ANNUAL REPORT
2020 - '21

natpac
KSCSTE - NATPAC

के एस सी एस टी इ - राष्ट्रीय परिवहन योजना एवं अनुसंधान केंद्र
KSCSTE - NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE
കെ എസ് സി എസ് ടി ഇ - ദേശീയ ഗതാഗത ആസൂത്രണ ഗവേഷണ കേന്ദ്രം
(An Institution of Kerala State Council for Science, Technology and Environment)
K. Karunakaran Transpark, Aakkulam, Thuruvikkal P.O, Thiruvananthapuram - 695011

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From Director’s Desk...

It gives me immense pleasure to share our Annual Report for the financial year 2020-’21. This year has been exciting on many fronts. First, we delivered unique expertise in the field of Traffic and Transportation Engineering for the service of the State and the general public.

An integrated land use transport model for Thiruvananthapuram was developed under the expertise of the Centre. Our research team came to the State’s service at the time of great Calamity. Recently, Kerala has witnessed recurring floods in consecutive years due to extreme rainfall which were accompanied with landslides and landslips. The recent flood in Kerala had a devastating effect on hilly regions like Munnar. KSCSTE-NATPAC formulated a befitting and robust transport means which will be helpful in all such challenging times. In addition, the Centre prepared an evacuation plan for regions vulnerable to isolation during natural calamities in Kerala.

The present pandemic COVID19 has affected the road transport industry adversely as all modes of transport (except emergency services) came to a standstill. In this context, NATPAC evaluated the road transport sector alone and its activities to study the impact of COVID-19 on the economy. Other than the said study, the air quality and traffic characteristics during COVID-19 lockdown period was also evaluated.

Our Scientists are developing a Road Asset Management System for the selected network of roads including National Highways, State Highways and Major District Roads. In addition, the Centre also conducted a study on enhancing public transport services in Thiruvananthapuram city. A study on the periodic updation of price indices for Intermediate Public Transport (IPT) Services in Kerala was also covered, which helped the Government take appropriate decisions whenever fare revision matters are taken up. Also, a study to develop a traffic signal control strategy to provide emergency vehicle priority that minimizes their travel time on a corridor and compensates other vehicles for the additional delay caused by this priority was covered during this period.

Our Traffic Safety Division works on the initiatives aimed at reducing fatalities and severe 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 the on-the-spot investigations of accidents in the State and thereby suggesting crash counter measures. Our Scientists are studying the overtaking characteristics followed by different types of vehicles. An android based mobile app for collecting road related data is being developed by the Centre. The Centre is in the process of creating a Web GIS-based road crash information system using Geospatial tools for Kerala. NATPAC also covered Road Safety Auditing for selected SH roads during this period.

The performance of porous asphalt mixes using Polymer Modified Bitumen-70 is being studied. The Centre assessed the moisture damage using bitumen grade VG 30. NATPAC suggested a climate resilient pavement surface course for Kerala and proposed a rehabilitation design methodology for the low volume roads in Kerala, based on the obtained DCPT values and the laboratory results of pavement layer parameters. 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, which 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 infrastructure development.

Inland Water Transport is a viable, sustainable alternative in 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 prepared a DPR for the development of an inland waterway between Mahe river and Valapattanam river and between Kovalam – Akkulam section. Our Scientists suggested a maintenance and management system for Parvathy Puthanar. NATPAC created a GIS based database management system to compile, store and analyse waterway related data of Kerala. The Centre also analysed the causes of recent accidents related to waterways, assessed various risks in the waterways and suggested measures for improving the safety.

The Library of KSCSTE-NATPAC is a specialized one that caters to the scientific community of the institute and 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 provide facilities and guidance to several students to accomplish their project work and training. Several students from reputed academic institutions carried out their project work for B.Tech/M.Tech programmes during this period.

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 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 their excellent work.

Prof. (Dr.) SAMSON MATHEW
DIRECTOR

SUMMARY OF PROJECTS

1. *Road Asset Management for National Highways and State Highways in Kerala*

Date of start : April 2017
Date of completion : Ongoing (Proposed up to March 2022)

Need and importance of the study

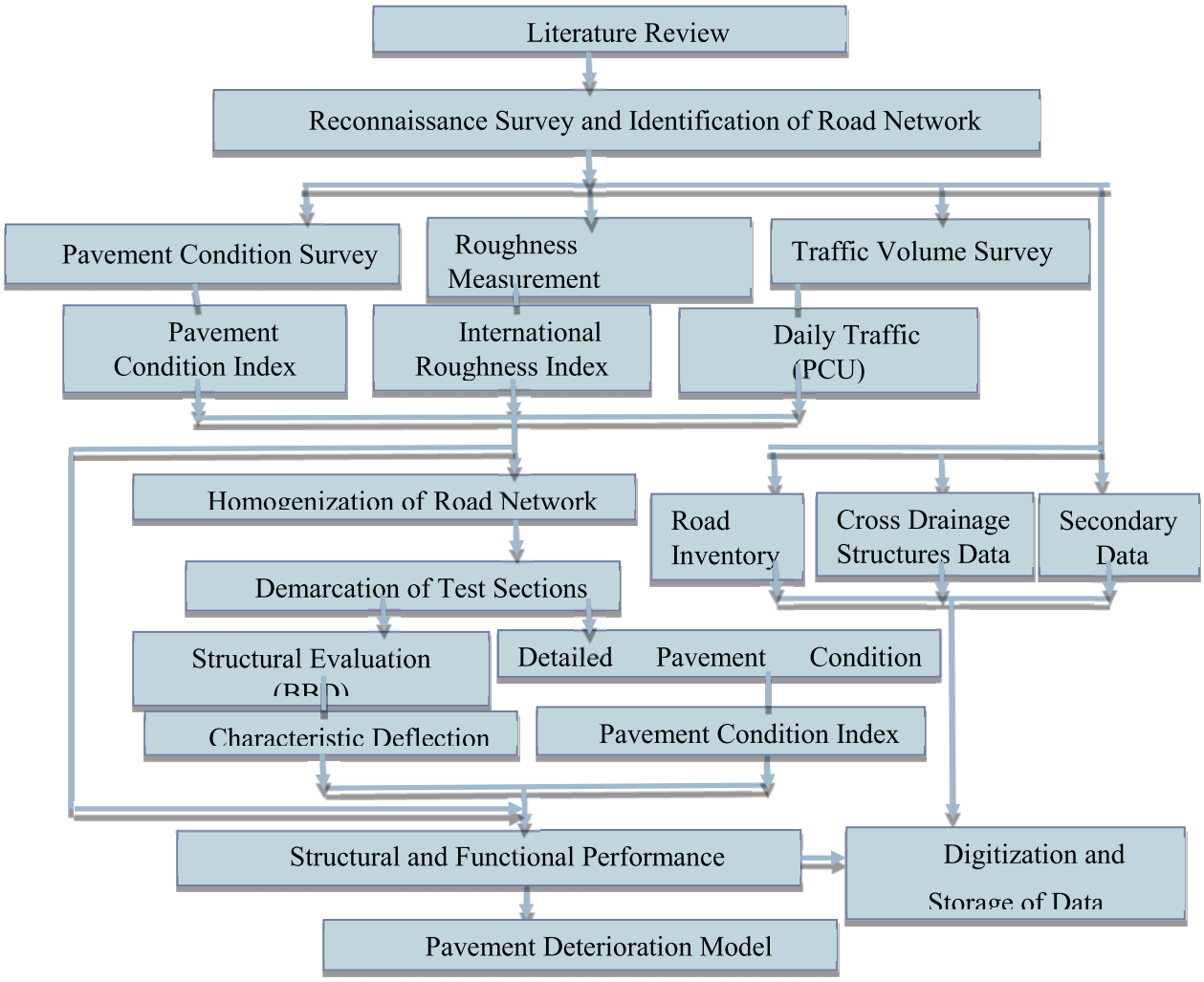
Kerala, southernmost state of India, has a good network of roads with efficient connectivity to all major and minor places in the state. Even though Kerala has a good road network, there is a lack of proper maintenance strategy. Hence an efficient Road Asset Management (RAM) system is necessary for the 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 level of service. This study deals with the initial steps for developing a RAM system for a network of roads in Kerala.

