environmental effects caused due to their disposal. The objectives targeted are:

- To study the effectiveness of shredded plastic wastes in stabilizing soil;
- To arrive at an optimum size and amount of waste plastic which can improve the soil by conducting compaction and unconfined compression (UCC) test;
- To evaluate the effects of the shredded plastic fibres on shear strength of soil by carrying out direct shear tests or unconfined compression tests or triaxial shear test depending on the soil type and stress history;
- To examine the effect of the shredded plastic fibers on the hydraulic conductivity of soil.

Progress of the work and interim findings

The effect of inclusion of shredded waste plastic in soil samples were studied by conducting tests with 0.1% of shredded waste plastic in different sizes. Four types of soil were collected and characterized to obtain their index properties, compaction characteristics and soil classification. The waste plastic was shredded and segregated to obtain plastic of size 4.75 mm, 2.36 mm, 1.18 mm, 0.6 mm and less than 0.6 mm. For two different percentages of plastic namely 0.12% and 0.2%; modified Proctor compaction tests were carried out for soil-plastic mix with different plastic size to arrive at optimum moisture content (OMC) and maximum dry density (MDD). UCC test were also carried out at OMC and MDD for different soil-plastic mixes.

Based on laboratory tests, the following conclusions were drawn.

- It is very much clear that mixing of shredded waste plastic in soil can increase the strength of soil;

- The effect of shredded waste plastic on soil is influenced by various factors such as size of shredded waste plastic and percentage of plastic waste;
- Compaction parameters and unconfined compressive strength of the soil improved in different types of soil tested even though the trend varies with type of soil. In MH soils both compaction parameters and UCC improved when 0.6 mm sized shredded plastic waste were added whereas in SM and GM soils better results were obtained with 1.18 mm sized shredded plastic waste.

This method is much effective in stabilization and it can be used as an effective method in disposing of waste plastic materials to some extent. Further research including the hydraulic conductivity is advisable.

16. Performance Evaluation of Plastic-Coated Aggregates on Bituminous Mixes

Plastic is non-biodegradable and it remains in the environment for numerous years. The disposal of waste plastics in landfill is unsafe because during the degradation process toxic chemicals percolate into the earth reaching the underground water thereby polluting the waterbodies. Therefore, it necessitates finding methods to dispose waste plastic in an eco-friendly manner. NATPAC carried out a study about the optimum waste plastic that can be added to the different bituminous grades such as VG 10 and VG 30.

Scope and Objectives

The objective of the study is to determine the optimum plastic content that could be added with different grades of bitumen to arrive at a bituminous mix. The scope of the work is limited to the preparation of bituminous mixes using the Marshall Mix design method. The performance evaluation of bituminous mixes was determined by comparing the Marshall, Retained Marshall, Indirect Tensile Strength Wet and Indirect Tensile Strength Dry values.

Methodology

The methodology includes the collection of materials such as Aggregate, Binder and waste plastics. The characterization of the material properties was done as per the IS code. The aggregates were graded conforming the MoRTH specifications. The Optimum Binder Content for the Viscosity Grade 30 (VG 30) and VG 10 binder is determined. Determination of Optimum

Plastic Content (OPC) was done by blending shredded plastic in different bitumen grades (VG 30 and VG 10) and thereby conducting performance evaluation.

Results and Discussions

The performance of HMA waste plastic mixtures was evaluated by conducting laboratory studies. The mixes were prepared using VG 30 and VG 10 bitumen for different percentages of waste plastics (2%, 4%, 6%, 8%, and 12%).

Based on the laboratory tests, the following conclusions were drawn.

- The dry mix of waste plastic is the best approach and also it is to be ensured that the plastic should be mixed with coarse aggregate so that it will form a thin surface film and later fine aggregate shall be added. This practice helps to reduce the immiscibility of plastic in the mix;
- The addition of shredded plastic increases the performance of the mix;
- The stability value increases with an increase in plastic content to a maximum of 8% and starts a decline in further increase of plastic content;
- The use of waste plastic in the VG 30 mix shows better performance than the VG 10 mix;
- All the plastic percentage ranging from 4 to 12% satisfies the minimum stability criteria of 9kN in VG 30 mix. However, the stability criteria for the VG 10 mix is achieved only by adding 8% waste plastic;
- All the mixes fulfilled the minimum criteria for TSR of 75%;
- The use of 8% of waste plastic shows a slight increase in performance when compared to the conventional mixes of VG 30 and VG 10.

From the laboratory tests, it can be understood that the addition of waste plastic in the bituminous mix performs similarly or even better than a virgin mix. Hence, it may be suggested to use waste plastic while paving roads. 8% of shredded plastic by weight of bitumen can be used in VG 30 and VG 10 mixes. This will help in the safe disposal of plastic waste and also increases the pavement performance thereby reducing the cost of construction and making the construction eco-friendly. Therefore, the use of HMA-waste plastic mix can be considered in Kerala where a huge amount of waste plastic can be disposed of in an eco- friendly manner thereby saving our valuable Environment.

17. Macadam Design for LSGD Roads in Kasargod District

The village roads in Kasargod District come under the Local Self Government. Among these village roads 70 to 80% are constructed with Chipping Carpet pavement. Considering the load carrying capacity and the average life of chipping carpet pavement, the Local Self Government Department in Kasaragod district decided to upgrade the pavement with structural layers such as Bituminous Macadam (BM) and Bituminous Concrete (BC). They approached NATPAC for carrying out a detailed study to finalize the required thickness of the pavement.

Scope and Objectives

The scope of the study is limited to the pavement design of twelve number of LSGD roads having a total length of 52.41 km. The main objective of the study is to design the roads with a structural layer by considering the properties of the subgrade soil, existing layer thickness and traffic intensity. General recommendations regarding the modification of vertical profile based on visual inspection also form part of the study.

Methodology

A reconnaissance survey followed by inventory survey was carried out in all the stretches to identify the sample collection points and to fetch the pavement characteristics and condition. Soil samples for laboratory tests were collected from the identified locations and trial pits were taken for investigating the existing pavement layers. Traffic surveys were conducted in all the roads at selected locations for calculating the design traffic. Pavement Design was done based on IRC 37-2012 and MORTH 2013. The rehabilitation strategies of full reconstruction or overlay were decided by analyzing the present pavement layer thickness and the California Bearing Ratio (CBR) from laboratory tests. Overlay is recommended for the pavements if the existing pavement layers are found to have adequate thickness and are in a good condition.

Summary

In all the twelve study stretches inventory survey, traffic volume survey, trial pit investigations for measuring the pavement composition etc. were carried out. Soil samples were collected and tested in the laboratory. The pavement design was conducted at par with the guidelines IRC 37 -2012 and MORTH 2013 using the details obtained from the field. Overlay is

recommended for the pavements if the existing pavement layers are found to have adequate thickness and are in a good condition.

18. Evaluation of Moisture Susceptibility of Asphalt Mixtures

Moisture susceptibility is the loss of strength in bituminous mixtures due to the presence of excess moisture content. Moisture damage is a significant concern as it diminishes the performance and service life of pavement. This results in huge maintenance and rehabilitation cost to the agencies.

Need for Study

Moisture damage is one of the major criteria to be taken care while designing a pavement especially in regions with heavy rain fall. This study helps to understand the damage caused by moisture content on various grades of bituminous mixes thereby providing a better solution.

Scope and Objectives

- To understand the moisture susceptibility behaviour of bituminous mix;
- To study the variation of air voids by Marshall compaction effect;
- To study the performance of mix in terms of indirect tensile strength, tensile strength ratio and stability.

Experimental Methods

The aggregates procured from the quarry in Thiruvananthapuram and the asphalt grade VG 30 was tested for its physical properties. It was observed that the properties of both aggregates and asphalt are in accordance with MORTH specifications. The compacted samples were prepared for OBC 5.3% with varying compaction blows and the performance was tested for stability and indirect tensile strength.

Findings

The bulk density of the compacted mix was examined at four compaction levels and it was observed that as the compaction level decreases the density of the mix increases. The bulk density of the mix has a great impact on the compaction levels. The maximum dry density of the loose aggregates from the designed mix seems to be unchanged. This is due to the fact that the

compatibility of the asphalt mix does not have any cause on the maximum dry density. Stability of the design mix decreases as compaction level decreases in the case of two conditioning processes. The maximum stability was observed for the sample compacted with blow of 75 numbers per face. All the asphalt mix with the compaction blow of 75 on each face satisfy the minimum amount of 80% Tensile Strength Ratio (TSR); rather the mix with low compaction level does not satisfy the tensile strength ratio and the stability ratio varies from 75% to 82%.

19. Utilization of Geoinformatics Tools for Development of Comprehensive Road Network for Kerala State

Availability of accurate road data is the most important element for the successful analysis and decision making process for research activities in general and for Geoinformatics analysis in particular. Geographical Information System (GIS), Remote Sensing (RS) and Global Positioning System (GPS) are the three pillars in Geoinformatics technology. GIS distinguishes itself from the other two technologies in that it enables data from diverse sources to be integrated, analyzed and even modelled owing to its powerful analytical functionality. NATPAC intended to use the Geoinformatics technology to update the road network map for Ernakulam district in the state of Kerala.

Scope and Objectives

- To collect the road network map available with various Government and non-Government organizations and bring them to common platform using GIS software;
- Generate road network map using online resources;
- Conduct field surveys to locate and mark the missing road network in the study area using remote sensing and GPS technique;
- Prepare a database for the entire district which can be shared with various user agencies.

Study Area

Ernakulam district lies between 9° 46'42"N and 10° 18'3"N north latitude and 76°9'50"E and 77°5'20"E east longitude and covers an area of 305826 hectares (Figure 1). Ernakulam district is surrounded by Thrissur district to the north, Idukki District and Tamil Nadu State to the east, Alappuzha and Kottayam districts to the south and Arabian Sea to its west.

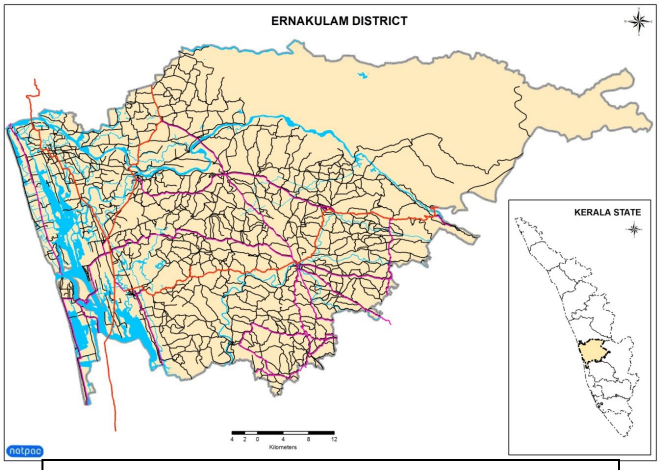


Figure 13: Location Map of Study Area

Methodology

Keeping in view the objectives of the study, available road network data set with Government and other agencies were obtained and were integrated in ArcGIS software. Detailed road network map for the district was prepared from satellite imageries available in the ESRI website and other online resources. Road network for the district was generated and attribute information pertaining to the road were updated. Doubtful roads were visited and all the required data was collected and updated in GIS environment.

Results

Detailed road network map for Ernakulam district was attempted using Geoinformatics tools. Study relied on secondary as well as primary data. Online resources, viz ESRI web portal, Google Earth, Google Maps and Open Street maps were utilized. Study was completed in 20 Panchayats in Ernakulam district.

The key advantage of the study was to integrate all data using Geographical Information System, ArcGIS 10.1 software. The generated data will be highly beneficial as a base map for different studies and will benefit user agencies like PWD, Police and Health Department.

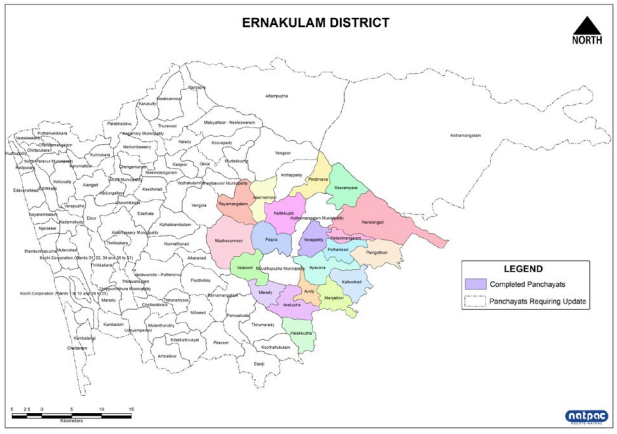


Figure 14: Completed Panchayats – Ernakulam District

20. Web GIS based Road Crash Information System

For successful implementation of road safety activities, availability of data is the cornerstone and is essential for the diagnosis of the road crash problem and for monitoring road safety efforts. NATPAC carried out a study to develop a Web GIS based road crash information system using Geospatial tools for Kerala.

Scope and Objectives

- To develop a WebGIS based road crash information system highlighting road crash black spots for the state of Kerala;
- Develop Information system using GIS as backend application, highlighting the road crash scenarios;

Study Area

Study will consider the State of Kerala to develop WebGIS based crash system which will highlight the vulnerable locations within the state.

Status of Work

RCIS (Road Crash Information System) will be a web portal solution to manage crash information. The software developed will assist in the management of road safety work on the road network. It is an integrated data management system, consisting of a road crash database and mapping tools. The system combines and integrates geospatial technologies and the crash database. The information system is a spatial referenced database with all data modelled as spatial objects (point and line) and encoded in geospatial format, which stores all crash related data for the study area in a centralized location, providing functionalities to perform spatial query and spatial analysis and integration with other spatial database. The present study taking in the broad objective of building Crash Information System (CIS) has started the process. The framework for the CIS and the programming languages to be used are finalized. Full-fledged crash information system will be developed with the availability of crash data in new format from State Crime Records Bureau.

