ANNUAL REPORT

2019- '20

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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)

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

It gives me immense pleasure to share with you our Annual Report for the financial year 2019-'20. This year has been exciting on many fronts. We had delivered unique expertise in the field of Traffic and Transportation Engineering for the service of the state and the general public.

KSCSTE-NATPAC's research team formulated policies to enhance the ridership of metro services in Kochi City. A traffic growth rate model for the National Highways in Kerala was developed under the expertise of the Centre. Our research team came to the State's service at the time of great Calamity. The recent flood in Kerala had a devastating effect in hilly regions like Munnar. KSCSTE-NATPAC formulated a befitting and robust transport means which will be useful in all such tough times. The Centre is in the process of preparation of an evacuation plan for regions vulnerable to isolation during natural calamities in Kerala.

We formulated the traffic and transportation section plan for Kollam City. The Centre assessed the techno-economic feasibility of a suburban highway between Thodupuzha and Ernakulam. Our Scientists are in the process of developing a Road Asset Management System for the selected network of roads which includes National Highways, State Highways and Major District Roads.

As part of improving traffic safety of Ottapalam Municipal bus stand, KSCSTE-NATPAC suggested remedial measures. In order to avoid the delay of ambulance services in reaching the accident spot and back to the hospital we are implementing a safe system which would control the traffic signals so that emergency services will get priority.

The main aim of our Traffic Safety Division is to develop traffic safety initiatives aimed at reducing fatalities and serious injuries from motor vehicle crashes. This division is implementing programmes in traffic safety that helps to keep our roads safe. The Centre is continuously monitoring the crash scenario in Kerala by regularly undertaking on-the-spot investigation of accidents in the State and thereby suggesting crash counter measures. Our Scientists are studying the overtaking characteristics followed by different types of vehicles. We identified the road crash black-spots for the entire State of Kerala with crash data for the year 2016-'18 and prioritized them for implementation of rectification measures. The Centre is in the process of developing a Web GIS - based road crash information system using Geospatial tools for Kerala.

The periodic updation of price indices for Intermediate Public Transport (IPT) Services in Kerala helps the Government to take appropriate decision whenever fare revision matter is taken up.

The study of using shredded plastic waste as a solid stabilizer is an economical and gainful utilization when good quality soil is scarce for embankments and fills. This is also an alternative method of disposal of plastic waste. Data produced by our Highway Engineering Division – 'Resource Mapping of Road Construction Materials in Kerala' helps to identify and classify potential construction aggregate resources and fill materials for use in infrastructure development.

Inland Water Transport is a viable sustainable alternative for addition to road and rail transport. Though environmentally friendly and the most economical mode of inland transport, it remains largely under-exploited. Our Water Transport Division is preparing a DPR for the development of inland waterway between Mahe river and Valapattanam river. They also carried out the digitization of water way nrtwork in Kerala. Our Scientists suggested maintenance and management system for Parvathy Puthanar.

The Library of KSCSTE-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 other research institutions and universities. The Library is maintaining a blog natpaclibrary1.blogspot.in to make users abreast of the latest developments in the library. Web OPAC extension of KSCSTE-NATPAC Library is available in https://natpac.libsoft.org/.

We are providing facilities and guidance to several students for accomplishing 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 Public Works are thankfully acknowledged. The continuous support obtained from the Executive Vice President of KSCSTE, Research Council and Management Committee of KSCSTE-NATPAC has helped us to discharge our duties for the benefit of the Society. Our team is our strength. I must thank my scientific, technical and administrative colleagues for all the excellent work.

Prof. (Dr.) SAMSON MATHEW
DIRECTOR

SUMMARY OF PROJECTS

1. *Study on the Effect of Metro on the Mode Choice Behaviour of Commuters in Kochi City*

Date of start: 04/2019
Date of completion: 03/2020

Need and importance of the Study

The public transport system in Kochi city mainly comprises of metro, train and buses. After the introduction of Kochi metro, no significant reduction was observed in the number of trips using private vehicles on the road. Hence, it is necessary to analyse the effect of metro on the mode shift behaviour of commuters in Kochi city. The present study focuses on formulating policies to enhance the ridership of metro services in Kochi city.

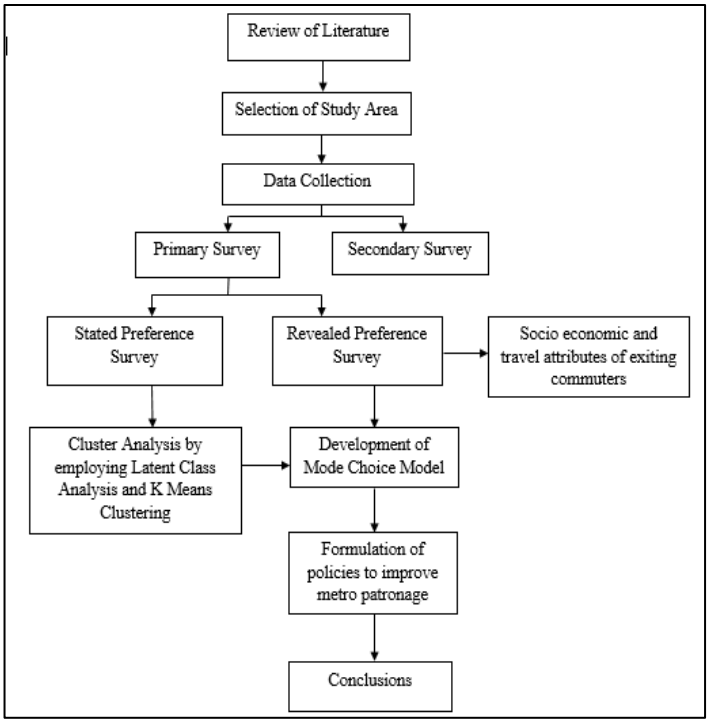
Objectives and Scope

The scope of the study is limited to major urban locations in Kochi city. The major objectives of the study are listed below:

- To study the socio-economic and travel characteristics of existing public transport users in Kochi city;
- To develop a mode choice model for commuters in Kochi city;
- To classify the non-metro commuters in Kochi city into different categories on account of their willingness to shift to metro by conducting cluster analysis;
- To formulate policies for improving metro patronage in Kochi city.

Methodology

The detailed methodology for the study is shown below:



Data Collection

Revealed Preference Survey was conducted at selected metro stations among existing metro users to study the socio-economic characteristics and travel characteristics. About 800 commuters were interviewed as a part of the study. The Stated Preference survey was used to determine the willingness of the commuters to shift to the metro system from their existing modes. Each respondent was provided with six distinct scenarios that consisted of both existing and proposed values for system attributes like travel cost, waiting time, parking facility and feeder services. About 700 commuter responses were obtained as part of the study. The surveys were undertaken at bus stop locations, major commercial developments, and office and employment zones in Kochi city. Secondary data collected included study reports from Town Planning department and Kochi Metro Rail limited.

Development of Mode Choice Model

Mode choice models using N Logit software were developed to predict the shift of commuters from their existing mode to metro. Separate models were developed for commuters using two wheeler, car and bus. At first, a model was calibrated using 75% dataset. Another model was calibrated and the Log-likelihood was estimated using the rest 25% data. The model initially

calibrated with the 75% data was applied to the hold out sample and the Log-likelihood was calculated. Then, these two values of Log-likelihood were compared to their closeness. The overall model fit of all the models developed was observed to be within acceptable limits.

Cluster analysis was conducted to find out the optimum number of classes to which the commuters could be divided based on their willingness to shift to metro. It was employed by means of latent class analysis and k-means clustering which were conducted using R studio software. By conducting latent class analysis, the five-class model was found to be the best fit on account of the minimal value of Bayesian Information Criterion (BIC) and maximum log likelihood value as the highest when compared to other models. While conducting k-means clustering, the number of clusters was increased by one in each step starting from two clusters and the optimum number of clusters was found out using elbow curve which was obtained as four for the present study.

Conclusion

- From the analysis of Revealed Preference Survey data, it was found that the high income commuters are devoid of using metro due to lack of sufficient parking facilities. Car and two wheeler were found to be most preferable as the access as well as egress modes among high income commuters whereas bus was found to be a more desirable mode for access and egress trips among low income commuters.
- From the mode choice analysis, it was found that travel time, travel cost, monthly income, travel purpose and age were the parameters significantly influencing the probability of shift of commuters from bus to metro whereas travel time, travel cost, monthly income, vehicle ownership and gender were the major parameters influencing the probability of shift of commuters from two wheeler to metro. The probability of shift of commuters from car to metro was found to be highly influenced by travel cost, occupation, age and travel distance.
- From latent class analysis, it was found that about 42% of the total commuters were willing to shift to metro. K means clustering analysis showed that about 23% of the total commuters were found to be willing to shift to metro at a reduced metro fare

with an increase of only 25% when compared to the existing public transport fare paid by them. These were the commuters traveling with major purpose as work.

- It was also found that there was an increase in probability of shifting to metro among car commuters (4.25%) and two wheeler commuters (13.64%) with a reduction in metro fare by 25%.

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

Date of start: 04/2015
Date of completion: 03/2020

Need and importance of the Study

This study aims to develop a traffic growth rate model for the National Highways in Kerala.

Objectives of the Study

- Establishment of volume count stations;
- Establishing relationships between the collected traffic data and socio-economic indicators;
- Development of different regression models for traffic growth rate and validation.

Data collection

Three locations situated in southern Kerala, middle Kerala and northern Kerala were selected for the primary data collection and four set of 7 days 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 (NH- 66) at Kollam district, Paliyekkara (NH 544) at Thrissur District and Mahe near Vadakara (NH 66) at Kozhikode district. All the relevant secondary data such as vehicle registration data of selected districts, population growth, population density, per capita income, Gross State Domestic Product/ Net State Domestic Product, agriculture, industries, other services were also collected.

Model identification

The various techniques available for developing a model for traffic growth rate were identified. A hybrid method i.e. a combination of ARIMA and ANN is utilized for deriving a model for traffic growth rate for the NH in Kerala.

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 satisfied. Regression models were also developed combining the time series models with a nonlinear model. The obtained models were compared with the results obtained from the hybrid model.

Conclusion

Different traffic prediction models were prepared and found that hybrid model in the form of combination of ARIMA and Artificial Neural Network has the maximum accuracy.

3. *Resilient Transportation Planning for Disaster Prone Area - A Case Study of Munnar Town*

Date of start: 04/2019
Date of completion: 03/2020

Need and importance of the Study

Critical infrastructure networks, including transport, are crucial to the social and economic function of urban areas but are at increasing risk from natural hazards. Minimizing disruption to these networks should form part of a strategy to increase urban resilience. The recent flood havocs in Kerala had a devastating effect in hilly regions like Munnar, wherein most of the roadways were disrupted and the inundated town got completely cut off for days from rest of Kerala. Absence of a resilient transportation network was well evident while the evacuation plans were sought for. This highlights the necessity of providing a befitting and robust transport means which would remain useful in all such tough times.

Objectives and Scope

The broad objectives of the study are to identify the elements of risk, vulnerability and resilience associated with the transport plan of the study region, to identify the basic parameters of resilience engineering and identify the key variables for a site specific resilience design, to form a holistic plan for a robust transport system for the region which can absorb the effects of unexpected events like natural calamities and comply with a desired performance level, to evolve out a transport plan which can ensure operational continuity in times of natural disasters, to frame recommendations on up gradation of existing transport system and introduction of appropriate future transport systems which can remain resilient and serve the purpose in adverse climatic conditions and to evaluate the economic benefits of resilience activities in the future transportation planning.

Study Area

Munnar town and its outskirts which are most affected by the natural disasters like flooding and landslides are demarcated for this study. Munnar is a town and hill station located in the Idukki district of the south western State of Kerala. The study area is selected such that almost all roads affected during the floods are included.

Methodology

The first phase of the study is inventory of the existing infrastructure. Then, identification of disaster affected/prone areas and road routes and identification of alternate routes with potential for further up gradation. Geotechnical investigations at disaster affected areas were conducted to recommend for suitable slope protection techniques. Next, hydrology studies were done to investigate the cause and effect factors affecting the transport infrastructure. Attribute database were prepared for each of the identified routes in the transport network and generation and integration of various thematic layers, viz. landslide distribution, landslide hazard zonation, land use/land cover, drainage order and lithology were done. Geotechnical and hydrology data were prepared using GIS technique.

Data Collection

Detailed inventory of the transport infrastructure in the study area was collected and analysed. Major structure collapses like the demolition of Periyavarai Bridge connecting Munnar with Marayoor and cities of Tamil Nadu like Udumalapet were analysed. This bridge was damaged during the 2018 torrential rains. A temporary bridge was constructed to ensure connectivity between the two sides. This temporary structure got washed away again in the 2019 flood. The bridge is the only link connecting Udumalpet in Tamil Nadu with Munnar and Ernakulam. So when the bridge collapsed, the other side was completely isolated from the rest of Kerala.

Data Analysis

Numerous roadways were destructed by natural disasters and alternate routes were identified. Detailed geotechnical investigations of the study area were being done. Data acquisition on road construction parameters and possibility of alternate routes was examined. Hydrological studies were also done using data compiled from different sources to analyze the impact of the hydrology of the area on the transport infrastructure.

Interim Conclusion

Existing road network in study area is passing through severe landslide prone area. This causes serious after effects like complete isolation of Munnar from the rest of the state, complete disruption to the transport network, etc. This emphasizes the need for another set of roads which can be used alternatively in critical situations. Connectivity of road network with alternate routes of all-weather roads is necessary especially to NH85 as a measure of evacuation. During natural calamities, first priority is for the evacuation process. For that, the transport network should be efficient.

Recommendations for Further Work

The research is pursued and will contribute to the development of planning strategies for cost-efficient maintenance of highway infrastructures exposed to landslide hazards. Comprehensive transport plan for a resilient infrastructure to be developed considering the geotechnical and hydrological characteristics of the area.

4. *Preparation of Evacuation Plan for Regions Vulnerable to Isolation during Natural Calamities in Kerala*

Date of start: 04/2019
Date of completion: 03/2021

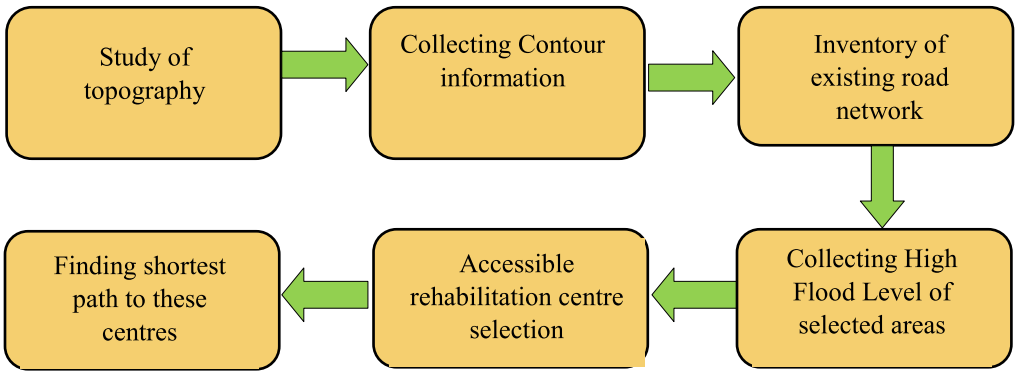
Need and importance of the Study

In Kerala, the floods and landslides are recurring in some areas. In such situations the public transport system fails and some of the regions get literally stranded and isolated. In order to assess the impact of 2019 floods on traffic and transportation, a team of officers from KSCSTE-NATPAC visited the major flood affected locations across the state where traffic was reported to be disrupted due to the rain havoc and subsequent floods.

Objectives and Scope

The scope of the study is limited to regions that are likely to get stranded and isolated during the times of flood. The major objectives of the study are to assess the existing transport network in the isolation prone areas, study the post flood scenario on the transportation network of selected regions, analyse the loss of connectivity in the wake of recent floods, identification of feasible alternate transport systems for rescue and recovery operations, study the technical and economic viability of alternate transportation systems and to formulate evacuation plans for vulnerable and likely to be isolated regions.

Methodology



Major flood affected regions in the districts of Idukki, Palakkkad, Malappuram, Kozhikode, Wayanad and Kannur were visited. Based on detailed analysis, Attappadi block in Palakkad district has been selected as the study area.

Data Collection and Analysis

Primary reconnaissance survey to the six worst hit districts during the 2019 floods. Secondary Information has been collected from the Kerala State Disaster Management Authority. Digital Elevation model of the study stretch was acquired from USGS Earth Explorer. Data Analysis includes hazard zonation mapping for flood and landslide of the study area in ArcGIS.

Interim Findings

Many regions of Attppadi are prone to landslides. Mannarkkad- Attappadi Road is the only primary road to the region from the mainland and landslides are recurring at many portions of this road. This results in the isolation of Attappadi from the rest of the state. 3000 persons belonging to 850 families in Attappadi region was affected due to landslides in August 2019. This shows the need for a suitable evacuation plan for the region.

Expected Outcome

The study would bring out impact of natural hazards on our current transportation system. On the basis of recent floods, the available rehabilitation process will be studied. Suitable data such as High Flood Levels of study area and traffic volume data will be collected and appropriate transportation methods will be recommended.

5. *Study on the INDO-HCM Adjustment Factors for Capacity Analysis of Intersections in Kerala*

Date of start: 04/2019
Date of completion: 03/2022

Need and importance of the Study

At grade intersections are critical points of road network where delay normally occurs due to sharing of space and time between conflicting streams. It is necessary to study them to arrive at various capacity and Level of Service (LOS) under different operating conditions. Indo-HCM

presents concepts and procedures for estimating the same. Different adjustment factors are used for adjusting the base saturation flow for specific conditions. It put forth adjustment factors for bus blockage, exclusive right turns and initial surge. But it doesn't give the adjustment factors for parking activity, pedestrian activity, interference due to bus stop, approach grades at intersections etc. which are typical characteristics of intersections in the state of Kerala. Meanwhile the HCM 2010 gives adjustment factors for all these specific conditions present in the intersection approach. This study intends to analyse the adjustment factors for typical characteristics of intersections in Kerala.

Objectives and Scope

Studies are conducted at intersections with specific features to arrive at adjustment factor that accounts for reduction in saturation flow due to particular features at intersection. The study intends to determine customized values of adjustment factors for features like presence of bus stops, parking/pedestrian activity, approach grades at intersections etc.

Methodology

The intersections considered for this phase of the study include both three arm and four arm intersections with typical characteristic features classifying them to base and non-base type. The intersections considered for the study are given in **Table 1.**

Table 1: Study Intersections

Name of Junction	Details of Intersections						Base/ Non base
	Number of arms	Approach width (No of lanes)	Bus stop near the junction **Yes/No**	Longitudinal Gradient **Yes/No**	Curve Present **Yes/No**	Channelised**Yes/No**	
Pattom	4	4 lane divided	Yes	Yes	Yes	Yes	Non Base
Palayam	4	4 lane divided	Yes	No	Yes	No	Non Base
Paruthippara	3	4 lane undivided	Yes	No	Yes	Yes	Non Base
Vetturoad	3	2 lane divided	No	No	No	Yes	Base

The first phase of the study involved selection of intersections where data pertaining to geometric, traffic and other control parameters could be collected. The saturation flow is estimated from the field studies and compared with theoretical saturation flow. Correlation

between the measured saturation flow and geometric and traffic factors is then found out. The estimated saturation flow is calibrated and modified adjustment factors are determined.

Data Collected

The major tasks involved in the study included collection of geometric details (total station survey), Signal timing, Phasing plan, Traffic volume data (peak period data), field measurement of saturation flow, queue length determination, field delay estimation, estimation of traffic parameters for capacity and LOS analysis by videography method, data on parking activity, pedestrian activity, presence of bus stops- bus manoeuvring, calibration of existing models developed for estimation of saturation flow, determination of modified adjustment factors to better account for ground conditions existing at non-base intersections as proposed in Indo-HCM manual could be calibrated using the data for prevailing conditions in Kerala.

Data Analysis

Geometric details of the intersections under study are collected and drawings prepared. The traffic details of few junctions along with the control conditions like signal phasing are also analysed. The estimation of saturation flow at different junctions is being analysed to find the influence of various parameters. It is found that different category of vehicles and its composition in the traffic flow at the intersection is having some influence on the saturation flow.

Interim Conclusion

From the studies conducted so far it is found that the saturation flow is very sensitive to all the categories of vehicles.

Recommendations for Further Work

The study is to be further pursued with more detailed data collection and analysis. The influence of various factors like stopping of buses in the vicinity, parking and pedestrian activity etc. on the saturation flow and capacity of intersections need to be researched into.

6. *Traffic and Transportation Studies for Amrut Cities - Kollam Corporation*

Date of start: 07/2019
Date of completion: 03/2020

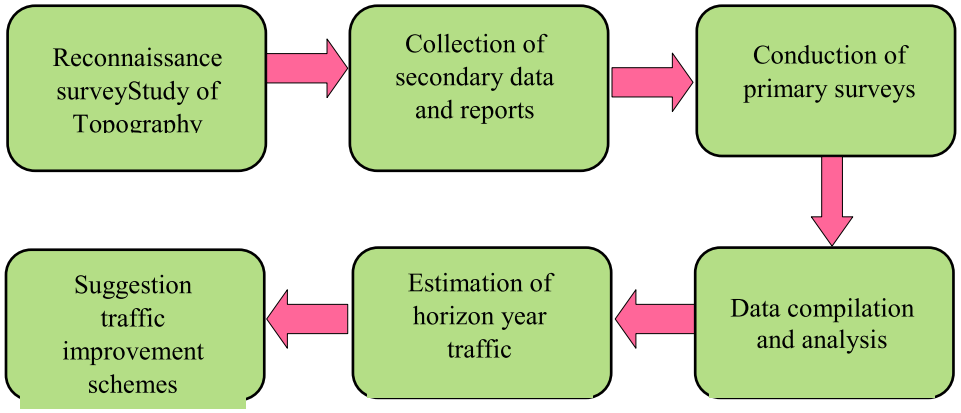
Need and importance of the Study

Department of Town and Country Planning, Government of Kerala is in the process of preparation of GIS based Master Plans for Six cities in Kerala State under the centrally sponsored scheme of "Formulation of GIS based Master Plans for Amrut Cities". KSCSTE-NATPAC was requested to carry out study in these cities and Kollam is one of six selected cities.

Objectives and Scope

Detailed objectives are formulated for preparation of traffic and transportation sectional plan for Kollam city. This includes, study of existing condition of road network and find out bottle necks in the study area, speed and delay characteristics and delay cause, find out peak hour and volume of intersections, parking and pedestrian characteristics study, origin destination movement of traffic and by passable traffic, existing street furniture, need for road making and street lighting, estimation of traffic flow for horizon year and to develop suitable plan for horizon year.

Methodology



Data Collected

Following surveys were conducted for data collection - road inventory survey, speed and delay, link volume, traffic volume at major intersections and parking and pedestrian survey. Along with these surveys previous year road accident trip details from bus terminal, Kollam Port and Inland Water Transport departments were also collected.

Data Analysis

Inventory studies were done to study road network and speed characteristics obtained from speed and delay survey. From intersection analysis peak value, link volume and capacity utilization results were acquired. Parking and pedestrian analysis gives intensity of parking and pedestrians. Origin Destination (OD) analysis were done to get inter-city travel and to find by passable traffic.

Recommendations

Recommendations for Kollam town study addressed traffic and transportation related problems. For intersections, geometrical improvement and grade separated facilities were proposed. For pedestrians, walkway between bus terminal and railway station was proposed. Multilevel car parking and on street parking facilities were also needed to address parking problems. To accommodate goods traffic, new goods terminal was proposed.

7. Traffic Improvement Schemes for selected internal roads at Valiyamala LPSC Campus in Thiruvananthapuram District

Date of start: 05/2019
Date of completion: 07/2019

Need and importance of the Study

Liquid Propulsion Systems Centre (LPSC) of Indian Space Research Organization is proposing road widening and speed calming measures for the internal roads at Valiyamala Campus in Thiruvananthapuram district, Kerala. LPSC has sought the services of KSCSTE – NATPAC to carry out a study and suggest appropriate measures.

Objectives and Scope

Objective of the study was to conduct topographic survey of four selected intersections with in the campus and to propose improvement measures.

Methodology

The methodology adopted for the study consisted of reconnaissance survey, traffic and topographic survey, situation analysis and improvement proposal. Four main roundabouts are selected for improvement proposal. They were Mini Roundabout Junction, LPSC/ASMG Junction, Semi- Cryo Junction and Karippur gate Junction. Mini round about is a seven arm intersection with a central roundabout of diameter 5metre. Other three junctions are three arm intersections.

Data Analysis

Traffic survey were analysed for LPSC mini roundabout and LPSC/ASMG intersections and peak value was found to be 333 Passenger Car Unit (PCU) and 195 PCU respectively. Detailed geometric design for respective intersections were prepared.

Recommendations

Proposed road safety treatment for the internal roads of LPSC consists of the geometric corrections at intersections, traffic calming measures, traffic signal, road markings and safety improvement schemes.