Scope and Objectives

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

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

Methodology



Data Collected

An initial reconnaissance survey was conducted along the roads in Thrissur district and a road network was selected for the study. Road network selected are NH 66, SH 51, SH 61 and SH 75, MDRs Peringottukara-Kanjaani- Chavakkadu road and Cherpp- Thriprayar road. Homogenisation of road network has been done on the basis of Pavement Condition Index, International Roughness Index and traffic volume. Test sections (29 Nos.), each with a length of one kilometer and 64 numbers of 200m long sections are identified for structural and functional performance evaluation. Detailed Pavement Condition Survey was carried out at all the test sections. Roughness of each homogeneous section was measured at every 100m interval on each lane using Merlin and Roughometer. Benkelman Beam Deflection studies were carried out on the test sections. Traffic volume survey is also carried out for a

period of 24 hours at each test section. A total of 16 bridges are present in the road network under study and their details for the development of Building Information Management System (BIMS) are collected through thorough inspection. Secondary data including type of pavement surface layers, maintenance history and details of future maintenance plan was collected from the Public Works Department.

From the collected data, Pavement Condition Index, International Roughness Index, characteristic deflection and daily traffic in terms of Passenger Car unit (PCU) were calculated. A Pavement Condition Index (PCI) prediction model based on cumulative number of equivalent single axle load was developed for the road network.

2. *Development of Integrated Land Use Transport Model for Thiruvananthapuram*

Date of start : April 2020
Date of completion : Ongoing

Need and importance of the study

As the public transport modes improve a concentrated development at the major public transport nodes happens and they lead people to choose a faraway location from city area as their residents for a better living environment. This leads to increase the private transport usage, to ensure last mile connectivity. Thus the city began to sprawl. As city sprawls the travel distance also increases which may lead to increase in congestion, crashes and pollution. As per Alonso's theory, land value and population density decreases as one move away from city Centre. Whereas a compact city reduces the travel distance there by the adverse effects. A compact city will be socially sustainable with mixed use and less need to travel. Land use and transport are interrelated and changes occurs in those are mostly irreversible. Integrating urban development with transport is the way forward for compact cities.

Scope and Objectives

The proposed study aims to develop an Integrated Land Use Transport model for Thiruvananthapuram, the Capital City of Kerala. The study is proposed as a three year study. The following are the identified objectives for the study:

- To assess and understand the nature of existing settlement pattern, land use, redevelopment plans and socio economic background;
- To develop land use model for the region and to identify the land requirement for future population and allocation of land use;
- Development of travel demand models of the population;
- Development of an integrated land use - transport model integrating the travel characteristics as well as land use factors.

Data Collected

The demographic data for Thiruvananthapuram Corporation area has been collected from Census of India. The other major secondary data collected is the land use map from Department of Town and Country Planning. As primary data collection, a land price survey, establishment details collection and an employment opportunity collection is carried out. In land price survey site specific land price details has been collected with the other details regarding accessibility and spatial location. For establishment details collection, details of establishment in Thiruvananthapuram Corporation have been collected and a correction factor is applied for the estimation of total shops, the correction factor is calculated from ground checking the data. An employment opportunity survey also has been conducted in each ward for the collection of details regarding employment opportunity available.

Interim Findings

- The settlement pattern of the city shows that major part of the city area is having urban character with more than ¾ of the area being used as mixed residential;

- The land price, maximum number of shops and employment opportunity is high in Central Business District (CBD) area and decreases as we move away from CBD area;
- The output from this study reveals that these identified data can be used in the development of Land Use Model for Thiruvananthapuram Corporation, along with the land use transition over the years and neighborhood characteristics.

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

Date of start : April 2019
Date of completion : March 2022

Need and importance of the study

Traffic congestion is one of the most constraining problems in many urban areas. Urban road intersections are the major critical points in the safety, capacity, delay and efficiency point of view. Therefore, both from the safety perspective and the level of service perspective, the study of intersections is very important for the traffic engineers especially in the case of urban scenario. Indian Highway Capacity Manual (Indo-HCM) 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 Kerala State. Meanwhile the HCM 2010 gives adjustment factors for all these specific conditions present in the intersection approach.

Objectives and Scope

- To study the effect of traffic and roadway factors in the saturation flow rate of an approach (effect of factors like composition and type of vehicles, turning movements, roadway width, presence of other elements like bus stops);
- To estimate Dynamic Passenger Car unit (PCU) values for determining saturation flow of signalized intersections based on comparative study of various methods for estimation of dynamic PCU;

- To determine modified adjustment factors to account for the effect of presence of bus stop activity at intersections on estimation of saturation flow.

The scope of the study is limited to signalized intersections in Kerala.

Methodology

- Field data collection - Inventory details of intersection, geometric details (total station survey), signal timing, phasing plan, traffic volume data (peak period data);
- Field measurement of saturation flow;
- Estimation of traffic parameters for capacity and Level of service (LOS) analysis - Video graphic method;
- Data on parking activity, pedestrian activity, presence of bus stops- bus maneuvering;
- 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 Collection and Analysis

For the study, various intersections were identified in Thiruvananthapuram and Kollam Districts in Kerala State. Field data collection was completed at all the identified study intersections and data extraction of five intersections was completed.

Field measurement of saturation flow was initially done using static PCU values provided in Indo HCM for signalized intersections. To further improve the accuracy of the field measurement of saturation flow, usage of dynamic PCU was opted for the study. The dynamic PCU calculation methods like time headway method [Method 1] and area occupancy method [Method 2] were identified from literature based on the practical easiness of data collected required for the PCU estimation. The better method suitable for the study was selected after comparison with the dynamic PCU range provided in Indo HCM. The effect of vehicle type and its composition on the saturation flow was also studied.

Interim Conclusions

The field measurement of saturation flow using dynamic PCU showed much better results than static PCU. In the comparison between Method 1 and Method 2, it was observed that the percentage difference between field measured and calculated saturation flow was much lesser when Method 1 was used. In the case of Method 2, the percentage difference was same as that obtained when static PCU provided in Indo HCM for signalized intersections was used. In this study, Method 1 was further used for dynamic PCU estimation as it was going in better conformity with the range of values given in Indo HCM.

Strong correlation was observed between vehicle composition and saturation flow. Two-wheelers, cars and auto rickshaw percentage composition were found to be significant. Heavy vehicles were neglected due to very less percentage composition. Vehicle type and its composition were found to be a significant factor in saturation flow estimation. Saturation flow was observed to be directly proportional to the percentage composition of two-wheelers. Inverse proportionality was observed between saturation flow and percentage composition of cars. For auto rickshaw, inverse proportionality was observed between its percentage composition and saturation flow.

Recommendation for Further Work

Further studies are being conducted to develop the modified adjustment factors to account for the effect of presence of bus stop activity at intersections on the estimation of saturation flow.