21. Development of GIS - based Road and Traffic Database for Kerala

Road authorities put great effort and expense into collecting large quantities of data related to road assets. Management of collected data is a severe problem due to scattered data sets and information among different agencies. Reliable and detailed data help road practitioners accurately identify problems, risk factors and priority areas, and to formulate strategy, set targets and monitor performance. Road Asset Management System (RAMS) is a strategic and systematic process of maintaining, upgrading, and operating road assets effectively. Information collected and made available through this system will be useful for the agencies responsible for road development and maintenance, investors, as well as road users.

Road Asset Management System prepared using Geographical Information System (GIS) will facilitate to analyse, map and query details of different assets of particular road stretch. GIS-based Road Information and Management System can serve as an effective workable model for governing bodies of organizations and can go a long way in not only enabling policy makers, but also solving the problems of spatial data.

NATPAC aims to prepare road and traffic database for the roads in Kerala. The study can be further extended to prepare database pertaining to road crashes, pavement management system, Traveller/Tourist Information System etc. for the entire state.

Scope and Objectives

The scope of the present study is limited to compilation of road and traffic data from the studies conducted during last 10 years. The objectives of the study are:

- To develop an up-to-date digital database of roads for effective monitoring, management, planning and subsequent development of the road network;
- Collection of road and traffic data from previous studies conducted by NATPAC and various other agencies in Kerala;
- To develop spatial and attribute database system in GIS platform for the road network of the study area.

Methodology

The methodology adopted for the study consisted of compilation of data pertaining to road inventory and traffic data from earlier studies, collection of road network map in shape file format from secondary sources and mapping of missing road networks and inputting the collected data to the GIS platform and develop a macro database for road inventory and traffic data for the entire state.

Data Collected

Primary data of earlier studies conducted by NATPAC during 2011 - 2015 were collected for the selected districts in Kerala, namely Thiruvananthapuram, Ernakulam and Kozhikode. Primary road inventory data which includes chainage, width of roadway elements, type of roadway elements, carriageway width, type of land use, length of road, traffic regulation, etc were compiled. Primary traffic data such as intensity of vehicular traffic, pedestrian traffic intensity, speed and delay, parking accumulation and duration etc were also compiled.

Study Status

Road network map is being prepared with the help of various secondary sources namely, Survey of India maps, PWD maps, AutoCAD maps, Image maps, Google maps, Arc Server Maps and open street maps. Road network map for the study is being developed with help of data collected from various sources.

It is envisaged to conduct periodic updation of GIS database comprising of traffic, road network, transportation network and crash spots. Road and traffic database system will be developed in GIS, which can be retrievable for various analytical and research purposes.

22. Road Safety Treatment for Adoor-Kazhakkoottam Stretch of MC Road in Kerala State as part of Safe Corridor Demonstration Project

Adoor – Kazhakkoottam section of Main Central Road is one of the important travel corridors in Kerala covering the districts of Thiruvananthapuram, Kollam and Pathanamthitta. The length of the corridor is about 80km which was developed under Kerala State Transport Project. It carries heavy traffic throughout the day and is witnessing high number of road fatalities during the last few years. All major components of safety were taken into consideration in this study.

Scope and Objectives

It was proposed to enhance road safety measures on this high-risk corridor by developing it as Safe Corridor under the World Bank funded KSTP-II by implementing proven road safety interventions and international good practices. Major objectives include road treatment for road signage, road marking, street lighting, crash barrier, short term junction improvement plan, bus stop, school zone and collection of accident data.

Road Signage

As part of safety scheme, sign boards are provided on both SCDP corridor and major side roads as per the guidelines of IRC 67-2012. Dimension and spacing of boards were decided on the basics of speed of the corridor. The sign board includes mandatory, cautionary, direction and informatory. To create awareness about type of lane marking used in the corridor a special type of board, Marking Information Sign board, was included in this study. A total of 3897 signboards were provided on the major road and a total of 732 boards were on side roads.

Road Marking

Road marking was done in two categories, i.e, for intersections and for mid blocks. The types of marking selected for the stretch was based on IRC 35-2015. Segments of marking were longitudinal marking, transverse, hazard, block, arrows, directional and facility marking.

Short term intersection improvement

In short term intersection proposal a total of 30 major intersections are selected and classified volume count was done. The improvement proposals included pedestrian crossings, off-and on-street parking lay outs, location of bus stops, appropriate signages etc. within the bell-mouth area of each junctions. The treatment was done with minimum land acquisition.

School Zone treatment plan

A total of 59 schools which had direct access to SCDP corridor were considered for inventory survey. Out of this, 27schools were shortlisted for school zone treatment. The major attraction of zone school treatment was the zig zag longitudinal marking from start and end of school zone. Every school zone was associated with a pedestrian crossing of width 3m and a Pelican signal. Pedestrian crossing was followed by a stop line and STOP text. To safeguard the movement of

pedestrian, side walk with guard rail was also provided along the entire length of school zone. On both sides of road, student drop off/pick up points area were also assigned with proper marking and text. To control speed within the zone, three set bar markings (at 50, 80, 120m from pedestrian crossing) were provided. Necessary sign boards such as pedestrian crossing (both cautionary and informatory), bus bay, bus stop and School zone board (Combination of school zone ahead and Speed limit) were also provided.

Bus stop

Every bus stop was placed such that it should visible to both passengers as well as drivers. Bus stop should be placed nearer to pedestrian crossing so that walkable distance between pedestrian crossing and bus stop will be miimum. Suitable side walk facilities should be provided for safe movement of pedestrian near bus stops. It should be placed away from junctions, traffic signals, bends and other traffic hazards. The position of bus stop should be such that minimum of 75 m away from approach of bridges, intersection and school gates. The bus stops were demarked with a solid yellow line with a length of 15m (approach slope 1:8 and departure slope of 1:4). Bus Bay board at start of bus stop and bus stop board at stop position were also given. Type of treatment of bus stop was done on the basis of availability of space for bus shelter. Two types of bus shelter - one of size 6x2.5m and other 5x2m were adopted.

Street Lighting

Street light was provided on intersections, mid blocks and pedestrian crossing for enhancing safety of vehicles as well as pedestrians. Solar mounted LED lights were recommended for the study stretch. Proper light reflectors were proposed on lamp post to enhance night visibility of post. The lamp pedestal construction was done such that there was a minimum clearance of 0.5 to 0.7m. Selection of medium or high mast lamp was done in such a way that it avoids spreading of light over adjacent residential building and also reduce glare factor to approaching traffic.

Crash Barrier

Since the study corridor consists of lots of dangerous curves, crash barrier was the main needed component in view of safety. Safety measures were selected based on IRC 119-2015. W-beam steel barrier was selected and proper end treatments were given.

Road Studs

Retro-reflective studs are used to supplement longitudinal/transverse reflectorized road markings, which would improve visibility in night time and adverse weather conditions. Road studs are also used across the carriageway to serve as Speed Arrestor coupled with eschewing warning through the creation of the rumbling sensation to the user. Series of such road reflector studs are to be laid in advance of junction/crossings/end of the flyover section wherein road crashes are prevalent.

Crash Analysis

The study aims to identify high priority crash prone areas and provide short term improvements in the section. Crash spots were identified and prioritized. Total 34 locations were identified; out of which 7 locations comes under priority I.

23. Enhancing Road Safety through Emergency Vehicle Prioritisation System

Emergency Vehicle Priority (EVP) is an Intelligent Transportation System (ITS) application, based on advanced telecommunication and information technology which offers great potential for improving the road safety situation for all types of road-users. NATPAC intends to implement a safe system which would control the traffic signals so that the emergency services get priority and reach their destination without any delay in time. This project is divided into three main phases, first phase includes GPS related work to trace the position of ambulance at road junctions, second phase of project will include Radio Frequency (RF) and GSM system to activate the vehicle priority system at junctions when ambulance approaches the junction and third phase of the project is to improve the system performance via predicting the shortest route and the hospital within the path. The work has been initiated in association with M/s Keltron.

Scope and Objectives

The scope of the study covers the 5km road stretch around the Medical College Hospital, Thiruvananthapuram**.** The main objectives of the study are:

a. To assess the existing operations of ambulance services in a fixed time Traffic Signal control environment;
b. To device a system architecture for Emergency Vehicle Prioritization system for pre-emption of ambulance vehicles;

c. To develop an algorithm for the proposed system under various scenarios;
d. To evaluate the impact of the proposed system in comparison to fixed time signal environment;
e. To develop an algorithm for geo-fencing area detection;
f. To develop GPS locator;
g. To develop RF transceiver algorithms.

System Architecture

The System Architecture followed for the development of the EVP system is shown in **Figure 15.**

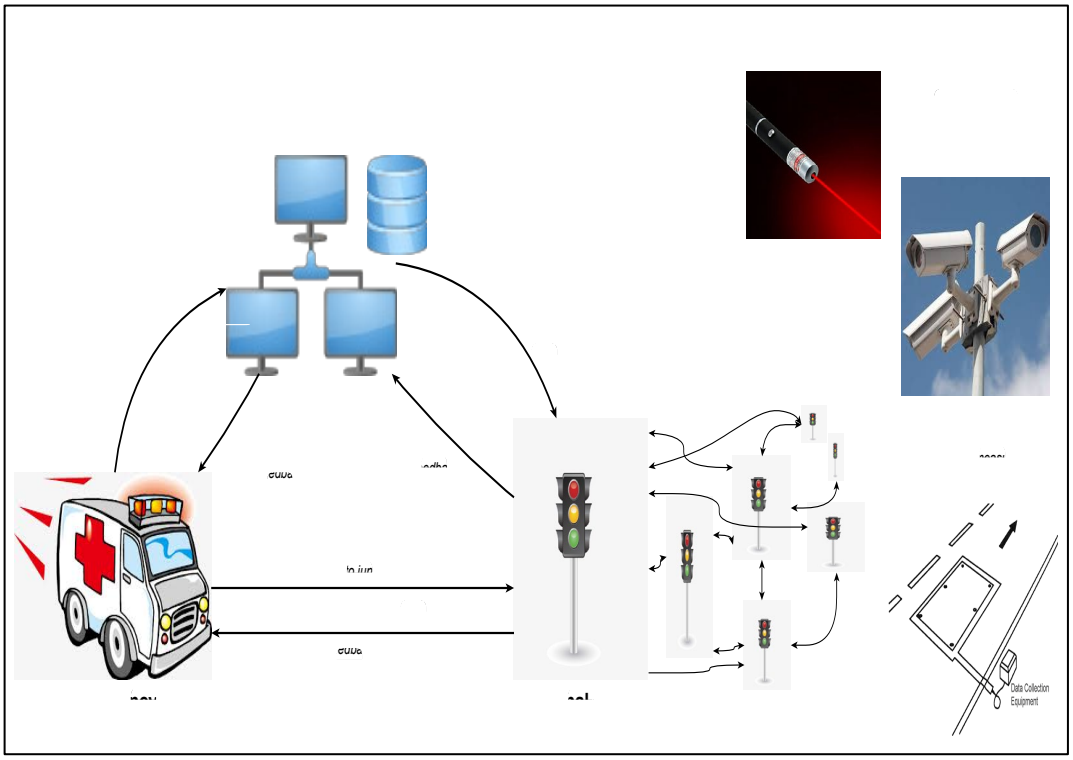


Figure 15: System Architecture of EVP System

Functioning of the proposed EVP System

i. Once the Emergency Vehicle (EV) gets detected at the entry point of the corridor/ junction through RF, this information (along with the arm of junction on which EV is approaching) is passed onto the signal unit;
ii. The GPS within the vehicle gives the location, speed and direction of movement of the EV;

iii. This information is used to estimate the time required by the EV to reach the junction;

iv. The Phasing plan status is checked and if the Green is running for the EV detected arm then it would be prolonged till EV passes or else the running green would be stopped and Green will be switched on for the EV detected arm;

v. Along with this, hooter and LED display would be activated to make other road users aware about the approach of the EV to the junction;

vi. Once the EV passes the junction, the other arms are compensated for the additional delay caused by giving priority to the EV. Then the normal phasing plan is activated;

vii. The dissipation time of real-time queue as well as travel time prediction of the EV between junctions would also be included.

Majority of the works on the prototype has been completed. After assembling the board, the system will go for three month real-time on-site test. After the successful testing, tracking system and Specific ID number will be introduced for each emergency vehicle.

24. Investigation of Major Accident Spots, Causative Analysis and Mitigative Measures

As part of the plan program of the Centre, NATPAC is continuously monitoring the crash scenario in Kerala by regularly undertaking on-the-spot investigation of recent crashes in the State, analyzing the causative factors and suggesting counter measures. Accordingly, NATPAC investigated six major road traffic crashes that occurred in the year 2018-19.

Crashes are categorized by the severity index and site visits are done at the earliest to gather maximum evidence which comes very useful in accident reconstruction. The study team visits the site and gathers information regarding the road characteristics through volume count, spot speed, videography and moving car observer method. With the help of police personals, the FIR, Mehser and post mortem reports are collected to get an idea about the injury patterns and their investigations. The vehicles involved in the crashes are inspected for getting the vehicle characteristics and the probable failures happened during the crash which may have contributed to the severity. On-site witnesses like local public and involved vehicle driver statements are taken to visualize the event from their point of view. All the above collected details are scrutinized very closely and scientific conclusions regarding major cause of crashes are listed

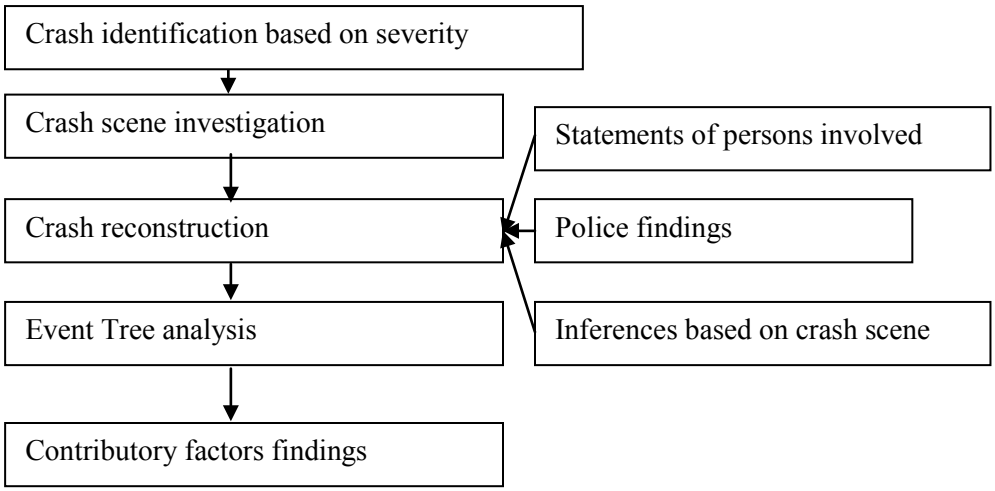
out. Once the causative factors are identified, the most suitable short term mitigate measures are suggested to avoid any further recurrence in that particular site.