8. *Feasibility Study for developing a Suburban Highway between Thodupuzha and Ernakulam*

Date of start: 2018
Date of completion: Continuing

Need and importance of the Study

Ernakulam city, the commercial capital of Kerala and Thodupuzha, located in the Idukki district are two major urban centres in Kerala. There is a large number of floating populations which moves from Thodupuzha to Ernakulam district for employment and other activities. By

road, Thodupuzha is connected with Ernakulum via Muvattupuzha by SH8 and NH85. This road carries more than 80% of the Thodupuzha - Ernakulam traffic and the road is congested due to heavy traffic. Also, the ribbon development along the road corridor and the activity centres such as Vazhakulam, Muvattupuzha, Kolenchery, Thiruvankulam etc. increases the travel time of the road users. Widening the existing road will ensure smooth traffic flow with less congestion but involves high cost due to considerable R&R activities. Hence the option of exploring a greenfield alignment connecting Thodupuzha and Ernakulam is considered. In this context, the Public Works Department, Government of Kerala has entrusted KSCSTE-NATPAC to carry out the feasibility study of 'Thodupuzha – Ernakulum Suburban Highway'.

Scope and Objectives

The scope of the study is confined to assess the techno- economic feasibility of a suburban highway between Thodupuzha and Ernakulam. The main objectives of the study were:

i. To assess the demand for providing a new road;
ii. To identify and assess the existing shortest routes connecting Thodupuzha - Ernakulam and thereby analysing the scope of developing them;
iii. To identify and compare alignments based on technical, economic, social and environmental friendly manner and thereby suggesting a best feasible alignment.

Methodology

Towards achieving the targeted objectives, a detailed methodology has been formulated which consists of the following tasks;

i. Start-up activities, site appreciation and reconnaissance survey;
ii. Review of past study reports, development proposals etc;
iii. Collection of data including traffic volume, Origin-Destination characteristic and existing operating speed etc. to understand the existing traffic and travel characteristics of the study area;
iv. Identify new/existing possible alignments and verify it with the ground level;
v. Compare the developed alternative alignments and arrive the most feasible alignment that connects Thodupuzha with Ernakulam.

Study Outcome

SH-8, SH-40, and SH-41 are the three major roads connecting Thodupuzha to Ernakulam of which SH-8 plays a vital role as it carries major share of traffic between these two towns.

The traffic studies conducted on these roads reveal that the capacity of the existing roads is insufficient for handling the existing traffic. This fact is revealed by V/C ratios in SH -8 which varies from 1.1 to 1.2. This necessitates developing the connectivity by means of widening the existing roads or by developing a new highway between these two towns. Developing the existing corridor involves a huge disturbance to the roadside developments and found as a costlier effort. Hence, alternative roads are explored as part of the study.

The possibility of four alignments was explored including the leewayof existing State Highway. These three alignments were initially developed considering the shortest path analysis method and later scrutinized by smoothening of sharp curves and connecting important nodal points. The fourth optional alignment arrived was the widening of existing SH 8 (Thodupuzha – Muvatttupuzha - Ernakulum) to a four-lane bypassing the Muvattupuzha town area. The bypass stands out to be a greenfield alignment covering 5.8km. All the alignments are designed for a speed of 80kmph. All the alignments considered starts at Thodupuzha - Ramamangalam and Vengallor – Kolani Bypass Road junction and end at the proposed Thrippunithura bypass. Alternative 1 has a length of 39.12 km and connects Nellikavu, Arakuzha, Meenkunnam, Peruvamuzhi, Ramamangalam, Athani and Thiruvaniyoor. Alternative 2 has a length of 40.3 km and connects Nellikavu, Pandappilly, Aaroor, Mannathoor, Pampakuda, Kizhumuri, Parambathupady, Kanayannur, Chottanikkara, Kottayathupara and Kadungamangalam. Alternative 3 has a length of 38.22 km and connects Nellikavu, Pandappilly, Aaroor, Mannathoor, Pampakuda, Kizhumuri, Parambathupady, Kanayannur and Thiruvaniyoor. The primary soil investigation studies show that the existing soil available in all the alignment paths has a good CBR value which implies that it can be considered for subgrade construction.

A traffic demand estimate was done using the Origin Destination survey data. The traffic for the operational year 2023 is projected from base year using growth factors provided in IRC. The AADT estimated for alternative 1 is 16358 PCU and for alternative 2 and 3 is 15180 PCU.

The Economic feasibility analysis was carried out for all the four alignments. The Economic Internal Rate of Return (EIRR) for option III is well followed by options I, II and IV.

On reviewing the technical and Economic feasibility, Option III is most suitable for a new Greenfield suburban alignment connecting Thodupuzha and Ernakulam.

9. *Traffic Studies in Connection with the Traffic Diversion in Kuthiran for HVDC Cable Laying*

Date of start: 19/01/2020
Date of completion: 02/2020

Need and importance of the Study

Power Grid Corporation of India Limited (PGCIL), an Indian state-owned electric utility company, was planning to lay underground power cables through Kuthiran curves in Thrissur of NH 544. Hence, traffic through Kuthiran needs to be restricted and diverted during excavation and construction period due to limited right of way and terrain conditions. At the instance of the Powergrid Corporation of India Ltd, KSCSTE-NATPAC conducted a study to assess the traffic scenario in Kuthiran region.

Objectives and Scope

1. To assess the volume and composition of existing traffic in the study corridors and their existing characteristics;
2. To Identify feasible alternate roads for temporary traffic diversion;
3. To prepare preliminary road safety assessment for the identified alternatives;
4. To inspect the safety aspects of the tunnel at Kuthiran for permitting temporary movement of goods vehicles;
5. To prepare a detailed Safe Operating Procedure (SOP) during mock drill to be held before continuous operation through tunnel.

Methodology

Traffic volume survey for 24 hour time period was carried out at selected locations on NH 544, SH 74 and SH 22. Based on this, the potential amount of traffic to be diverted was estimated.

Then feasible alternate roads for temporary traffic diversion were identified and preliminary road safety assessment for the identified alternatives was done. A detailed Safe Operating Procedure (SOP) for the Kuthiran tunnel was also prepared.

Table 2 shows the summary of alternate road sections for Route A adopted for traffic diversion.

Table 2: Summary of Alternate Road Sections for Route A

Alternative	Road Section		
	Initial Section	**Common Section**	**Distance from Mannuthy**
1	Mannuthy – West Vellanikara – Therambam – Ponganamcode – Kundukadu – Ottupara (22.8km)	Ottupara – Nelliyamkunnu (39.8km)	62.60 km
2	KAU - Mudikkode – Chirakkakode – Therambam – Ponganamcode – Kundukadu – Ottupara (24.9km)		70.0 km
3	Mannuthy - Chembukavu – GEC Thrissur – Viyyur – Wadakkanchery – Ottupara (26.5km)		66.30 m

A preliminary safety assessment of the alternative routes was carried out and is addressed. Quick systematic on-site review was conducted by the study team for identifying hazardous conditions and avoiding probable confusion to the motorists. From the 24 hour traffic volume survey and from the analysis of collected data, traffic volume on the existing Kuthiran region was obtained. The amount of traffic which needs to be diverted through the alternates routes and effect of this diversion on the alternative routes were also identified. Safety aspects of the tunnel for permitting temporary Goods vehicular movement were inspected and detailed Safe Operating Procedure (SOP) was prepared.

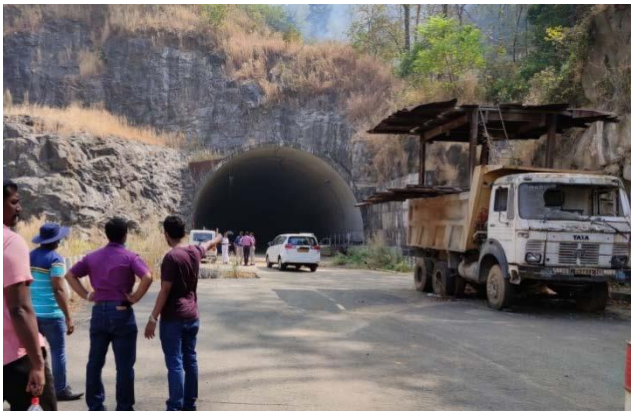


Plate 1
Work zone separation during trial run

Plate 2
View of Tunnel during trial run

Summary

Traffic volume data was collected from Kuthiran for a period of 7 days and the analysis of the collected data was carried out. From the analysis it is observed that an average of 25,923 veh/day pass through Kuthiran. Based on the traffic study conducted on selected locations, KSCSTE-NATPAC suggested three alternate routes for the diversion of light vehicles like cars, two wheelers, passenger tempos and passenger trucks from Thrissur to Palakkad during the period of laying of HVDC cables through Kuthiran curve.

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

Date of start: 04/2017
Date of completion: Ongoing Study (Proposed up to March 2022)

Need and importance of the Study

Kerala is a state with average annual rainfall of about 3000 mm and high vehicular traffic through National Highways, State Highways and Major District Roads. Hence a good and efficient Road Asset Management (RAM) system is necessary for the better performance and sustainability of road network and road infrastructure at minimum financial input. Due to the lack of an efficient RAM, the road network and infrastructure in Kerala may not have a desired LoS. This study deals with the initial steps for developing a RAM system for a network of roads in Kerala.

Objectives and Scope

Scope of this work is limited to National Highways, State Highways and Major District Roads (MDR) in the selected district of Kerala. The objectives of this work are:

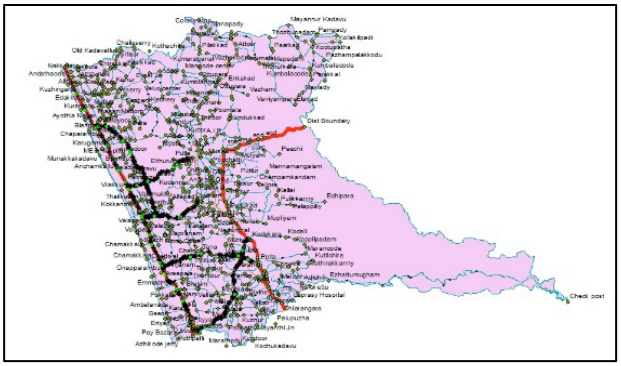
- To create a Road Asset Management System (RAM) for the selected network of road which includes National Highway (NH), State Highways (SHs) and Major District Roads (MDRs);
- To develop Pavement Deterioration Models.

Methodology

An initial reconnaissance survey was conducted in Thrissur district of Kerala and a suitable road network was selected for the study. The network includes one National Highway (NH), three State Highways and two Major District Roads (MDRs). Portion of NH 66 (Kanyakumari to Panvel) passing through Thrissur district was selected for the study. The State Highways selected for the study were: SH 75 (Vadanapally- Thrissur), SH 61 (Potta- Moonupeedika) and SH 51 (Kodakara-Kodungalloor). The MDRs selected were: Peringotukara- Kanjaany-Chavakkadu road and Cherpu- Thriprayar road. All the State Highways and MDRs selected for the study has one end at NH 66.

Data Collection and Analysis

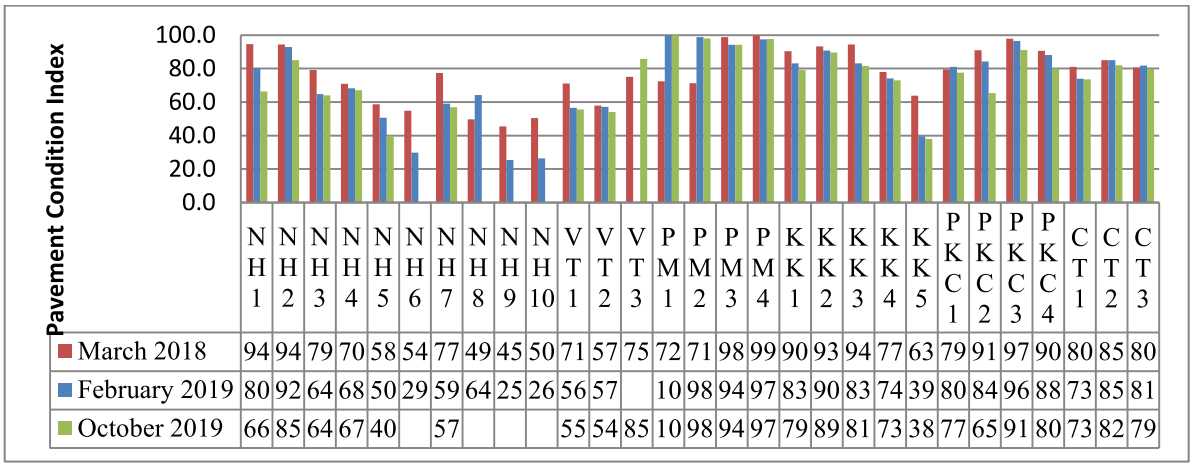
During the previous financial years of 2017-18 and 2018-19, data collection was done on 29 control sections each having a length of 1 km. But after the flood that occurred in August 2019, some of the sections in the road network got severely damaged. In addition to 1 km long test sections, 64 sections each having a length of 200 m, were demarcated from each 1 km of the road network. Detailed Pavement Condition Survey was carried out to calculate the Pavement Condition Index. **Figure 1** shows the average PCI of 1 km long test sections.



Roughness of each homogeneous section was measured at every 100m interval on each lane using Fifth Wheel Bump Integrator and the data was represented in terms of IRI. Traffic volume survey was carried out at 28 major

mid-block sections with in the road network on a normal working day. The data was expressed as daily traffic in terms of Passenger Car Unit (PCU), towards the purpose of standardization.

The collected data was properly tabulated and stored for further analysis. GIS platform was used for the storage of the data. Then homogeneous sections and test sections were demarcated in the road network. The data is stored in the form of attribute tables.



	NH1	NH2	NH3	NH4	NH5	NH6	NH7	NH8	NH9	NH10	VT1	VT2	VT3	PM1	PM2	PM3	PM4	KK1	KK2	KK3	KK4	KK5	PKC1	PKC2	PKC3	PKC4	CT1	CT2	CT3
March 2018	94	94	79	70	58	54	77	49	45	50	71	57	75	72	71	98	99	90	93	94	77	63	79	91	97	90	80	85	80
February 2019	80	92	64	68	50	29	59	64	25	26	56	57		10	98	94	97	83	90	83	74	39	80	84	96	88	73	85	81
October 2019	66	85	64	67	40		57				55	54	85	10	98	94	97	79	89	81	73	38	77	65	91	80	73	82	79

Figure 1: Average PCI of 1 km Long Test Sections

Interim Conclusion

During the past three years of this work, surveys carried out for collecting data includes pavement condition survey, roughness measurement, traffic survey, structural performance evaluation, road inventory and secondary data collection. From the collected data PCI, IRI and daily traffic in terms of PCU were calculated. By comparing the PCI value of 1km test sections, it was observed that the rating of most of the sections remains same, while the rating of some test sections fell down. On comparing the IRI value, the IRI value of some of the sections decreased, while some sections shows increase in IRI.

Further work

The study is to be extended for two more years. Based on the various data collected, pavement deterioration models will be developed. Also the process of development of a Bridge Management System is ongoing.

11. Traffic Safety Improvement Plan for Ottapalam Municipal Bus Stand

Date of start: 12/06/2019
Date of completion: 12/07/2019

Need and importance of the Study

The Joint Regional Transport Officer, Ottapalam requested KSCSTE-NATPAC to conduct a study on Ottapalam Municipal Bus Stand and to suggest remedial measures to improve traffic safety inside the bus stand.

Objectives

- To identify the safety issues inside the Ottapalam Municipal Bus Stand
- To suggest possible improvement measures that could be made to improve the overall traffic safety in the bus stand.

Methodology

A reconnaissance survey was conducted in order to assess the traffic safety scenario and the circulation plan of buses and other vehicles in the Ottappalam Bus stand. Relevant secondary data like number of buses, base map of the study area and crash data inside the study area were collected. Using these data, improvement plans were prepared in order to reduce the traffic issues within the Bus stand.

The passengers were found to be walking through the open area of the bus stand and in particular zig-zag movement of passengers. Due to this, chances of pedestrian – bus conflict was very high inside the bus stand. Designated pedestrian walkways/ sidewalks were not provided inside the bus stand. Markings were also not provided inside the bus stand to guide the bus traffic.

Plate 3
Pedestrian zig-zag movement inside the bus stand

Plate 4
Pedestrian – bus conflict

Recommended Possible Improvement Measures

After identifying the existing safety issues inside the Ottapalam Municipal Bus Stand, the KSCSTE-NATPAC team recommended two improvement proposals. The main aim of the two proposals was to segregate the bus traffic and pedestrian traffic in order to decrease the pedestrian – bus conflict. Some physical structures and markings were introduced to avoid/reduce the conflicts. It has been ensured that a segregated pedestrian walkway was possible so as to have a proper pedestrian circulation around the bus stand, with minimum vehicular conflict. **Figure 2** and **Figure 3** show the two improvement proposals recommended by KSCSTE-NATPAC. While considering the two proposals, there exists a bus to bus conflict area inside the bus stand in Proposal 2. Hence Proposal 1 is more advisable. All the alterations and modifications are made so as to avoid changes to the existing bus bays and auto rickshaw stand. Along with the proper circulation plan, traffic calming measures, road markings and suitable channelizers has also been incorporated to obtain a safer movement for both the pedestrians and vehicles.

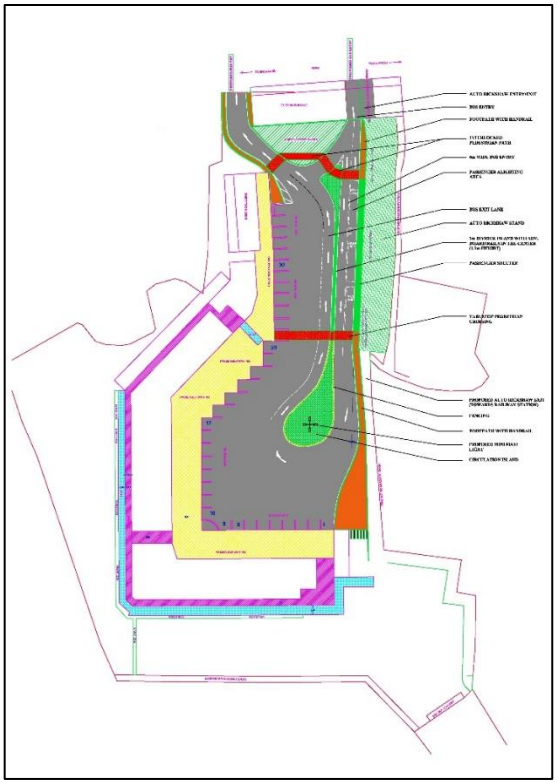


Figure 2
Improvement Proposal 1

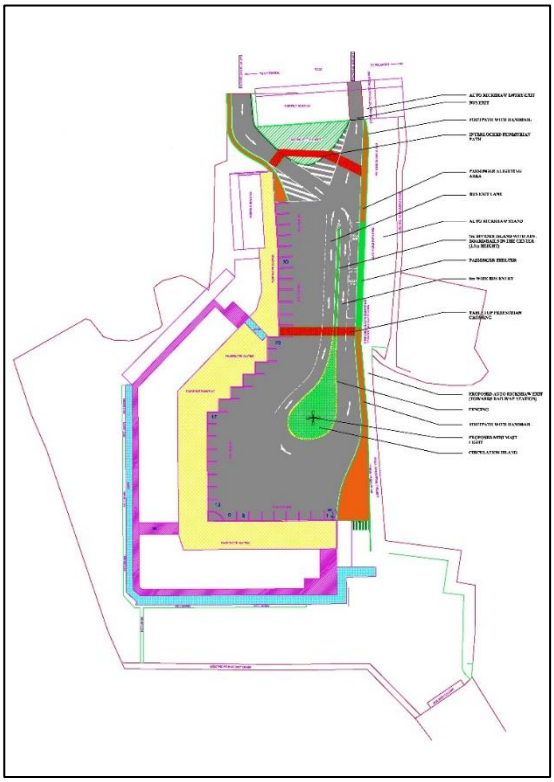


Figure 3
Improvement Proposal 2

12. Intelligent Transportation System Applications in Enhancing the Transport Infrastructure

Date of start: 04/2018
Date of completion: 03/2021

Need and importance of the Study

One of the most critical problems after an accident is the delay of Ambulance services in reaching the spot and back to the respective hospital. The idea behind this project is to implement a safe system which would control the traffic signals so that emergency services get priority and reach their destination without any delay in time. The Emergency Vehicle Priority system is mainly focused to assign priority to ambulance. 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.

Objectives and Scope

- Assess the existing operations of ambulance services in a fixed time Traffic Signal control environment;
- Device a system architecture for Emergency Vehicle Prioritization system for pre-emption of ambulance vehicles;
- Develop an algorithm for the proposed system under various scenarios;
- Evaluate the impact of the proposed system in comparison to fixed time signal environment.

The scope of the Study is limited to Paruthipara junction in Thiruvananthapuram.

Methodology

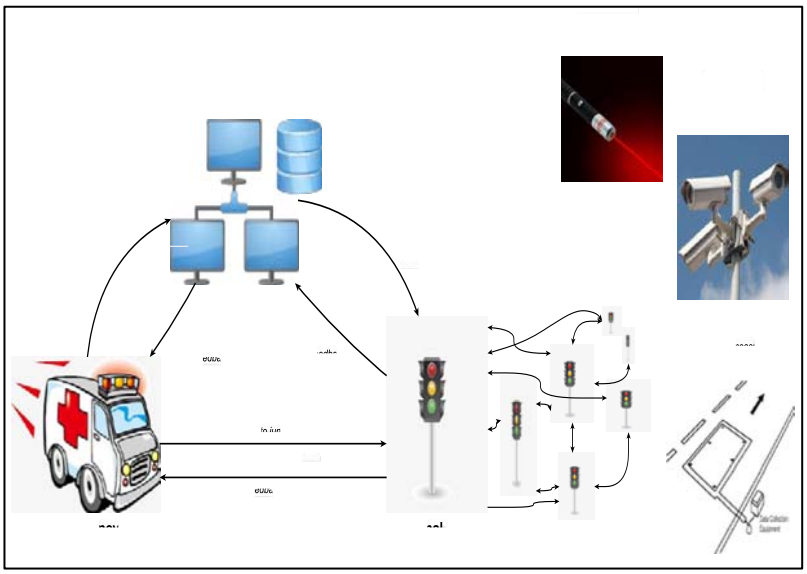


Figure 4: System Architecture of EVP System

Functioning of the 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.

Interim Conclusion and Further Work

Initial field testing and majority of EVP system development is completed successfully. After assembling the board, the system will go for real time on site test with a duration of three months. After the successful on site testing, tracking system and Specific ID number for each emergency vehicle would have to be introduced along with development of a mobile app for avoiding the system's misuse.

13. Feasibility Study for the Installation of Signals at various locations in Alappuzha and Kollam District

Date of start: 05/2019
Date of completion: 03/2020

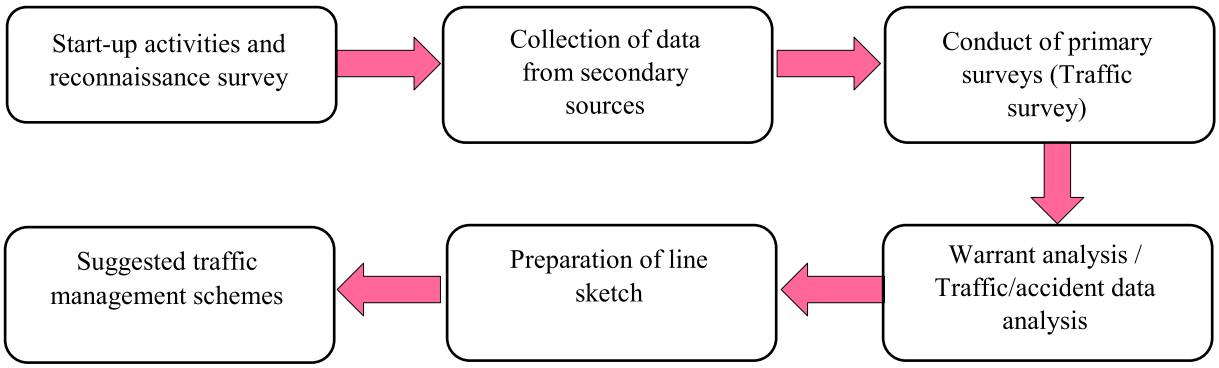
Need and importance of the Study

Major intersections in Kerala experiences traffic and safety problems which attracts attention from public as well as government agencies. This study was conducted as per suggestion from Kerala police and MLA, Karunagapally. Various intersections in Kollam and Alappuzha districts were selected for traffic signal, high mast lamp, surveillance camera and blinkers. In Alappuzha, Collectorate junction and eleven other intersections and in Kollam district, Paravoor and intersections in Karunagapally were selected for signal studies.

Objectives and Scope

The main objective of the study is to ascertain the feasibility of providing traffic signals as per IRC warrants at these junctions. In addition to signal installation need and position of high mast lamp, surveillance camera and blinkers were also studied. To strengthen the study accident analysis was also conducted with other traffic studies.

Methodology



Data Analysis

Detailed data analysis was carried out for this study. Main part of the analysis was the checking of warrants with IRC:93-1985. Among all selected intersections Collectorate junction at Alappuzha and Paravoor intersection at Kollam experiences major traffic issues.