4. *Study on Overtaking Behaviour – a Case Study on Selected Roads in Kerala*

Date of start : April 2020
Date of completion : March 2024

Need and importance of the study

About 75% of roads in India are two-way two-lane roads. Overtaking is a common manoeuvre in traffic, with significant impacts on safety as well as on system performance. Unsafe overtaking accounts for 18.7% of road accidents in 2017 and 20.9% in 2018 (as per MoRTH Report). In mixed traffic conditions, a speed differential exists between fast- and

slow-moving vehicles, hence overtaking manoeuvres are inevitable. The infrastructure and traffic related variables may influence the occurrence and consequences of overtaking manoeuvres and in certain circumstances the overtaking accidents as well. Hence this needs to be studied in detail.

Objectives and scope

- To study the overtaking characteristics of vehicles and the relation between parameters like the *speed, acceleration, vehicle length, composition and overtaking characteristics* of different types of vehicles for understanding the nature of overtaking maneuvers on two-lane two-way highways under heterogeneous traffic;
- To develop mathematical models for overtaking distance, duration, acceleration and deceleration characteristics for different scenarios and types of overtaking observed on two lane highways under heterogeneous traffic and *a relook into the IRC method of safe overtaking.*

Methodology

Study road stretches were identified based on reconnaissance survey. Straight stretches on National Highway-66 Alummoodu – Mangalapuram and Mangalapuram - Thonnakkal were taken for initial studies. Videographic data collected by moving car method was used for analysis. Data was extracted using frame to frame analysis. Data on dynamic characteristics of vehicles during overtaking operations like speed, time involved and lateral distance etc. were also extracted.

Data Analysis

The data collected from field were analysed. Mainly the overtaking characteristics of four different categories of vehicles were studied like cars, two wheelers, light commercial vehicles and heavy vehicles.

Findings and Discussion

The types of overtaking prevalent on study road stretches were analysed and found that mainly three types of overtaking occur like flying, accelerative and multiple overtaking manoeuvres. Accelerative overtaking is predominant in case of LCV and HV while flying

overtaking was slightly dominating than accelerative in case of cars and two wheelers. Mean overtaking time for Heavy Commercial Vehicles (HCV) is higher compared to other categories of vehicles like two-wheelers, cars and Light Commercial Vehicles (LCV). Mean value of passing gap accepted by two-wheelers were smaller compared to other categories of vehicles like cars, LCV and HCV. Mean value of overtaking speed for different vehicles ranges between 52 km/hr and 58km/hr. It is also found that smaller passing gaps are associated with higher speeds of overtaking vehicles.

Interim Conclusion

During overtaking manoeuvres, drivers tend to complete the manoeuvres by increasing their speed to reduce the risk of accidents with the vehicles moving in opposing direction. Drivers tend to spend more time on the opposing lanes if the time gap with the opposing vehicles were longer and a positive correlation is observed between passing gap and duration of overtaking. It was also found that time taken for overtaking increases as the speed difference increases.

Recommendations for further work

A detailed analysis and understanding of overtaking characteristics help to resolve the related road safety issues to a great extent. The parameters related to overtaking operations can be used to develop prediction models to predict safe overtaking opportunities which can be of use to road users.

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

Date of start : April 2019
Date of completion : March 2021

Need and importance of the study

Recently, Kerala has witnessed recurring floods in consecutive years due to extreme rainfall which were accompanied with landslides and landslips. Transportation network along the flood affected region were severely crippled as a result. This in turn disrupts relief and rescue operation as well as supply chain management.

Objectives and scope

The scope of the study is limited to regions that are likely to get stranded and isolated during the days of flood. Those regions which are subjected to complete loss of connectivity during the disaster-prone days require a strengthening of its transportation network and this study intends for a scientific approach to bring in a paradigm renovation to the existing scenario.

Methodology

Preliminary survey was conducted in the major locations across the state where traffic was reported to be disrupted due to the rain havoc and subsequent floods. The major flood affected regions in the districts of Idukki, Palakkad, Malappuram, Kozhikode, Wayanad and Kannur were visited. The main causes of disruption of transportation network were due to flooding in roads, washing away of bridges and embankments and landslides. Based on the previous site visits and disaster impact analysis, Attappady block in Palakkad district and Panamaram block, Edavaka panchayath and Mananthavady municipality in Wayanad district have been selected as the study areas for this project.

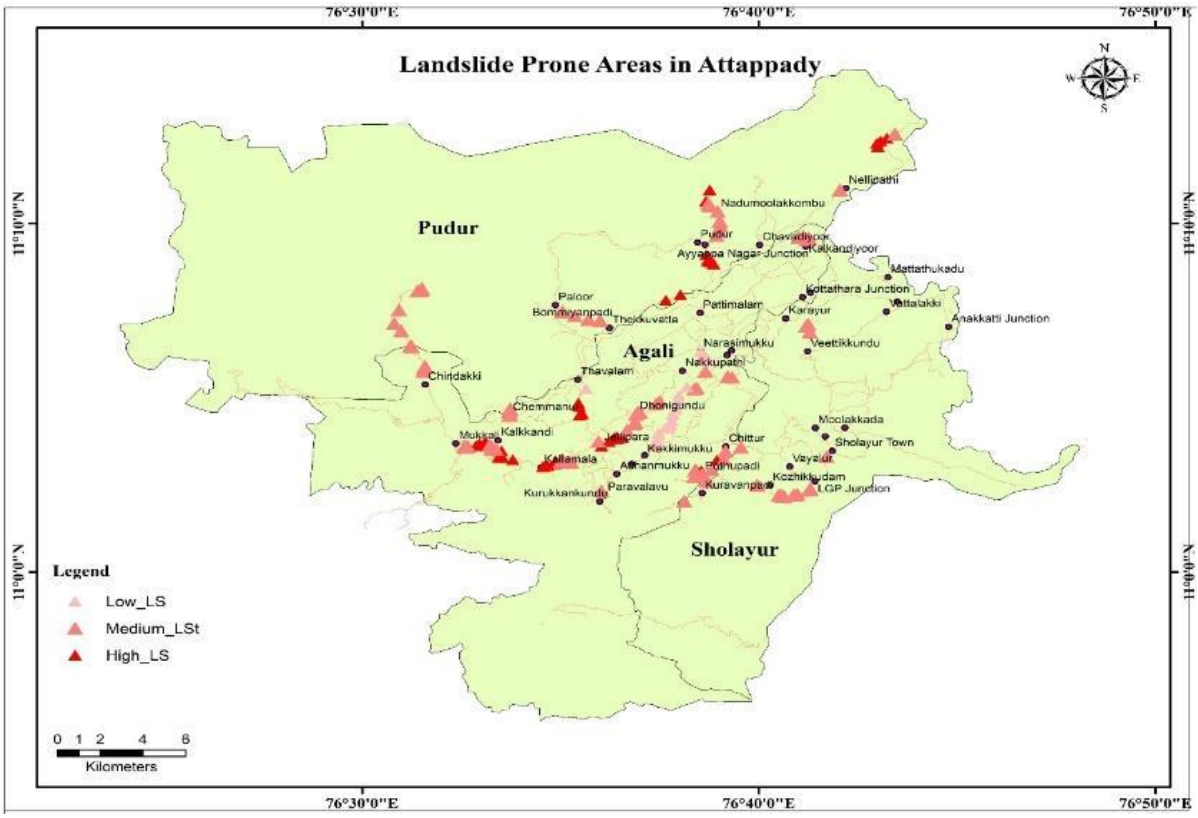


Figure 1: Landslide prone areas in Attappady Block based on susceptibility

Data Collected

- Flood prone and Landslide prone locations of entire state of Kerala, Flood affected locations (2018, 2019), Landslide affected locations (2018,2019) (Source: KSDMA);
- Flood proneness Vs Satellite map of study areas, Landslide proneness Vs Satellite map of study areas, Communication map, Transportation map (Prepared by KSDMA, collected from KILA);
- 30m X 30m ASTER DEM and 12.5 X 12.5m ALOS PALSAR DEM (Source: ASF Vertex facility);
- Demographic details of study areas, disaster history, disaster prone areas (Source: Disaster Management Plan prepared by local body offices).