Objectives

The main objectives of the study are:

1. To identify the root cause of crashes;
2. To reconstruct the crash using software toolkits;
3. To suggest site improvement measures to avoid recurrence of crashes;
4. To develop road safety education materials based on the finding on crash analysis and reconstruction.

Methodology



Detailed investigation relating to human, road and environmental factors are analyzed in detail and various short term measures are suggested to the local authorities for improvement. Most of the accidents are caused due to human errors only, of which overtaking has been the single most reason for majority of accidents. Straight stretches with ample visibility have contributed to more fatalities due to increased sight distances and higher operating speed. Vehicle incompatibility has also been a factor, as fatalities and grievous injuries are more in case of such crashes.

Major recommendations/suggestions evolved through the study are related to infrastructure, road safety education, issues requiring policy initiatives and enforcement. It is anticipated that, by

implementing the recommendations, the incidence and severity rate on the analysed road segments can be reduced considerably.

Human factors are supposed to be the leading contributory factor in any crash analysis. Nevertheless, vehicle factor cannot be eliminated due to the lack of information from the vehicle prospective. Automatic vehicles are more suited and is used in developed countries where roads and allied facilities are of high quality. Modern ITS based automatic over speed detection cameras and surveillance camera system is observed as very effective in reduction of crashes.

25. Assessment of Risk Potential of State Highways using iRAP Methodology: a Case Study of Ettumanoor – Poonjar State Highway 32

Constructing superior quality roads require significant investment and it is necessary to ascertain the safety of users on those roads before, while or after constructing the road. Critical assessment of existing road networks has been conducted to determine the level of safety assured for their users. This road safety assessment was conducted using iRAP methodology for four categories of road users viz. Vehicle occupants, motorcyclists, pedestrians and bicyclists in the 33.60 km long Ettumanoor - Poonjar stretch of State highway 32 in Kerala and recommendations for improvement are made.

Objectives

- To generate the existing star rating indices in terms of safety aspects of the selected road stretch;
- To propose road improvement plans to reduce road crashes.

The whole road stretch has been rated from 1 to 5 star for all road users which shows the zones of high risks (1 or 2 stars) as well as safe zones (4 and 5 stars). The raw star ratings show that about 16.32% of road length is rated as 1 and 2 stars for vehicle occupants whereas for motorcyclists, the share is about 24%. The entire road stretch has majorly 1 and 2 star ratings for the pedestrians and bicyclists. The share of 3 star for the vehicle occupants and motorcyclist is 34.12% and 37.98% respectively. However 5 star ratings are 21.66% for vehicle occupants, 9.53% for motor cyclists, 2.08% for bicyclists and none for pedestrians.

Based on the current road condition, countermeasures for improving the safety performance have been suggested. By implementing these measures, the star ratings of the road can be improved. From the safety point of view the implementation of countermeasures will contribute heavily to the fatality reduction in the stretch.

Major findings of the Study

Pedestrian and motorcyclist safety needs to be uplifted and various improvement measures such as pedestrian fencings, footpaths, street lightings, shoulder condition improvement, edge drop rectification, hazardous objects and removal of trees etc. are suggested at critical locations. Presence of schools along the corridor makes it more essential to enhance the safety of the children and thus school zone treatments are required. The change in star rating after countermeasure implementation denotes potential improvement in pedestrian and motorcyclist star ratings which points that better safety can be attained with the suggested improvements. The cost along with the estimated fatalities and the benefit cost ratio suggested that the proposed countermeasures will be very much effective in reducing the crash frequency at the road stretch. Apart from this, enforcement strategies are also needed to ensure stringent punishment to the violators of traffic rules and regulations.

26. Feasibility Study on Installation of Traffic Signal System at Thonnal Devi Temple Intersection and Mangalapuram Intersection

At the instance of Kerala Road Safety Authority, NATPAC conducted a study on the feasibility of installation of a traffic signal at the three arm intersection near Thonnal devi temple on the National Highway 66 and four arm intersection at Mangalapuram, Thiruvananthapuram.

Objectives

The objectives of the study are:

- To identify and enlist the factors that cause frequent crashes in the vicinity of these intersections;
- To explore the present traffic flow parameters, pedestrian flow parameters and other characteristics of the Highway stretch between Kazhakkoottam and Mangalapuram intersection;

- To analyze the existing level of service (LOS) of the stretch and the intersections within the selected stretch;
- To assess the feasibility of installation of a traffic signal system in improving the probability of road crashes;
- To check the scope for coordination of adjacent signal system to enhance and regulate the traffic flow for achieving overall safety;

Key Findings

i. All five intersections viz. Vettu road intersection, Aalummoodu intersection, Thonnal devi temple intersection, CRPF Pallippuram intersection and Mangalapuram intersection has to be redesigned based on IRC specifications for geometric design of at grade intersections;
ii. Alternate system may be implemented such as long bus bays at the opposite side of the bus station in order to avoid frequent turning movement of KSRTC buses to/from Kaniyapuram bus stand;
iii. The scope of installation of traffic preemption techniques such as hurry call facility is little since volume of emergency vehicles plying on the highway are higher and in such conditions, embedded traffic preemption techniques may lead to total system failure as the intersections are closely spaced and minor roads also cater considerable traffic volume;
iv. The street lighting facility provided at the intersection is inadequate and it should be upgraded to reduce collision during dark hours;
v. Road Markings and Traffic Sign Boards should be provided as per latest IRC specification;
vi. The road infrastructure should be maintained time to time to ensure smooth functionality.

Recommendation

Independent signal system installation at Thonnal devi temple intersection without any geometric improvement does not serve the purpose of attaining safety since there is no provision of turning lane facility to store and queue the right turning stream of traffic (majorly consists of two wheelers) once the through phases in either directions are opened.

To improve the overall safety and ensure smooth flow of traffic, geometric improvements of these five intersections along with progressive signal system installation is recommended. Geometric design of intersections is observed as the key parameter required to enhance safety at this stretch. Once the intersections are redesigned, installation of progressive signal system with add on enforcement modules such as red light violation, lane violation, over speed detection along with stringent enforcement will help to achieve overall safety.

27. Study on Accidents and Safety Aspects Related to Inland Waterways

Inland waterways of Kerala are comparatively under-utilized and the density of traffic is very less compared to other modes. Due to this, the number of accidents occurring in waterways is less compared to other modes. Though accidents are less compared to road sector, several high profile fatal boat accidents in passenger boats, barges and inland fishing boats occurred in recent past. Safety of navigation assumes a set of conditions and requirements to be fulfilled by inland waterways, ports, navigation, boats and other vessels. In this regard, NATPAC has embarked on a study to assess the accident and safety aspects related to inland waterways in Kerala. This is a continuing project for three years.

Scope and objectives

The scope of the work is limited to the accidents and other safety related aspects of the vessels operating in the inland waterways of Kerala State. The main objectives of the study are to examine the existing rules and regulations related to inland waterways in safety aspects and examining their adequacy so that the need to make a policy for improving safety regulations can be assessed. The causes of recent accidents in waterways are to be studied and the waterways in Kerala are to be examined in terms of safety and risks involved and improvement measures are to be suggested. Stake holders meeting are to be conducted on the issue of safety in order to understand the problems and possible solutions. Waterway safety awareness programs and materials for creating awareness are to be designed. Hand books and best practice manuals for various users of waterway on safety are also to be prepared.

Methodology adopted for the study

Methodology adopted for the study consisted of literature review, analysis of accident data, review of rules related to waterway, conducting stakeholders meeting, questionnaire survey for passengers and crew, waterway safety audit, preparation of disaster management plan for accidents in waterways, study of effectiveness of training programs, conducting safety awareness programs and preparing materials for creating awareness, preparation of handbooks and best practice manuals for users of waterway and suggesting improvements to waterways for safe navigation.

Data analysis and findings

The review of rules related to inland waterways, analysis of accident data and questionnaire survey data analysis are in progress. Some of the observations are listed below:

- The duration for training program for boat crew for certification is 4 days, which is not sufficient for effective training;
- Safety measures in boats are to be improved;
- Jetties are to be more safe;
- Awareness programs are to be conducted for passengers.

Status of study

Accident data were collected from Alappuzha Port office and Kollam. Details of training programs conducted by Kerala Maritime institute were collected and discussions were made with various departments. Details of boats operated by State Water Transport Department (SWTD) are collected. Safety audit of canals in Alappuzha was also accomplished. Detailed literature review were made for updation of laws and regulations and to get information about safety related training programs conducted in various parts of the world and for preparation of guidelines. Details of various safety related training programs were collected and analysed.

Expected outcome of the project

An action plan to improve waterway safety will be formulated. Improvements in the existing rules and policies will be suggested and materials will be developed to conduct safety awareness programs.

28. Database Creation and Management for Inland Waterways in Kerala using Geographical Information System

Introduction

NATPAC had conducted many studies related to the inland waterways throughout Kerala and have collected data regarding the existing waterway infrastructure. It is proposed to compile all data related to water transport and tourism in Kerala and create a Geographical Information System (GIS) database to store and retrieve data for future reference. This will make valuable information accessible quickly.

Scope and objectives

The scope of the work is limited to creation and updation of a GIS database for inland waterways in Kerala.

The objectives of the study are:

- To compile the available data related to waterways in Kerala and related to various projects in NATPAC;
- To compile maps and other related data available in internet;
- To conduct field verification, wherever necessary;
- To create and manage a waterway information system using GIS;
- Facilitate effective use of data.

A database in GIS platform is to be created for the data management and updation. Web GIS platform may be developed for this purpose. It is proposed to develop a Windows based Web GIS system with all other components as open source.

Web GIS server components

The following are the components of Web GIS server;

- **Database Server:** The database server may have a file based system or Relational Database Management System (RDBMS) based or a combination of files and RDBMS.
- **GIS or Map Server**: Map server or GIS server is a software package or program, which is responsible for rendering the GIS data into web browser.
- **Application Server:** An application server is a software which provides customized software applications.

- **Web Server:** A web server is a computer program which uses the client/server model and the World Wide Web's Hypertext Transfer Protocol (HTTP), serves the files that form web pages to web users.

Expected outcome of the project

- To create and manage a waterway information system using GIS.

EXTENSION SERVICES

1. Workshop on 'Road Safety'

National Transportation Planning and Research Centre (NATPAC) organized a one day workshop on 'Road Safety' in association with Kerala Road Safety Authority (KRSA) on 5th February 2019 at Thiruvananthapuram as part of Road Safety Week 2019. The aim of the Workshop was to discuss various aspects of road safety. The focus of the Workshop was to emphasize the importance of road safety and steps to reduce the road crashes. The opening session started with introductory remarks by Shri.S.Shaheem, Director (i/c), NATPAC.

The programme was attended by Shri.Rajeev Puthalath; Joint Transport Commissioner, Shri.T.Elangovan; Executive Director, KRSA and representatives from all important stakeholder departments/organisations.

Introductory remarks by Shri.S.Shaheem, Director (i/c), NATPAC

Shri.Rajeev Puthalath, Joint Transport Commissioner addressing the participants

Technical Presentations made during the Workshop

Sl.No.	Name	Designation	Topic
1	Shri.T.Elangovan	Executive Director, KRSA	Road Accident Scenario, Road Safety Policy and Action Plan
2	Shri.Krishnan Srinivasan	Representative of World Bank	World Bank's support to Road Safety in India
3	Shri.Arun Chandran	Scientist, NATPAC	An Overview of Safe Corridor Demonstration Project
4	Shri.Tony Mathew	Representative of TRL	Traffic Management and Road Safety Enforcement

5	Shri.Adarsh Kumar	Joint RTO (Retired)	Rules of Road Regulation
6	Shri.S.Shaheem	Director (i/c), NATPAC	Road Safety Auditing and Black Spot Identification
7	Shri.V.S.Sanjay Kumar	Senior Scientist, NATPAC	Elements of Road Safety in Road Development
8	Shri.Mahesh	Motor Vehicle Inspector	Implementation of Trauma Care Squad
9	Dr.Shiju Stanley	HoD, Trauma Care, Ananthapuri Hospital, Thiruvananthapuram	First Aid and Trauma Care

View of the participants

2. Road Safety Week – 2019

KSCSTE-NATPAC observed 'Road Safety Week – 2019' by organizing a series of activities from February 04-10, 2019. The theme of this year's Road Safety Week was "Road Suraksha – Jeevan Raksha".

Activities conducted by KSCSTE-NATPAC during 30th Road Safety Week:

- Pedestrian Crossing Drill at Medical College Junction, Thiruvananthapuram on 6th February 2019 aimed at demonstrating how road crossing could be done safely at a signalised intersection.
- Class on "Road Safety" for the Staff of HLL Life care Limited, Peroorkada. 69 officials of HLL attended the session.
- 'Safe Road to School'at Ponnurunni, Ernakulam on 6th February 2019. 73 students participated.

- Road Safety Youth Leadership Programme in association with NSS and Civil Engineering Department of Govt. Engineering College, West Hill, Kozhikode on 7th February 2019. 60 students attended the programme.