Recommendations

Signals, Blinkers, surveillance camera and high mast lamp were proposed for the study. Collectorate junction at Alappuzha satisfies warrants recommended by IRC:93-1985, but due to geometric limitations at the intersection, installation of signal may affect effective functioning of intersection by increasing delay. Suitable traffic management measures and recommendations have been suggested to ensure smooth flow of traffic and to ensure better convenience to all categories of road users. Paravoor intersection also satisfies warrants but geometry of intersection was a major concern. So redesigning of intersection is recommended. **Table 3** shows details of other recommendations in Alappuzha and Kollam.

Table 3
Details of other recommendations in Alapuzha and Kollam

Sl.No.	Traffic Signal	Blinker Light	Mini Mast lamp	Surveillance Camera
1	Alappuzha			
	6	7	10	-
2	Karunagapally,Kollam			
	1	5	-	23

14. Road Crash Investigation, Crash Reconstruction and Development of Mitigative Measures

Date of start: 2016 - 2017
Date of completion: 2020 - 2021

Need and importance of the Study

This is a five year research study formulated as a reactive measure to explore the causative factors of major crashes occur in the State of Kerala and to derive mitigation strategy in a system approach to avert recurrence of the same. This study comprises the analysis and reconstruction of selected crashes occurred during 2019-20 in Kerala.Accidents are categorized by the severity index and site visits are done at the earliest to accumulate maximum evidence which comes very useful in accident reconstruction. Once the causative factors are identified the most suitable short term, medium term and long term mitigative measures are formulated and suggested to the local bodies, policy makers, Stake Holding Departments etc. for implementation.

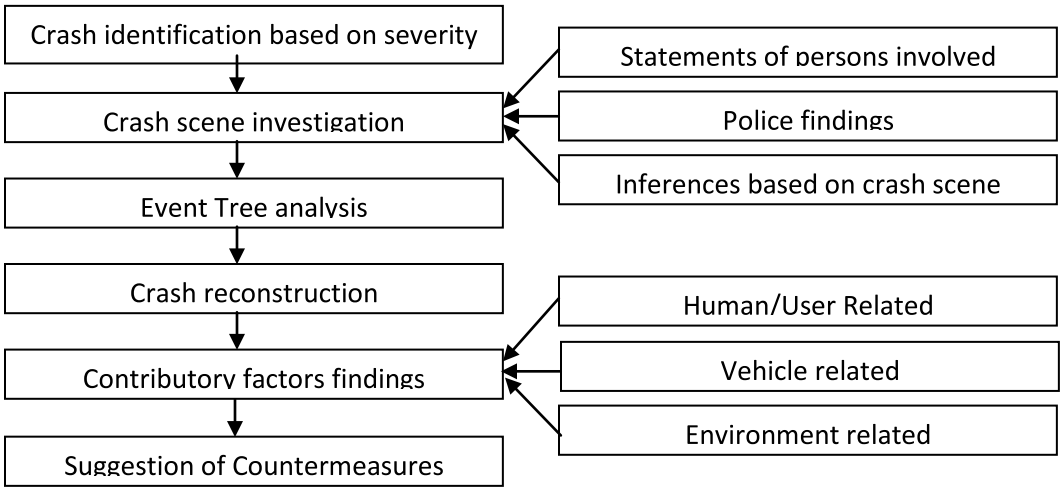
Scope and Objectives

- To study the root cause behind severe crashes and to find solutions to reduce future recurrence;
- To identify the influencing factors that led to the crash;
- To analyze the causative factors and reconstruct the crash using advanced software techniques;
- To suggest proper countermeasures to the local authorities to prevent any further crashes on that road stretch.

The scope of the study is confined to major crashes involving two or more fatality or more than five severe injuries happening in Kerala only.

Methodology

The flow chart below explains the crash investigation methodology adopted.



During 2019-20, crash investigation study has been conducted for nine major crashes. Even tree and Haddon Matix analysis has been conducted for all these cases, causative factors were analyzed and reports were prepared and submitted to Stake Holding Departments for implementation of mitigative measures. These crashes were also reconstructed using modern 3d animation techniques in video format and are utilized in various training programmes and outdoor campaigns for public awareness on road safety.

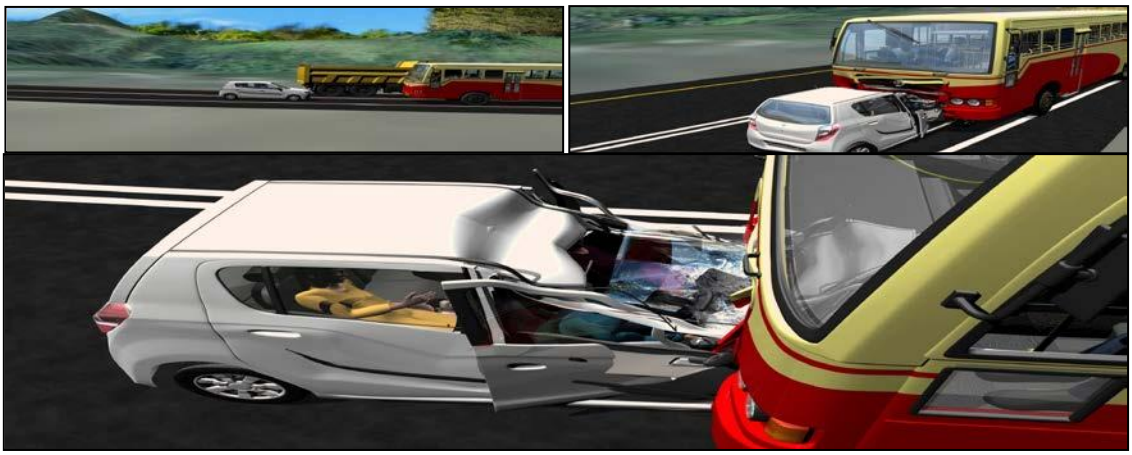


Plate 5: Snap shots of crash reconstruction

15. Crash Prediction Modelling of Undivided Two Lane Two-Way Road Networks in Kerala

Date of start: 2019 - 2020
Date of completion: Continuing (Proposed for three years)

Need and importance of the Study

Crash prediction models (CPMs) are used for a variety of purposes; most frequently to estimate the expected accident frequencies from various roadway entities (highways, intersections, rural roads etc) and also to identify geometric, environmental and operational factors that are associated with the occurrence of crashes. Majority of roads in Kerala are undivided two lanes two ways and thus it is important to examine the relationships between roadway, environmental and operational factors and accidents to understand the causal mechanisms involved in accidents and to predict their occurrence.

Effective road safety management requires knowledge of the present safety performance and expected future performances if proposed actions are taken. As one of the main methods, CPMs which describe relationships between the number of accidents and factors that are believed to be related to accident occurrence have been developed by several authors to estimate current or future road safety performance.

Objectives

- Developing a crash prediction model to predict the number of crashes on Kerala roads so that appropriate actions are taken in the future;
- To consider various causative factors of crashes and to find out the significance of these variables so that one can know which variables had significant effects on accident occurrence;
- Deficiencies in road geometry, driver specific and other factors pointed as part of the research can be corrected in future by suggesting suitable counter measures.

Methodology

- Road environmental factors –identifying road stretches with higher number of accidents from previous year crash data's and analysing specific road geometric factors and their relationship with crashes;
- Driver specific – identifying the driver specific causative factors such as gender, age group, driver experience, alcohol use etc.;
- Other factors –AADT, weather conditions, time of the day etc.

Interim conclusions

Severity of accident can be reduced by applying prediction model with proper input of parameters. The likelihood of accidents on the study stretch can be reduced. The need of costly remedial work can be reduced. Significance of various road elements can be found out and care can be given to rectify the significant parameters. Crash prediction models can also be very useful in road safety programs conducted by transportation agencies, police, and health departments, education institutions etc.

Progress of the Study

This Study is intended to develop crash prediction modelling for two way two lane road networks in Kerala. Literature Survey and research methodology part is completed during the first year. The second phase is collection of accident data and its filtering and analysis. Accident data pertaining to 2017, 2018 and 2019 are collected and the analysis is in progress.

16.Assessment of Risk Potential of State Highways in Kerala State

Date of start: 2016 - 2017
Date of completion: 2020 - 2021

Need and importance of the Study

Kerala has been among the top 5 contributors to Indian road accidents per year. Most of the accidents occur on National and State highways owing to their better road conditions and quality.There has been a need to think deeply into the safety matters of the road and the present study undergoes deep into the causative factors and have listed various causative factors for

immediate correction. International Road Assessment Programme (IRAP) as well as other mathematical tools has been used to model the accident causative factors and various mitigating measures have also been suggested.

The roads taken for study are the major State Highways. The roads act as a bypass to the NH and thus there has been heavy and increasing traffic on the road. Also the highway pass through densely populated semi-urban and rural areas and thus safety aspects are to be taken care of for the safety of road users as well as pedestrians.

Objectives

- To perform Road Safety Audit (Existing Roads) on the selected road SH;
- To generate the existing star rating indices in terms of safety to road users using iRAP methodology;
- To identify black spots and development of mitigate measures;
- To prioritise road safety improvement plans on the basis of critical safety issues identified in Road Safety Audit (RSA) and ranked using iRAP for its severity;
- To generate safe road investment plan.

Data Collection

The purpose of the data collection process is to find the main problems faced by the road user and quantifying them for reducing fatalities and serious injuries. Data collection was done manually as well as through video graphic methods. The road geometry and the location specific analysis were done for every 100 m road stretch. The database consisted of details regarding roadway geometry and condition, crash data and traffic volume. Existing roads RSA Methodology and iRAP methodology was followed as reference for data collection.

Data Analysis

Preliminary analysis of data was performed to understand the relation between various variables. Preliminary analysis list out various factors which have contributed to road crashes in the past. Addressing least contributory factors will be time waste as well as non-economical, so prioritization was done.Most vulnerable category of road users and their risk factors was

accessed. Star ratings indices from the IRAP was used as a benchmark in defining major concerns across the road network along with various mathematical modelling techniques. Scatter plot analysis and correlation analysis was done to find the quantitative association between various factors.IRAP data analyses were done using the IRAP India Vida software and checked with the manually modeled factors to find the relation between the rating of roads and the main influencing factors. The safe road improvement plans will be derived for improving the critical road safety issues.

Interim conclusions

In this study, an attempt will be made to examine the interrelationship amongst the different variables and various types of road crashes and to identify the most suitable model. iRAP methodology will be followed to generate star ratings and safe road investment plans. It helps to optimize and logically invest money to improve the key parameters pertaining to safety enhancements. Effects of already installed safety features will also be evaluated.

17.Overtaking Behaviour of Drivers - A Case Study on selected Roads in Kerala

Date of start: 2019 - 2020
Date of completion: 2023 - 2024

Need and importance of the Study

In Kerala, majority of roads are undivided and overtaking has been the prime reason behind many of major road accidents. Overtaking is one of the most complex and important maneuver on undivided roads where the vehicles use the opposing lane to overtake the slower vehicles with the presence of oncoming vehicles from opposite direction. This study was motivated by several accidents which have been reported on undivided roads due to overtaking.

Objectives

- To study the overtaking characteristics followed by different types of vehicles;
- To study the driving behaviour of peoples on different classes of roads extending to all districts of Kerala;

- To develop relationships between overtaking frequency with traffic flows in the ongoing direction, opposite direction and in both the directions;
- To study the change in overtaking characteristics when different test vehicles (car, truck and buses) are used.

Methodology

- Selection of suitable roads having considerable accident rates along 14 districts of Kerala;
- Moving car observer method, Videography and registration plate method for data collection;
- Data analysis and modelling.

Interim conclusions

The overtaking characteristic of vehicles on undivided roads in mixed traffic and non-lane discipline traffic conditions was studied. The overtaking characteristics of all types of vehicles under mixed traffic conditions were observed and mathematically modeled. The data collected includes acceleration characteristics, speeds of the overtaking vehicles, overtaking times and overtaking distances, safe opposing gap required for overtaking, flow rates, overtaking frequencies, types of overtaking strategy, and types of overtaking and overtaken vehicles. The model output can be effectively used in providing various countermeasures for reducing road crashes while overtaking. The study also find implications on estimation of overtaking sight distance and designing of overtaking zones on main roads.

Many studies conducted on this particular field have been limited to only one test vehicle and the behaviour studied are limited. However this study focuses on a wider spectrum and usage of different category of test vehicles especially in real time scenario using video graphic survey technique and image processing analysis. Thus it can generate more logical and valid outcome which will be very much beneficial in modeling traffic on heterogeneous traffic conditions.

18.Identification and Prioritization of Crash Black-Spots in Kerala State

Date of start: 03/2019
Date of completion: 31/2019

Need and importance of the Study

In 2018, Kerala witnessed 40,181 road crashes resulting in 4,303 fatalities, grievous injuries to 31,672 persons and minor injuries to 13,786 persons as per the data collected from Kerala State Crime Bureau. According to Ministry of Road Transport and Highways (MoRTH) report on Road Accidents in India-2017, the share of road accidents in Kerala accounted for 8.3% of total road accidents in the country, occupying the fifth position among all the States.

Black Spot Management (BSM), which is a reactive approach within the discipline of traffic safety, involves scientific analysis of crash data, identifying the nature and cause of crashes and designing appropriate engineering interventions leading to the prevention of such road accidents in future. Identification, analysis and treatment of these black spots are widely regarded as one of the most effective approaches in preventing road crashes. There is an urgent need to identify the black spots and prioritize them so that scarce resources can be utilized more judiciously for road safety measures.

KSCSTE-NATPAC had submitted 'Protocol for Black-spot management (BSM) of the road network in Kerala' to Government of Kerala and Kerala Road Safety Authority in the year 2016. Accordingly, as per the Protocol for Black-spot management, it was proposed by KSCSTE-NATPAC to undertake study in two stages for identification and prioritization of accident black spots and to carry out road safety inspections of prioritized accident black-spots to identify suitable short term immediate improvement measures. At the instance of Kerala Road Safety Authority, KSCSTE-NATPAC has conducted Stage-1 study on identification and prioritization of crash black-spots in the Kerala State.

Scope and Objectives

The major objective of the Stage-1 study is to identify the road crash black-spots with crash data for the year 2016-2018 and to prioritize them for implementation of rectification measures in Kerala State. The scope of the study covers the entire State of Kerala.

Methodology

Secondary data from various sources was collected related to the study area, which includes crash statistics for the past three years, road network characteristics, vehicle population statistics, demographic characteristics, area statistics, etc. Crash data with geographical co-ordinates pertaining to the years 2016-2018, collected from Police department were compiled and refined for further macroscopic and geo-spatial analysis. The macroscopic analysis was performed to assess existing crash scenario and trend for previous three calendar years (2016 - 2018) in the Kerala State. The geospatial analysis was performed using GIS software to identify and prioritize crash black-spots.

Findings

An indicative list of more than 4700 road stretches of 500m was identified as vulnerable locations in Kerala State. The identified vulnerable locations were ranked and prioritized for implementing remedial measures based on severity factors. A total of 340 road stretches are prioritized as 'Priority crash black-spots', which are further classified into High-risk black-spots (232 locations) and moderate-risk black-spots (108 locations). All the prioritized crash black-spots should be rectified on immediate priority basis in the state. Map showing priority crash spots identified in Kerala State are shown in **Figure 5.**

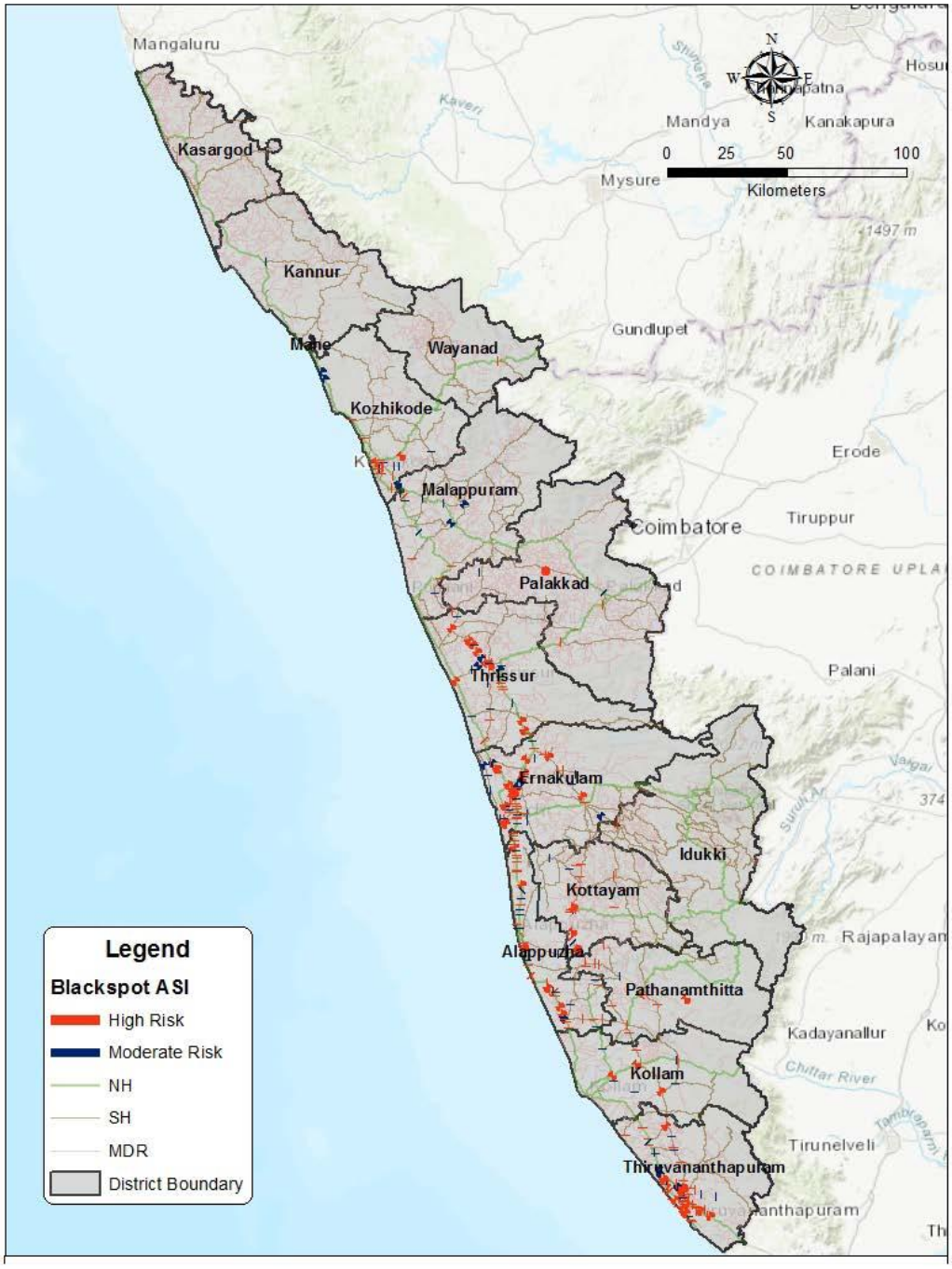


Figure 5: Map Showing Crash Black Spot Locations in Kerala State

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

Date of start: 04/2016
Date of completion: 03/2021

Need and importance of the Study

A comprehensive geographic information system (GIS) is an effective tool for integrating, managing, querying, and spatially analyzing transportation data. Moreover, it provides an efficient means for interpreting and displaying empirical trends and patterns in transportation data. 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.

The present study 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.

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 KSCSTE-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

- 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.
- Inputting the collected data to the GIS platform and develop a macro database for road inventory and traffic data for the entire state.

Findings

Primary data of earlier studies conducted by KSCSTE-NATPAC in the study area during 2011 - 2015 were collected for the major districts in Kerala, namely Thiruvananthapuram, Ernakulam, and Kozhikode. Road inventory and traffic data for preparing database was extracted from the study reports and were compiled. Road inventory and traffic data compiled were coded and converted into attribute dataset for further development of geo-database. Primary road inventory data include 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 compiled.

Road network map was developed 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. GIS map of National Highways and State Highways in Kerala was prepared in the scale of 1:500 and was validated with field data.

After creating attributes table of entire study area, different asset details like Road inventory, Traffic Volume, Traffic Volume Projection and Parking Accumulation data are being compiled and assigned to each road stretch. Collection and assignment of road chainages are under progress.

Figure 6, 7 and 8 show the road network map developed, road inventory attribute table developed and the development of database in GIS software for Thiruvananthapuram district respectively.

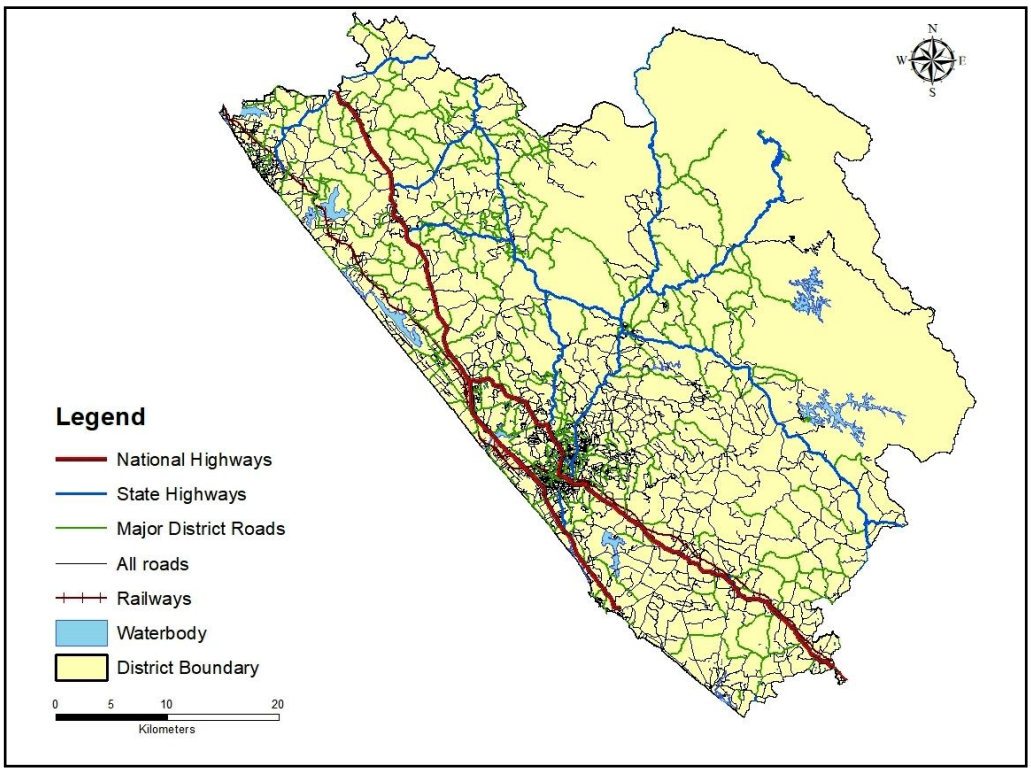


Figure 6: Road Network Map developed for Thiruvananthapuram District

Figure 7: Road Inventory Attributes

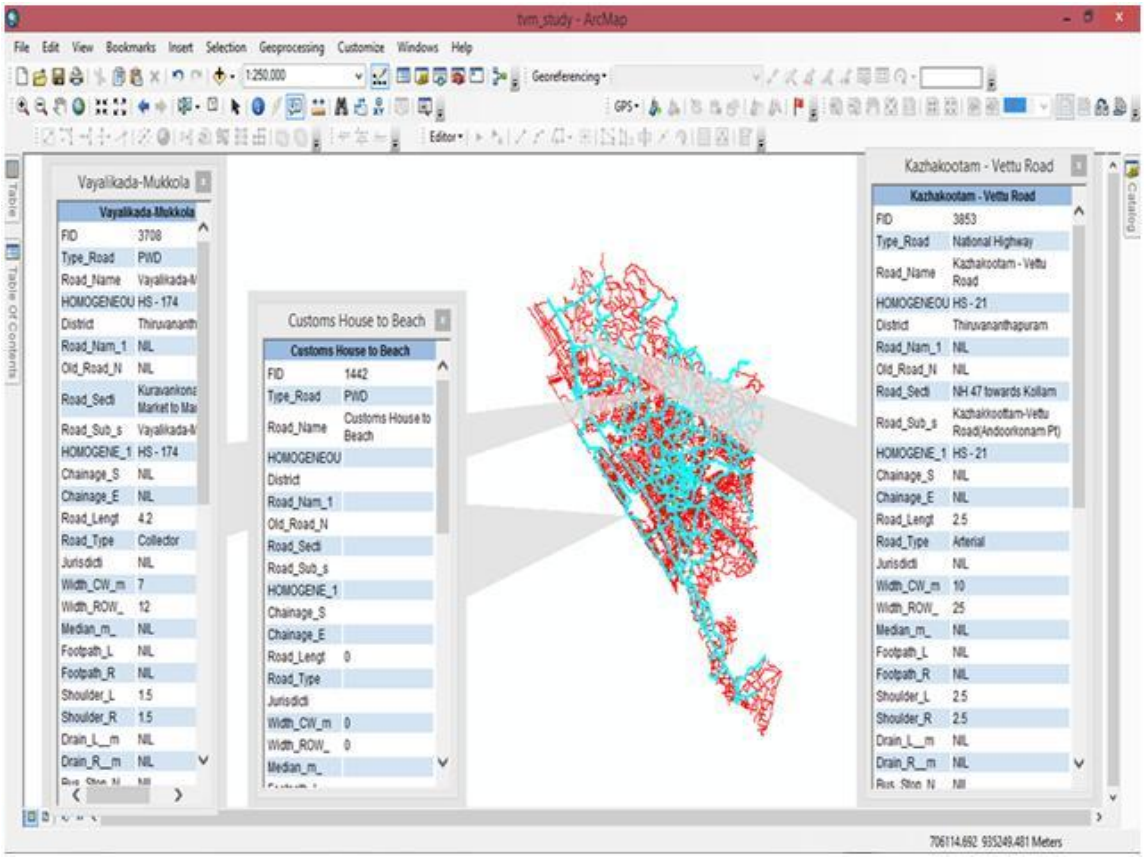


Figure 8: Road Inventory Database (Thiruvananthapuram)

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.