Analysis

Weighted overlay analysis was carried out to prepare hazard zonation mapping of study areas based on five factors; viz., elevation, slope, drainage density, population/settlements, land use/land cover and validated with landslide hit areas. General framework of evacuation plan based on relief and rescue perspective is formulated. Road network of study areas were developed using QGIS and ArcGIS. Shortest route connecting isolated areas and potential evacuation infrastructures was identified by closest facility analysis tool (Network analyst) of ArcGIS.

Findings and discussions

General framework for disaster preparedness is developed to reduce the degree to which a community's condition is worsened by a disaster relative to its pre-disaster condition. While preparing an evacuation plan, certain objectives must be minimized such as total travelling distance from evacuation zones to shelter sites on primary paths, evacuee risk reaching a shelter facility on primary paths, total travelling distance from evacuation zones to shelter sites on backup paths, evacuee risk while staying at shelter, total evacuation time from shelters to a hospital and number of shelters to be opened. Important factors to be considered when selecting an evacuation route and sites for rescue centres are suggested. Features of emergency sheltering are also included. Locations proposed for emergency sheltering and temporary air lifting points are identified and ways to enhance evacuation in the study areas are recommended.

Conclusions

- While preparing an evacuation plan, it is important to broaden planning assumptions by considering the most extreme conditions and impacts possible for each hazard, not merely the scope of previous disasters;
- Existing Mannarkkad-Anakkatti route to Attappady is an over utilised route and during disaster-prone days many trips are experiencing difficulties due to recurring landslides and had to rely on the inter-state routes for their needs. Thus, alternative road to Attappady is inevitable;

- Understanding evacuation zone is essential for formulating an evacuation plan for a certain area;
- Escape routes should not be blocked by those fleeing the disaster, or be cut off by the hazard itself; where routes are cut off, people should be aware of alternative routes;
- Closest facility analysis provided in Network analyst tool of ArcGIS can be used to identify shortest route connecting isolated areas and potential evacuation infrastructures;
- Multipurpose rescue centres are recommended to ensure long term sustainability and should be located in the safe locations and should withstand the hazards concerned.

Recommendations for further work

Developing disaster preparedness plan and its timely execution will reduce the degree of disaster impacts and losses. To enhance transportation capacities in an emergency, it is often beneficial to establish transportation networks prior to an emergency. Identification of shortest safe route to evacuation infrastructures, location of temporary air lifting points, location of multipurpose rescue centres, disaster prone areas etc are recommended for other areas also that may get isolated during calamities.

6. *Planning for Resilient Transport Infrastructure in a disaster prone area - a case study of Munnar Region*

Date of start : April 2019
Date of completion : March 2022

Need and importance of the study

The transportation system is a complex network of infrastructure, vehicles, power sources, communications, and human capital. The resilience in transportation sector refers to the ability of the transportation system to recover and regain functionality after a major disruption or disaster. Disaster resilience is everyone's business and is a shared responsibility among citizens, the private sector and government. Increasing resilience to disasters will require decisions and actions that are informed and forward-looking.

The western flank of the Western Ghats covering the eastern part of Kerala is identified as one of the major land slide prone areas of the country. The Landslides in the state include rock falls, rock slips, debris flow and in a few cases rotational types of slides. About 1500 km2 area in the Western Ghats is prone to landslides. Every year with the onset of monsoon, land slips and landslides are reported.

Objectives and scope

- To identify the elements of risk, vulnerability and resilience associated with the existing 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 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 apposite future transport systems which can remain resilient and serve the purpose in adverse climatic conditions.

Methodology

- Inventory of the existing infrastructure;
- Identification of disaster affected/prone areas and road routes;
- Identification of alternate routes with potential for further up gradation;
- Hydrology studies to investigate the cause and effect factors affecting the transport infrastructure;
- Geotechnical investigations at disaster affected areas to recommend for suitable slope protection techniques;
- Preparation of attribute database for each of the identified routes in the transport network;

- Generation and integration of various thematic layers, viz. landslide distribution, landslide hazard zonation, land use/land cover, drainage order and lithology, geotechnical and hydrology data using GIS technique;
- Vulnerability analysis of the study area using GIS;
- Planning of a safer and cost-effective route involving comparatively lower recurring costs for road development and maintenance using computer-assisted methodology of route planning for least cost paths.

Data Collected

Field survey conducted, traffic volume count, soil samples, GIS shapefiles, secondary data from PWD, LSGD, Panchayats.

Analysis and model building

Landslides or slope failures in Munnar, landslides - causes and classification, general hydrology and rainfall in the study area.

Findings and discussions

Alternate routes are proposed, potential evacuation centres within and outskirts of Munnar town, prospects of alternate modes of transport – Ropeways and Railways.

Interim Conclusion/ Conclusions

Torrential rain and landslides for the last three consecutive years has made severe impacts on the transport infrastructure of Munnar. Munnar being one of the worst affected areas every year, needs a robust and resilient transportation network which can withstand such situations. Along with the upgradation of the existing road networks, new roads have to be made which can be used in case of rescue and relief operations. The alternate routes identified in the primary survey have the potential to be developed. Along with the infrastructure development, we have to understand the vulnerability of the area during a natural calamity. Vulnerability is defined as the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard**.**

Recommendations for further work

Future work includes conducting risk and vulnerability analysis using GIS techniques intended towards planning for a resilient road network system.

7. *Enhancement of Public Transport Services in Thiruvananthapuram City*

Date of start : April 2020
Date of completion : March 2021

Need and importance of the study

An efficient public transport system is an on-going need for the unhindered mobility of commuters in Thiruvananthapuram City. There has not been much studies conducted regarding the public transport system in Thiruvananthapuram city The ridership in public transport can be gradually surged only through implementation of effective policies. In this context, NATPAC intends to conduct a study on the enhancement of public transport services in Thiruvananthapuram city.

Objectives and Scope

The broad objectives are to study the characteristics of existing public transport system operating in a medium sized City as well as to identify significant factors and latent variables influencing the mode choice behaviour of working population in Thiruvananthapuram city. The study also aims to propose policies for improving public transport patronage in Thiruvananthapuram city and estimate modal shift from personalized vehicles to public transport mode by modelling of proposed policies and strategies. The scope of the present study is confined to the employees working within the precincts of Thiruvananthapuram city.

Methodology

Data collection by primary surveys involved conducting Revealed Preference Survey and Opinion Survey among government employees working in Thiruvananthapuram city. Exploratory Factor Analysis was performed as a major step to identify the major latent variables influencing the attitude of commuters towards public transport. Confirmatory factor analysis was performed as the next step to test the hypothesis of how well the

observed variables are representative of the latent factors identified through exploratory factor analysis. Analysis of mode choice decisions of employees working in Thiruvananthapuram city was done by developing separate multinomial logit models for commuters using buses, cars, auto-rickshaws and motorized two-wheelers. Conventional mode choice model as well as latent variable integrated mode choice model was developed. Latent variable enriched mode choice model was used for performing sensitivity analysis in order to evaluate the influence of various policy options on the mode choice behaviour of commuters.