- Road Safety Youth Leadership Programme in association with NSS and Malabar Christian College, Kozhikode on 7th February 2019.

Road Safety Youth Leadership Programme at Govt. Engineering College, West Hill, Kozhikode

Road Safety Youth Leadership Programme at Malabar Christian College, Kozhikode

- Awareness programme on Road Safety at three major junctions of Kollam District, viz., Kallumthazham Junction, High School Junction and Paravur Junction on 8th February 2019. Pamphlets and other road safety related publications were distributed to the public.

3. Training Programme on 'Road Safety'

National Transportation Planning and Research Centre (NATPAC) organized a five day Training Programme on 'Road Safety' in collaboration with Asian Institute of Transport Development (AITD), New Delhi under the aegis of Ministry of Road Transport and Highways, Government of India on 25th February 2019 – 1st March 2019 at Thiruvananthapuram. The training programme aimed at building capacity in the area of road safety for the field engineers.

Shri.Shaheem S, Director (i/c), KSCSTE - NATPAC welcomed the gathering. Dr.B G Sreedevi, Chief Scientist, KSCSTE - NATPAC delivered the presidential address. The training programme was inaugurated by Shri.M.C.Dathan, Scientific Advisor to the Hon'ble Chief Minister, Kerala. He addressed the participants by highlighting the involvement of AITD in various road safety related activities and programmes.

Shri.S.Shaheem, Director (i/c), NATPAC welcoming the participants

Inaugural Address by Shri.M.c.Dathan, Scientific Advisor to the Hon'ble Chief Minister, Kerala

Technical Presentations made during the Training Programme

Sl.No.	Name	Designation	Topic
Day – 1 (25.02.2019)			
1	Dr.B.G.Sreedevi	Chief Scientist, KSCSTE-NATPAC	Overview of Global and Indian road safety scenario: Five pillars of road safety
2	Shri.T.Elangovan	Executive Director, KRSA	Road Safety Scenario
3	Shri.V.S.Sanjay Kumar	Senior Scientist, KSCSTE-NATPAC	Role of Engineering in Road Safety and System approaches to Road Safety
Day – 2 (26.02.2019)			
4	Shri.K.C.Wilson	Scientist, KSCSTE-NATPAC	Safety in Road Design
5	Shri.Chandra Prathap	Junior Scientist, KSCSTE-NATPAC	Safety in Road Design – Hill roads, Culverts, Bridges and Flyovers
6	Shri.Arun Chandran	Scientist, KSCSTE-NATPAC	Traffic Control Devices and Roadside Appurtenances
7	Shri.Anish Kini	Junior Scientist, KSCSTE-NATPAC	Human Factors in Road Safety
Day – 3 (27.02.2019)			
8	Dr.Gunasekaran	Professor, Anna University	Safety in Road Design
9	Shri.Ebin Sam	Junior Scientist, KSCSTE-NATPAC	Hazardous Road Locations
10	Shri.Jegan Bharath Kumar	Junior Scientist, KSCSTE-NATPAC	Safety for VRUs and PwDs
Day – 4 (28.02.2019)			
11	Shri.S.Shaheem	Director (i/c), NATPAC	Road Safety Audit
Day – 5 (01.03.2019)			
12	Shri.Subin B	Scientist, KSCSTE-NATPAC	Case Studies, iRAP

On the 4th day of the training programme "Field Exercise on Geometric Design and other deficiencies in NHs and SHs" was conducted for the participants. They were taken to a road section having safety issues and were made to identify probable road safety measures required.

35 participants representing the departments of PWD, PMGSY, C&TP etc., participated in the training programme. The training was successfully held and the main objectives were all achieved. The feedback from the participants was very positive.

4. Training Course for Drivers of Vehicles Carrying Dangerous and Hazardous Goods

Government of Kerala accorded sanction to NATPAC for conducting 'Training Course for Drivers of Vehicles Carrying Dangerous and Hazardous Goods' vide G.O. (Rt) No.138/2015/Tran., dated 17th March 2015.

The State level inauguration of the programme 'Training on Safe Transportation of Hazardous Goods to Drivers' was done by Shri. Thiruvanchoor Radhakrishnan, Hon'ble Minister for Transport and Forest, Govt. of Kerala on 16th April 2015 at Sasthra Bhavan, Pattom, Thiruvananthapuram.

A total of 32 programmes were completed this year at the NATPAC office, *K Karunakaran Transpark*, Aakkulam, Thiruvananthapuram as per the following schedule.

Date	Number of drivers Participated
04/04/2018 – 06/04/2018	24
04/04/2018	1
06/04/2018	7
09/04/2018	36
11/05/2018	37
23/05/2018	19
12/06/2018 – 14/06/2018	24
12/06/2018	7
14/06/2018	5
27/06/2018	11
17/07/2018	16

31/07/2018		9
16/08/2018 – 18/08/2018		25
17/08/2018		5
18/08/2018		5
06/09/2018		48
19/09/2018		17
10/10/2018 – 12/10/2018		27
10/10/2018		1
12/10/2018		7
29/10/2018		9
13/11/2018		22
30/11/2018		8
14/12/2018		17
26/12/2018 – 28/12/2018		33
26/12/2018		13
28/12/2018		1
29/01/2019		17
18/02/2019		12
06/03/2019 – 08/03/2019		26
07/03/2019		5
08/03/2019		8
Total		**502**

Participants with NATPAC Officials (4th – 6th April 2018)

5. *Training Programmes Conducted*

a) External Training/Presentations

Sl. No.	Details of Training	Date
i.	Two-day training on Mx road software to the PG students of Rajiv Gandhi Institute of Technology, Kottayam by Shri.K.C.Wilson, Scientist	

b) Road Safety Training for Various Target Groups

Sl. No.	Details of Training	Date
i.	Training on Road Safety to the Police Trainees at Kerala Police Academy, Thrissur.	28.05.2018– 31.05.2018
ii.	Training on Road Safety to the Police Trainees at Kerala Police Academy, Thrissur.	01.06.2018
iii.	Training on 'Traffic Offences and the connected case laws of Supreme Court and other Courts under IPC' to the Police Trainees at Police Training College, Thycaud. 34 Police Officers participated.	13.07.2018
iv.	Training on 'Identification of hazardous goods and the methods to mitigate emergency' to the Police Officials at Kerala Police Academy, Ramavarmapuram, Thrissur. 45 Police Officers participated.	28.07.2018
v.	Training on Road Safety to Special Armed Police (SAP) recruits at SAP Camp Training Centre, Oolampara, Peroorkkada. 250 SAP recruits participated.	30.07.2018– 01.08.2018
vi.	Training on Road Safety to Excise drivers and Excise Civil Officers at Kerala Excise Academy, Poothol, Thrissur. 45 participants including 42 women Civil Excise Officers attended the training.	14.09.2018
vii.	Training on 'Identification of hazardous goods and the role of Police in mitigating emergency situations' to Police Officials at Kerala Police Academy, Thrissur. 45 police officials attended the training.	15.09.2018
viii.	Training on Road Safety to the Police Driver Trainees at Kerala Police Academy, Ramavarmapuram, Thrissur. 130 Police Driver Trainees participated.	26.09.2018 – 28.09.2018
ix.	Training on 'Identification of hazardous goods and safe handling of emergency situations' to SAP Trainees. 200 SAP Trainees participated.	16.10.2018
x.	Training on Road Safety to Students Police Cadets (SPC) at Govt. Higher Secondary School, Chathannoor. 85 Students Police Cadets participated.	24.12.2018
xi.	Training on Road Safety to National Service Scheme (NSS) volunteers at VHSS, East Kallada. 85 National Service Scheme (NSS) volunteers participated.	24.12.2018
xii.	Training on 'Road Safety' to Students of St.Rita's Public School, Ponnurunni, Ernakulam	06/02/2019

6. Exhibitions

1. Road Safety Exhibition and audio-visual programmes in connection with Rural Innovation Meet 2018 (RIM 18) at M S Swaminathan Research Foundation (MSSRF), Kalpetta, Waynad, 14th -16th May 2018.
2. Road Safety Exhibition and audio-visual programmes in connection with Road Safety Week -2019 at Chandrasekharan Nair Stadium, Trivandrum, 4th – 10th February 2019.

7. Participation in Workshops, Seminars/Conferences and other Training Programmes

Name of Programme	Organised by	Date (s)	Venue	Participants
Seminars/Conferences				
International Conference on Infrastructure Development: Issues, Innovations and the Way Forward (ICID 2018)	Mar Baselios College of Engineering & Technology, Thiruvananthapuram	21.06.2018-23.06.2018	Mar Baselios College of Engineering & Technology, Thiruvananthapuram	Shaheem S V S Sanjay Kumar P N Salini Arun Chandran Anish Kini
Annual Session of 79th Indian Roads Congress	Indian Roads Congress	22.11.2018-25.11.2018	Nagpur	Shaheem S Ebin Sam
International Seminar on Construction and Rehabilitation of Rigid Pavement- Current Practice and Way Forward	Indian Roads Congress, Ministry of Road Transport and Highways-Govt of India, PIARC and JICA	18.01.2019-19.01.2019	New Delhi	Wilson K C Jegan Bharath Kumar A
Workshops				
Three day workshop on "Real Time Applications of Intelligent Transportation Systems (RAITS 2018)	Transportation Engineering Research Centre (TRC)	12.12.2018-14.12.2018	CET, Thiruvananthapuram	P N Salini
International Workshop on Rebuilding a Resilient Kerala after Floods		06.01.2019-07.01.2019	Mascot Hotel, Trivandrum	U Salini

Workshop on "Natural Hazard Mitigation with Geosynthetics"		11.01.2019-12.01.2019	CET, Thiruvananthapuram	U Salini
Workshop on Transportation Sector		15.01.2019	Transport Commissionerate	Shaheem S T Ramakrishnan
Workshop on Electric Vehicle Charging Infrastructure in Kerala	KSEB Ltd.	29.03.2019	Apollo Dimora, Trivandrum	Shaheem S B Anish Kini
Training Programmes				
Real Time Kinematic DGPS Field Survey	Leica Resource person	03.05.2018	KSCSTE-NATPAC	M S Saran
Discrete Mode Choice Techniques		25.07.2018-27.07.2018	IISC, Bangalore	Shaheem S
GIAN Course on "Geographic Information Systems (GIS) Methods for Flood Risk Management"	NIT, Warangal	25.07.2018-01.08.2018	NIT, Warangal	Sabitha N M
Training for Trainer Development	IMG	31.07.2018	IMG, Thiruvananthapuram	Dr.B G Sreedevi
GIAN Course on 'Effective Road Safety Practices: Prevention is better than cure'	Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat	06.08.2018-10.08.2018	Sardar Vallabhbhai National Institute of Technology (SVNIT), Surat	V S Sanjay Kumar B Subin Arun chandran Ebin Sam
RTI Training Programme	IMG Thiruvananthapuram	12.09.2018		Shaheem S
Training course on Road Safety Audit and other related aspects		10.12.2018-24.12.2018	Central Road Research Institute, New Delhi	Shaheem S Anish Kini B
Management Development Programme, "Leadership Essentials & Strategic Insights" for Scientists of KSCSTE	KSCSTE	07.01.2019-11.01.2019	IIMK Campus, Kozhikode	P N Salini Sabitha N M Wilson K C

8. *Guidance to Students' Internships/Project Work and Thesis*

Students from various National Institutes and reputed Professional Colleges have undertaken their Internships /Project Works/Thesis under the guidance of NATPAC Scientists. The list of guidance provided by the Scientists is given below:

Name of the Institution	Course	Guide	No.of Students	Topic
Azad National Institute of Technology	B.Tech (Civil)	Shaheem S	1	Town Planning Studies
National Institute of Technology, Mizoram	B.Tech (Civil)	Shaheem S	1	Town Planning Studies
College of Engineering, Thiruvananthapuram	B.Tech (Civil)	Shaheem S	3	Intra-city Travel Characteristics of Commuters in Trivandrum City
National Institute of Technology, Trichy	M.Tech (Transportation Engg.)	Shaheem S	1	Impact of Road Safety Initiatives in Karamana - Pravachambalam Road
Jyothi Engineering College, Cheruthuruthy, Thrissur	M.Tech (Transportation Engg.)	Shaheem S	2	Implementation of Ambulance Priority from Pattom to Ulloor via Medical College Using Vissim Software
School of Planning and Architecture, Vijayawada	M.Tech (Transportation Engg.)	Shaheem S	1	Internship on Consultancy Projects
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Transportation Engg.)	Shaheem S	7	• Road Safety Treatment for Adoor and Kazhakkoottam stretch of MC road as part of Safe Corridor Demonstration Project • Traffic Impact Study of Proposed Lulu Mall on Mini By-pass in Calicut City • Design of Ring Road for Kunnamkulam Junction
College of Engineering, Thiruvananthapuram	M.Tech (Transportation Engg.)	Shaheem S	2	Parking policy for Thiruvananthapuram
Visvesvaraya National Institute of Technology,Nagpur	M.Tech (Transportation Engg.)	Shaheem S	1	Parking Policy for Thiruvananthapuram Corporation
Rajadhani Institute of Engineering and Technology, Nagaroor	B.Tech (Civil)	Shaheem S	2	Traffic Improvement Measures in Munnar Town during Neelakurinji season
VIT University, Chennai	B.Tech (Civil)	V S Sanjay Kumar	1	
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Transportation Engg.)	P N Salini	2	Development Plan for an Integrated Parking System at Medical College