20. Development of Mobile App for Road Data Collection

Date of start: 2018-'19
Date of completion: 2021-'22

Need and importance of the Study

Availability of accurate road network along with its associate characteristics is very essential for efficient planning and implementation. Availability of digital road network is most essential for quick decision making. The study is an attempt towards this direction with main objective of developing a mobile app for road data collection.

Objectives

- Conduct field surveys to locate and mark the missing road network in Ernakulam district using remote sensing and GPS technique and prepare a database for the entire district which can be shared with various user agencies;
- Develop an android based mobile app for collecting road related data.

Methodology

For preparation of GPS based updation of road network data for Ernakulam district in GIS environment, 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 were prepared from satellite imageries available in the ESRI website and other online resources. Road network for the district were generated and attribute information pertaining to the road was updated. Doubtful roads were visited and all the required data were collected and updated in GIS environment. Development of mobile app requires the design of the App which basically requires the development environment. Android studio software was used for the development of this App. After development of the mobile app testing was conducted to check the functioning of the tools.

Data Collection and Analysis

The present study updated road network using GPS and GIS technology for the twenty local bodies in Ernakulum district. A mobile android app named "*GetMap*" was developed to install at the user side for recording the travel path of the user. This system is deployed using the latest technology i.e. Android based smart phones. The android based application was developed using the software Android Studio. The app consists of two screens – welcome screen and map

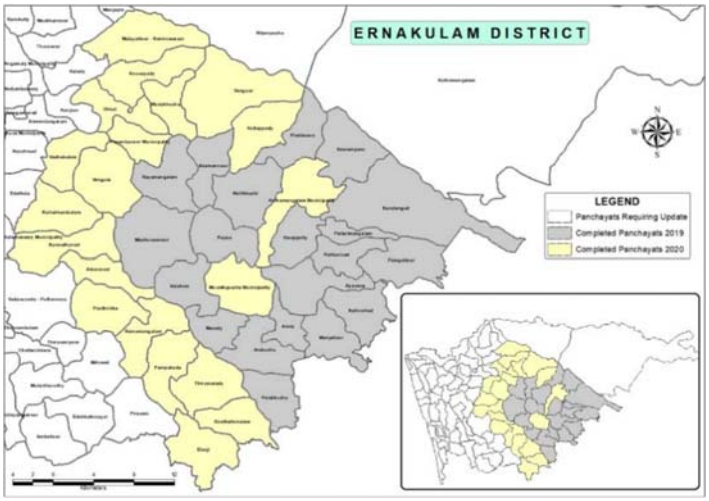


Figure 9: Completed Local Bodies in Ernakulam

screen. The welcome screen appears when the app is loading and the map screen appears after that. The app automatically loads the map of current location of the user.The app user can record a new road and provide its information to the app and provision is provided to record point information. The travel paths are shown on a real-time Open Street Map (OSM) that can be saved as a KML file. In GetMap recording of tracks starts by entering a track name, then stopping the track as needed and save the file. The app automatically checks the user location from time to time, and plots the results on a real-time OSM map. The app also provides a method to record points in the travel path while they are travelling. When the recording is completed the user can saves the current track by simply saving it as a KML file. The newly saved KML file will consists of all the tracks and points recorded. These features can be directly opened in Google Earth.

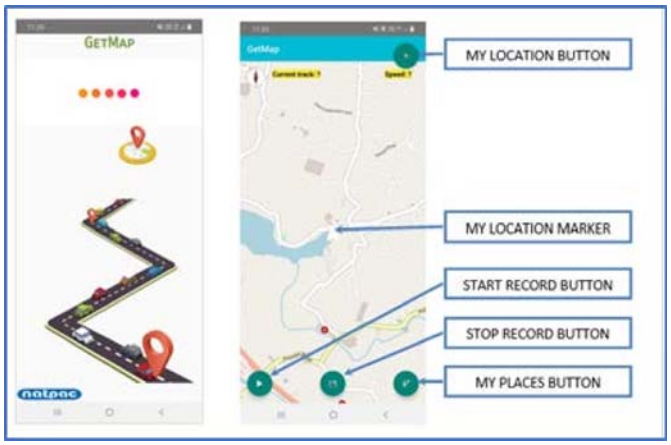


Figure 10: GetMap – Developed Mobile App

Plate 6: App testing in - NH Bypass Trivandrum

Conclusion and Further Work

GetMap app is in its initial phase of development and testing is a promising tool to all the agencies who are engaged in the road related works and research. Currently the app is able to capture the details of the roads along the track. Cross section data capturing along with creation of land use layer along the roads will be taken during the next financial year.

21. Web GIS based Road Crash Information System

Date of start: 2018-'19
Date of completion: 2021-'22

Need and importance of the Study

Traffic safety, awareness and enforcement are gaining greater relevance in recent times. For successful implementation of road safety activity, availability of data is the cornerstone and is essential for the diagnosis of the road crash problem and for monitoring road safety efforts. The study is taken up with the main objective to develop a Web GIS based road crash information system using Geospatial tools for Kerala.

Objectives

- To develop a WebGIS based road crash information system highlighting road crash black spots for the state of Kerala;
- To develop information system using GIS as backend application, highlighting the road accident scenarios;
- Update accident scenario in KSCSTE-NATPAC website periodically.

Methodology

For the present study accident black spot data of the State is taken from an existing study of KSCSTE-NATPAC (KRSA funded project). Database management of this application is undertaken in MySQL database. Wamp Server software is used to create MySQL database and tables for the system. The spatial data and attribute data of accident spots in Kerala were inserted into the tables of the database. Two tables were created in the database, one table is used to store the details of crash spots and other is used to store the login information of the user. Road Crash Information System is developed using the programming languages HTML, JavaScript, CSS and PHP with the help of Visual Studio Code software.

Data Collection and Analysis

The web application displays the location of the crash spots on a customized Leaflet OSM map. After successful login to the application, the user can access the Home page of the web

application which consists of a customized Leaflet OSM map and a control panel. The control panel consists of different options to filter the result. First section in the control panel is used to display the district wise accident spots in Kerala. A dropdown list of districts in Kerala is provided from which user can select one district and clicks on 'View Accident Spots' button to view the crash spots in that district. A pie chart is also provided to assess the number of crashes based on the type of road – NH, SH and OR. To get the detailed view of crash spots, user can enlarge the map by clicking zoom button on bottom left corner of the map. Crash spots are displayed as markers on the map with two different colours indicating the priority order. Different types of queries are given in the program which shows its result in a graphical form, which make it easy for the users to understand.

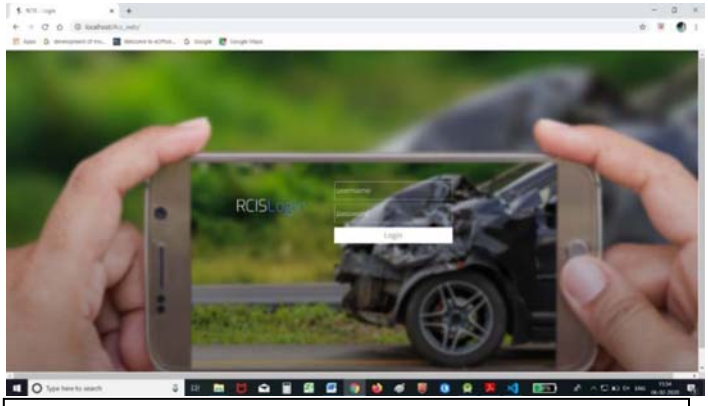


Figure 11: RCIS – Login Page

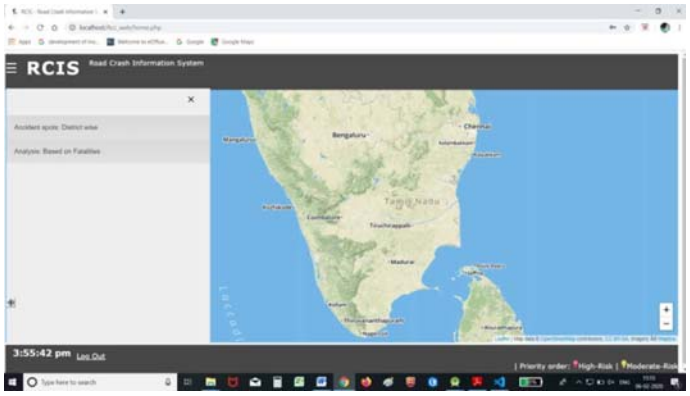


Figure 12: RCIS – Home Page

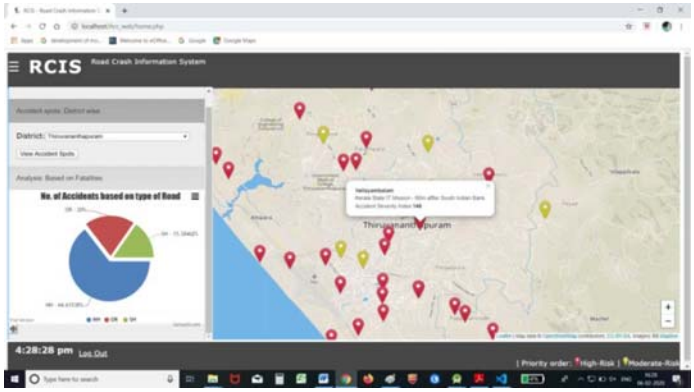


Figure 13: RCIS – Display of Accident Scenario

Conclusion and Further Work

The RCIS is tested on a trial basis on the available accident black spot data for Ernakulum district. It is proposed to expand the scope of the work in the next financial year by incorporating more districts and finally making a detailed accident database for the state.

22.Street Lighting Plan for Safe Corridor Demonstration Project

Date of start: 11/2018
Date of completion: 01/2019

Need and importance of the Study

As part of Safe Corridor Demonstration Project undertaken by Kerala State Transport Project (KSTP) with financial support from the World Bank, out of the various components entrusted to KSCSTE-NATPAC, street lighting plan for the 80km study stretch from Vetturoad to High School junction, Adoor was prepared and submitted for implementation. State Highway 1, also known as the main central road connects the central Kerala to the capital city. The study focused on the importance of installing street lights in the stretch from Vetturoad to High school junction, Adoor. The road passes through some of the densely populated and business districts of three districts namely Trivandrum, Kollam and Pathanamthitta.

Methodology

Detailed survey was conducted during day and night to explore existing visibility parameters as well as the details of existing service poles (electricity, telephone etc.), transformers etc.

Recommendations

Solar mounted LEDs have been found economical and most energy efficient alternative to all other types of street lightings. Thus for SH-1, solar mounted LED lights were recommended with location plan and spacing detail ensuring sufficient light with reduced glare factor and improved efficiency.

It was recommended to have a cut off or semi cut off type of luminaire with an outreach of at least 0.70m from the road end. Keeping at least 0.50m from the road edge is mandate keeping into account the safety parameter. It was also suggested to install the solar mounted LED lights on the opposite side of the electrical lines as keeping both on one side increases the chances for electrical hazard in case of dilapidation of lighting poles in case of vehicle runoff related collision. Spacing was suggested based on lux values taken during night surveys and the illuminance level values suggest a spacing of 25 to 27m between the poles. Spacing more than 27m between the poles will cause areas of no light in between the poles which ultimately

nullify the intended purpose of the street lights. Special treatments and spacing were suggested for intersections, accident prone areas, curves and locations with heavy pedestrian movements. Spacing has been reduced up to 20m for above mentioned special locations to enhance the overall safety during dark hours.

Audit on existing service poles and its potential impact on road user safety was also conducted and safety improvement strategies were suggested such as removal/relocation, safety barricading, hazard markers provision etc. The locations for installation of mini/medium mast lighting, luminary types and cut-off angles required etc. were also mentioned.

23. Periodic Updation of Price Indices for IPT Services in Kerala - A Study on Auto-rickshaw Mode

Date of start: 04/2019
Date of completion: 03/2020 (Continuing Study)

Need and importance of the Study

KSCSTE-NATPAC has been undertaking studies related to public transport such as Taxi, Auto, etc. and compute the cost of operation in the state. This study helps the Government to take appropriate decision whenever fare revision matter is taken up. The cost table approach is being adopted to compute cost of operations of vehicles under optimum utilization of capacity, which is derived from detailed analysis of life cycle behavior of almost all important vehicle components. A price index is also being computed at the entry – level conditions for two time periods to assess and compare the movement of prices in different periods. The index gives a scientific basis for making decisions such as fare revisions on different public and freight transport operations in the state.

Scope and Objectives

The scope of the study is confined to passenger auto-rickshaw operations in Kerala state. Also, the present study is to arrive at the minimum fare for autos and to prepare a new price index. The index represents a clear scientific methodology that would be helpful for taking decision on revision of fare for auto-rickshaw services. The major objectives of the study are:

- To assess operational characteristics, load and lead factors, fixed and variable cost expenditures and earnings of different types of autos;
- To assess the socio –economic aspects of auto-rickshaw sector in Kerala;
- To determine the minimum fare for autos;
- To prepare a price index for auto operations for understanding the periodical movement of prices of various vehicle operating costs inputs for autos;
- To prepare draft policy for auto-rickshaw services.

Methodology

An attempt has been made in the present study to arrive at the minimum fare for autos. Adequate representation was made in the sample to include different types of autos and routes operated in different terrain conditions viz. plain, rolling and hilly regions and also urban, semi- urban and rural areas. The area selected for the study was three districts ie. Thiruvananthapuram, Kozhikode and Ernakulam. To obtain operational characteristics and revenue collection and socio– economic aspects, a sample size for conducting the operator survey was selected based on Bill Godden's formula. Based on the literature survey and the discussions held with vehicle technicians, the parameters affecting the performance and cost of operations were selected. The cost of operation of autos will be worked based on Standard Cost Tables. Based on all the aforesaid, the fare fixation will be carried out covering the socio – economic aspects of the auto-rickshaw sector in Kerala. **Table 4** shows details of data collected.

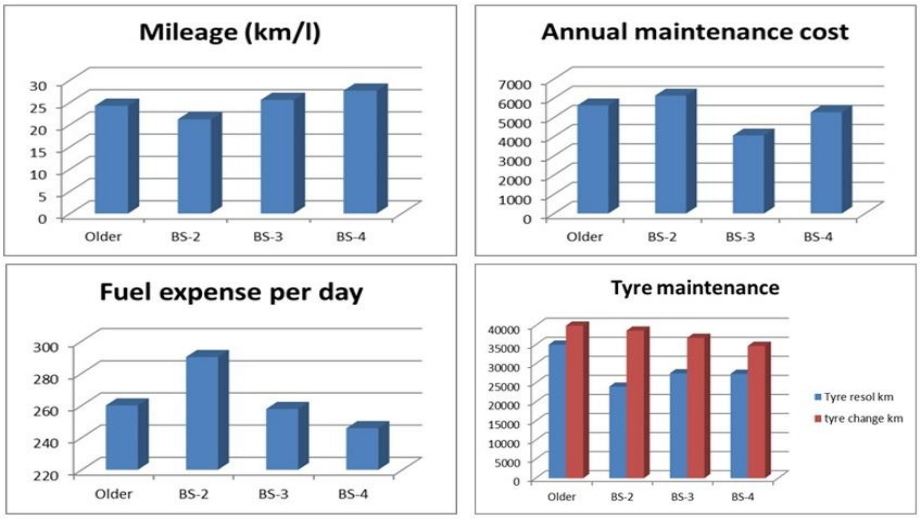
Table 4: Details of Data Collection

Method of Data Collection	Area	Information Collected
Primary data collection	Driver profile	Age, Driving Experience, Accident history
	Vehicle Profile	Vehicle Age, Type of fuel and Engine, Mileage, Maintenance interval
	Market characteristics	Work place, Trip details, Service area
	Operational characteristics	Average km/year, Mileage, route length
	Economic profile	Fuel Expenses, Insurance and permit charges, EMI, Rent/Salary, Maintenance cost, recurring expenses
Primary and secondary data collection	Component Details and Labour cost	Engine System & its sub systems, Clutch System & its sub systems, Housing System & its sub systems Propeller System & its sub systems, Gear box system & its sub systems, Exhaust system & its sub systems Wheel &Tyres, Body & Frames etc.

Table 5: Details of typical analysis of BS-4 vehicle samples from Thiruvananthapuram Region

Type of Fuel	Mileage (km/l)	Tyre changed after (km)	Fuel expense per day (in Rs.)	Maintenance cost (in Rs.)
Petrol	27.65	34,684	381.72	5,270.69
Diesel	36.04	34,891	211.89	4,335.22
CNG	21.64	40,507	270.06	5,412.34
Others	31.54	38,339	197.85	3,633.96

Figure 14: Typical analysis based on fuel type: Petrol Vehicles



Interim Conclusions

Preliminary data of the surveyed regions (Thiruvananthapuram & Kozhikode) were analyzed based on fuel type and engine type characteristics. It could be observed that vehicles fitted with BS-4 engine type were more fuel efficient and economically sound. Overall annual maintenance costs of these vehicles were also found to be less. Vehicles running on petrol were found to have highest maintenance and fuel expenses. Diesel vehicle operators had lesser fuel expenses but had higher maintenance costs. To arrive at the standard cost for operations, cost tables were developed by thorough analysis of collected vehicle components with product life cycle.

Recommendations for further work

The current analyzes are pertaining to the areas surveyed in the first stage at Thiruvananthapuram and Kozhikode districts. Further part of the work can be pursued after the completion of remaining data collection at Ernakulam district. Future scope of the study includes the development of a price index with standard cost principles which represents a clear scientific methodology that would be helpful for taking decisions on revision of fare for auto –rickshaw services.

24. Integrated Development of Coastal Highway and Cycle Tracks

Date of start: 2018
Date of completion: Continuing

Need and importance of the Study

Considering the imperative benefits of the Coastal Highway and its impact in the life of the people of the State, Public Works Department and Government of Kerala entrusted KSCSTE-NATPAC to conduct an alignment study in 2016. The alignment study recommended a total route length of 655.6 km with a rough cost estimate of Rs. 6048 crore. Government of Kerala, in the budget 2017-2018 announced the ambitious plan of developing Coastal Highway with Kerala Infrastructure Investment Fund Board (KIIFB) funding.

The Coastal Cycling Tourism Destination Project (CCTDP) aims to make Kerala the "Most Preferred Coastal Cycling Tourism Destination" in the world. Simultaneously, it also aims to reduce poverty among coastal communities in Kerala through creation of new economic activities and opportunities and employment in the coastal areas.In this context, the need of integrating the proposed CCTDP with the proposed Coastal Highway Project is of paramount importance. The proposed improvement of the coastal highway is to be expanded further for integrating the Cycle Track.

Objectives and Scope

The objective of the study is to prepare a master plan for the construction of coastal highway integrated with cycle tracks. Scope of services shall comprise of:

- Review of existing studies, reports and alignment study for the development of coastal highway;
- Study new alignment (which include Greenfield stretches) and other options;
- Preparation of revised alignment and master plan for the Project;
- Identify land parcels suitable for resettlement and rehabilitation;
- Study connectivity to hinder land tourism spots within a reasonable distance from the Coastal Highway.

Study Area

Kerala coast line is passing through nine districts such as Thiruvananthapuram, Kollam, Alappuzha, Ernakulum, Thrissur, Malappuram, Kozhikode, Kannur and Kasaragod and runs for about 590 km. The coastal regions in the Kerala were well connected with roads in olden times for the goods movement through the sea. After independence, the roads in the land area were improved a lot and thereby trade through sea and waterways got reduced. Hence the development/maintenance of the coastal roads was pending for a long time. In the last two decades, some of the roads were improved but continuity of roads is missing due to physical and geographical constraints.

Methodology

The study focuses on the revision of coastal highway alignment with cycle track and thereby prepares a masterplan for the coastal highway. The methodology adopted for the study consisted of reconnaissance survey, primary surveys, secondary data collection, selection of alternatives, categorization of links and preparation of masterplan.

Work Status

A review was conducted on the secondary data and a combined reconnaissance survey was carried out along the proposed route. Consultation with MLAs, local authorities and publics were done at majority of the LA constituencies. The views obtained from the stakeholders meeting were duly considered for the finalization of alternatives and the same is under progress. The possible rehabilitation and resettlement areas were identified and incorporated

along with the masterplan. The preparation of masterplan is under progress and masterplan of about 200 km stretch was finalized and submitted.

Interim Conclusions

Once the Coastal Highway is completed, it will be beneficial to nine districts in Kerala in the form of better connectivity which in turn results in better living condition of people in the coastal region. The master plan prepared by KSCSTE-NATPAC will act as a key input in the coastal highway DPR preparation and implementation.

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

Date of start: 04/2018
Date of completion: 03/2021

Need and importance of the Study

The disposal of the plastic wastes without causing any ecological hazards has become a real challenge to the present society. 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. Soil properties vary a great deal and construction of structures depends a lot on the bearing capacity of the soil. Hence, we need to stabilize the soil if it is inferior. As an alternative method of disposal plastic waste, we can add shredded plastic to the soil which will help in the improvement of the shear strength of poor soil.

Objectives and Scope

- 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, California Bearing Ratio (CBR) test and unconfined compression (UCC) test;
- To evaluate the effects of the shredded plastic fibers on the engineering properties such as permeability, shear strength and compressibility of soil.

The scope of the study is limited to addition of three different sizes of shredded plastic waste namely 4.75 mm, 2.36 mm, 1.18 mm, 0.6 mm and less than 0.6 mm at four percentages namely 0.1%, 0.2%, 0.5% and 1% to the soil.

Methodology

- Characterize different soil types available locally;
- Examine the compaction behavior by conducting Modified Proctor compaction tests;
- Arrive at optimum size and percentage of shredded waste plastic from the results of UCC tests and CBR tests on the soil mixed with shredded plastic waste;
- Carry out consolidation test to obtain the degree of consolidation and hydraulic conductivity of the mix;
- Carry out triaxial shear tests to obtain the shear parameters.

Experimental program

The effect of inclusion of shredded waste plastic in soil samples were studied by conducting tests with 0.1%, 0.2%, 0.5% and 1% of shredded waste plastic in different sizes. Four types of soil commonly available in Kerala 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 all the sizes of shredded plastic and for all the percentages of shredded plastic, 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 tests and CBR tests were carried out at OMC and MDD for different soil-plastic mixes to arrive at optimum plastic-soil mix. SEM analysis was also carried out to understand the behavior of soil-plastic mixes. The effect of shredded plastic fibers on the engineering properties such as permeability, shear strength and compressibility of soil is in progress.

Interim conclusions

Based on laboratory tests, the following conclusions were drawn:

- The addition of optimum amount of Shredded waste plastic improved the strength of soil. The effect of shredded waste plastic on soil is influenced by various factors such as size and percentage of shredded waste plastic and soil particle size;
- The addition of finely shredded waste plastic (0.6 mm and 1.18 mm size) led to increase in dry density while the addition of coarsely shredded waste plastic (2.36 mm and 4.75 mm size) led to decrease in dry density;
- The CBR value also showed similar trend and it was highest for soil with 0.1% of 0.6 mm size plastic;
- In MH soils both compaction parameters and UCC improved when 0.6 mm sized shredded plastic waste at 0.1% were added whereas in SM and GM soils better results were obtained with 1.18 mm sized shredded plastic waste at 0.1%.

Recommendations for further work

The effects of the shredded plastic fibers on the engineering properties such as permeability, shear strength and compressibility of soil needs to be examined in laboratory before the soil-plastic mix can be recommended for use as subgrade or embankment material in field.

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

Date of start: 04/2018
Date of completion: 03/2021

Need and importance of the Study

The benefits acquired through the utilization of WMA technologies will only be useful if the performance of pavements constructed using WMA mixtures is comparable to the performance of conventional HMA pavements in terms of pavement durability, functionality and quality. Therefore, a comprehensive laboratory investigation needs to be carried out to study the performance such as indirect tensile strength, rutting and moisture susceptibility of WMA mixes as compared to the conventional HMA mixes. Hence, the study compares the mix design of WMA mixes using different WMA additives namely Sasobit and Evotherm at different percentages. The use of RAP may also lead to less depletion of the natural resources and may reduce the maintenance cost due to the reuse of existing pavement materials. Hence the study

also evaluates the performance of WMA mixes with varying amounts of recycled asphalt pavements (RAP).