Data Collected

Revealed Preference Survey and Opinion Survey were organised for data collection on a sample basis among government employees working in Thiruvananthapuram city. The existing socio- economic attributes as well as travel characteristics of the commuters were collected using Revealed Preference Survey. The questionnaire section for the opinion survey involved certain statements reflecting attitude of commuters towards public transport which were to be rated by the commuters themselves on a five-point scale.

Analysis and Model Building

Exploratory factor analysis using varimax rotation was conducted on the data collected using opinion survey and the major latent variables influencing the attitude of commuters towards public transport were identified separately for the government employees, private employees and the combined data of all the employees. Confirmatory Factor Analysis was also performed to analyse the relation between observed attributes and their underlying latent factors. Mode choice decision of employees working in Thiruvananthapuram city was studied by using multinomial regression analysis. Mode choice models developed were of two types: Conventional mode choice model considering the socio-demographic variables as well as travel attributes and Conventional Mode Choice Model integrated with latent variables. The scenario analysis was also done by reducing the total travel time using public transport by 5%, 10%, and 15%. It was found that by reducing travel time using bus by 15%, the share of bus commuters increased by about 17%. The following utility equations were developed using NLOGIT for latent variable integrated model:

U (BUS) = 3.559 - 6.231 *TTPERTD+ 0.829*TC
U (CAR) = - 6.231*TTPERTD+ 0.829 * TC – 0.242 *HHSIZE - 0.283 *SS - 0.395 *AFF - 0.263 *REL - 5.257*TD
U (AUTO) = -6.231*TTPERTD+ 0.829 *TC – 9.410 *TD + 2.519 *GENDER -0.817 *REL -1.226 *VEHOWN -1.971 *GRADE - 0.573*INCOME
U (TW) = - 6.231*TTPERTD+ 0.829 * TC -0.928 *TD -0.478 *PTAVAIL -0.281 *AFF - 0.133*REL + 0.384 *GRADE

Interim Conclusions

In case of government employees, the major latent factors identified were Reliability, Convenience, Safety and Security, Comfort and Affinity. The major latent factors influencing the attitude to public transport of the private employees as well as the combined dataset of all the employees were found out to be Convenience, Comfort, Safety and Reliability. Moreover, latent variable integrated mode choice model is found to have a relevant role in the mode choice decisions made by the commuter. The recommendations provided by the present study include reducing travel time of buses by introducing more number of limited stop buses for intra city commuters as well as providing exclusive bus services for employees from their home to workplace at subsidised fare rates.

Recommendations for Further Work

The present study offers valuable insights into the mode choice behaviour of employees working in a medium-sized city of a rapidly developing country. The models developed as part of the study will help transport planners and policy makers to develop policies and recommendations for improving public transport patronage in Thiruvananthapuram city.

8. *Economic Performance of Road Transport Sector in Kerala due to COVID-19 - Macro Level Reform Measures*

Date of start : June 2020
Date of completion : March 2021

Need and importance of the study

The present pandemic COVID19 has affected the road transport industry adversely as all modes of transport (except emergency services) came to a standstill. In this context, a study on the road transport sector alone and its activities are needed to evaluate the impact of COVID-19 on the economy. This will help to formulate an action plan for implementing various recovery measures.

Objectives and Scope

The study's main objective is to assess the impact of COVID-19 on the socio-economic status of livelihoods of the people in Kerala who are directly involved in the road transport sector alone. Therefore, the scope of the study is restricted to the road transport sector alone.

Methodology

The first step was identifying all factors relevant to activity-based in the road transport sector from the literature. To obtain operational characteristics and revenue collection, and socio-economic aspects, a sample size for conducting the survey was selected based on Bill Godden's' formula.–Adequate representation was made in the sample to include major operators directly and indirectly in the road transport sector. However, separate questionnaires were designed for Workshop/Industry, Stage Carriages, Truck, Auto and Taxi operators. Due to the pandemic spread, the responses were collected through telephone, online, and limited face-to-face interviews with the respondents.

Data Collected and Analysis

The data collected include the distance travelled per day, fuel expenses per day, daily income, monthly EMI of the vehicle, repair and maintenance (km wise/time period), annual tax, insurance etc. The data were collected in three different scenarios viz., before lockdown, during the lockdown and after lockdown. Likewise, other modes of passenger and goods road transport operating details were also collected and analysed for the study to understand their operational characteristics, revenue collection and socio-economic aspects.

Findings and Discussions

In general, the truck industry, including pick-up, suffered losses during the lockdown even though the movement of essential goods was necessary but recovered to a good percentage after lockdown compared with the situation. On the other hand, the workshop industry, including spare parts shops, reopened earlier in the unlock phases but faced huge losses during lockdown but has remarkable recovery after lockdown; the certainty of the sector is a critical reason for that. The intermediate public transportation sector like auto and taxi

has improved significantly from their lockdown conditions, even though they suffered a massive income crisis. Still, the recovery of the auto and taxi sector is not very commendable, getting no or very few trips even after lockdown. Both the stage carriages (KSRTC and private) have not been in operation during the lockdown. The private bus industry is trying to recover after unlocking phases; with 2/3 workers per bus, but the losses were enormous. After restarting their operations, the income has not been matched up even to their daily expenditures. Also, the maintenance expenses increased due to the non-utilisation of vehicles. The KSRTC has already rolled out many programs for improving public transportation like Buses on Demand, BonD services, etc., but still could not attract more public.

This study attempts to transportation landscape based on the perceptions of individuals assessed through the survey. Subsequently, measures to mitigate the adverse inference of the COVID-19 on sustainable mobility were also suggested in a short, medium and long term aspects, which likely results in a stepping up of changes that have long been in motion towards a new, different, and more limited form.

Recommendations for further work

The eventual effect of the pandemic will depend upon how well medium- and long-term policies can deal with a change away from sustainable transport modes. This will help the government stakeholders, and private players plan their future approaches in such a way that the government designing sustainable transport policies for the post lockdown period can draw on experiences from previous crises to predict likely behaviour and design policies that fit the purpose. Likewise, more in-depth outcomes can be suggested too, which suits the purpose of having a micro-level assessment separately in each transport mode.

9. *Evaluation of Air Quality and Traffic Characteristics during COVID-19 Lockdown period*

Date of start : April 2020
Date of completion : March 2021

Need and importance of the study

The Government of Kerala announced a statewide lockdownon from 23rd March 2020 to 31st March 2020 to prevent the spread of COVID-19. On 24th March 2020, Government of India ordered a nationwide lockdown for 21 days, thus limiting the mobility of the entire 1.3 billion population of India. On 14th April 2020, the national wide lockdown was extended till 3rd May 2020, with a conditional relaxation after 20th April 2020 for the regions where the spread has been contained.

The coronavirus pandemic severely impacted the daily lives of millions of people in the State and brought economy to a grinding halt. Air quality has improved drastically. The daily average levels of particulate matter of size less than 2.5 micron (PM2.5) and nitrogen dioxide (NO_2) in the cities have reduced sharply from the pre-lockdown days. There is an opportunity to take a close look at how air pollution levels have responded to extra ordinary measures adopted. After the restrictions are lifted and economic activities started, there was be a sudden spike in air pollution, which can further increase the respiratory illness and can contribute to the spread of COVID-19.

Scope and Objectives

The objectives of the study are:

- To understand the air quality levels during pre/post lock down in major cities in Kerala;
- To estimate the emissions during lockdown period;
- To recommend traffic management measures and appropriate strategies for reducing vehicular emission in the post lockdown scenario.

Methodology

- Literature study;
- Collection of secondary data which includes air pollution concentration from KPCB during pre-lockdown and post lockdown period;
- Collection of traffic characteristics in the selected city during pre-lock down period and post lock down period which are close to the air quality monitoring stations;
- Comparison of emission of during lock down and post lock down;
- Formulations of mitigations and adaptive measures.