Viswajyothi College of Engineering and Technology, Thodupuzha	B.Tech (Civil)	P N Salini	5	Traffic and Transportation Studies for Kondotty Town
SCMS School of Engineering and Technology, Ernakulam	B.Tech (Civil)	P N Salini	4	Integrated Designs for Public Bus Transport Terminals
Sree Krishna College of Technology, Coimbatore	M.Tech (Transportation Engg.)	P N Salini	1	Public Bus Transport Infrastructure – Kondotty a case study
UKF College of Engineering, Parippally	M.Tech (Transportation Engg.)	Sabitha N M	1	Determination of solid waste generation rate in the surrounding region of Parvathi Puthanar
SVNCE, Pandalam	B.Tech (Civil)	Ebin Sam	4	Development of GIS Database
Mt. Zion College of Engineering, Pathanamthitta	B.Tech (Civil)	R Chandra prathap	4	Performance Evaluation of BC mix prepared by adding different plastic types.
Vellapally College of Engineering	B.Tech (Civil)	R Chandra prathap	3	Comparative study on BC mix prepared by adding waste plastics with different Binder Grades

9. *Presentation of Papers in Seminars/Workshops*

Sl. No.	Author(s)	Paper details	Date
i.	V S Sanjay Kumar Vishnu Mohan, Salini U	"*Development of Pavement Design Strategy for Rural Roads*". International Conference on Advances in Engineering and Technology 2018, ICAET 2018, organised by Sri Vellappally Natesan College of Engineering, Mavelikara, Kerala.	20th April 2018
ii.	Joseph Abin, V S Sanjay Kumar	"*Towards Developing A Pavement Management System for A Road Network*". 5th Colloquium on Transportation Systems Engineering and Management (CTSEM), organised by National Institute of Technology Warangal.	17th – 19th May 2018
iii.	R Chandra Prathap, Wilson K C, V S Sanjay Kumar, B G Sreedevi	"*Impact of Vizhinjam Deep Water International Multipurpose Port on Traffic and Transportation System"*. 5th Colloquium on Transportation Systems Engineering and Management (CTSEM 2018), organised by Transportation Division, Department of Civil Engineering, National Institute of Technology Warangal. Published in the proceedings.	17th – 19th May 2018
iv.	V S Sanjay Kumar	"*Effect of Accessibility on Potential Tourist Destinations -A Case Study of Kozhikode District in Kerala*". International Conference on Infrastructure Development: Issues, Innovations and the Way Forward (ICID 2018), organised by Mar Baselios College of Engineering & Technology, Thiruvananthapuram, Kerala.	21st -23rd June 2018
v.	Sabitha N M B G Sreedevi	*"Challenges in the Restoration of Inland waterways for Navigation - A Case Study of Parvathy Puthanar in Kerala"*. 33rd Indian Engineering Congress, Udaipur, organised by The Institution of Engineers (India). Published in the Technical Volume (ISBN No. 978-81-938404-9-8) pp 547-552.	21st – 24th December 2018

vi.	V S Sanjay Kumar	"*Strategic Plan for the Development of NH Network in Kerala – A Case Study of Kozhikode Division in Kerala*". 33rd Indian Engineering Congress, Udaipur, organised by The Institution of Engineers (India). Published in the Technical Volume (ISBN No. 978-81-938404-9-8), pp 124-129.	21st – 24th December 2018
vii.	Shaheem S, Gopika Mohan	"*Performance Analysis of KSRTC Depots in Thiruvananthapuram City using Analytical Hierarchical Process*". 31st Kerala Science Congress, organised by Kerala State Council for Science Technology and Environment (KSCSTE) in association with Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) at Fatima Matha National College, Kollam.	2nd – 3rd February 2019
viii.	Shaheem S, Sreelekshmi S	"*Identification of major factors influencing work trips in Thiruvananthapuram City*". 31st Kerala Science Congress, organised by Kerala State Council for Science Technology and Environment (KSCSTE) in association with Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) at Fatima Matha National College, Kollam.	2nd – 3rd February 2019
ix.	Shaheem S, Remjish R S	*"Improvement proposal for rectification of traffic problems in congested junctions using ring road concept – A case study of Kunnamkulam junction in Thrissur District".* 31st Kerala Science Congress, organised by Kerala State Council for Science Technology and Environment (KSCSTE) in association with Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) at Fatima Matha National College, Kollam.	2nd – 3rd February 2019
x.	P N Salini Ardra S Krishna Manupriya	*"Development of Ring road and NMT corridor for an emerging town in Kerala".* 31st Kerala Science Congress, organised by Kerala State Council for Science Technology and Environment (KSCSTE) in association with Jawaharlal Nehru Tropical Botanic Garden and Research Institute (JNTBGRI) at Fatima Matha National College, Kollam.	2nd – 3rd February 2019
xi.	Shaheem S	*"Engineering in Safe Corridor Demonstration Project".* Focus Group Discussion in Enforcement Plan and Strategy for Safe Corridor Demonstration Project at Guest House, Thycaud, Thiruvananthapuram.	11th March 2019

Papers Published in Referred Journals

- **V S Sanjay Kumar, Saleel K, Teena John, "***Effect of Accessibility on Potential Tourist Destinations – A Case Study of Kozhikode District in Kerala",* IJEAT, Vol.8, pp.127-130.
- **K C Wilson, P N Salini, V S Sanjay Kumar, B G Sreedevi, "***Transportation System Planning for a Work Centre Campus with Direct Access to National Highway",* Indian Highways, Vol.47, 2019.

- **Nair L N, Salini U**, "*Lime Stabilization of Subgrade with Waste Sand as Partial Soil Replacement*". Ground Improvement Techniques and Geosynthetics, Springer, Singapore, 2019, pp. 125-133.
- **Aswathy, M, Salini, U, Gayathri, V G**, "*Utility of Lime and Red Mud in Clay Soil Stabilization".* Geotechnical Characterisation and Geo environmental Engineering, Springer Singapore, 2019, pp. 19-26.

Book Chapters

- **B. Subin, R. Srinath, R. Rajesh, R. Sasikumar,** *"Modelling the Perception towards In-Vehicle Distracted Driving among Four-Wheeler Drivers in Kerala",* Chapter 9, Industrial Safety Management: 21st Century Perspectives of Asia by J.Maiti, Pradip Kumar Ray (eds), Springer (2018)

10. *Invited Talks/Media Interactions*

Dr. B G Sreedevi

Media Interactions

Sl. No.	Topic	Media	Date
1.	*'Discussion on Road and Waterway Development'*	'Varthamanakalam' in Doordarshan	22/05/2018
2.	*'Opinion on Parking issues and solutions for cities'*	'Prabhathabheri' in All India Radio	11/06/2018
3.	*'Discussion on Students and Road Safety'*	'Varthamanakalam' in Doordarshan	12/06/2018
4.	*'Discussion on Night Driving'*	'Samvadam' in Manorama	25/09/2018
5.	*'Discussion on road safety'*	Asianet	02/10/2018
6.	*''Discussion on road safety'*	Doordarshan	03/10/2018
7.	*'Comment on Black Spots and their Rectification'*	'Prabhathabheri' in All India Radio	November 2018
8.	*'Comment on Vehicle Modification and Safety'*	'Prabhathabheri' in All India Radio	04/12/2018
9.	*'Discussion on road safety'*	Doordarshan	27/12/2018
10.	*'Discussion on Waterway Development'*	'Varthakeralam'in Doordarshan	22/01/2019
11.	*'Discussion on Road Safety Week'*	Doordarshan	05/02/2019

Invited Talks

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Road safety policies and action plan for Kerala'*	Seminar organized by Press Club, Thiruvananthapuram	08/10/2018
2.	*'Sustainable Transport'*	Department of Civil Engineering, College of Engineering, Trivandrum	26/10/2018
3.	*'Road safety action plan'*	Consultative Workshop on Sustainable Development Goals (SDGs), organized by All India Womens' Conference (AIWC), Sreevaraham Vanitha Samithi	26/11/2018
4.	Panelist	Workshop on 'Keralam Munnotte', organized by Malayala Manorama	07/12/2018
5.	*'Highway Development for Kerala'*	International Seminar on Resilient Kerala	29/12/2018
6.	Keynote Speaker	International Day of women and girls in science, organized by Holistic Health and Education Mission at Govt. High School Attakulangara	11/02/2019
7.	Chief Guest	'Urgakiran' programme of Energy Management Centre, Kariyam Grama Panchayat	02/03/2019
8.	*'Road safety and women'*	Subash Nagar NSS Karayogam	10/03/2019
9.	*'Road safety and women'*	AIWC, Vattiyoorkavu	12/03/2019
10.	*'Tourism and Transport for Waterways – Opportunities and Challenges'*	International seminar on Rejuvenation of Aakulam lake, organized by Dept. of Translational Engg., Govt. Engg College Barton Hill	15/03/2019

V S Sanjay Kumar

Media Interactions

Sl. No.	Topic	Media	Date
1.	*'Talk on PMGSY – Pradhan Mantri Gram Sadak Yojana'*	Akashavani	20/09/2018
2.	*'Oil and its Conservation'* in connection with the Energy Conservation Week	All India Radio	04/01/2019

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Road Safety and Youth'*	Key note Address delivered in the National Conference on 'Emerging Vistas of Engineering & Management (NCEVEM 2019), at Viswajyothy College of Engineering and Technology, Vazhakulam, Ernakulam	30/03/2019

M S Saran

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Visual Image Interpretation'*	Training lecture to post graduate students of Inter University Centre for Geospatial Information Science and Technology (IUCGIST), University of Kerala, Kariyavattom	11/02/2019

Wilson K C

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Role of geometry on road safety'*	Lecture in the one-day symposium on road safety held at GEC, Kannur	08/02/2019
2.	*Expert Group Discussion on Road Safety*	Organised by CED and CUTS International	14/02/2019

11. *Nominations to Technical Committees/Advisory Bodies/Membership of Professional Institutions*

Dr.B.G.SREEDEVI

- Member of Administrative Reforms Committee (ARC), Govt. of Kerala in the area of Infrastructure, (2019-20)
- Member, Technical committee for the projects of Rebuild Kerala Initiatives (RKI), Local Self Govt. Department (LSGD), (2019-20)
- Independent Engineer for Karamana River Scientific Management Project (KRSM) of Kerala State Council for Science Technology and Environment (KSCSTE), (2015-2020)

ANISH KINI.B

- Technical Committee Member: Integrated Digital Traffic Enforcement System for Police Department

12. Achievements/Awards

V S Sanjay Kumar

- Based on the recommendation by the undersigned as per letter No.01/HH-KKD/RTD/NATPAC dated 02/07/2018, the Government of Kerala have declared the Hill Highway Route in Kozhikode District vide G O No. 39/2018 dated 16/10/2018.

M.S.Saran

- Appointed as Guest faculty in Inter University Centre for Geospatial Information Science and Technology (IUCGIST), University of Kerala, Trivandrum.
- Appointed as member of the Team to study the" Feasibility of establishing a botanical garden at Wayanad".

Anish Kini B

- Certified as Road Safety Auditor from CRRI, New Delhi.

13. *Road Safety Education Materials*

Films

1. Savari, A Documentary Film on Road Safety – For Auto rickshaw Drivers
2. Gathy, A Short Film on Two Wheeler Safety
3. IRC Film (English and Malayalam) – For School Children
4. Right Step (English and Malayalam) – For School Children
5. VIC Roads, Australia – For School Children
6. A Picnic on Pedals – For School Children
7. Vazhikkannumai – On Pedestrian Safety
8. Sradhha – Transportation of GoodsVehicles
9. Take care
10. A Film on Seatbelt
11. A film on Rash Driving
12. A Film on Pedestrian Crossing

Booklets

1. Safe Road to School (English & Malayalam)
2. Preventing Accidents
3. Two Wheeler Driving Manual
4. Road Safety Manual for Goods Vehicle
5. All about Lane Driving and Road Safety
6. Safe Cycling
7. Autorickshaw Driving Manual (English & Malayalam)
8. Defensive Driving
9. Teacher's Manual (English & Malayalam)
10. Safe Community Programme for Panchayats (English & Malayalam)
11. Helping Road Accident Victims (English & Malayalam)
12. Rules of Road Regulations,1989
13. On Car and Safe Driving
14. Defensive Bus Driving and Road Safety Guide
15. Road Safety Slogan
16. Vehicle Upkeep and Safety
17. Alphabets of Road Language
18. Road Safety Quiz
19. Safe and Responsible Parking
20. Road Safety and Youth Leadership Programmes
21. Safety Rules for Railway Level Crossing and Around Tracks
22. Safe and Secure Travel by Train
23. Driver's Guide (Malayalam)
24. Formation and Activities of Road Safety Cell in Schools (Malayalam)
25. കാൽനട യാത്രക്കാർക്കുള്ള സുരക്ഷാ മാർഗരേഖ
26. സ്കൂൾ കുട്ടികൾക്കുള്ള റോഡ് സുരക്ഷാധിഷ്ഠിത ബോധവത്കരണം
27. പപ്പു ഉറങ്ങുകയല്ല

28. സുരക്ഷിതമായ സൈക്കിൾ സവാരി
29. സുരക്ഷിത പാർക്കിംഗ്
30. റോഡിലെ ഭാഷയുടെ അക്ഷരമാല
31. റോഡ്സുരക്ഷാ മുദ്രാവാക്യങ്ങൾ
32. റോഡ് ഗതാഗത നിയന്ത്രണ ചട്ടങ്ങൾ
33. ലെയിൻ അധിഷ്ഠിത ഡ്രൈവിംഗും റോഡ് സുരക്ഷയും
34. പ്രതിരോധാത്മക ഡ്രൈവിംഗ്
35. റോഡ് സുരക്ഷയും യുവജന നേതൃത്വ പരിപാടികളും
36. ഇരുചക്ര വാഹനമോടിക്കുന്നവർക്ക് ഒരു കൈപുസ്തകം
37. ചരക്ക് വാഹനങ്ങൾക്കുള്ള റോഡ് സുരക്ഷാ സഹായി
38. പ്രതിരോധാത്മക ബസ് ഡ്രൈവിംഗും റോഡ് സുരക്ഷയും
39. റോഡപകടങ്ങൾ തടയുന്നതിനുള്ള മാർഗങ്ങൾ
40. വാഹനങ്ങളുടെ പരിപാലനവും സുരക്ഷയും