Objectives and scope

- To study the performance of WMA mixtures prepared with two additives namely 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 HMA mixes.

The scope of the study is limited to laboratory evaluation on WMA –RAP mixes using two WMA technologies namely Sasobit and Evotherm.

Methodology

The methodology adopted for the study consisted of material collection, mix design by Marshall method, preparation of RAP (30% and above) -WMA surface mix and performance evaluation by testing rutting, tensile strength and moisture susceptibility tests.

Experimental program

The VG 30 bitumen and aggregates were collected and characterised. 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 (0.3%, 0.4%, 0.5%, 1.0% and 1.5%) and sasobit (1.0%, 1.5%, 2.5%, 3.0% and 3.5%) 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. Mix design of RAP-HMA mixes were also carried out.

Interim conclusions

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

- The Marshall Stability and retained stability values showed reduction for sasobit mixes compared to HMA mixes for some mixes but the values were well above the specified values of 12 kN in MORTH;
- The evotherm mixes showed better performance compared to sasobit mixes;
- The ITS dry and ITS wet for mixes were greater than the recommended values of n 225 kPa and 100 kPa respectively;
- The retained stability ratio and tensile strength ratio was lower for WMA mixes compared to HMA mixe showing that they were more susceptible to moisture for the dosages adopted;
- For all the mixes except for 0.3% evotherm and 2.5% sasobit, the stability ratio and TSR were well within the acceptable range of 75% and 80% respectively.

From the laboratory tests it is understood that dosages of 3% or 3.5% sasobit and 0.4% or 0.5% evotherm can be taken as the optimum dosage for this Bituminous Concrete (BC) 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.

Recommendations for further work

The WMA-RAP mixes for different percentages of RAP (till 30%) need to be mix designed in the laboratory and their performance needs to be evaluated so as to examine the feasibility of using high RAP content (upto 30%) in these mixtures.

27.Resource Mapping of Road Construction Materials in Kerala - Phase II

Date of start: 04/2019
Date of completion: 03/2025 (On going)

Need and importance of the Study

The need of this project and data is to identify and classify potential construction-aggregate resources and fill materials for use in infrastructure development. The highway construction

material varies widely from region to region and from district to district in Kerala state. Similar mapping was already carried out for aggregates and their current status is updated in this study.

Objectives and Scope

- To identify resources of Highway construction materials - licensed quarries with reference to Department of Mining and Geology;
- To examine the engineering properties of materials;
- To project into geo-referenced maps in GIS platform and attach attributes such as lead distance, quantum of materials and their properties.

The scope of the study is limited to the mapping of licensed aggregate quarries in Trivandrum district in the current year.

Methodology

- Collection of details of quarry, soil map, terrain data etc. from government agencies such as Department of Mining and Geology;
- Survey of the availability of aggregates in quarry and their collection so as to assess their quality;
- Compilation of data of engineering properties of coarse aggregate, fine aggregate and soil by conducting conventional engineering testing in accordance with Indian Standards (IS);
- To evaluate the engineering properties of the materials suitable for road construction in accordance with MORTH specification;
- To generate spatial data storage of highway material information system using Geographical Information System (GIS).

Interim conclusions

Aggregate Samples collected from 30 quarries of Trivandrum District were evaluated for their use in pavement construction. Based on experimental study and analysis, the suitability of available resources of aggregates for varied pavement construction purpose is drawn. It was found that the aggregates available in Trivandrum District have specific suitability to varied

application in pavement construction. The geo-referenced spatial and attribute database of these resources incorporating their properties and desirable application are prepared, which will help in appropriate resource selection and optimal material planning for the licensing authorities and execution departments.

28.Macadam Design for LSGD Roads in Kasargod District

Date of start: 2019
Date of completion: 2020

Need and importance of the Study

Kasaragod district is well connected with road networks and among these, majority of the roads are constructed and maintained by the Local Self Government Department (LSGD). Seventy to Eighty percentages of the LSGD roads are constructed as chipping carpet pavements. Chipping carpet pavements are inferior in quality considering its load carrying capacity and weather resistance and thus possess comparatively less life. In this circumstance, it is high time to think about designed pavement with structural layers especially for medium to heavily trafficked village roads to ensure durability and quality of pavements. As a result, the LSGD in Kasaragod district decided to improve the roads so as to include structural layers. The Kasaragod LSGD department approached KSCSTE-NATPAC for the Macadam Design of two existing LSGD roads comprising of a total length of 7.61 km.

Scope and Objectives

The scope of the study is limited to the pavement design of two LSGD roads namely Bovikanam- Mallam- Paika road and Pilicode Farm- Padanna road having a total length of 7.61 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.

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 strategy of full reconstruction or overlay was decided by analyzing the present pavement layer thickness and the 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.

Pavement Design

In both study stretches, inventory survey, traffic volume survey, trial pit investigations for measuring the pavement composition, etc., were carried out in the field. Soil samples were collected and tested in the laboratory. The pavement design was conducted at par with the guidelines IRC:37-2012; 2018 and MORTH 2013 using the details obtained from the field. The summary of the pavement design is given in **Table 6.** Though the design only warrants Semi-dense Bituminous Concrete (SDBC) at the study stretches, providing Bituminous Concrete Mixes (BC) as wearing course will enhance the life of the pavement and bring long term benefits.

Table 6: Summary of the Pavement Design proposed in the study roads

Name	Chainage (km)	Design CBR	Design Traffic	Proposed Pavement Layers (mm)				
				SDBC	DBM	GB	GSB	Total
Bovikanam-Mallam road	0/000 - 5/200	15	2	30	50	250	100	430
Pilicode Farm-Padanna road	0/000 - 2/400	15	2	30	50	250	200	530

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

Date of start: 2017
Date of completion: 2021

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 Dynamic Cone Penetrometer Test

(DCPT) method, the strength of each layer of pavement can be obtained easily with less effort. Although many studies have been conducted to obtain the correlation of different soil parameters and CBR value with the DCPT value, rehabilitation design using the DCPT value is rarely investigated in India. This study 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 involves the following objectives:

- To assess the pavement layer properties using the DCP test;
- To compare various overlay design methods;
- To develop an overlay design chart applicable for village roads based on DCP test;
- To validate the DCP design charts obtained.

The study stretch includes selected village roads in Trivandrum and Alappuzha districts in Kerala.

Methodology

The methodology adopted for the study consisted of collection of baseline data, laboratory tests for determination of soil properties, traffic studies, structural and functional evaluation of the pavements, DCPT test of laboratory samples and preparation of rehabilitation design.

Works in Progress

DCP test were conducted on selected village roads in Trivandrum and Alappuzha district. Road inventory and condition survey of these roads were also done for the structural and functional evaluation of the pavement. Traffic volume count was conducted by manual counting method. 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 California Bearing Ratio (CBR) method/ Benkelman Beam Deflection (BBD) method. The different methods were compared and found that the existing methods are not comparable. So, there is a need for the revision of design DCP overlay charts/nomograms. Preparation of laboratory samples is under progress for conducting the DCP test for understating the number blows required for penetrating a layer prepared under standard conditions and also estimating the difference in number blows/ depth of penetration in an inferior /superior pavement layer.

Interim Conclusions

Different rehabilitation design methods were compared and found that the existing methods are not comparable and hence it is required to prepare a new DCP nomogram or design chart suitable for Indian condition.

Further Works

- Assessment of DN for different layers constructed in an ideal condition and also for aged pavement;
- Development of Nomograms/ Charts for overlay design.

30.Study on Strength Characteristic of Flexible Pavements in Water logged areas

Date of start: 2019
Date of completion: 2021

Need for the Study

In waterlogged or flooded areas, water percolates into the layers of flexible pavement. This leads to the loosening of pavement materials, stripping of bitumen, etc., and finally ends up in the deterioration of the whole pavement. Since flexible pavement works like a system as a whole, even small deteriorations in pavement layers will be exhibited as cracks or damages in the surface layer. Hence the flexible pavements in waterlogged or flooded areas fail

prematurely. The design of pavement structure is based on the strength of the compacted subgrade and same will get weakened on inundation for long periods. Hence for understanding the pavement layers behaviour under prolonged inundation needs to be studied.

Objectives

- To investigate the effect on sub-grade strength and properties due to road submergence period and repeated submergence of the pavement by carrying out California Bearing Ratio (CBR) test and consolidation test;
- To study the behaviour of treated subgrade soil considering different inundation period.

Methodology

- Identification and collection of soil samples from flood affected road stretches.
- Collection of subgrade soil and carrying out Dynamic cone penetrometer Test (DCPT) along the road corridor and examining their index and engineering properties.
- Simulate the effect of inundation by keeping the samples in water for 1, 4, 7, 28 and 56 days and examining its strength criteria by carrying out the CBR test.
- Study the effect of loading capacity and duration of submergence on the subgrade settlement by conducting the Consolidation test.

Work in Progress

The study stretches were identified based on flood maps from Kerala State Disaster Management Authority (KSDMA) and a study conducted by KSCSTE-NATPAC on flood-affected roads during 2019. Three road stretches were selected based on terrain, soil type, and land use pattern etc. The study stretches are Panamaram – Nadavayal Road (MDR) in Wayanad district, Areekode- Edavana Road (SH 34) in Malapuram district and Alappuzha - Changanassery Road (SH11) in Alappuzha district.

The primary surveys were carried out in all the three locations. A 10 km road stretch was identified and conducted pavement condition survey, Dynamic cone penetrometer (DCP) test, field density test and laboratory investigation of soil samples etc. Soil tests such as Grain size

analysis, Atterberg limits, Modified Proctor Test, CBR, Free Swell test as per the IS specifications were carried out. Laboratory simulation of the effect of inundation was done by keeping the samples in water for 0, 1, 4, and 7 days and examined the strength of soil by the CBR test.

Proposed Work Plan 2020-2021

- Laboratory simulation of the effect of inundation by keeping the samples in water for 28 and 56 days and examining its strength criteria by carrying out the CBR test.
- The effect of loading capacity and duration of submergence on the subgrade settlement will be studied by conducting the Consolidation test.
- Determination of effect of the period of inundation on soil permeability, settlement, and strength with cement and lime.

The study will deliver the behaviour of subgrade soil in terms of variation of permeability, settlement and strength at different period of inundation.

31.Experimental Investigations on Porous Asphalt

Date of start: 04/2019
Date of completion: 03/2021

Need for the Study

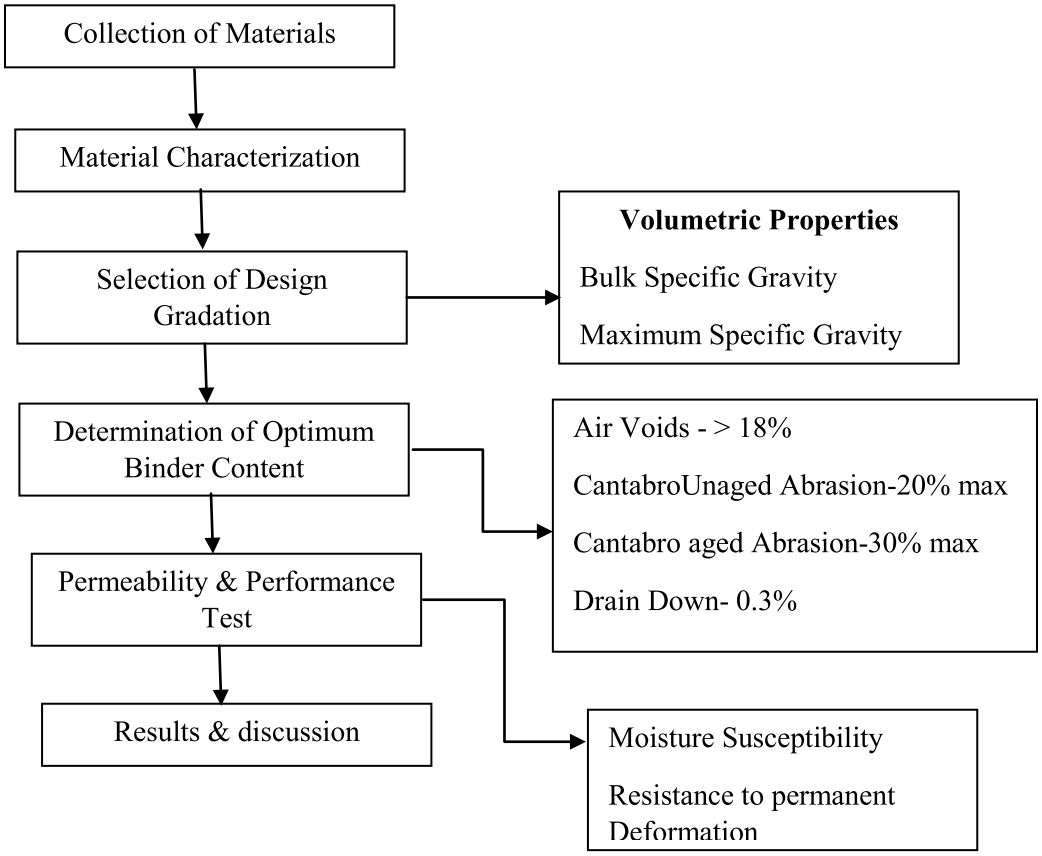
There are several problems associated with the use of impervious pavement surfaces. Grading of impervious pavements to direct storm water into storm drains is the most commonly used technique to prevent ponding of water on roads and parking lots. However, the current drainage practices are found to be ineffective, leading to the development of pervious surfaces. Porous Friction Course mixes, in this context, helps in the efficient removal of water from pavement surface and also initiates the groundwater replenishment when the pavement is designed accordingly.

Scope and Objectives

The purpose of this research is to investigate the potential use of an emerging storm water management technology as it applies to the Kerala climatic conditions. The study aims to provide an initial framework for the porous asphalt mixes and performance measures.The main objectives of the study are:

- To determine the aggregate gradation that satisfies the requirement of porous asphalt;
- To determine the optimum asphalt content from the Cantabro abrasion tests, percentage air voids and drain down test;
- To evaluate the performance of porous asphalt for tensile strength and rutting behavior.

Methodology



Experimental Methods

The aggregates procured from locally available quarry from Trivandrum and the asphalt grade was tested for its engineering properties such as abrasion, aggregate impact, water absorption, flakiness and elongation and specific gravity. The selected asphalt grade, polymer-modified bitumen of STYRELF 70 was tested for its physical properties such as penetration, softening point, viscosity, elastic recovery and softening point. It was observed that the properties of both aggregates and asphalt found to be following the MORTH specifications and suitable for road construction. Two different types of gradation were selected to prepare porous asphalt mix. Then the optimum asphalt content was selected by preparing three Marshall's specimen each with 4.5%, 5.0%, 5.5%, 6.0% and 6.5% STYRENE 70, compacted by applying 50 blows and 35 blows on either faces of specimen. The binder content at which air voids (>18%), Cantabro abrasion test on the aged specimen (< 30%), Cantabro abrasion test on Unaged specimen (< 20%) and drain down (< 0.3%) conditions are satisfied was selected as the Optimum Binder Content. Then the porous mix shall undergo a performance test such as resistance to moisture damage and rut characteristics.

Interim Conclusions

Material Property

- The aggregates (crushed granite aggregates) used in the study observed to satisfy the standard requirements of physical properties for porous asphalt mix.
- STYRELF 70 range of Polymer Modified Binder (PMB) sample, satisfied all necessary tests conducted to evaluate its properties.

Aggregate gradation for porous mixes

Two different gradations, proportioned to follow the NCAT target gradation was formulated to design for porous asphalt mix.

Optimum Asphalt Content

- For the gradation type I, optimum asphalt content arrived at 5% for the compaction level of 50 blows on both faces of the mix.

- For the gradation type II, asphalt content arrived at 5% for the compaction level of 50 blows on both faces of the mix.
- For the gradation type I, asphalt content arrived at 4.5% for the compaction level of 35 blows on both faces of the mix.

Performance test of porous mix

- The tensile strength ratio for porous mixes prepared with gradation type I with 5% binder content satisfied the minimum retained tensile strength requirements as specified by ASTM D 7064 (2004).

Further Works

- To determine the gradation type I, optimum asphalt content for the compaction level of 35 blows on both faces of the mix;
- To determine the permeability of the porous mix;
- To determine the rut characteristics of the porous mix.

32.Study on Roughness of City Roads in Trivandrum – Trivandrum City Road Improvement Project

Date of start: 05/2020
Date of completion: Continuing

Need for the Study

Roughness is considered as one of the key factors in planning for further road works. Pavement roughness is measured in terms of International Roughness Index (IRI) or bumps. This can be measured using different equipment and amongst them, the towed fifth wheel bump integrator is widely accepted and is economical equipment. At the instance of Kerala Road Fund Board (KRFB), KSCSTE-NATPAC has conducted Bump Integrator studies on selected city roads coming under Thiruvananthapuram City Road Improvement Project (TCRIP).

Scope and Objectives

Scope of the work covers the selected city roads of Thiruvananthapuram having a total length of 24 km which includes two, four and six lane carriageways. The main objective of the study

was to assess the riding quality of selected stretches of city roads in Thiruvananthapuram using Fifth Wheel Bump Integrator.

Methodology

Roughness survey was conducted as per the guidelines of IRC SP:16-2018. Towed fifth wheel bump integrator was used for measuring the unevenness of the study roads. The equipment, trailer towed to a jeep was driven over the study road stretches at a speed of 32 ± 1 km/hour by keeping steady motion and avoiding swerve. The bump integrator wheel was made to follow the prevalent wheel path of the study road. The bump integrator values are recorded for every 100 m. The surveys were conducted on a normal day and the data were collected during the night hours to maintain the speed of the mounted vehicle as the study roads are heavily trafficked. A total of 3 runs were made in each lane and the average of the 3 runs was used to determine the bumps in the road stretch. The IRI value was then worked out using the calibration equation obtained.

Summary and Conclusion

Roughness study was conducted on the study stretches and found that the entire study stretch comes under the 'Average' to 'Poor' surface condition. It was recommended that all the roads stretches to be improved to 'Good' surface condition by providing appropriate surface treatment measures. It was also suggested to confirm the structural strength of pavements having 'Poor' category before deciding the surface treatments.

33.Development of Waterway between Mahe and Valapattanam

Date of start: 2017
Date of completion: Continuing

Need for the Study

The decision of developing the waterway through the entire length of the state is taken by the Government of Kerala considering the potential of waterway for freight movement, passenger movement and tourism. The seamless connectivity of the West Coast Canal from Kovalam to Hosdurg will be possible only if connectivity is established between Mahe River and

Valapattanam River where there is a missing link and this can be done by way of three artificial cuts.

Objective of the Study

The main objective of the study is to prepare DPR for the development of inland waterway between Mahe river and Valapattanam river.

Methodology

The methodology adopted for the study consisted of reconnaissance survey and joint inspection with officials of Kerala Waterways and Infrastructure Ltd. (KWIL) and Inland Navigation Departments for finalizing the best possible alignment for the uncut portions, inventory surveys, preparing the land acquisition plans, traffic studies, data analysis, design of canals, preparation of preliminary designs and cost estimates for the structures, economic analysis and report preparation.

Study Area

The study area is located between Mahe river and Valapattanam river where there is a missing link. In order to obtain the through waterway connectivity between Mahe river and Valapattanam river, three artificial cuts are to be constructed. The discontinuous portion between Mahe and Eranjoli river is considered as first cut, Eranjoli river and Dharmadom river is considered as second cut and the portion between Anjarakandy river and Valapattanam river is considered as third cut. The approximate discontinuous lengths for each of these cuts are 10, 0.85 and 15 km respectively.

Work status

The proposed water way was decided to develop as Class III waterway as per the Inland Waterways Authority of India (IWAI) classification. The decision was grounded on the terrain conditions, minimum disturbance to public and expected traffic etc. The proposed artificial canals are designed based on the self-propelled vehicle alone and omitted one tug and two barges combination. Hence the bend radius is limited to 130 m. But the proposed structures such as bridges, canal locks etc. are premeditated to meet the class III standards. Thus, 11m

wide and 80m long (including the lock heads) lock structures are proposed for the artificial canals to maintain it as a fresh water body.

Interim summary

For ensuring the connectivity between Mahe River and Valapattanam River, alignments for the artificial cuts were prepared from the analysis of various options emerged based on the reconnaissance survey, map study and corresponding field studies. For each artificial cuts, a minimum of three alternatives were studied and the routes passes through the low-lying area and affects minimum number of structures are given more priority. Also, project components were identified and listed based on the preliminary studies. The land acquisition plans were prepared and submitted. The preparation of DPR is under progress and the same is submitted in accordance with the water balance study being carried out by the client.

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

Date of start: 04/2019
Date of completion: 03/2020

Need and importance of the Study

KSCSTE-NATPAC has undertaken consultancy and research works for various local bodies and Government departments and agencies like Inland Waterways Authority of India (IWAI), Tourism Department, Varkala Development Authority, Bakel Resort Development Corporation, and Infrastructure Kerala Ltd (INKEL) etc. Data related to these projects are not easily accessible for further use as these data are not compiled properly or stored in a common database. So it is proposed to create and update a GIS based database management system to compile, store and analyse waterway related data.

Scope and Objectives

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

- To compile the available data related to waterways in Kerala for mapping flood prone area;

- To create and manage a waterway information system using GIS;
- To map flood prone area along the waterways, including available infrastructure and identify critical areas and possible evacuation routes in case of emergencies.

Data Collection/Compilation

The data which is already collected as part of various studies in KSCSTE-NATPAC related to inland waterways is to be compiled for database creation. Data collected from other departments for various studies and that available online may also be included. Various relevant data available in internet were also used.

Database Creation

The first step in database management system of inland waterway transport for Thiruvananthapuram district was collection of primary and secondary data. The primary data includes details collected from field surveys in the form of GPS points and the data which is already collected as part of various studies in KSCSTE-NATPAC related to inland waterways. The primary data also includes inventory of canal, cables, cross structures, boat jetty and drains, total station survey on waterway, hydrographic survey and water quality analysis. The secondary data collected for database creation is by Georeferencing and Digitization of scanned copies of Survey of India Toposheet, Open street map and Indian water resources information system as Shape file in ESRI ArcMap 10.1.

Secondary data are administrative boundary, water body and rail and road networks. GPS survey points were converted into point shape file and further details are added in the form of attribute table. All the point, line and polygon features were projected in to WGS 84 / UTM zone 43N coordinate system. Before database creation all collected data are verified with present condition. During field verification any changes or any further details are observed from earlier condition. Data must be updated before database creation by including the details.

For Inland waterway Database creation a new Geodatabase is created in ArcGIS 10.1. Data collected by GPS survey was converted into vector data as point, line and polygon features. The primary data created in the geodatabase are location of existing boat jetty, cross structures, cables crossing the waterway, drains joins into the waterway and water quality data as point

feature and width, depth, condition of bank and waterway as point feature. The details of vector data in excel tables were entered into GIS as attribute table. Along with primary data, secondary data such as administration boundary, water body, rail network, road network and location was also added into the Geodatabase.

Interim Conclusions

The work completed in financial year 2019-2020 includes digitization of water body in Kerala from open street map. Geo database was created for Inland waterway in Thiruvananthapuram District and compilation of inventory data was available for remaining waterways in Kerala. In continuation of this project, it is proposed to prepare a geo-database for inland waterways for each district, inventory of missing details related to waterway and regular and periodic updation of the database.

35. Maintenance and Management of Waterways : A Case Study of Parvathy Puthanar

Date of start: 04/2019
Date of completion: 03/2020

Need and importance of the Study

Inland waterways are one of the transportation alternatives available to the congested roads in Kerala. Government of Kerala proposes to develop inland waterway from Kovalam to Hosdurg and to make it navigable by the year 2020. Government has constituted a new SPV called Kerala Waterways and Infrastructures Ltd (KWIL) to plan and execute this prestigious project and the waterway development works are going on which KSCSTE-NATPAC is also participating as a consultant. Regular maintenance and management of waterway is important to keep it operational. So, it is proposed to suggest a maintenance and management system for Parvathy Puthanar.

Scope and Objectives

The scope of the project is limited to the maintenance and management of Parvathy Puthanar. The main objectives of the study are:

- To monitor the condition of the waterway in terms of infrastructure, water quality and waterway operation;
- To suggest a maintenance and management system for ParvathyPuthanar;
- To assess the present situation and suggest improvements and maintenance needs;
- To maintain proper database for further analysis and decision making in GIS.

Methodology

The methodology adopted includes a detailed canal inventory survey, road inventory survey, drainage inventory survey, cable inventory survey and condition survey for canal to assess its present condition. The survey was conducted on a fixed interval of 100m. Hence the bottlenecks such as insufficient width, points of dumping solid waste etc. were identified. The width of canal varies from 7m to 160m. Amayizhanchan thodu, Thekkanakara canal, Kariyilthodu and Karamana River are the major feeders of the canal. As part of development of the portion of Parvathy Puthanar between Kovalam and Akkulam, which connects two major tourist locations of the area, KWIL has conducted an initial cleaning of this stretch under the supervision of KSCSTE-NATPAC. Cleaning was initiated during the month of June. The major cleaning ended by August. Periodical cleaning of weeds in different stretches are still in progress.