Findings

The COVID-19 pandemic drastically changed working and social habits of billions of people.

- The sharp drop in PM2.5, PM10, NO_2, and CO levels during the COVID-19 lockdown in Kerala is due to strict transportation, industry and construction restrictions. As a result, this pandemic could be viewed as a huge setback;
- AQI remained 'satisfactory' throughout the lockout processes and fell even more afterward. As a result of the occasional showers coupled with the lockout conditions, the AQI started to change dramatically during the unlock phases;
- The AQI values are higher at Vyttilla during pre-lockdown periods, and later it changes to satisfactory condition;
- Consider the traffic characteristics, vehicle composition variation is different for both locations;
- With the variation in the usage of vehicles, it is clearly visible that human psychology has a major influence on traffic behavior and mode choice behavior.

10. Intelligent Transportation System Applications in Enhancing Transport Infrastructure

Date of start : April 2018
Date of completion : March 2021

Need and importance of the study

Among the Indian states, Kerala has recorded one of the highest counts in accidents for the past few years. As is commonly known, there are basically 4 Es of Road Safety – Education, Engineering, Enforcement and Emergency Care. One of the most critical problems after an accident is the delay in Ambulance services for reaching the spot and back to the respective hospital. Most motorists cannot give way for an ambulance because of heavy traffic and also due to insufficient width of roads. This leads to ambulance driving in the wrong direction, manual intervention at traffic signals etc. which are not at all an optimal solution. 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 minimising the delay encountered.

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

- Device a system architecture for Emergency Vehicle Prioritization system for pre-emption of ambulance vehicles;
- Develop an algorithm for the proposed system under single EV scenario;
- Evaluate the impact of the proposed system in comparison to fixed time signal environment.

Scope is limited to Pattom-Medical College corridor in Thiruvananthapuram.

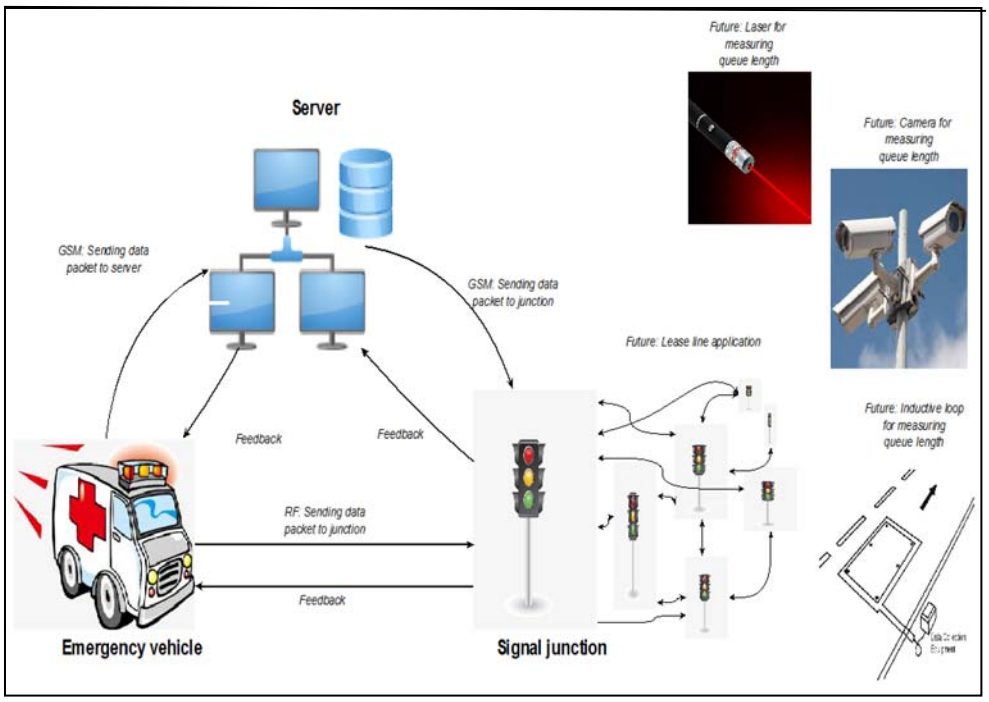


Figure 2: System Architecture of EVP system

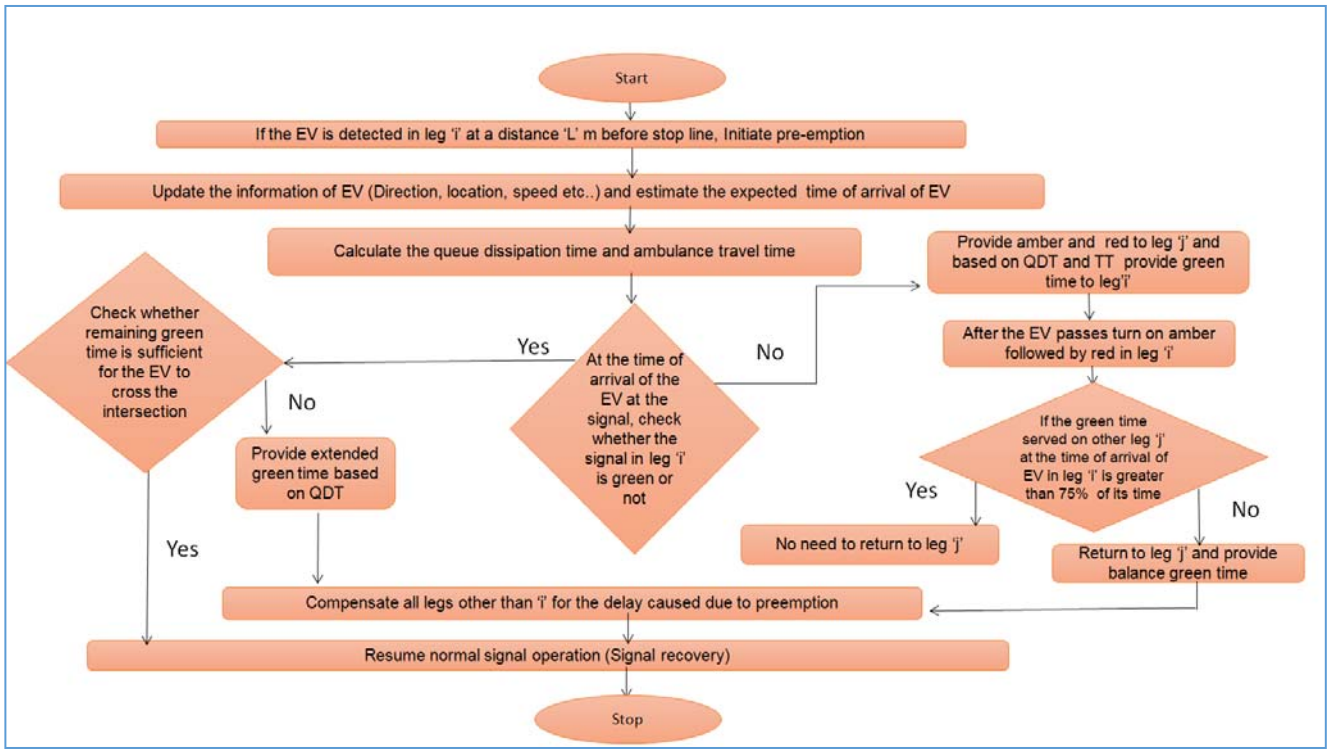


Figure 3: Functioning of the System

Analysis and Model building

Micro-simulation in VISSIM was carried out using the developed Queue Dissipation Time model for optimising the green allocation for EV to pass through the junction. This was tried using Vehicle Actuated Programming as well as COM interface.