Student Badges

1. Be Careful and Be Safe
2. Don't Be Safety Blinded Be Safety Minded
3. Follow Traffic Rules and Be Safe
4. You Can't Fix Your Brain at a Body Shop – Buckle Up!
3. Road Safety is a Mission, Not an Intermission
4. Before Crossing Stop! Think! Then Act
5. Kindness is Giving the Right of Way
6. Look Carefully and Drive Safely
7. Be smart, think, then Start
8. Leave sooner, drive slower, live longer
9. Drive as if every child on the street were your own
10. Be careful and be safe
11. At work at play let safety lead the way
12. Safety is a simple ABC- Always Be Careful
13. Safety on road, Safe tea at home
14. The safe way is the best way
15. While Driving Put off Mobile! Put on Seat Belt!
16. Better to Arrive Late Than Never
17. Courtesy and Common Sense Promote Road Safety
18. നിൽക്കൂ!ശ്രദ്ധിക്കൂ!റോഡ് മുറിച്ച് കടക്കൂ!
19. സൂക്ഷിച്ച് വാഹനമോടിക്കൂ, റോഡിലെ തിരക്കിൽ നിങ്ങളുടെ കുട്ടികളും ഉണ്ടായിരിക്കാം
20. വേഗതയിലല്ല സ്മാർട്ടാകേണ്ടത്, സുരക്ഷയിലാണ്
21. ശ്രദ്ധിച്ച് നോക്കൂ, സുരക്ഷിതമായി ഡ്രൈവ് ചെയ്യൂ
22. സുരക്ഷിതത്വം മഹത്വമാണ്
23. വീഥിയിലൂടെ വേഗത വേണ്ട
24. ശ്രദ്ധിക്കൂ സുരക്ഷിതരായിരിക്കൂ
25. അശ്രദ്ധ അപകടമാണ്
26. നേരത്തെ ഇറങ്ങൂ, നേരെ ഓടിക്കൂ, നേരായവിധം ജീവിക്കൂ

27. ശ്രദ്ധയുള്ളിടത്ത് സുരക്ഷ ഉണ്ട്
28. പാഞ്ഞു പോകരുത്, പ്രാണൻ എടുക്കരുത്
29. സുഗമമായ പാത നിങ്ങളുടെ മാത്രം സ്വന്തമല്ല

Calenders

1. Steps to Use Bus safely
2. Safe Road to school – Crossing the Road Safely
3. Safe Road to School – Kerb Drill
4. Safe Road to school – Lessons from Animals
5. Road Signs
6. Important Road Safety Tips for Children
7. കുട്ടികൾക്കു വേണ്ടിയുള്ള പ്രധാനപ്പെട്ട റോഡ് സുരക്ഷാ സൂചനകൾ

Leaflets

1. Who is Walking on the Wrong Side
2. Police Hand signals
3. Safe and Correct Ways of Parking
4. Protect your Child from Injury
5. Spot the Hidden Dangers
6. Two Wheeler Driving
7. Follow this Simple Kerb Drill
8. School Safety – A Checklist for Parents
9. Understanding Traffic Rules and Regulations (English & Malayalam)
10. Don't Be Rash and End in Crash (English & Malayalam)
11. Helmets (English & Malayalam)
12. Golden Rules for Defensive Driving (English & Malayalam)
13. Untied Duppatta/Saree – Risks and Remedies (English & Malayalam)
14. Safe Travel by Bus
15. Safe Bus Driving
16. Safe Car Driving
17. Safety Precautions for Two-Wheeler Drivers
18. Safe and Responsible Parking
19. Traffic Control Devices
20. Don't find out the hard way…
21. Trains of thought- Use Extreme caution when crossing
22. Trains of thought- Safety Slogans - Just Think
23. Trains of thought- Safety Slogans - Just Think over these
24. Railway level Crossings- Safety Tips for Vehicle Drivers
25. Safe Crossing of Railway Tracks-Tips for Pedestrians and Cyclists
26. Railway Level Crossing- Safety Tips for School Buses
27. Railway Level Crossing- Safety Tips for Truck drivers
28. സുരക്ഷിത ഇരുചക്രവാഹന സവാരി
29. രാത്രികാല റോഡപകടങ്ങൾ എങ്ങനെ ഒഴിവാക്കാം
30. സുരക്ഷിത യാത്രയ്ക്കുള്ള മാർഗനിർദ്ദേശങ്ങൾ
31. പ്രതിരോധാത്മക ഡ്രൈവിംഗ്
32. റോഡ് സുരക്ഷയും മുതിർന്ന പൗരന്മാരും
33. അമിത വേഗതയും അപകടസാധ്യതകളും
34. സുരക്ഷിത പാർക്കിംഗ്

35. സുരക്ഷിത ബസ് യാത്ര
36. ബസ് യാത്രയിൽ/കാൽനടയാത്രക്കാർ
37. ഡ്രൈവർമാർ/അമിത വേഗത
38. സ്ക്കൂട്ടർ/മോട്ടോർ/ഹെൽമെറ്റ് ധരിക്കൂ
39. മൊബൈൽഫോൺ/സീറ്റ് ബെൽറ്റ്
40. ആട്ടോറിക്ഷയിൽ/മദ്യപിച്ച്
41. റോഡിൽ എങ്ങനെ സുരക്ഷിതരാകാം

Display Boards

1. Railway Level Crossing – Safety Tips for Vehicle Drivers
2. Railway Level Crossing – Safety Tips for Pedestrians and Cyclists
3. Do not play near Track
4. Safety at Railway Level Crossing
5. Trains of thought
6. Railway Level Crossings Safety Tips
7. Safety Rules while waiting at Railway Stations
8. Indian Railways at your Service
9. Indian Railways- Lifeline of the Nation
10. Precautions for Bicyclists around Tracks
11. Precautions for Pedestrians
12. Children Safety around tracks
13. Take care at Crossings
14. Precautions at Crossings
15. Never Try to Beat a Train
16. Railway Level Crossing Signs
17. Safe Crossing of Railway Tracks
18. Know and Remember
19. തീവണ്ടിയെകുറിച്ചുള്ള ചില ചിന്തകൾ
20. റെയിൽവെ ലെവൽ ക്രോസ്സിംഗ് സുരക്ഷാ സൂചനകൾ
21. റെയിൽവെ സ്റ്റേഷനിൽ കാത്തു നിൽക്കുമ്പോൾ പാലിയ്ക്കേണ്ട സുരക്ഷാ നിയമങ്ങൾ
22. നിങ്ങളുടെ സേവനം ഇന്ത്യൻ റെയിൽവേയുടെ ലക്ഷ്യം
23. ഇന്ത്യൻ റെയിൽവെ രാജ്യത്തിന്റെ ജീവനാഡി
24. സുരക്ഷിതമായി റെയിൽപ്പാത മുറിച്ചു കടക്കൽ
25. അറിയൂ ! ഓർമ്മിക്കൂ !

Road Safety Posters

1. പത്തിനും പതിനഞ്ചിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം1
2. പത്തിനും പതിനഞ്ചിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം2
3. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം1
4. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം2
5. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം3
6. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ1
7. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ2
8. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ3
9. ചില റോഡ് സുരക്ഷാ പ്രവർത്തനങ്ങൾ1
10. ചില റോഡ് സുരക്ഷാ പ്രവർത്തനങ്ങൾ2

11. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേണ്ട കാര്യങ്ങൾ1
12. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേണ്ട കാര്യങ്ങൾ2
13. റോഡ് സുരക്ഷയെ കുറിച്ച് അറിഞ്ഞിരിക്കേണ്ട മറ്റ് കാര്യങ്ങൾ1
14. റോഡ് സുരക്ഷയെ കുറിച്ച് അറിഞ്ഞിരിക്കേണ്ട മറ്റ് കാര്യങ്ങൾ2
15. നിങ്ങളും റോഡ് സുരക്ഷിതത്വവും 1
16. നിങ്ങളും റോഡ് സുരക്ഷിതത്വവും 2
17. ക്രോസിംഗ് ഡ്രിൽ 1
18. ക്രോസിംഗ് ഡ്രിൽ 2
19. യാത്ര ചെയ്യുമ്പോൾ ശദ്ധിക്കേണ്ട കാര്യങ്ങൾ
20. സിഗ്നൽ ലൈറ്റുകൾ
21. സൈക്കിൾ സവാരി ചെയ്യുമ്പോൾ
22. റോഡിൽ നടക്കുമ്പോൾ
23. Protect your life with seat belt and helmet
24. സുരക്ഷിതമായി ബസ്സിൽ യാത്ര ചെയ്യുന്നതിന് ചില നിർദ്ദേശങ്ങൾ
25. സിഗ്നൽ ലൈറ്റുകൾ കാൽനടയാത്രക്കാരുടെ ശ്രദ്ധയ്ക്ക്

INFRASTRUCTURE

1. Testing Facilities and Equipments

NATPAC is well equipped with the state of the art equipments for testing of highway materials, pavement evaluation and mix design. There is also a Geotechnical Lab for soil testing with all the equipments for routine testing of soil. The Traffic Engineering Lab of NATPAC is equipped with several softwares used for traffic modelling and analysis.

The Environmental Lab services provide air quality monitoring, noise level measurement and measurement of meteorological parameters. The list of equipments/softwares available with NATPAC is given below:

Sl. No.	Item
a) Highway Engineering Laboratory	
I.	**Soil Testing Equipments**
1.	Soil sieves
2.	Mechanical sieve shaker(motorized)
3.	Liquid limit test apparatus
4.	Shrinkage limit test set
5.	Compaction test equipment-light & heavy
6.	Automatic motorized universal compactor
7.	Core cutter for field density test
8.	Sand pouring cylinder (10cm,15 cm&20 cm dia) for field density test
9.	CBR test equipment
10.	Rapid moisture content - Infrared moisture meter
11.	Rapid moisture content - Calcium carbide test apparatus
12.	Post hole auger
13.	Direct Shear Test
14.	Triaxial Shear Test
15.	Unconfined Compression Test
16.	Consolidation Test
17.	Permeability Test
18.	Combined soil quality measurement instrument
19.	IS Sieve set for soil classification
II.	**Aggregate Testing Equipments**
20.	Aggregate sieves
21.	Aggregate Impact Value test equipment

22.	Los angles abrasion testing machine
23.	Stripping value test equipment
24.	Specific gravity test - Density basket
25.	Shape test - Thickness gauge & Length gauge, Angularity number test mould
III.	**Bitumen & Emulsion**
26.	Penetration test equipment
27.	Flash & fire point Test apparatus
28.	Softening point test - Ring & ball apparatus
29.	Ductility testing machine
30.	Standard Tar Viscometer
31.	Specific gravity - Pycnometer
32.	Dean and Stark apparatus - water content
33.	Distillation test apparatus
34.	Wax content test apparatus
35.	Solubility test equipment
36.	Particle charge test apparatus - emulsion
37.	Residue on 600 micron sieve test apparatus - emulsion
38.	Coagulation test apparatus - emulsion
39.	Settlement test apparatus – emulsion
IV.	**Tests on Mixes**
40.	Marshall stability test equipment.
41.	Motorized centrifuge extractor
42.	Core cutting machine - (100mm dia. core bit)-undisturbed sampling of bituminous pavement.
43.	Elastic recovery mould
44.	Triaxial shear apparatus
V.	**Test on Pavement and Evaluation**
45.	Fifth Wheel type Bump Integrator
46.	MERLIN - Machine for evaluating roughness using low cost instrumentation
47.	Benkelman beam test equipment
48.	Portable wheel weigh bridge/pad
49.	Portable Skid Resistance Tester
50.	Sand Patch method test set
51.	Wheel Rut Tester
b) Traffic Engineering Laboratory	
52.	Noise level meter
53.	Speed Radar

54.	Distometer
c) Topographic Survey	
55.	DGPS
56.	Single Frequency GPS-5 Nos.
57.	Total stations-3 Nos.
58.	Automatic levels-2 Nos.
59.	Theodolite
60.	High end plotters -2 Nos.
61.	Electronic Total Station
d) Environment Laboratory	
62.	CO Analyzer
63.	CO_2 Analyzer
64.	NO_2 Analyzer
65.	CH_4 Analyzer
66.	Cup Anemometer
67.	Wind vane
68.	Wind logger
69.	RH meter
70.	Thermo couple sensor
71.	Spectro photo meter
72.	Respirable Dust Sampler (APM 460)-2 Nos.
e) Water Transport Laboratory	
73.	Echo sounder
74.	Portable canti lever scale
75.	Distometer
f) General Accessories for Laboratory	
76.	Thermostatically controlled drying oven 0-150^{0}C
77.	Thermostatically controlled water bath
78.	Electronic balances – 200 g, 2 kg, 50 kg
79.	Soaking tank
80.	Heater
81.	Semiautomatic balance 10 kg – 2 nos.
82.	Traffic safety appurtenances
83.	Power generator- 2 nos.
84.	External car battery-3 nos.
85.	Digital Thermometer
86.	Agg plus for Corelok device
87.	Fall cone penetrometer
88.	Dynamic cone penetrometer

89.	UCC moulds
90.	Dial gauges
91.	pH meter
92.	Conductivity meter
93.	Turbidity meter
94.	DO meter
95.	Electronic balance (0.0001g accuracy)
96.	vacuum pump and hot plate
g) Application Softwares	
97.	MX ROAD
98.	AUTO CAD
99.	ARC GIS
100.	3DS MAX
101.	TALLY
102.	STADD PRO
103.	HDM IV
104.	SPSS
105.	ERDAS

2. *Library and Information Services*

The NATPAC Library is endowed with the responsibility of providing assistance to the scientists, researchers and students in their scientific and academic activities. The Library continued to cater to the information needs of the institute and students. The Library has a vast collection of books on Transportation, Traffic Engineering, Transport Economics, Urban and Regional Planning, Water Transport, Environment, Management, Operations Research, Geography, Statistics and allied subjects. The Technical Reports prepared by NATPAC are also available for reference purpose. The library has a good collection of the publications by Indian Roads Congress (IRC) and this collection is being updated regularly. A number of new journals, both National and International, have been added to the library during this year.