Data Collection and Analysis

Water quality sampling was done before and after cleaning. The sampling location was selected based on introduction of waste and ease of accessibility for collection of sample. The e-coli count was high at Muttathara region. This indicates the fecal contamination of water. This area is highly congested and houses are located close to one another. These houses discharge both solid and liquid waste directly into canal.

The canal is completely filled with sand near the Panathura Subramanya Swami Temple for 160m. At present a part of the canal is completely polluted due to human intervention from SM lock to Muttathara. There is no visible flow of water in these regions. The bank protection is to be repaired for 70% of the sections and is covered with plant growth. The major structure obstructing the waterway is SM Lock which is abandoned as it is very old. The canal near

Koonam Thuruthi Moorthy Temple, Pachalloor is not navigable as it is silted by waves. Moonnattumukku to Enchakkal is also not navigable as the canal is narrow, blocked by weeds, highly silted, cross structures with less clearance. The canal is highly polluted due to dumping of domestic waste as well as waste from sewage treatment plant, making the water unsuitable for growth of aquatic life. Untreated liquid waste from houses and hotels are dumped into the canal, which has boosted the breeding rate of mosquitoes and caused outbreak of waterborne diseases to the dwellers on both sides of canal. Good service road parallel to the canal exists. There are 12 road bridges, 2 rail bridges, 10 foot bridges, 1 aqueduct, 3 pipeline bridges and a lock exits at this section. World vegetable market, Kochuveli Railway Station, Trivandrum International Airport, Sewage Treatment Plant, Lulu Mall, All India Radio are situated near the canal.

Aerobic compost bins are used for the solid waste management. This technology is not labour intensive. Along with the aerobins, material recovery facility is also available at these centres. There are 15 aerobic compost centres under the health inspector zone of the study area. People living nearby these centres show a positive response by giving their biodegradable and non-biodegradable wastes to this facility rather than dumping them into the canal. More units are to be installed along the canal so that people would give their waste to these units. There are no measures taken for the liquid waste management in this region. All the details obtained from the survey are compiled in a GIS database for further reference.

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

Date of start: 04/2019
Date of completion: 03/2020

Need and importance of the Study

Inland waterways are one of the transportation alternatives available to the congested roads in Kerala. Though accidents are less compared to road sector, several high profile fatal boat accidents in passenger boats, barges and inland fishing boats occurs.

Scope and Objectives

The Scope of the study is limited to accidents and other safety related aspects of the inland waterways of Kerala State. The main objectives of the study are:

- To study the existing rules and regulations related to Inland Waterways in safety aspects and examine their adequacy;
- To study the cause of recent accidents related to waterways;
- To examine the waterway sections in Kerala in terms of safety and risk involved and suggest improvement measures;
- To design waterway safety awareness programs and materials for creating awareness.

Methodology

Inland Water Transport (IWT) is one of the oldest and economical modes of transportation. Although it sounds to be an effective mode of transportation, IWT too have its own demerits. Despite being less frequent to the accident occurrences as compared to roadways, the severity of any such mishaps in IWT is much more alarming. That is why there arises a need for study on accidents in water transport. So all the possible factors that could lead to accidents in waterways need to be identified. The weightage of each factor in waterways varies and this needs to be calculated. After a thorough literature review, it has been found that Analytical Hierarchal Process (AHP) developed by Saaty in 1980s proved to be a useful tool in calculating the relative weights of each safety factors, based on which it is possible to rank the waterways according to safety aspect. Later many research studies were carried out on AHP discussing the improvements and Satty himself has proposed many such improvements.

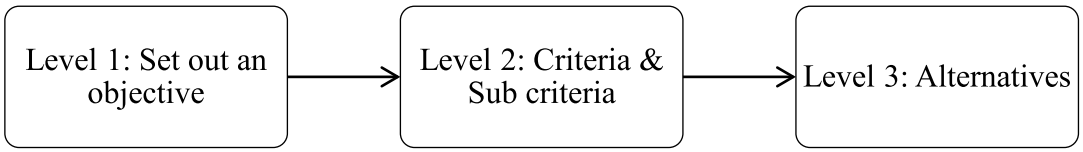


Figure 15: General Outline of AHP

The present work is to identify the safest waterway from selected list of seven waterways in Kerala. The water ways selected for the study are Alappuzha – Kottayam Canal (AK Canal) -

24 km , Alappuzha – Changanacherry Canal (AC Canal) - 29 km , Nedumudi –Edathva -14.8 km, Vytila – Kakkanad -5.2 km, Ernakulam – Varappuzha -13.3 km, Kollam – Sambranikodi - 5 km and Panavally - Irappuzha - South Paravur -10.6 km. Identification of the safety factors and sub criteria acting on these waterways are also discussed in this study. Hierarchal distribution of safety factors and its sub criteria shown in **Figure 16.**

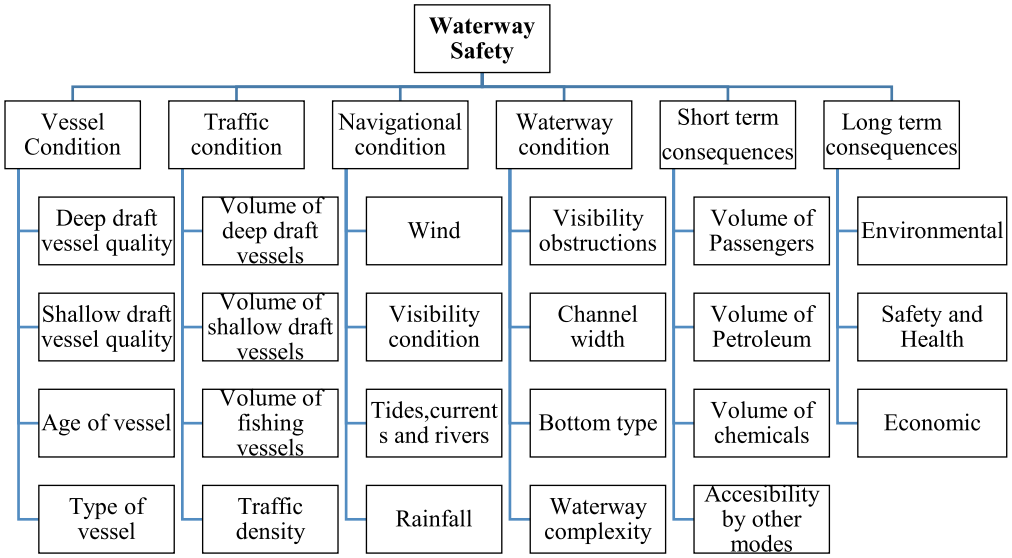


Figure 16: Hierarchal Representative Diagram

Based on the relative importance of each of the above criteria and how it affects different waterways considered, AHP can provide ranking of different waterways in relation to safety aspect. The value of relative importance is based on Saaty's scale which ranges from 1 to 9 in increasing order of relative importance with 1 indicating equal importance and 9 indicating extreme importance. Eigen vectors of this comparison matrix will give out the relative weights of the criteria considered. In order to check for consistency of the resulting values, a Consistency Index is developed and further a Consistency Ratio (CR) and Saaty allowed a tolerance of 10% inconsistency for the obtained weights to be treated valid. Otherwise repeat the process till inconsistency reaches within the limits.

EXTENSION SERVICES

1. Road Safety Week – 2020

KSCSTE-NATPAC observed 'Road Safety Week – 2020' by organizing a series of activities from January 11-17, 2020. The theme of this year's Road Safety Week was "Sadak Suraksha – Jeevan Raksha".

Activities conducted by KSCSTE-NATPAC during 31st Road Safety Week:

Thiruvananthapuram and Kollam Districts

- Pedestrian Crossing Drill at Medical College Junction, Thiruvananthapuram on 13th January 2020 aimed at demonstrating how road crossing could be done safely at a signalised intersection.

- Outdoor campaign on Road Safety at Panaveli Junction and Vayakkal Junction near Kottarakkara on 14th January 2020. Road safety awareness drama 'Yathrakkapuram' was performed at these two junctions.

- Pedestrian Crossing Drill at Chinnakkada Junction, Kollam on 15th January 2020.

Displaying placards having road safety slogans at Chinnakkada Junction

- Outdoor campaign on Road Safety at Thattathumala on SH 1 and at the premises of RKV auditorium, Karette on 15th January 2020, at Chadayamangalam Bus Stand, Kuriyode Junction, Nilamel Junction and Kilimanoor Bus Stand on 16th January 2020. Road safety awareness drama 'Yathrakkapuram' was also performed.

- Pedestrian Crossing Drill at Pulamon Junction, Kottarakkara on 17th January 2020.

- Class on "Safe Driving Practices for driving school instructors" at Dhanya Auditorium, Kottarakkara on 17th January 2020 as part of the valedictory session arranged by Motor

Vehicles Department, Kollam. About 350 driving school instructors within Kollam District attended the session.

Class on "Safe Driving Practices for driving school instructors" at Kottarakkara

- "One-day Road Safety Awareness Programme for Drivers" at *S*ahitya Panchanana Smaraka Granthashala, Vattiyoorkavuon 17th January 2020. Adv. V. K. Prasanth, MLA, Vattiyoorkavu inaugurated the programme. Two technical sessions were made during the seminar, i.e., 'Motor Vehicle Amendment' by Shri.Shaji, Retired Transport Commissioner, Kerala Motor Vehicles Department and 'Defensive Driving for Drivers' by Shri.T.V.Satheesh, Retired SP. Nearly 40 drivers participated.

Welcome Address by Dr.Samson Mathew, Director, KSCSTE-NATPAC

Inaugural Address by Adv. V. K. Prasanth, MLA, Vattiyoorkavu

<u>Kozhikkode and Malappuram Districts</u>

- Pedestrian Crossing Drill in front of KSRTC bus stand, IG Road, Kozhikode on 14th January 2020.

- Soft policing exercise at Moffusil Bus Stand Junction, Kozhikkode on 14th January 2020 with the help of Traffic Police and student volunteers. This focuses on the non-coercive elements of policing, typically community engagement, situated knowledge and negotiated order maintenance.

- Workshop on 'Road Safety for Practitioners' at Hotel Delicia, Malappuram on 15th January 2020. Sri Abdul Karim U IPS, District Police Chief, Malappuram, delivered the key note address. Engineers from PWD (NH), PWD (Roads) and LSGD participated.

Technical Presentations made during the Workshop:

Sl.No.	Name	Designation	Topic
1	Shri. V S Sanjay Kumar	Senior Scientist, KSCSTE-NATPAC	Overview of Road Crash Scenario
2	Shri. Ebin Sam	Junior Scientist, KSCSTE-NATPAC	Identification and Prioritization of Crash Prone Locations
3	Shri. Arun Chandran	Scientist, KSCSTE-NATPAC	Road signs and markings
4	Dr.M V L R Anjaneyulu	Professor, NIT Calicut	Road safety improvements

- Road Safety Youth Leadership Programme at MES Engineering College, Kuttippuram on 16th January 2020. Two technical sessions were made during the programme, i.e., 'Road Safety and Youth' by Shri V.S Sanjay Kumar, Senior Scientist, KSCSTE-NATPAC and 'Driving Behaviour and Safety' by Dr. Mohammed Najeeb, Dy. Transport Commissioner (Rtd).

Class on "Road Safety and Youth" at MES Engineering College, Kuttippuram

- Safe Road to School (SRS) at MSP English Medium School, Malappuram and Government Boys HSS, Malappuram on 17th January 2020.

Class on "Driving Behaviour and Road Safety" at MSP English Medium School, Malappuram

Kannur

- Safe Road to School (SRS) at Government Boys Higher Secondary School, Madayi on 15th January 2020. Shri.T V Rajesh, MLA, Kalliasseri inaugurated the programme. Three technical sessions were made during the programme, i.e., 'Road Rules and Regulations' by Shri. Sreenivasan P, Motor Vehicle Inspector, 'Road Safety Awareness' by Shri. Praveen P, Senior Civil Police Officer, Thiruvananthapuram and 'Accident Causes and Remedies' by Shri. S Shaheem, Principal Scientist, KSCSTE-NATPAC. 80 students attended the training programme.

Inaugural Address by Shri.T V Rajesh, MLA, Kalliasseri

- Road Safety Awareness Program for drivers at District Panchayat office, Kannur on 16th January 2020. Smt.P.P.Divya, Vice President District Panchayat inaugurated the programme. Three technical sessions were made during the programme, i.e., 'Motor Vehicle Amendment' by Shri. P Sudhakaran, Motor Vehicle Inspector, 'Defensive Driving for Drivers' by Shri. Praveen P, Senior Police Officer, Thiruvananthapuram and 'Road

Safety Awareness Program for Drivers' by Shri. S Shaheem, Principal Scientist, KSCSTE-NATPAC. 50 drivers participated.

2. 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 from 5th – 9th August 2019 at Centre for Water Resources Development and Management (CWRDM), Kozhikode. 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. Shri.Karat Razack MLA delivered the presidential address. The training programme was inaugurated by Shri. A. K. Saseendran, Honorable Minister for Transport, Govt. of Kerala.

The programme was attended by Shri. A. V. George IPS, Commissioner of Police, Kozhikode City, Dr. Anitha A. B, Executive Director, KSCSTE-CWRDM and representatives from all important stakeholder departments/organisations.

Inaugural Address by Shri. A. K. Saseendran, Honorable Minister for Transport, Govt. of Kerala.

Technical Presentations made during the Training Programme

Sl.No.	Name	Designation	Topic
Day – 1 (05.08.2019)			
1	Shri.S.Shaheem	Director (i/c), KSCSTE -NATPAC	Comparative Overview of Global and Indian road safety scenario
2	Shri.V.S.Sanjay Kumar	Senior Scientist, KSCSTE-NATPAC	Role of Engineering in Road Safety and System approaches to Road Safety
3	Dr. Mohammed Najeeb	Deputy Transport Commissi (Rtd.).	Human Factors in Road Safety
Day – 2 (06.08.2019)			
4	Shri.Arun Chandran	Scientist, KSCSTE-NATPAC	Night Time Visibility Measures for Road Safety
5	Shri.Ebin Sam	Junior Scientist, KSCSTE-NATPAC	Hazardous Road Locations and Case Studies
6	Dr. Krishnamurthy. K	Associate Professor, NIT Calicut	Road Safety Audit
7	Shri.Jegan Bharath Kumar	Junior Scientist, KSCSTE-NATPAC	Road Safety for Vulnerable Road Users (VRUs) and Person with Different Abilities (PwDs)
Day – 3 (07.08.2019)			
8	Dr. M.V.L.R. Anjaneyulu	Professor, NIT Calicut	• Safety in Road Design Junction • Safety in Road Design-Links and Roadside Safety
9	Shri. Ronak Bhudhrani	AITD	Safety in construction zones and importance of maintenance in safety
10	Shri.Anish Kini	Junior Scientist, KSCSTE-NATPAC	ITS and its applications in Road Safety
Day – 4 (08.08.2019)			
11	Shri.V.S.Sanjay Kumar	Senior Scientist, KSCSTE-NATPAC	Safety in Road Design- Hill Roads, Culverts, Bridges and Flyovers
12	Shri. Albin Tharakan	Road Safety Engineer	Star Ratings of Roads and Non Enginee Measures for Road Safety
Day – 5 (09.08.2019)			
13	Dr. Sarkar P. K	AITD	Traffic Calming Measures
14	Dr. Neethu	Emergency Medicine, Aster MIMS	Incident Management and Trauma Care

On the 4th day of the training programme "Field Exercise on Road Safety" 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.

The training was successfully held and the main objectives were all achieved. The feedback from the participants was very positive.

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

Government of Kerala accorded sanction to KSCSTE-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.

A total of 7 programmes were completed this year at the KSCSTE-NATPAC office, *K Karunakaran Transpark*, Aakkulam, Thiruvananthapuram as per the following schedule.

Date	Number of drivers Participated
03/05/2019	
19/05/2019 – 21/05/2019	24
19/05/2019	9
20/05/2019	9
21/05/2019	12
08/08/2019	24
30/08/2019	23
Total	**101**

4. *Training Course for Police Officials on Safe Handling of Dangerous and Hazardous Goods*

KSCSTE - NATPAC in association with Kerala Police organised a three day training programme on 'Safe handling of dangerous and hazardous goods'.

Five programmes were completed during this period as listed below.

- Kerala Police Academy, Thrissur - 10/10/2019 – 12/10/2019 (35 persons participated)
- Kerala Police Academy, Thrissur - 17/10/2019 – 19/10/2019 (35 persons participated)

- Kerala Police Academy, Thrissur - 23/10/2019 – 25/10/2019 (40 persons participated)
- Kerala Police Academy, Thrissur - 29/10/2019 – 31/10/2019 (40 persons participated)
- Kerala Police Academy, Thrissur - 05/11/2019 – 07/11/2019 (40 persons participated)

5. Safe Corridor Demonstration Project (SCDP) - Safe Road to School Programme

The Kerala State Transport Project–II (KSTP) with financial assistance from The World Bank is implementing a Safe Corridor Demonstration Program (SCDP) between Kazhakkoottam on NH 66 and Adoor on MC Road (SH-1).

SCDP envisages a number of road safety interventions and countermeasures to reduce fatalities and injuries due to road traffic crashes. One of the sub-components of the project was to impart knowledge in Traffic Rules, Road Safety and Basics of First Aid and Life Support among Local Community, School Children, Drivers and Youth within and outside the project area.

The Road Safety Education and Awareness Programme in the SCDP were formally inaugurated by Smt.Aisha Potty, Hon'ble MLA, Kottarakkara on 19th September 2019 at Hotel Ambalakkara Regency, Kottarakkara.

Smt.Aisha Potty, Hon'ble MLA, Kottarakkara inaugurating the Road Safety Education and Awareness Programme in the SCDP

The second phase of the Safe Corridor Demonstration Project (SCDP), the first programme being 'Safe Road to School' (SRS) was formally inaugurated by Smt.Bindu S, Counsellor, Chanthavila on 11th November 2019 at St.Thomas School, Kattayikonam. 128 students from six schools participated in the programme.

SRS Programme at St.Thomas School, Kattayikonam

Thirteen programmes were completed during this period as listed below.

Sl.No.	Details of the Programme	Participants	Date
1	St Thomas Public School, Kattayikonam Govt UPS, Kattayikonam Govt UPS, Chanthavila Alan Feldman School St. Thomas UPS GHSS, Ayiroopara	35 students, 5 teachers 20 students, 2 teachers 11 students, 1 teacher 30 students, 2 teachers 11 students, 1 teacher 21 students, 2 teachers	11.11.2019
2	Govt.UPS, Koliyakode Govt. VHSS, Pirappancode	42 students, 3 teachers 60 students, 3 teachers	12.11.2019
3	Govt HSS, Venjarammodu Govt UPS, Venjarmmodu Shalini Bhavan Convent School	40 students, 3 teachers 30 students, 3 teachers 30 students, 3 teachers	18.11.2019
4	Devaswom Board HSS, Vamanapuram Govt UPS, Vamanapuram Govt UPS, Anakudy Mulamana HSS, Anakudy	40 students, 3 teachers 30 students, 3 teachers 20 students, 2 teachers 30 students, 3 teachers	20.11.2019
5	MGM International School, Kilimanoor Govt UPS ,Pulimath	97 students, 6 teachers 7 students, 1 teacher	25.11.2019

6	Govt HSS, Thattathumala Govt Town UPS, Kilimanoor	60 students, 5 teachers 40 students, 3 teachers	27.11.2019
7	MM HSS, Nilamel Govt UPS, Nilamel Sabarigiri New Gen school	76 students, 5 teachers 20 students, 2 teachers 13 students, 1 teacher	03.12.2019
8	Govt.MGHSS, Chadayamangalam Govt UPS, Chadayamangalam Marthoma Central school	60 students, 4 teachers 26 students, 2 teachers 23 students, 2 teachers	04.12.2019
9	St.Anns Central School, Ayoor Govt JHS, Ayoor St.George UPS, Ayoor Little Flower EM School	35 students, 4 teachers 51 students, 2 teachers 15 students, 1teacher 4 students, 1 teacher	10.01.2020
10	Govt HSS, Sadanandapuram RVVHSS, Valakom	54 students, 4 teachers 50 students, 2 teachers	14.01.2020
11	Marthoma HSS, Valakom DVUPS, Vayakkal	85 students, 4teachers 10 students, 2 teachers	16.01.2020
12	Marthoma Girls HS, Kottarakkara GHSS, Kottarakkara GBHS & VHS, Kottarakkara	42 students, 4 teachers 31 students, 2 teachers 36 students, 2 teachers	21.01.2020
13	MGM Residential Public School, Kottarakkara St. Marys HS Kottarakkara St. Marys HSS Kottarakkara	60 students, 4 teachers 30 students, 2 teachers 20 students, 2 teachers	28.01.2020

SRS Programme at Govt HSS, Venjarammodu

SRS Programme at DB HSS, Vamanapuram

SRS Programme at St.Anns Central School, Ayoor

6. Safe Corridor Demonstration Project (SCDP) –Out Door Campaign

As part of the outdoor campaign, public meetings were organized at important junctions in the safe corridor. Interactive sessions based on road safety, road markings and regulations were conducted. Launching of the outdoor campaign was done by Smt.Syamala Amma, Municipal Chairperson, Kottarakkara on 19th September 2019 at Hotel Ambalakkara Regency, Kottarakkara.

Road safety awareness drama 'Yathrakkappuram' was played at all the locations. The drama was played by professionals from Folk Media Traffic Education Society Thiruvananthapuram. Road Safety drama 'Signal' created and presented by Kerala Police was also played. Leaflets/Pamphlets on road safety were distributed to the participants.

View from Street Drama on Road Safety – 'Yathraykkappuram'

View from Street Drama on Road Safety – 'Signal'

Twenty one programmes were completed during this period as listed below.

Sl.No.	Date	Location	District
1	19.09.2019	Puthusserybhagom	Pathanamthitta
2	19.09.2019	Market Jn, Adoor	Pathanamthitta
3	20.09.2019	Vadakadathukavu	Pathanamthitta
4	20.09.2019	Enath	Kollam
5	20.09.2019	Puthoormukk	Kollam
6	20.09.2019	Kulakkada	Kollam
7	20.09.2019	Kalayapuram	Kollam
8	21.09.2019	Pulamon Jn	Kollam
9	21.09.2019	Sadanandapuram	Kollam
10	21.09.2019	Valakom	Kollam
11	21.09.2019	Ayoor	Kollam
12	18.11.2019	Venjarammoodu SNDP Hall	Thiruvananthapuram
13	20.11.2019	Kilimanoor Town Hall	Thiruvananthapuram
14	14.01.2020	Panaveli	Kollam
15	14.01.2020	Vayakkal	Kollam
16	15.01.2020	Thattathumala	Kollam
17	15.01.2020	Karettu	Thiruvananthapuram
18	16.01.2020	Chadayamangalam Bus Stand	Kollam
19	16.01.2020	Kuriyode	Kollam
20	16.01.2020	Nilamel	Kollam
21	16.01.2020	Kilimanoor Bus Stand	Thiruvananthapuram

7. Safe Corridor Demonstration Project (SCDP) – Youth Leadership and Road Safety

Recognizing the role of youth in road safety drama KSCSTE-NATPAC launched a programme, 'Youth Leadership and Road Safety' to educate youngsters about the key risk factors involving youth in road crashes and remedial measures.

Six programmes were completed during this period as listed below.

Sl.No.	Details of the Programme	Participants	Date
1	GBHSS, Adoor		22.11.2019
2	St Gregorious College, Kottarakara	60 NSS Volunteers	29.11.2019
3	NSS College, Nilamel	60 students	10.12.2019
4	Marthoma Institute of Science and Technology, Ayur	54 students	12.12.2019
5	MGM Polytechnic College, Kilimanoor		24.01.2020
6	Marthoma Institute of Information Technology, Ayoor	63 students and 10 teachers	31.01.2020

Class on 'Road Safety' at St Gregorious College, Kottarakara

Youth Leadership and Road Safety Programme at Marthoma Institute of Science and Technology, Ayur

8. Safe Corridor Demonstration Project (SCDP) –Road Safety Training for Drivers

KSCSTE-NATPAC organized one day programme to educate different categories of drivers on Rules & Regulations on roads, safe driving techniques and on reduction of road accidents and fatalities.

KSCSTE-NATPAC conducted two programmes during this period.