Conclusion and Further Work

The microsimulation runs showed that the travel time for ambulances for covering a distance of 2.35 km from Pattom to Medical College reduced by 35.26% on an average. It could also be observed that the number of stops also reduced drastically indicating the benefits of implementing the EVP system. The work can be extended to include more than one EV at a junction as well as Travel Time model between junctions.

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

Date of start : April 2020
Date of completion : March 2021 (Continuing)

Need and importance of the study

NATPAC has been undertaking studies related to IPTs such as Taxi, Auto, etc. and computing the state's cost of operation. This study helps the Government to take appropriate decisions whenever fare revision matter is taken up.

Objectives and Scope

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;

The scope of the study is confined to passenger auto-rickshaw operations in Kerala state.

Methodology

Adequate representation was made in the sample to include different types of autos and routes operated in various terrain conditions, viz. plain, rolling and hilly regions and also urban, semi-urban and rural areas. The area selected for the study was six districts, ie. Thiruvananthapuram, Kollam, Ernakulam, Idukki, Thrissur and Kannur. 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 those above, the fare fixation will cover the socio–economic aspects of the auto-rickshaw sector in Kerala.

Analysis and model building

All the collected data, including the operational characteristics, revenue collections and socio-economic aspects, were analysed for the study. The information for the costing has been taken independently from the detailed study of vehicle parts and their behaviour during the asset's economic life. The various cost items have been grouped into variable and fixed costs. These were done for material and labour maintenance cost elements system-wise. The cost arrived from Cost Table containing selected main components, and quantities were used to prepare the Price Index. And this price index model is built based on scientific methodology with the primary objective of comparing the overall impact of the movement of prices of significant cost inputs in the operation of autos between two time periods.

Findings and Discussion

The standard costs of operation of autos were arrived from the cost table approach.

Table 1: Total Consolidated Cost Sheet – Diesel Engine

Particulars	Results of Cost/Km increased (Rs.)	% growth in price from 15th December 2018 to 15th March 2021
Total Variable Costs	6.1997	18.70
Total Fixed Costs	2.7072	8.10
Total Operating Cost/km	8.9069	15.46

The last fare revision for autorickshaw services were announced by the Government in December 2018. Between 15th December 2018 and 15th March 2021, the auto operations have shown a growth of 15.46%. This suggests that fare level of auto services in the State can be considered for revision by 15.46% from the existing rate. The said Price index presents a transparent scientific methodology that would help decide the revision of fare for autos in the State.

Recommendations for further work

The price index worked out in the study can quickly estimate the cost of operation of auto services and the movement of prices for the current situation concerning the base year. The method compares entry-level conditions for the two time periods. It has the advantage that the indication of costs can be assessed and the index revised for any horizon period.

12. Development of Mobile App for Road Data Collection

Date of start : April 2018
Date of completion : March 2022

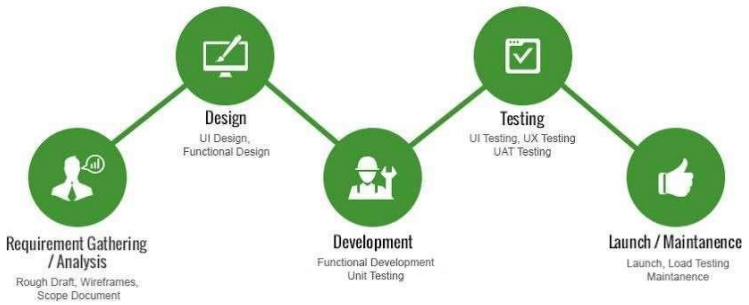
Need and importance of the study

Road network are the lifeline for the movement of passengers and freight all over the world. Availability of accurate road network along with its associate characteristics are very essential for efficient planning and implementation. Availability of digital road network is most essential for quick decision making. The study was an attempt towards this direction with main objective of developing a mobile app for road data collection.

Objectives of the Study

- To develop an android based mobile app for collecting road related data.

Methodology



The android based application was developed using the software Android Studio. Android Studio is the official integrated development environment (IDE) for Google's Android operating system, designed specifically for Android development. It has a strong editor tool for developing creative User Interfaces (UI) and emulators for different versions to test and simulate sensors without having actual Android devices. The travel paths are shown on a real-time Open Street Map (OSM) that can be saved as a KML file. The app uses osmdroid Android library that provides Tools / Views to interact with Open Street Map. Location drivers in the smartphones allow the app to publish updates to the device's physical location through the Android location services. The app automatically checks the user location from time to time, and plots the results on the real-time OSM maps. User can also record points in the travel path while they are travelling by simply long pressing at the point in the map. The user can also view the saved files in the map.

Data Collection and Analysis

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 mainly consists of two screens – welcome screen and map screen.

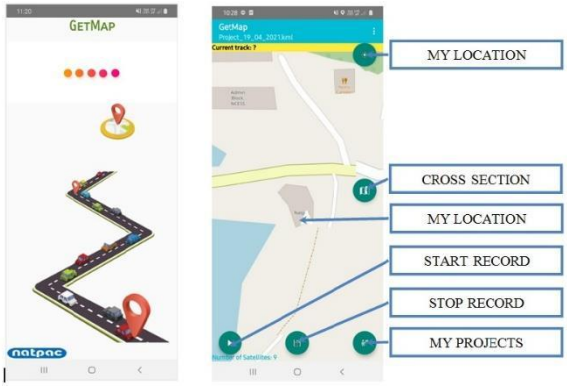


Figure 4: GetMap – Developed Mobile App

The welcome screen which is the start splash 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 MY LOCATION MARKER on the map shows the live movement of the user. While opening the app, an instruction screen with different icons of the map screen is displayed. It guides the user to decide which button is to be pressed for performing different functions. The user can simply close the instruction screen by clicking CLOSE button.

After closing the instruction screen, the app prompts the user as to decide whether to create a new project or to open existing projects. The term project represents a KML file with different number of tracks, points, road inventory and road cross sectional details saved as a single file. If the user selects the option to create new project, the app prompts the user with a textbox to enter the name of the project. After entering the name of the project, the app creates a project to store the upcoming tracks and points. The app also shows the current project name in the top navigation bar of the app screen as subtitle. Current track name, speed, distance travelled and the number of satellites available are displayed on the Map Screen.

Conclusion and Further Work

Road network are the lifeline for the movement of passengers and freight all over the world. Availability of accurate road network data along with its associate characteristics are very essential for efficient planning and implementation. Availability of digital road network is most essential for quick decision making. This study was an attempt towards this direction. A mobile App named GetMap was developed as part of this project. GetMap app which 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 landuse layer along the roads will be taken during the next financial year.

13. WebGIS based Road Crash Information System

Date of start : April 2017
Date of completion : March 2022

Need and importance of the study

Availability of crash data is the cornerstone for successful implementation of road safety activity 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 WebGIS based road crash information system using Geospatial tools for Kerala.

Scope and Objectives

- To develop Road Crash Information system (RCIS) using GIS as backend application, highlighting the road accident scenarios;
- To update accident scenario in NATPAC website periodically.

Methodology

Crash related data for the study was taken from the State Crime Records Bureau (SCRB). Database management of this application is undertaken in MySQL database. WampServer 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 accident spots and other is used to store the login information of the user.