An in-house database of books, periodicals, bound volumes of journals, reports, etc., is being updated. NATPAC library is automated and managed using LIBSOFT. Bibliographic records of books available in the library can be accessed through Online Public Access Catalogue (OPAC).

The major services rendered to users by the library are reference service and literature search. Clippings from newspapers, web resources, etc. are maintained in the library for the benefits of users. E-mail alerts are sent to scientists and technical staff for new arrival of books and publications. NATPAC has been extending academic support and other R&D facilities to Researchers as well as Professionals to carry out their research and project works. During this year many Research scholars / students from different institutions undertook project works using the facilities available in NATPAC library.

Students and Research Scholars visited the library from various institutions like Rajiv Gandhi Institute of Technology, Kottayam; National Institute of Technology, Calicut, Kozhikode; Saintgits College of Engineering, Kottayam; Nehru Yuva Kendra, Kollam; School of Planning and Architecture, Bhopal; College of Engineering, Trivandrum; ITS Planners and Engineers, Hyderabad; Baselios Mathews College of Engineering, Sasthamcotta; Mar Baselios College of Engineering, Thiruvananthapuram; Sree Buddha College of Engineering for Women, Pathanamthitta; University College, Trivandrum; Al Azhar College Of Engineering and Technology (AACET), Thodupuzha; Sarabhai Institute of Science and Technology (SIST), Vellanad; Mar Baselios Christian College of Engineering and Technology, Kuttikanam; Mahatma Gandhi College, Trivandrum; Marian Engineering College, Trivandrum etc.

ORGANISATION

National Transportation Planning and Research Centre (NATPAC) is an institution of Kerala State Council for Science, Technology and Environment, which is fully supported and funded by Government of Kerala.

I. KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY AND ENVIRONMENT

i. The Members of the State Council consist of the following:

1.	Chief Minister of Kerala	-	President
2.	Minister for Industries, Govt. of Kerala	-	Vice President
3.	Minister for Finance, Govt. of Kerala	-	Vice President
4.	Minister for Agriculture, Govt. of Kerala	-	Vice President
5.	Minister for Health & Family Welfare, Govt. of Kerala	-	Vice President
6.	Minister for Education, Govt. of Kerala	-	Vice President
7.	Minister for Forest, Govt. of Kerala	-	Vice President
8.	Minister for Water Resources, Govt. of Kerala	-	Vice President
9.	Vice Chairman, State Planning Board, Kerala	-	Vice President
10.	The Chief Secretary to Government of Kerala	-	Vice President
11.	The Executive Vice President, KSCSTE	-	Member
12.	The Secretary, Department of Science and Technology, Government of India	-	Member
13.	The Secretary to Government, Finance Department, Govt. of Kerala	-	Member
14.	The Secretary to Government, Planning and Economic Affairs Department, Govt. of Kerala	-	Member
15.	The Vice Chancellor, Cochin University of Science and Technology	-	Member
16.	The Vice Chancellor, Kerala Agricultural University	-	Member
17.	The Director, Vikram Sarabai Space Centre, Thiruvananthapuram	-	Member
18.	The Director, NIIST, Thiruvananthapuram	-	Member
19.	The Director, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram	-	Member
20.	The Member Secretary , KSCSTE (nominated by Government)	-	Member
21.	Director, JNTBGRI, Palode, Thiruvananthapuram	-	Member
22.	Executive Director, NATPAC, Thiruvananthapuram	-	Member

Five eminent persons nationally known for their expertise in S&T, Industry and Environment (nominated by Government).

ii. Executive Committee of KSCSTE

1.	Executive Vice President (Ex-officio)	-	Chairman
2.	Secretary, Department of Science & Technology, Government of India or his/her nominee (Ex-officio)	-	Member
3.	Secretary, Planning & Economic Affairs, Government of Kerala (Ex-officio)	-	Member
4.	Secretary to Government, Finance, Government of Kerala (Ex-officio)	-	Member
5.	Executive Director, CWRDM, Kunnamangalam, Kozhikode	-	Member
6.	Director, KFRI, Peechi, Thrissur	-	Member
7.	One representative each of Science and Technology, Industry and Environment Departments nominated to the Council by Government of Kerala	-	Member
8.	Member Secretary, KSCSTE	-	Member

iii. Research Council of NATPAC

1.	Prof. (Dr.) Veeraraghavan Department of Civil Engineering, IIT, Chennai	-	Chairman
2.	Prof. (Dr.) Tom Mathew Department of Civil Engineering, IIT Mumbai	-	Member
3.	Sri.R M Nair Formerly Member (Tech.) IWAI, New Delhi	-	Member
4.	Dr. Chandra Satish Department of Civil Engineering IIT Roorkee	-	Member
5.	Director, Technical Education Department Government of Kerala	-	Member
6.	Principal Secretary to Government Transport Department, Government of Kerala	-	Member
7.	Director, NATPAC	-	Member & Ex-Officio Convener

iv. Management Committee of NATPAC

1.	Director, NATPAC	-	Chairperson
2.	Director, KSCSTE	-	Member
3.	Director, JNTBGRI	-	Member
4.	Dr.B.G.Sreedevi, Chief Scientist, NATPAC (On superannuation of Shri. D Robinson)	-	Member
5.	Smt. L Geetha, Additional Secretary to Govt., GoK	-	Member
6.	Registrar, NATPAC	-	Member

v. Information Officers as per the Right to Information Act

Public Information Officer (Technical)	-	Shri.Shaheem S, Principal Scientist (Till 16.12.2018) Smt.P N Salini, Scientist (Till 20.01.2019) Shri.Subin B, Scientist (From 21.01.2019)
Public Information Officer (Administration)		Shri.D.Shaju, Section Officer
Asst. Public Information Officer	-	Smt T S Sangeetha, Assistant
Appellate Authority, RTI Act	-	Director

vi. Internal Committees

a. Library Committee

Shri Shaheem S, Principal Scientist	-	Member
Shri V S Sanjay Kumar, Sr.Scientist	-	Member
Shri Arun Chandran, Jr.Scientist	-	Member
Smt K S Veena, Jr.Scientist	-	Member Convenor

b. Purchase Committee

Dr.B G Sreedevi, Chief Scientist	-	Chairperson
Shri S Shaheem, Senior Scientist	-	Member
Shri.George Koshy K, Registrar	-	Member

c. Grievance Redressal Committee

Shri K George Koshy, Registrar	-	Chairman
Shri D Robinson, Sr.Principal Scientist	-	Member
Shri K Mohanakumar, Deputy Registrar	-	Member
Shri T Ramakrishnan, Technical Officer V	-	Member
Shri K C Wilson, Scientist	-	Member
Smt. T S Sangeetha, Assistant Grade-1	-	Member-Convenor

d. Complaint Committee to prevent sexual harassment of working women at work place of NATPAC

Smt PN.Salini, Scientist	-	Chairperson
Smt.R.Padmini Nair, Accounts Officer, VSSC (Retd)	-	Member
Shri M S Saran, Scientist	-	Member
Smt N M Sabitha, Scientist	-	Member
Smt Mayadevi, Assistant Grade -1	-	Member Convenor

e. Editorial Board

1. Annual Report	-	Director Registrar Shri.D Robinson, Sr.Principal Scientist Smt.P N Salini, Scientist Smt.Veena K S, Jr.Scientist
2. Safe Savari	-	Director Shri.D Robinson, Sr.Principal Scientist Shri.Subin B, Scientist Smt.Veena K S, Jr.Scientist Shri.Sanjai R J, Technical Officer – I
3.Mobility	-	Director Shri.D Robinson, Sr.Principal Scientist Shri.T.Ramakrishnan, Techincal Officer- V Shri.Anish Kini, Jr.Scientist Smt.Veena K S, Jr.Scientist

General Administration

Research Council Meeting

The 20th meeting of the Research Council was held on 8th December 2018 at NATPAC under the chairmanship of Prof. (Dr.) Veeraraghavan.

Management Committee Meeting

The 32nd meeting of the Management Committee was held on 8th May 2018 at NATPAC under the chairmanship of Director, NATPAC.

Other NEWS

- Green Protocol Oath taking ceremony was conducted in NATPAC on 5th June 2018. Shri.George Koshy, Registrar, NATPAC delivered the oath to the staff of NATPAC.

- NATPAC observed the Constitution Day on 26th November 2018. Shri.George Koshy, Registrar, NATPAC read the preamble of the Constitution to the staff of NATPAC.

- NATPAC observed the National Voters' Day, pledge taking ceremony on 25th January 2019.

- The Republic Day celebration on 26th January 2019 at K Karunakaran Transpark.

- NATPAC observed the commemoration day of Mahatma Gandhi by keeping silence for 2 minutes at 10.55 AM on 30th January 2019.

NATPAC STAFF –AS ON 01.04.2019

Sl.No.	Name		Designation
	Shaheem S	-	Director (i/c)
Scientific Staff			
1.	Dr.B.G.Sreedevi	-	Chief Scientist
2.	V. S.Sanjay Kumar	-	Senior Scientist
3.	B.Subin	-	Scientist
4.	P. N. Salini	-	Scientist
5.	M. S. Saran	-	Scientist
6.	N.M.Sabitha	-	Scientist
7.	K. C.Wilson	-	Scientist
8.	Arun Chandran	-	Scientist
9.	Veena K.S.	-	Jr. Scientist
10.	S. Ebin Sam	-	Jr. Scientist
11.	A. Jegan Bharath Kumar	-	Jr. Scientist
12.	R. Chandra Prathap	-	Jr. Scientist
13.	Dr.U. Salini	-	Jr. Scientist
14.	B. Anish Kini	-	Jr. Scientist
Technical Staff			
15.	K. M. Syed Mohammed	-	Principal Technical Officer
16.	T.Ramakrishnan	-	Technical Officer Grade -5
17.	V. G. Sasi	-	Technical Officer Grade -3
18.	M.S. Radhakrishnan	-	Technical Officer Grade -3
19.	E. P. Surendran Pillai	-	Technical Officer Grade -3
20.	R. J. Sanjai	-	Technical Officer Grade -1
21.	Deepa Radhakrishnan	-	Technical Officer Grade -1
22.	R. Radhakrishnan Thampi	-	Technical Assistant Grade-3
23.	Shyama C.	-	Jr.Library Assistant Grade-1
Administrative Staff			
24.	K.George Koshy	-	Registrar Grade - 2

25.	T. Vijayan	-	P.A. to Registrar Grade-4
26.	Abey George	-	P.A. to Director Grade-4
27.	D. Shaju	-	Section Officer Grade-1
28.	R. Lekha	-	Typist cum Stenographer Grade-5
29.	Arya S.K.	-	Assistant Grade – 1
30.	Maya Devi M.	-	Assistant Grade – 1
31.	Veena S	-	Assistant Grade – 1
32.	Muhammed Naserudeen C.	-	Assistant Grade – 1
33.	Sangeetha T.S.	-	Assistant Grade – 1
34.	Lajila K.B.	-	Stenographer Grade – 1
35.	A.Praveen Kumar	-	Clerical Assistant Grade -2
36.	G.Ragesh	-	Driver Grade - 2
37.	A.Somaraj	-	Driver Grade - 2
38.	Surendran Kulangara	-	Driver Grade – 2
39.	Shijil P. R.	-	Driver Grade – 2
40.	Sukhdev Kolay	-	Jr. Assistant
41.	P. X. Mathew	-	Jr. Assistant
42.	S. Jayakumar	-	Helper Grade -5
43.	G. Suresh Kumaran Nair	-	Helper Grade -4
44.	A.Anil Kumar	-	Helper Grade -2
45.	Athira S.Kumar	-	Helper Grade -1

RETIREMENT

Smt.S Geetha
Technical Assistant – 3
Superannuated on 31st March 2019

RESEARCH STUDIES UNDERTAKEN DURING 2018-'19

Sl.No.	Code	Project
1	Plan-296	Development of Traffic Growth Rate Model for National Highways in Kerala
2	Plan-297	Road Asset Management for National Highways and State Highways in Kerala
3	Plan-298	Pavement Rehabilitation Design Based on Dynamic Cone Penetrometer Test (DCPT)
4	Plan-299	Study on Accidents and Safety Aspects Related to Inland Waterways
5	Plan-300	Database Creation and Management for Inland Waterways in Kerala Using GIS – Phase II
6	Plan-301	Investigation of Major Accident Spots, Causative Analysis and Mitigative Measures
7	Plan-302	Assessment of Risk Potential of SH in Kerala State: a Case Study of Selected SH in Central Kerala
8	Plan-303	Evaluation of Moisture Susceptibility of Asphalt Mixtures
9	Plan-304	Development of GIS-based Road and Traffic Database for Kerala
10	Plan-305	Periodic Updation of Price Indices for Different Public Transport and Freight Operations
11	Plan-306	Development of Accident Information System Highlighting Accident Black Spots for the State of Kerala
12	Plan-307	Integrated Designs for Public Transit Terminals in Urban areas
13	Plan-308	Utilization of Geoinformatics Tools for Updation of Existing Road Network Database
14	Plan-309	Influence of Vehicle on Saturation Flow Rate at Signalized Intersection
15	Plan-310	Regional Transportation Development Plan for Various Districts in Kerala
16	Plan-311	ITS Applications in Enhancing the Transport Infrastructure
17	Plan-312	Performance Evaluation of Plastic-Coated Aggregates on Bituminous Mixes
18	Plan-313	Evaluation of Warm Mix Asphalt Mixes with the addition of Reclaimed Asphalt Pavement
19	Plan-314	Influence of Randomly Distributed Shredded Waste Plastic on Shear Strength and Hydraulic Conductivity of Cohesive Soil
20	Plan-315-1	Traffic studies for Medical College Area
21	Plan-315-2	Enhancing Road Safety with Adaptive Traffic Signal System-Demonstration cum Implementataion
22	Plan-315-3	Study on Failure of Roads in Kuttanad Region
23	Plan-315-4	Traffic Studies for Thalassery Town
24	Plan-315-5	Designing of Model Road Safety Corridor on Pilathara Pappinnissery KSTP road in Kannur district
25	Plan-315-6	Improvements to Eruthuapuzha – Kanamala Parallel Road
26	Plan-315-7	Designing of Model Road Safety Corridor on Pilathara Pappinnissery KSTP road in Kannur district
27	Plan-315-8	Improvement for critical intersections in Kerala
28	Plan-315-9	Preparation of base plan for Malabar Botanical Garden in Kozhikode
29	Plan-315-10	Traffic Improvement Plan for Koyilandy Junction

CONSULTANCY/SPONSORED PROJECTS IN 2018-'19

Sl.No.	Code	Project	Sponsored by
1		Preparation of Intersection improvement plan for important junctions in Dharmadam Constituency	Need based Study
2		Feasibility study of Multi storied commercial complex near Secretariat , Thiruvananthapuram	
3	C 00718	Preparation of detailed alignment sketch for ring roads in Kunnamkulam	
4		Macadam design for LSGD roads	
5		Integrated development of coastal highway with cycle tracks	
6	C 00118	Road Safety Treatment for Adoor and Kazhakkoottam stretch of M C Road in Kerala State as part of Safe Corridor Demonstration Project (SCDP)	

NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE, TRIVANDRUM
(A unit of Kerala State Council for Science, Technology & Environment. Govt. of Kerala)
Balance Sheet as at 31st March 2019

(in Rs.)