Sl.No.	Details of the Programme	Participants	Date
1	VamanapuramGramaPanchayath Hall	50 Drivers	21.12.2019
2	ManikalPanchayath Hall		11.01.2020

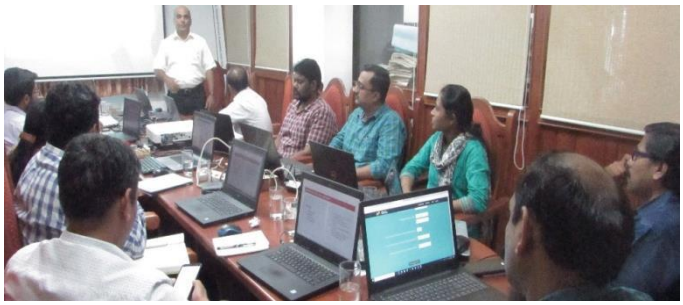
Road Safety Training for drivers at Vamanapuram Grama Panchayath Hall

9. Training Programmes Conducted

a) In-house Training/Invited Expert Talk

Sl. No.	Details of Training	Date
i.	Presentation on 'Integrated agent based simulation for urban transportation planning', by Dr.B.K.Bhavathrathan, Assistant Professor, Civil Engineering, IIT Palakkad	22.05.2019
ii.	Technical presentation on 'Pavement Engineering QC Equipment: Falling Weight Deflectometer, Light Weight Deflectometer and Multifunctional Vehicle with LCMS & RSP System', by Shri.Stephen M Wormald, Dynatest	23.05.2019
iii.	One day training on 'ESRI ArcGIS 10.6.1' by Mr.Syed Wasim, ESRI, Chennai	29.05.2019
iv.	One Day training on 'Erdas Imagine 2018 Software' by Mr. Vasudeva RaoVemana, Intergraph, Delhi	03.06.2019
v.	Presentation on 'Latest Technology NDT Equipment's and Consultancy Services for QC & QA in Civil Constructions for Roads, Buildings, Bridge Works etc', by M/s Sriyan Infra Projects India Pvt Ltd., Hyderabad	27.09.2019
vi.	Presentation on 'Transport Modeling – an Overview', by Sri.Vinoba Sunder Singh for Scientists	04.10.2019
vii.	Hands-on training on Statistical Tools and Data Handling by Shri.Binoy John, Director, Norma School to Scientists and Technical Officers	25.10.2019 – 26.10.2019

viii.	Talk on 'Data-enabled Transportation Planning for the Modern World: Correcting the wrongs we learned from the West', by Prof.R.Jayakrishnan, Civil and Environmental Engineering, University of California, Irvine	01.01.2020
ix.	One day Workshop on 'Open Road Designer' (earlier known as MX Road), by Mr.Roashan Bucha, Bentley for Scientists and Technical Staff	26.02.2020



Hands-on training on Statistical Tools and Data Handling

b) Road Safety Training for Various Target Groups

Sl. No.	Details of Training	Date
i.	Road Safety training for KSRTC drivers at K KarunakaranTranspark, Aakkulam. 38 drivers participated.	03.09.2019
ii.	'Nalla Driver' - One day road safety training for Auto drivers organized by Nemom Police Station and Nemom Residential Association in association with NATPAC.	
iii.	Two day two batch training program on "Road Safety Residential Training Program for Student Police Cadets" at Centre for Water Resources Development and Management (CWRDM), Kozhikode. The programme was inaugurated by Shri.A K Saseendran, Hon'ble Minister for Transport, GoK.	24.09.2019– 27.09.2019
iv.	'Safe Road to School' (SRS) at St.Mary's Higher Secondary School, Pattom. 100 Student Police Cadets participated.	19.10.2019

SRS Programme at St.Mary's Higher Secondary School, Pattom

10. *Exhibitions*

1. KSCSTE-NATPAC organized pavilion for KSCSTE in Mega Science, Technology and Industry Expo at 5th India International Science Festival – IISF jointly organised by Ministry of Science & Technology and Earth Sciences, Govt. of India and VijnanaBharati (VIBHA), Kolkatta, 5th – 8th November 2019.
2. Road Safety Exhibition and audio-visual programmes in connection with Mega Expo at Holy Innocent Public School, Varkala, 28th – 30th November 2019.
3. Road Safety Exhibition and audio-visual programmes at Venganur HSS, 5th -7th December 2019.
4. Mega Expo in the 27th National Children's Science Congress, hosted by Kerala State Council for Science, Technology and Environment (KSCSTE), Government of Kerala in association with Mar Ivanios College and Mar Baselios College of Engineering and Technology at Mar Ivanios Vidya Nagar, Nalanchira, Thiruvananthapuram, 27th - 31st December 2019.
5. Road Safety Exhibition and audio-visual programmes in connection with 32nd Kerala Science Congress Jointly organized by KSCSTE and KFRI at Yuvakshetra Institute of Management Studies, Mundoor, Palakkad, 25th -27th January 2020.
6. Road Safety Exhibition and audio-visual programmes in connection with India Skills Kerala 2020 at Kozhikkode, 22nd - 24th February 2020.

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

Name of Programme	Organised by	Date (s)	Venue	Participants
Seminars/Conferences				
3rd meeting of Transport Planning and Traffic Engineering Committee (H-1)	Indian Roads Congress		IRC Bhavan, New Delhi	Shaheem S
Stake holders meeting for State Legislative Road Safety Gap Analysis	CED and CUTS International	21.05.2019		K C Wilson

218th Midterm Council Meeting of Indian Roads Congress	Indian Roads Congress	09.08.2019-11.08.2019	Goa	Shaheem S
5th International Conference of Transportation Research Group of India (CTRG 2019)	Maulana Azad National Institute of Technology, Bhopal	18.12.2019 – 21.12.2019	Maulana Azad National Institute of Technology, Bhopal	Shaheem S V S Sanjay Kumar Sabitha N M Jegan Bharath Kumar A R Chandra Prathap Dr.U Salini T.Ramakrishnan
Research to Practice-Towards better roads		18.01.2020	College of Engineering, Trivandrum	Dr.Salini U
"Geospatial Caravan"	Geospatial Media and Communication, along with Survey of India and Kerala State IT mission and KSDI	17.02.2020	Appollo Dimoro Hotel, Tvpm	M S Saran
Workshops				
Regional Level Consultation Workshop on 'Risk Informed and Effective Town Planning'	Town and Country Planning Department, Kozhikode	20.02.2020	Hotel Hyson Heritage	Ebin Sam
Training Programmes				
Enforcement and Crash Investigation Methods	TRL and JP Research	07.05.2019-08.05.2019	Police Training College	Ebin Sam
Faculty Development Program on "Recent Trends in Mechanical Characterization of Bituminous Binders and Mixtures"		24.06.2019-28.06.2019	Mar Baselios College of Engineering and Technology, Thiruvananthapuram	Jegan Bharath Kumar A Dr.Salini U
Training Program on "QGIS Software"	Kerala State Spatial Data Infrastructure (KSDI)	24.06.2019-28.06.2019	KSCSTE-NATPAC, Aakkulam	M S Saran, Sabitha N M, Ebin Sam
GIAN course on Design and Construction of Sustainable Concrete Pavements	IIT Madras and MoHRD, GoI	09.12.2019-13.12.2019	IIT Madras	Jegan Bharath Kumar A R Chandra Prathap

12. 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 KSCSTE-NATPAC Scientists. The list of guidance provided by the Scientists is given below:

Name of the Institution	Course	Guide	No.of Students	Topic
Rajadhani Institute of Engineering and Technology, Thiruvananthapuram	B.Tech (Civil)	Shaheem S, T Ramakrishnan	4	A Comparative study on the travel characteristics of Rural and Urban population – Ernakulam District
National Institute of Technology, Surathkal	M.Tech (Tptn.)	Shaheem S, T Ramakrishnan	2	Study of effect of metro on Kochi city
National Institute of Technology, Tiruchirappalli	M.Tech (Tptn.)	Shaheem S	1	Transport Potential Indices of Panchayats – Case study of Ernakulam district
National Institute of Technology, Tiruchirappalli	M.Tech (Tptn.)	Shaheem S	2	Traffic and Transportation studies for Thalasserry town
Jyothi College of Engineering	M.Tech (Tptn.)	P N Salini B Anish Kini	1	Studies on Emergency Vehicle Prioritization at Signalised Intersections
Jyothi College of Engineering	M.Tech (Tptn.)	P N Salini B Anish Kini	1	Queue dissipation time and travel time estimation model for emergency vehicles under pre-emption control
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Tptn.)	P N Salini	2	Development Plan for an Integrated Parking System at Medical College
Viswajyothi College of Eng. and Technology, Vazhakkulam, Thodupuzha	B.Tech (Civil)	P N Salini	5	Traffic and Transportation Plan for small/medium Towns
SCMS School of Engineering and Technology, Ernakulam	B.Tech (Civil)	P N Salini	5	Integrated planning for Public Transport in a City
UKF College of Engineering and Technology, Parippally	M Tech	Sabitha N M		Solid waste management at Kovalam Akkulam Section of waterway
Sree Budha college of Engineering	B.Tech (Civil)	Wilson K C		Pavement performance of State Highway 1
Sree Budha college of Engineering	B.Tech (Civil)	Wilson K C		Performance of roads in water logged areas
TKM college of Engineering	B.Tech (Civil)	Wilson K C		Traffic management plan for Technocity
Vidya Academy of Science & Technology	B.Tech (Civil)	Wilson K C	4	Moisture susceptibility of bituminous concrete

Jyothi Engineering College	M.Tech (Tptn.)	Arun Chandran	1	Traffic and Transportation studies for Kollam City
Sree Vellapily Natesan College of Engineering , Pandalam	B.Tech (Civil)	Ebin Sam	3	Application of GIS technique in data management of selected major roads in Kerala
SVNCE, Pandalam	B.Tech (Civil)	Ebin Sam	4	Development of GIS database
Jyothi College of Engineering	M.Tech (Tptn.)	Ebin Sam	1	Identification of crash black spots in Kerala
Jyothi College of Engineering	M.Tech (Tptn.)	Ebin Sam	1	Road Safety Impact Safety Analysis of Two-lane to Four-lane conversions on National Highway
Reva University, Bengaluru, Karnataka	M.Tech (Tptn.)	Jegan Bharath Kumar A	2	Traffic Data Analysis and Design of Pavements
St. Thomas Institute for Science and Technology	M.Tech (Tptn.)	Dr.Salini U	1	Study on the swell-shrink behavior of Akkulam clay
John Cox Memorial CSI Institute of Technology	B.Tech (Civil)	Dr.Salini U	4	Mapping of aggregate resources in Trivandrum District
Sree Budha College of Engineering	B.Tech (Civil)	Dr.Salini U	4	Mapping of aggregate resources in Kottayam District
TKM Institute of Management, Kollam	MBA	Sanjai R J	1	Study on operational efficiency on KSRTC city bus service in Thiruvananthapuram District

13. Presentation of Papers in Seminars/Workshops

Sl. No.	Author(s)	Paper details	Date
i.	Shaheem S, Sreelekshmi S	*"Identification of major latent variables influencing mode choice behaviour of non-work trips in medium sized Cities".* 15th World Conference on Transport Research (WCTR), organised by IIT Bombay.	26th – 31st May 2019
ii.	P N Salini, Ardra S Krishna	*"Estimation of Trip Generation Rates for Different Land Uses".* 15th World Conference on Transport Research (WCTR), organised by IIT Bombay and the paper published in Elsevier Conference Proceedings	26th – 31st May 2019
iii.	Wilson K C, Dr.B G Sreedevi, Shindon Baby, Teena John	*"Overlay design of low volume roads using Dynamic Cone Penetrometer - a review in Indian scenario".* 15th World Conference on Transport Research (WCTR), organised by IIT Bombay.	26th – 31st May 2019
iv.	Sabitha N M, Dr.B G Sreedevi, T Ramakrishnan	*"Renovation of Water Transport for Improving Urban Mobility in Kochi, Kerala".* The International Conference on Advanced Research and Innovations in Civil Engineering (ARICE 2019), conducted by Dept. of Civil Engineering, Muthoot Institute of Technology and Science (MITS), Ernakulam. Published in the Technical Volume.	13th – 14th June 2019

v.	Sabitha N M	*"Comparison of two event based rainfall runoff models for a small catchment in Kerala"*.The International Conference on Advanced Research and Innovations in Civil Engineering (ARICE 2019), conducted by Muthoot Institute of Technology and Science (MITS), Ernakulam.	13th – 14th June 2019
vi.	Jegan Bharath Kumar A, U Salini	"*Use of Shredded Waste Plastic in Stabilization of Subgrade Soil"*. International Conference on Geotechnics for High Speed Corridors, organized by Indian Geotechnical Society, Thiruvananthapuram Chapter and CET, Thiruvananthapuram, Published in Proceedings, pp 524-526.	25th – 26th July 2019
vii.	Sabitha N M, Dr.Santosh G Thampi, Dr.Sathish Kumar D	*"Comparison of Two Event Based Rainfall Runoff Models for a Small Catchment in Kerala"*. 5th International Conference on MODELING AND SIMULATION IN CIVIL ENGINEERING - ICMSC 2019, conducted by T K M College of Engineering, Kollam at Hyderabad, India.	11th – 13th December 2019
viii.	Shaheem, S, Shijil K, Sreelekshmi S	*'Development of Public Transport Serviceability Index for Metro Cities – A Case Study of Kochi City'*. 5th International Conference of Transportation Research Group of India (CTRG 2019), organized by Maulana Azad National Institute of Technology, Bhopal	18th – 21st December 2019
ix.	Shaheem, S, Remjish R S, T Ramakrishnan	*'Study on Impact of newly opened NH 66 by pass in Kollam City'*. 5th International Conference of Transportation Research Group of India (CTRG 2019), organized by Maulana Azad National Institute of Technology, Bhopal	18th – 21st December 2019
x.	V S Sanjay Kumar, Abin Joseph	*'A Heuristic Method of Prioritizing Flexible Pavement Sections'*. 5th International Conference of Transportation Research Group of India (CTRG 2019), organized by Maulana Azad National Institute of Technology, Bhopal	18th – 21st December 2019
xi.	V S Sanjay Kumar, M V L R Anjaneyulu	*'A purpose based trip distribution gravity model for an Indian city'*. 5th International Conference of Transportation Research Group of India (CTRG 2019), organized by Maulana Azad National Institute of Technology, Bhopal	18th – 21st December 2019
xii.	Sabitha N M, B G Sreedevi, Athulya A S, V S Sanjay Kumar	*'Development of Risk Assessment Model for Waterway Safety'*. 5th International Conference of Transportation Research Group of India (CTRG 2019), organized by Maulana Azad National Institute of Technology, Bhopal	18th – 21st December 2019
xiii.	Jegan Bharath Kumar A Anoop T Vijayan	*'Effect of Compaction levels on Moisture Susceptibility in Asphalt Mix'*. Proceedings of 5th International Conference of Transportation Research Group of India (CTRG 2019), organized by Maulana Azad National Institute of Technology, Bhopal	18th – 21st December 2019
xiv.	Ebin Sam, Shaheem S, ArunChandran, Deepa Radhakrishnan	*'Identification and Prioritization of Crash Prone Locations for selected road corridor in Kerala'*. 5th International Conference of Transportation Research Group of India (CTRG 2019), organized by Maulana Azad National Institute of Technology, Bhopal	18th – 21st December 2019
xv.	R Chandraprathap, Dr.Salini U	*'Experimental investigation on the Feasibility of using Construction Demolition Waste Materials for Sub-base Layer in Flexible Pavements'*. 5th International Conference of Transportation Research Group of India (CTRG 2019),	18th – 21st December 2019

		organized by Maulana Azad National Institute of Technology, Bhopal	
xvi.	Sabitha N M, Dr.B.G.Sreedevi	'*Hydrological and environmental aspects of developing waterways for navigation- A case study of Parvathy Puthanar in Kerala'*. Hydro 2019 – International Conference (Hydraulics, Water Resources and Coastal Engineering), organised by Indian Society of Hydraulics (ISH) and Dept. of Civil Engineering, University College of Engineering, Osmania University, Hyderabad. Proceedings of HYDRO – 2019 , pp.31-41.	18th – 20th December 2019
xvii.	Sabitha N M, Dr.Santosh G Thampi, Dr.Sathish Kumar D	'*Application of the TREX Model to Assess the Impact of Changes in Land-use on Runoff from a Small Catchment'*. Hydro 2019 – International Conference (Hydraulics, Water Resources and Coastal Engineering), organised by Indian Society of Hydraulics (ISH) and Dept. of Civil Engineering, University College of Engineering, Osmania University, Hyderabad. Proceedings of HYDRO – 2019, pp.987-994.	18th – 20th December 2019
xviii.	Vishnu Mohan, Wilson K.C, Dr.B.G. Sreedevi, Dr.Salini U	*"Development of pavement design strategy for rural roads"*. 32nd Kerala Science Congress Jointly organized by KSCSTE and KFRI at Yuvakshetra Institute of Management Studies, Mundoor, Palakkad	25th – 27th January 2020
xix.	Shaheem S, Sreelekshmi S	*"Study on the Effect of Metro on the Mode Choice Behaviour of Commuters In Kochi City"*. 32nd Kerala Science Congress jointly organized by KSCSTE and KFRI at Yuvakshetra Institute of Management Studies, Mundoor, Palakkad	25th – 27th January 2020
xx.	Gopika Mohan, Sreelekshmi S , T Ramakrishnan, Shaheem.S	*"Development of Various Transport Related Indices- A Case Study of Ernakulam District in Kerala"*. 32nd Kerala Science Congress Jointly organized by KSCSTE and KFRI at Yuvakshetra Institute of Management Studies, Mundoor, Palakkad	25th – 27th January 2020
xxi.	Shijil K , T Ramakrishnan, Shaheem S	*"Traffic Operation Plan for Medium Sized Towns in Kerala- A Case Study of Thalassery Town"*. 32nd Kerala Science Congress Jointly organized by KSCSTE and KFRI at Yuvakshetra Institute of Management Studies, Mundoor, Palakkad	25th – 27th January 2020
xxii.	Salini P N, Ardra S Krishna, Manupriya K	*"Traffic Studies and Parking Management for Medical College Campus, Thiruvananthapuram"*. 32nd Kerala Science Congress jointly organized by KSCSTE and KFRI at Yuvakshetra Institute of Management Studies, Mundoor, Palakkad. Published in 32nd Kerala Science Congress Proceedings Abstracts, page No. 95, ISBN No : 81 - 86366 - 97 – 0 -7. Best Poster Award for Technical Paper.	25th – 27th January 2020
xxiii.	Ebin Sam	"*Road Safety – Crash Prone Locations*'. Kerala Nirmiti Infrastructure Expo of KIIFB, organized by IIC, Kasargode	29th January 2020
xxiv.	V S Sanjay Kumar , Salini P N, Sabitha N M, Arun Chandran, Dr.Salini U	*"Impact of Natural Disasters on Traffic and Transportation - the 2019 Kerala floods"*. 4th International Conference on Materials, Mechanics and Management (IMMM 2020), organized by College of Engineering, Thiruvananthapuram, pp 381-386.	5th -7th March 2020

xxv.	Nidhi C Mohan, Vishnu U Krishnan, Saran Kumar M, Sabitha N M	*"Maintenance and Management of Parvathy Puthanar Canal in Thiruvananthapuram".* 4th International Conference on Materials, Mechanics and Management (IMMM 2020), organized by College of Engineering, Thiruvananthapuram.	5th -7th March 2020
xxvi.	Shaheem S	*"Identification of Black Spots and Mitigation Measures".* One day workshop organized by KRSA and Transport Department.	

Papers Published in Referred Journals

- **Shijil K, Shahul Hameed P K, Shaheem S,** *"Traffic Operation Plan for Medium sized Towns in Kerala- a Case Study of Iritty Town".* International Journal of Emerging Technologies and Innovative Research, 6 (1), June 2019, pp 537-542. ISSN:2349-5162.
- **Shilpa Pulinkave Variyam, Anu Plavara Alex, Manju Vasudevan Saraswathy, Shaheem Shahul Hameed,** "*Trip Assignment Modelling for an Indian City to Assess the Benefits of Proposing Ring Roads*". International Journal for Traffic and Transport Engineering, 10 (1), 2020. Indexed by Scopus, pp 69 – 80.
- **Wilson K.C, Salini P.N, V.S Sanjay Kumar, B.G Sreedevi, "***Transportation System Planning for a Work Centre Campus with Direct Access to National Highway*". Indian Highways, July 2019, Vol:47, No:7, pg:11 – 17.
- **V S Sanjay Kumar, Saleel K, Teena John**, *"Planning and Development of Transport Network Connecting Potential Tourist Destinations".* Indian Highways, Vol 48, 2020.
- **Jegan Bharath Kumar A, Ramakrishnan T**, *"Assessment of Walkability and Pedestrian Level of Service in Two Cities of Kerala".* Transportation Research. Lecture Notes in Civil Engineering, Springer, Vol.45, 2019, Page 533 -544.
- **P N Salini, B G Sreedevi, Ebin Sam,** *"Resource Mapping of Highway Materials along with their Characteristic Properties and Desirability".* Transportation Research Proceedings of CTRG 2017, Springer, Vol.45, Indexed by Scopus, January 2020, Page 709 - 723.
- **P N Salini, Ardra S Krishna, Jomy Thomas,** *"Estimating Modal Shift of Home-Based Work Trips due to the Development of Kochi Metro and Reduction in Fuel Consumption and Emissions".* Transportation Research Proceedings of CTRG 2017, Springer, Vol.45, Indexed by Scopus, January 2020, Page 229 - 242.

- **Ebin Sam, Ancy Santhosh, B K Bindhu,** "*Pedestrian Accident Prediction Modelling – A case study in Thiruvananthapuram City*". (CTRG) Transportation Research, Lecture Notes in Civil Engineering 45. Pages 637-646, 2020.

Popular Articles

- **B G Sreedevi, "***Road Infrastructure Development for Kerala".* Construction Management Philosophy, November 2019.
- **B G Sreedevi**, "*India's Road Map to Sustainable Transportation*". Mathrubhoomi Year Book plus 2020, pp 39-49.

14. *Invited Talks/Media Interactions*

Dr. B G Sreedevi

Media Interactions

Sl. No.	Topic	Media	Date
1.	Discussion on '*Traffic Signals in Kerala*'	All India Radio	15.10.2019
2.	Discussion on '*Traffic Signals in Kerala*'	All India Radio	15.10.2019
3.	Discussion on '*Road Safety needs of Kerala'*	Media One Channel	20.02.2020
4.	Discussion on '*Health care facilities in Kerala'*	Jai Hind TV	08.02.2020
5.	Discussion on *'Waterway Development for Kerala'*	All India Radio	February 2020

Invited Talks

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	Lead presentation	Stake Holder Meeting on 'Gaps in road safety bill' organized by CUTS International CED and KRSA	20.05.2019
2.	*'Road Safety Engineering and Black Spot Management'*	Workshop organized by CED and CUTS International	17.01.2020
3.	*'Road Safety Vision for Kerala'*	Symposium on Research to Practice for better roads, organized by TRC, CET	18.01.2020

Shaheem S

Media Interaction

Sl. No.	Topic	Media	Date
1.	*'Discussion on Road Safety Issues'*	"Varthamanakalam", Doordarshan	17.07.2019

V S Sanjay Kumar

Media Interactions

Sl. No.	Topic	Media	Date
1.	*'Precautions while Driving in Rain'*	All India Radio	14.06.2019
2.	Discussion on '*Use of FASTAGS*'	24x7 Channel	15.01.2020

Salini P N

Media Interaction

Sl. No.	Topic	Media	Date
1.	Audio Clip in 'Prabhathavedi',	Akashavani, Ananthapuri and in Radio Station, Thrissur	As part of Road Safety Week Observations

Sabitha N M

Media Interaction

Sl. No.	Topic	Media	Date
1.	*'Newly declared Inland Waterways'*	All India Radio	07.08.2019

Wilson K C

Invited Talks

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	'*Computer Aided Highway Designing*'	Three-day training programme for the PG (Transportation Engg.) students of RIT, Kottayam	02.05.2019 – 04.05.2019
2.	*'Road Design'*	Three-day skill development programme organised by Institution of Engineers	10.07.2019 – 12.07.2019

3	*'Pavement design - Case studies'*	For the final year students of Mar Basalios College of Engineering and Technology, Trivandrum	19.11.2019
4	Lecture on '*Signalised Intersections*'	For the final year students of Mar Basalios College of Engineering and Technology, Trivandrum	31.01.2020
5	Lecture on '*Basic Concepts in Pavement Construction'*	Induction training programme for 3rd grade overseers of PWD at KHRI organised by HRD Cell, PWD	10.02.2020 – 12.02.2020

Ebin Sam

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Hazardous Road Locations'*	Workshop on Road Safety, organized by KRSA at Kannur	13.01.2020

Dr.Salini U

Invited Talks

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Soil as Pavement Material'*	The preconference workshop of GHC 2019,organised by IGS Trivandrum chapter at Hotel White Dammar, Thiruvananthapuram	24.07.2019
2	*'Pavement Materials'*	Rajadhani Institute of Engineering and Technology, Nagaroor	27.02.2020
3	*'Geological Formations and their Conservation'*	LBS Institute of Technology for Women, Thiruvananthapuram	06.03.2020

15. *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)
- Member, Technical committee of KILA for formulating guidelines for Eco-DRR Roads for Kerala in the post flood situation., 2019-20
- Resource person on fuel conservation for three Urgakiran Programs of EMC, for Office staff at Central Stamp Depot, Dept. of Archeology and EPF office

WILSON K C

- Technical committee member of KRSA
- Expert committee member of Administrative reforms commission for the study "Infrastructure -Optimum Usage and Conservation".

EBIN SAM

- Membership in PIARC

16. *Achievements/Awards*

SALINI P N

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

17. *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 Goods Vehicles

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. കാൽനടയാത്രക്കാർക്കുള്ളസുരക്ഷാമാർഗരേഖ
26. സ്കൂൾകുട്ടികൾക്കുള്ളറോഡ്സുരക്ഷാധിഷ്ഠിത ബോധവത്കരണം
27. പഷു ഉറങ്ങുകയല്ല
28. സുരക്ഷിതമായ സൈക്കിൾ സവാരി
29. സുരക്ഷിത പാർക്കിംഗ്
30. റോഡിലെ ഭാഷയുടെ അക്ഷരമാല
31. റോഡ് സുരക്ഷാ 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. ചരക്ക്വാഹനങ്ങൾക്കുള്ള 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!
5. Road Safety is a Mission, Not an Intermission
6. Before Crossing Stop! Think! Then Act
7. Kindness is Giving the Right of Way
8. Look Carefully and Drive Safely
9. Be smart, think, then Start
10. Leave sooner, drive slower, live longer
11. Drive as if every child on the street were your own
12. Be careful and be safe
13. At work at play let safety lead the way
14. Safety is a simple ABC- Always Be Careful
15. Safety on road, Safe tea at home
16. The safe way is the best way
17. While Driving Put off Mobile! Put on Seat Belt!
18. Better to Arrive Late Than Never
19. Courtesy and Common Sense Promote Road Safety
20. നിൽക്കൂ!ശ്രദ്ധിക്കൂ!റോഡ്മുറിച്ച്കടക്കൂ!
21. സൂക്ഷിച്ച് വാഹനമോടിക്കൂ, റോഡിലെ തിരക്കിൽ നിങ്ങളുടെ കുട്ടികളും ഉ ായിരിക്കാം
22. വേഗതയിലല്ല സ്മാർട്ടാകേ ത്, സുരക്ഷയിലാണ്
23. ശ്രദ്ധിച്ച് നോക്കൂ, സുരക്ഷിതമായി ഡ്രൈവ് ചെയ്യൂ
24. സുരക്ഷിതത്വം മഹത്വമാണ്
25. വീഥിയിലൂടെ വേഗത വേ
26. ശ്രദ്ധിക്കൂ സുരക്ഷിതരായിരിക്കൂ
27. അശ്രദ്ധ അപകടമാണ്
28. നേരത്തെ ഇറങ്ങൂ, നേരെ ഓടിക്കൂ, നേരായവിധം ജീവിക്കൂ
29. ശ്രദ്ധയുള്ളിടത്ത് സുരക്ഷ ഉ
30. പാഞ്ഞു പോകരുത്, പ്രാണൻ എടുക്കരുത്
31. 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. കുട്ടികൾക്കുവേ ിയുള്ള പ്രധാനപ്പെട്ട റോഡ്സുരക്ഷാസൂചനകൾ

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. രാത്രികാലറോഡപകടങ്ങൾ എങ്ങനെ ഒഴിവാക്കാം
30. സുരക്ഷിതയാത്രയ്ക്കുള്ള മാർഗ നിർദ്ദേശങ്ങൾ
31. പ്രതിരോധാത്മക ഡ്രൈവിംഗ്
32. റോഡ് സുരക്ഷയും മുതിർന്ന പൗരന്മാരും
33. അമിതവേഗതയും അപകടസാധ്യതകളും
34. സുരക്ഷിത പാർക്കിംഗ്
35. സുരക്ഷിത ബസ്‌യാത്ര
36. ബസ്‌യാത്രയിൽ/കാൽനടയാത്രക്കാർ
37. ഡ്രൈവർമാർ/അമിതവേഗത
38. സ്ക്കൂട്ടർ/മോട്ടോർ/ഹെൽമെറ്റ് ധരിക്കൂ
39. മൊബൈൽഫോൺ/സീറ്റ്ബെൽറ്റ്
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. തീവ ിയെ കുറിച്ചുള്ള ചില ചിന്തകൾ
20. റെയിൽവെ ലെവൽ ക്രോസ്സിംഗ് സുരക്ഷാസൂചനകൾ
21. റെയിൽവെസ്റ്റേഷനിൽ കാത്തു നിൽക്കുമ്പോൾ പാലിയ്ക്കേ 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 വേ ി രക്ഷിതാക്കൾക്ക്എന്തു ചെയ്യാം -1
2. പത്തിനും പതിനഞ്ചിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേ ി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം -2
3. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേ ി രക്ഷിതാക്കൾക്ക്എന്തുചെയ്യാം -1
4. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേ ി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം -2
5. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേ ി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം -3
6. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ 1
7. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ 2
8. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ 3
9. ചില റോഡ് സുരക്ഷാ പ്രവർത്തനങ്ങൾ 1
10. ചിലറോഡ്സുരക്ഷാ പ്രവർത്തനങ്ങൾ 2
11. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേ കാര്യങ്ങൾ 1
12. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേ കാര്യങ്ങൾ 2
13. റോഡ്സുരക്ഷയെകുറിച്ച്അറിഞ്ഞിരിക്കേ മറ്റ്കാര്യങ്ങൾ 1
14. റോഡ്സുരക്ഷയെകുറിച്ച്അറിഞ്ഞിരിക്കേ മറ്റ്കാര്യങ്ങൾ 2
15. നിങ്ങളുംറോഡ്സുരക്ഷിതത്വവും 1
16. നിങ്ങളുംറോഡ്സുരക്ഷിതത്വവും 2
17. ക്രോസിംഗ് ഡ്രിൽ 1
18. ക്രോസിംഗ് ഡ്രിൽ 2
19. യാത്ര ചെയ്യുമ്പോൾ ശദ്ധിക്കേ കാര്യങ്ങൾ
20. സിഗ്നൽലൈറ്റുകൾ
21. സൈക്കിൾസവാരി ചെയ്യുമ്പോൾ
22. റോഡിൽ നടക്കുമ്പോൾ
23. Protect your life with seat belt and helmet
24. സുരക്ഷിതമായി ബസ്സിൽയാത്ര ചെയ്യുന്നതിന് ചില നിർദ്ദേശങ്ങൾ
25. സിഗ്നൽലൈറ്റുകൾ 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_2Analyzer
64.	NO_2Analyzer
65.	CH_4Analyzer
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 KSCSTE-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 KSCSTE-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. The Library is maintaining a blog natpaclibrary1.blogspot.in to make users abreast of the latest developments in the library. NATPAC library is automated and managed using LIBSOFT. Bibliographic records of books available in the library can be accessed through https://natpac.libsoft.org/.

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, VikramSarabai Space Centre, Thiruvananthapuram	-	Member
18.	The Director, NIIST, Thiruvananthapuram	-	Member
19.	The Director, SreeChitraTirunal 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.	Dr. A U Ravi Sankar, Professor Department of Civil Engineering, NIT, Karnataka Surathkal, Mangalore	-	Chairman
2.	Dr. MVLR Anjaneyulu, Professor Department of Civil Engineering, NIT Calicut	-	Member
3.	Dr.P K Sarkar, Professor (Rtd.) Dept. of Transport Planning, School of Planning & Architecture IP Estate, New Delhi	-	Member
4.	Dr. K V Jaya Kumar, Professor & Head Water & Environment Division Dept. of Civil Engineering, NIT-Warangal	-	Member
5.	Director, Technical Education Department Government of Kerala	-	Member
6.	Principal Secretary to Government Transport Department, Government of Kerala	-	Member
7.	Director, NATPAC	-	Ex-Officio Convener

iv. ***Management Committee of NATPAC***

1.	Director, NATPAC	-	Chairman
2.	Executive Director, CWRDM	-	Member
3.	Registrar, NATPAC	-	Member
4.	Dr.B.G.Sreedevi, Chief Scientist, NATPAC	-	Member
5.	Member Secretary, KSCSTE	-	Member
6.	Additional Secretary, S&T Department	-	Member

v. *Information Officers as per the Right to Information Act*

Public Information Officer (Technical)	-	Shri.Subin B, Scientist
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. V S Sanjay Kumar, Sr.Scientist	-	Chairman
Shri.M S Saran, Scientist	-	Member
Shri.Arun Chandran, Scientist	-	Member
Shri.Sanjai R J, Technical Officer	-	Member
Smt. K S Veena, Jr.Scientist	-	Member -Convenor

b. *Purchase Committee*

Shri. S Shaheem, Principal Scientist	-	Chairman
Shri.V S Sanjay Kumar, Sr.Scientist	-	Member
Shri.George Koshy K, Registrar	-	Convenor
Shri.Radhakrishnan Nair K, Dy.Registrar (A)	-	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 KSCSTE-NATPAC*

Smt.P N 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.V S Sanjay Kumar,
  Sr. Scientist
  Shri. Ebin Sam, Jr.Scientist
  Smt. Veena K S, Jr.Scientist
  (Convenor)

2. Safe Savari

- Director
  Shri.V.S Sanjay Kumar,
  Sr. Scientist
  Shri.Subin B, Scientist
  Smt.Veena K S, Jr.Scientist
  (Convenor)
  Shri.Sanjai R J, Technical Officer – I

3.Mobility

- Director
  Shri.V S Sanjay Kumar,
  Sr. Scientist
  Shri.T.Ramakrishnan,
  Techincal Officer- V
  Shri.Anish Kini, Jr.Scientist
  Smt.Veena K S, Jr.Scientist
  (Convenor)

General Administration

Research Council Meeting

The Research Council met on 23rd and 24th July 2019 (21st RC) and 14th and 15th February 2020 (22nd RC) at KSCSTE-NATPAC under the chairmanship of Dr. A U Ravi Sankar.

Management Committee Meeting

The 33rd meeting of the Management Committee was held on 16th August 2019 at KSCSTE-NATPAC under the chairmanship of Director, NATPAC.

Other NEWS

- Onam celebration on September 2019 at K Karunakaran Transpark.

- KSCSTE-NATPAC took part in Onam pageantry organised by Tourism Department, Government of Kerala on 16th September 2019. The theme of the float was '*Kerala Floods and the helplessness of common man in such cases*'.

- Malayala BhashaVaracharanam – 2019

  Bharana Bhasha Oath taking ceremony was conducted in NATPAC at 11 am on 1st November 2019. Shri.Shaheem S, Director (i/c), KSCSTE-NATPAC delivered the oath to the staff of NATPAC.

  A handwriting competition in Malayalam was conducted for the staff of KSCSTE-NATPAC on 5th November 2019.

The Centre organised a half day class on 'Thettillatha Malayalam 'in connection with the Malayala Bhasha Varacharanam on 6th November 2019 by Shri.Vattaparambil Peethambharan, a teacher and writer.

Five officially using English words and its corresponding Malayalam words were displayed in KSCSTE-NATPAC's Office.

Bharana Bhasha Oath taking ceremony

Handwriting Competition

Class on 'Thettillatha Malayalam' by Shri.Vattaparambil Peethambharan

- KSCSTE-NATPAC observed the Constitution Day at 11 am on 26th November 2019. Shri.Shaheem S, Director (i/c), KSCSTE-NATPAC read the preamble of the Constitution to the staff of NATPAC.

- Human Rights Oath taking ceremony was conducted in KSCSTE-NATPAC at 11 am on 10th December 2019. Shri.Shaheem S, Director (i/c), KSCSTE-NATPAC delivered the oath to the staff of NATPAC.

- KSCSTE-NATPAC observed the World Energy Conservation Day on 14th December 2019. Shri.Shaheem S, Director (i/c), KSCSTE-NATPAC delivered the energy conservation pledge to the staff.

- The Scientists of KSCSTE-NATPAC actively participated in the 27th National Children's Science Congress, hosted by Kerala State Council for Science, Technology and Environment (KSCSTE), Government of Kerala in association with Mar Ivanios College and Mar Baselios College of Engineering and Technology during 27th to 31st December 2019 at Mar IvaniosVidya Nagar, Nalanchira, Thiruvananthapuram.

- KSCSTE-NATPAC signed Memoranda of understanding with MoRTH and IRC on 13th January 2020 for imparting training on Road Safety and Safety Audit in the presence of Shri. Nitin Gadkari, Hon'ble Minister for Road Transport and Highways and Shri.Rajnath Singh, Hon'ble Defence Minister, Government of India at Vigyan Bhawan, New Delhi.

- Anti-drugs pledge was conducted in KSCSTE-NATPAC at 11 am on 16th January 2020. Shri.George Koshy, Registrar, KSCSTE-NATPAC delivered the oath to the staff of KSCSTE-NATPAC.

- Republic Day Celebration on 26th January 2020.

- New Year Celebration on 1st January 2020.

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.	ArunChandran	-	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. SurendranPillai	-	Technical Officer Grade -3
20.	R. J. Sanjai	-	Technical Officer Grade -1
21.	Deepa Radhakrishnan	-	Technical Officer Grade -1
22.	R. RadhakrishnanThampi	-	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.	SukhdevKolay	-	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

JOINING

Dr.Samson Mathew
Director
Joined on 1st January 2020

Smt.Reshmy R S
Asst.Registrar (Admn.)
Joined on 17th February 2020

Smt.Bindu S R
Asst.Registrar (Fin.)
Joined on 17th February 2020

RETIREMENTS

Shri.T Vijayan
PA to Registrar Grade –IV
Superannuated on
30th November 2019

Shri.P X Mathew
Jr.Assistant
Superannuated on
30th November 2019

RESEARCH STUDIES UNDERTAKEN DURING 2019-'20

Sl.No.	Code	Project
1	Plan-326	Influence of randomly distributed shredded waste plastic on shear strength and hydraulic conductivity of cohesive soil
2	Plan-327	Development of traffic growth rate model for NHs in Kerala
3	Plan-328	Periodic Updation of Price Indices for Different Public Transport and Freight Operations
4	Plan-329	Investigation of Major Accident Spots, Causative Analysis and Mitigative Measures
5	Plan-330	Assessment of Risk Potential of SH in Kerala State: a Case Study of Selected SH in Central Kerala
6	Plan-331	WEB GIS Based Road Crash Information System
7	Plan-332	Road Asset Management for National Highways and State Highways in Kerala
8	Plan-333	Development of GIS-based Road and Traffic Database for Kerala
9	Plan-334	Database Creation and Management for Inland Waterways in Kerala Using GIS – Phase III
10	Plan-335	Study on Accidents and Safety Aspects Related to Inland Waterways
11	Plan-336	ITS Applications in Enhancing the Transport Infrastructure
12	Plan-337	Utilization of Geoinformatics Tools for development of comprehensive road network for Kerala State
13	Plan-338	Evaluation of Warm Mix Asphalt Mixes with the addition of RAP
14	Plan-339	Pavement Rehabilitation Design based On Dynamic Cone Penetrometer Test (DCPT)
15	Plan-340	Resilient Transportation Planning for Disaster prone areas – A case study of Munnar Town
16	Plan-341	Experimental investigation on Porous Asphalt Mix
17	Plan-342	Resource Mapping of road construction materials in Kerala -Phase II
18	Plan-343	Overtaking Behaviour of Drivers – A Case Study on Selected Roads in Kerala
19	Plan-344	Crash Prediction Modelling of Undivided Two Lane Two-way Road Networks in Kerala
20	Plan-345	Maintenance and Sustainable Management of a Waterway - A Case Study of Parvathy Puthanar
21	Plan-346	Study on the Indo-HCM adjustment factors for capacity analysis of Intersections in Kerala
22	Plan-347	Preparation of Evacuation Plan for regions vulnerable to isolation during Natural Calamities
23	Plan-348	Study on the Effect of Metro on the Mode Choice Behaviour of Commuters in Kochi city
24	Plan-349	Study on strength characteristics of Flexible Pavement in Water-logged areas
25	Plan-350-1	Critical Evaluation of proposed one way regulation in front of Technopark on NH bypass in Thiruvnanthapuram city
26	Plan-350-2	Evaluation of Traffic Signal at Collectorate Junction Alapuzha
27	Plan-350-3	Evaluation of Traffic Signal at Collectorate Junction Paravoor in Kollam District
28	Plan-350-4	Traffic Management Schemes for Edappally and Palarivattam areas in Ernakuklam district
29	Plan-350-5	Maccadam design for LSGD roads in Kasaragod District
30	Plan-350-6	Traffic Management Schemes for Thiruvallam area in Thiruvananthapuram City

CONSULTANCY/SPONSORED PROJECTS IN 2019-'20

Sl.No.	Code	Project	Sponsored by
1	C 00519	Traffic and Transportation studies for Thalasseerry town in Kannur district	Town & Country Planning Department
2	C 00118	Road Safety Treament for Adoor Kazhakkoottam MC road in Kerala as part of Safe Corridor Demonstration Project of World bank	Kerala State Transport Project
3	C 00419	Identification and prioritization of crash black-spots in Kerala	Kerala Road Safety Authority
4	C 00817	Preparation of detailed project report for the development of Inland Waterways between Kovalam to Kollam	Kerala Waterways & Infrastructure Ltd. (KWIL)
5	C 01319	Preparation of Detailed Project Report (DPR) for Development of Inland Waterway between Hosedurg and Bakel	Kerala Waterways & Infrastructure Ltd. (KWIL)
6	C 00219	Speed Curtailing Measures for Internal Roads at Valiyamala Campus in Thiruvananthapuram district	Vikram Sarabhai Space Centre (VSSC)
7		Road Safety Management Studies for Ottappalam Bus Stand	
8	C 01819	Feasibility study of installing traffic signals/ blinkers at selected junctions in Alappuzha district	Kerala Road Safety Authority (KRSA)
9	C 01119	Improvement of Intersections in Cherthala Town	Public Works Department (PWD)
10	C 02219	State of Urban Transport in Tamil Nadu	Deolitte India Ltd.
11	C 01419	Improvement proposal for intersection leading to Vizhinjam port on NH 66 bypass	Adani Ports
12	C 00419	Improvement proposal for 75 accident black spots in Kerala State	Kerala Road Safety Authority (KRSA)
13	C 02119	Technical Study for Technopark Way in Expansion Works	Electronics Technology Park, Kerala
14	C 02019	Traffic Studies in Connection with the Traffic Diversion in Kuthiran for HVDC Cable Laying	Power Grid Corporation of India Ltd.
15	C 00819	Study on Roughness of City roads in Trivandrum - TCRIP	Kerala Road Fund Board (KRFB)
16	C 00618	Study on Roughness of LSGD Roads in Kasaragod	Local Self Government Department (LSGD)
17	C 01719	Macadam Design for LSGD Roads in Kasaragod District	Local Self Government Department (LSGD)
18	C 00719	Traffic and Transportation Studies for six Amrut Cities in Kerala	Town and Country Planning
	1	*Alappuzha Town*	
	2	*Kollam City*	
	3	*Ernakulam*	
	4	*Thrissur*	
	5	*Palakkad*	
	6	*Kozhikode*	
19	C 00115	Training on Safe Transportation of Hazardous Goods	

NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE, TRIVANDRUM

(A unit of Kerala State Council for Science, Technology & Environment. Govt. of Kerala)

Balance Sheet as at 31.03.2020

(in Rs.)

Liabilities	Sch No	As at 31.03.2020	As at 31.03.2019	Assets	Sch No	As at 31.03.2020	As at 31.03.2019
Reserves & Surplus	4	8,98,41,124	1,68,31,431	Fixed Assets	1	8,98,41,125	1,68,31,431
Building Fund Account	4	2,66,79,019	10,70,39,600	Work in Progress	1	4,43,322	4,43,322
Current Liablities	5	92,39,692	77,55,486	Current Assets	2	9,11,40,265	12,30,08,131
Unspent balance	6	3,65,15,786	5,40,01,447	Loans & Advances	3	2,12,05,748	9,85,13,599
Corpus fund	7	4,03,54,839	5,31,68,519				
Total		**20,26,30,460**	**23,87,96,483**	**Total**		**20,26,30,460**	**23,87,96,483**

Significant Accounting Policies and Notes to Accounts 15

For National Transportation Planning and Research Centre

Dy. Registrar (Finance) Registrar Director

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

19/12/20

Rajeev.R
Partner
Membership No. :211277

Place : Thiruvananthapuram
Dated : 17.12.2020

VARMA & VARMA Chartered Accountants Trivandrum

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 31.03.2020

(in Rs.)

Expenditure	Sch No	Year ended 31.03.2020	Year ended 31.03.2019	Income	Sch No	Year ended 31.03.2020	Year ended 31.03.2019
To Infrastructure Strengthening (Plan)	11	1,94,22,196	2,52,54,924	By Grant from Government of Kerala	8	6,46,71,626	4,39,31,673
To Infrastructure Strengthening (Non Plan)	12	48,31,277	57,78,590	By Other Receipts	9	41,17,056	3,18,38,800
To Salaries and Allowances (Non Plan)	13	4,45,35,209	4,47,36,960	By Depreciation written back	1	75,86,896	37,34,177
To Depreciation	1	75,86,896	37,34,177	By Income from Consultancy Project	10	73,43,764	1,79,54,194
To Consultancy Project Expenses	14	73,43,764	1,79,54,193				
Total		**8,37,19,342**	**9,74,58,844**	**Total**		**8,37,19,342**	**9,74,58,844**

Significant Accounting Policies and Notes to Accounts 15

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

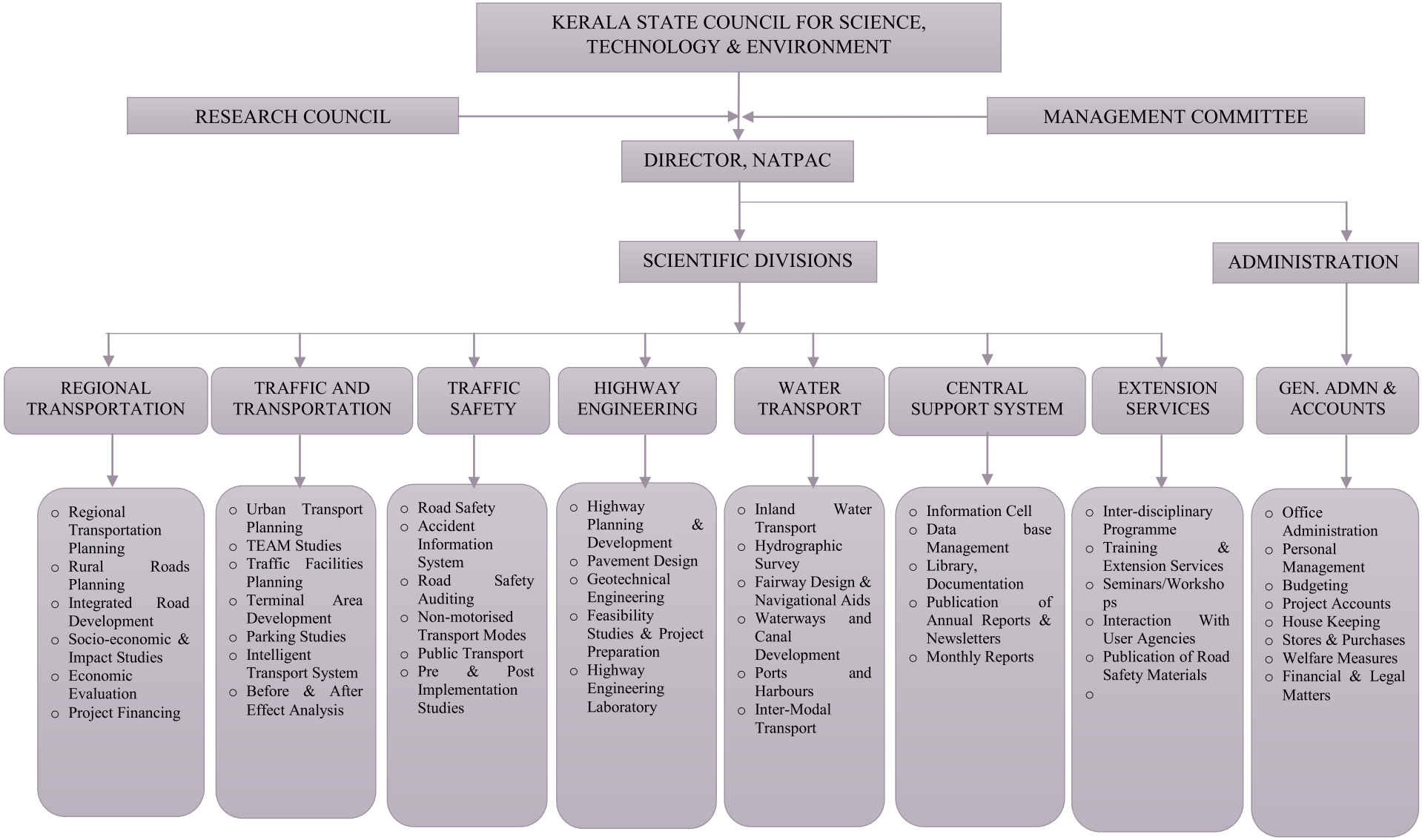
Rajeev.R
Partner
Membership No. :211277

Place : Thiruvananthapuram
Dated : 17.12.2020

VARMA & VARMA Trivandrum Chartered Accountants

Dy. I Registrar

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

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KSCSTE - National Transportation Planning and Research Centre

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

ANNUAL REPORT 2019- '20

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KSCSTE - National Transportation Planning and Research Centre

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