Liabilities	Sch No	As at 31.03.2019	As at 31.03.2018	Assets	Sch No	As at 31.03.2019	As at 31.03.2018
Reserves & Surplus	4	1,68,31,431	1,65,24,658	Fixed Assets	1	1,68,31,431	1,65,24,658
Building Fund Account	4	10,70,39,600	10,70,39,600	Work in Progress	1	4,43,322	4,43,322
Current Liablities	5	77,55,486	76,06,383	Current Assets .	2	12,30,08,131	4,19,32,660
Unspent balance	6	5,40,01,447	(1,67,74,457)	Loans & Advances	3	9,85,13,599	10,30,13,830
Corpus fund	7	5,31,68,519	4,75,18,286				
Total		**23,87,96,483**	**16,19,14,470**	**Total**		**23,87,96,483**	**16,19,14,470**

Significant Accounting Policies and Notes to Accounts 16

For National Transportation Planning and Research Centre

Dy. Registrar (Finance) Registrar Director

For Varma & Varma
Chartered Accountants
Firm Reg. No.: 004532S

Rajeev.R
Partner
Membership No. :211277

Place : Thiruvananthapuram
Dated : 31.10.2019

VARMA & VARMA Chartered Accountants Trivandrum

NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE (NATPAC) KSCSTE Thiruvananthapuram PIN- 695 031

NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE, TRIVANDRUM
(A unit of Kerala State Council for Science, Technology & Environment. Govt. of Kerala)
Income & Expenditure Account for the year ended 31/03/2019

(in Rs.)

Expenditure	Sch No	Year ended 31.03.2019	Year ended 31.03.2018	Income	Sch No	Year ended 31.03.2019	Year ended 31.03.2018
To Infrastructure Strengthening (Plan)	11	2,52,54,924	12,63,49,331	By Grant from Government of Kerala	8	4,39,31,673	17,80,91,261
To Infrastructure Strengthening (Non Plan)	12	57,78,590	81,63,900	By Other Receipts	9	3,18,38,800	69,26,061
To Salaries and Allowances (Plan)	13	-	-	By Depreciation written back	1	37,34,177	37,49,838
To Salaries and Allowances (Non Plan)	14	4,47,36,960	5,05,04,111	By Income from Consultancy Project	10	1,79,54,193	2,66,76,526
To Depreciation	1	37,34,177	37,49,838				
To Consultancy Project Expenses	15	1,79,54,193	2,66,76,526				
Total		9,74,58,844	21,54,43,706	Total		9,74,58,844	21,54,43,706

Significant Accounting Policies and Notes to Accounts 14

For National Transportation Planning and Research Centre

Dy. Registrar (Finance) Registrar Director

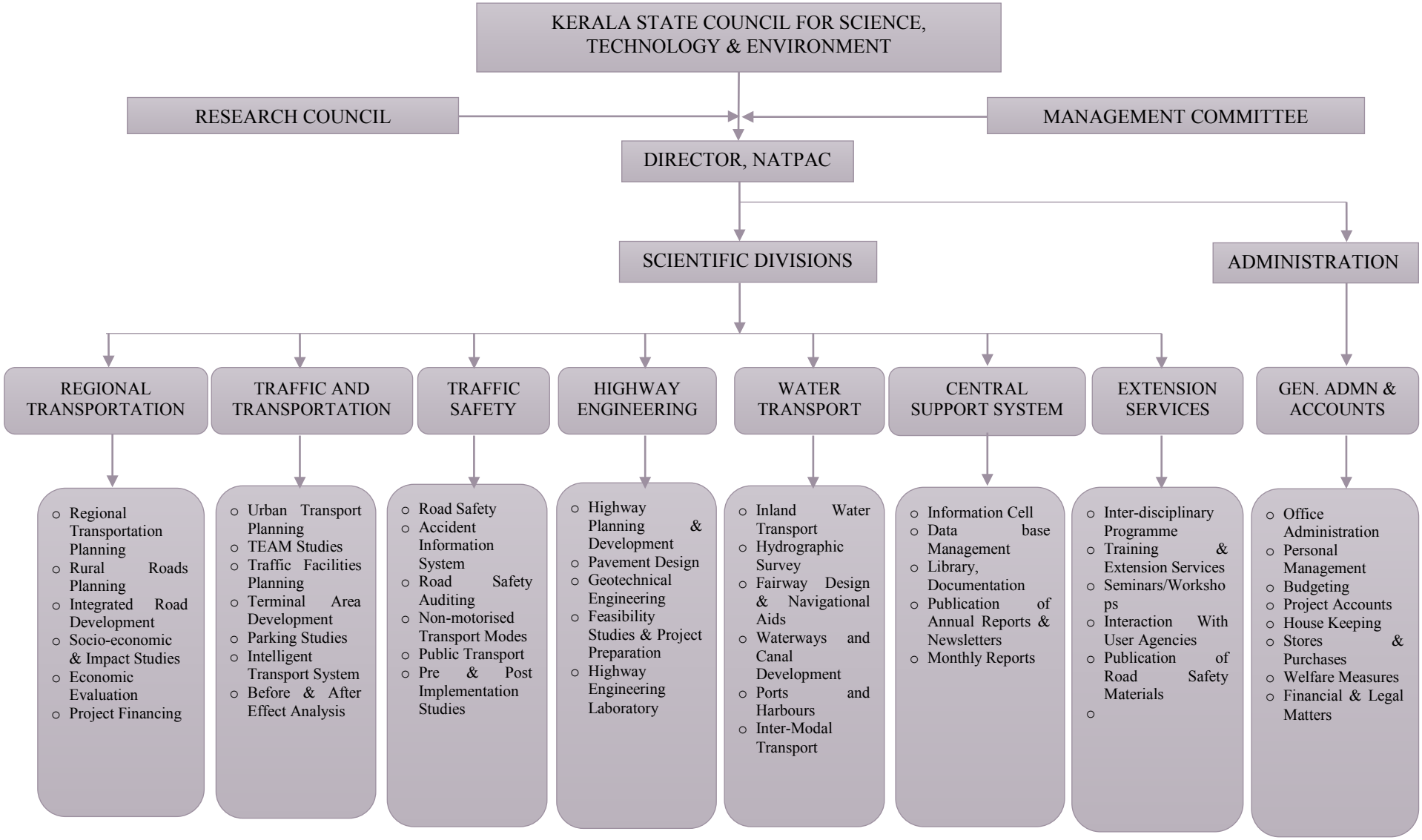
For Varma & Varma
Chartered Accountants
Firm Reg. No.: 004532S

Rajeev.R
Partner
Membership No. :211277

Place : Thiruvananthapuram
Dated : 31.10.2019

VARMA & VARMA Trivandrum Chartered Accountants

NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE (NATPAC) Thiruvananthapuram PIN- 695 031


KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY & ENVIRONMENT
RESEARCH COUNCIL
MANAGEMENT COMMITTEE
DIRECTOR, NATPAC
SCIENTIFIC DIVISIONS
ADMINISTRATION
REGIONAL TRANSPORTATION
TRAFFIC AND TRANSPORTATION
TRAFFIC SAFETY
HIGHWAY ENGINEERING
WATER TRANSPORT
CENTRAL SUPPORT SYSTEM
EXTENSION SERVICES
GEN. ADMN & ACCOUNTS
Regional Transportation Planning
Rural Roads Planning
Integrated Road Development
Socio-economic & Impact Studies
Economic Evaluation
Project Financing
Urban Transport Planning
TEAM Studies
Traffic Facilities Planning
Terminal Area Development
Parking Studies
Intelligent Transport System
Before & After Effect Analysis
Road Safety
Accident Information System
Road Safety Auditing
Non-motorised Transport Modes
Public Transport
Pre & Post Implementation Studies
Highway Planning & Development
Pavement Design
Geotechnical Engineering
Feasibility Studies & Project Preparation
Highway Engineering Laboratory
Inland Water Transport
Hydrographic Survey
Fairway Design & Navigational Aids
Waterways and Canal Development
Ports and Harbours
Inter-Modal Transport
Information Cell
Data base Management
Library, Documentation
Publication of Annual Reports & Newsletters
Monthly Reports
Inter-disciplinary Programme
Training & Extension Services
Seminars/Worksho ps
Interaction With User Agencies
Publication of Road Safety Materials
Office Administration
Personal Management
Budgeting
Project Accounts
House Keeping
Stores & Purchases
Welfare Measures
Financial & Legal Matters

ANNUAL REPORT 2018- '19

KSCSTE - National Transportation Planning and Research Centre

(An Institution of Kerala State Council for Science, Technology and Environment)
K. KARUNAKARAN TRANSPARK, Aakkulam,
Thuruvikkal P.O, Thiruvananthapuram, Pincode: 695011
Phone: 0471-2551282 / 2554467 / 2554476

E-mail: contactus.natpac@kerala.gov.in, Web: www.natpac.kerala.gov.in

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Pincode: 673005, Phone: 0495 - 2385505

KSCSTE - NATPAC

ANNUAL REPORT 2018- '19

के एस सी एस टी इ - राष्ट्रीय परिवहन योजना एवं अनुसंधान केंद्र

KSCSTE - National Transportation Planning and Research Centre

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K. KARUNAKARAN TRANSPARK, Aakkulam,
Thuruvikkal P.O, Thiruvananthapuram, Pincode: 695011
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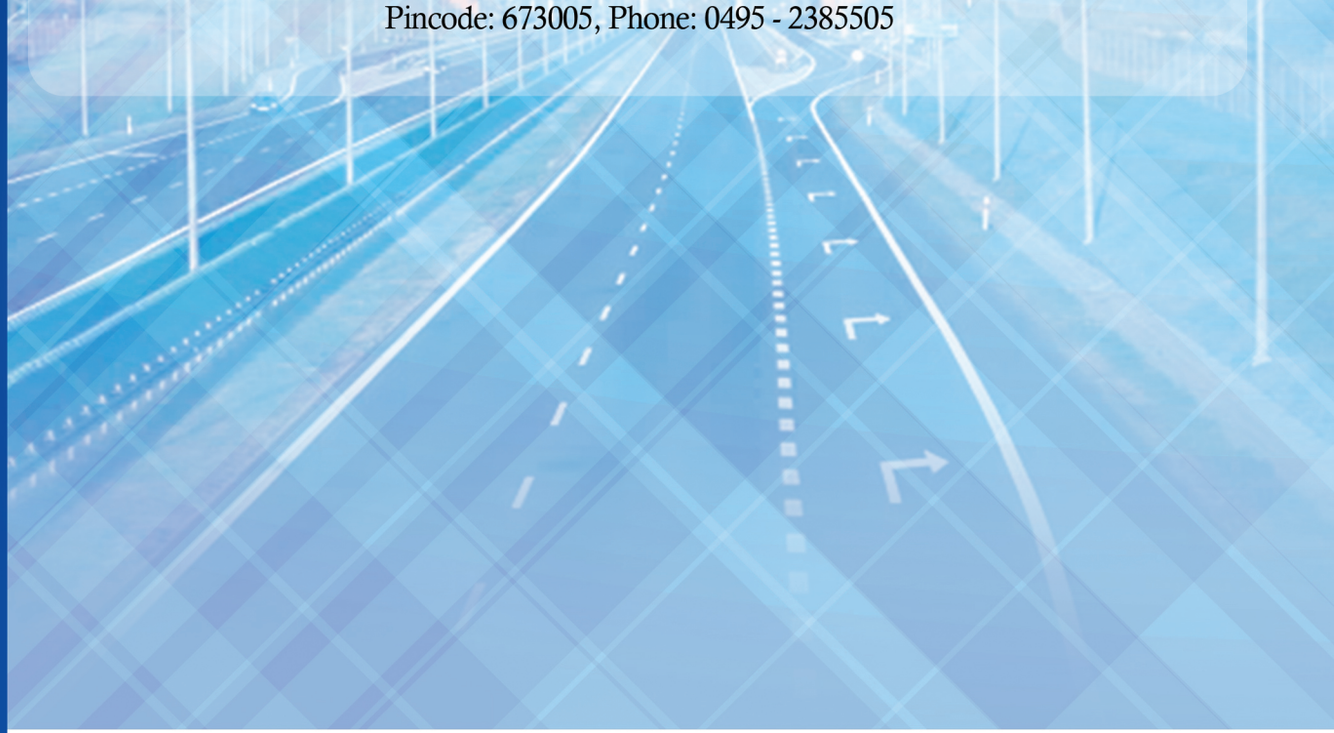

KSCSTE - NATPAC