Data Collection and Analysis

The web application is developed using the programming languages HTML5, JavaScript, CSS and PHP. The software used is Visual Studio Code which is a code editor redefined and optimized for building and debugging modern web and cloud applications. The web application displays the location of the

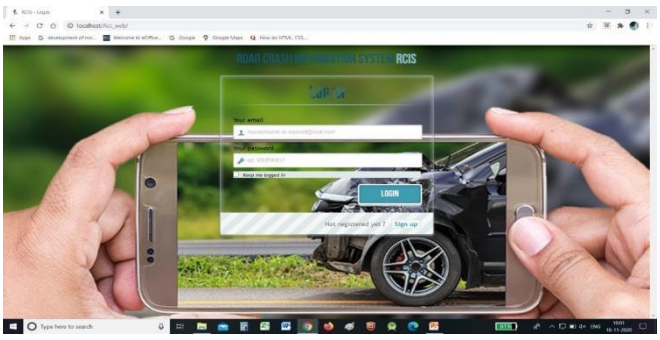


Figure 5: RCIS – Login Page

accident spots on a customized Leaflet OSM map which is the leading open-source JavaScript library for mobile-friendly interactive maps. A responsive HTML5 Charting Library named CanvasJS is used in the web application to visualize the Data as charts. The database in the backend is connected to the system using the programming language PHP.

The web application displays the location of the accident 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 accident spots in that district. A pie chart is also provided to assess the number of accidents based on the type of road - NH, SH and OR. To get the detailed view of accident spots, user can enlarge the map by clicking zoom button on bottom left corner of the map. Accident 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.

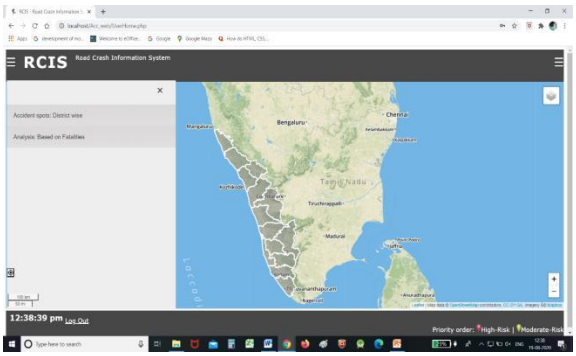


Figure 6: RCIS – Home Page

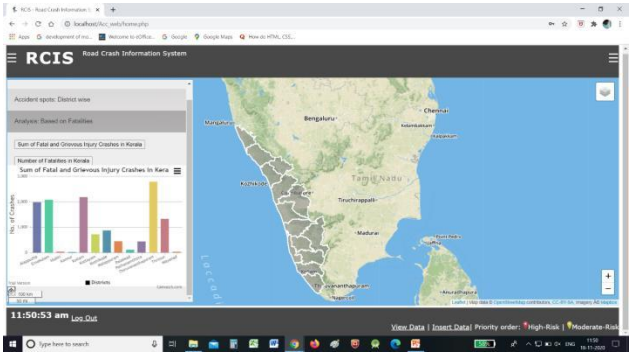


Figure 7: RCIS – Display of Accident Scenario

Administrator privilege was added to the web application. Admin can view the details of accident hot spots as a tabular column using the link provided at the bottom of the Admin Home page to View Data page of the web application. The data in the table can be filtered based on district and police station. The total number of accident spots satisfying the filtering condition is displayed. The options to Edit or Delete data in the database are also

provided. Admin can insert the details of new accident hot spots into the database using Insert Data page. All details of the new accident hot spots can be entered through the online form provided with textboxes and dropdown lists. After entering the details, the admin have to click on SAVE DATA button to submit the details to the database. A Log Out option is provided for the admin to log out from the web application.

Conclusion and Further Work

Reliable and accurate data are needed in each stage of road safety management in order to correctly identify problems and risk factors and priority treatments, and to formulate strategy, set targets and monitor performance. Data relevant to road safety, especially road accidents are collected every day, but for these data to be useful for informing road safety practice, they must be properly coded and visualized, processed and analysed in a systematic way. The analyzed data provide meaningful results especially the accident black spots. The vulnerable locations thus identified needs to be displayed to wider audience rather limited to the researchers and bureaucrats. The present study is an attempt in this direction. The study developed a Road Crash Information System (RCIS), the web application which shows the first and second order black spots within the Kerala State. Tools and graphical interfaces are given to the application to facilitate facile analysis and visualization of the accident details by common man.

14. Development of GIS – based Road and Traffic Database for Kerala

Date of start : April 2016
Date of completion : March 2021

Need and importance of the study

Road authorities put great effort and expense into collecting large quantities of data related to road assets. Management of collected data is a severe problem due to scattered data sets and information among different agencies. Reliable and detailed data help road practitioners accurately identify problems, risk factors and priority areas, and to formulate strategy, set targets and monitor performance. A comprehensive Geographic Information System (GIS) is an effective tool for integrating, managing, querying, and spatially analysing transportation data. Moreover, it provides an efficient means for interpreting and

displaying empirical trends and patterns in transportation data. The present study aims to prepare road and traffic database for the roads in Kerala.

Scope and Objectives

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

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

Methodology

- Compilation of data pertaining to road inventory and traffic data from earlier studies;
- Collection of crash data in the period of 2018, 2019 and 2020 from Kerala State Crime Records Bureau (SCRB).
- 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.

Data Collected

Reports and documents comprising earlier studies, and other relevant documents containing road inventory and traffic data pertaining to the study area and relevant for this study were collected and catalogued. 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 etc were compiled. Detailed crash data of the period from 2018 to 2020 were collected from SCRB. Secondary

Sources of data comprising of PWD Maps, Open Street Maps, Google Maps, etc were also compiled.

Tasks Completed

Road network map of all districts 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. Validation of developed map in GIS software for 1:500 and 1:1000 scale versions was done. Road and Traffic data from 75 study reports pertaining to all districts in the State of Kerala were extracted. Primary Surveys were conducted for development of GIS-based road and traffic database for roads in Kerala at selected 8 locations in 5 districts in the State, namely Wayanad, Kozhikode, Kollam, Thrissur and Thiruvananthapuram. The primary and secondary data collected were compiled and standardised. The geographical co-ordinates of compiled data were identified. Road Database, Traffic Database, Speed and Delay Database, Pedestrian Movement and Crash Database were created in File geodatabase format using ArcGIS.

Findings and Discussions

Road and Traffic data of all districts in the State of Kerala were collected, compiled and standardized. Road network map of Kerala covering NH, SH, MDR and other roads were prepared. GIS database for road and traffic data were created and stored in cloud.

Recommendations for further work

It is envisaged to conduct periodic updation of GIS database comprising of traffic, road inventory, transportation network and crash data. Road and traffic database system will be developed in GIS, which can be retrievable for various analytical and research purposes. In subsequent phases of the study, database will be stored and managed through a web-based application which will be hosted in the public domain.

15. Road Safety Scenario in Kerala during Covid 19 Lockdown

Date of start : April 2020
Date of completion : March 2021

Need and importance of the study

Covid-19 pandemic caught the world by surprise with its vicious ability to affect the daily life of people. Many countries announced complete/partial lockdown to restrict the spread of Covid-19 virus, which resulted in significant reduction in the movement of persons and goods. This has led to the change in mobility pattern and vehicular volume and is a crucial factor that affects the traffic crashes. Hence, the introduction of mobility restraints in the pandemic period must have had a great effect on the crashes. These changes in crashes and mobility due to imposed travel restrictions needs to be studied in detail.

Scope and Objectives

The scope of the study is to have an overall assessment of the road crash scenario in the state of Kerala and to focus on the major traffic corridors. The objectives of the study are:

- To evaluate the overall road safety scenario due to lockdown;
- To identify the crash hot spots, if any and their characteristics in the selected study stretches from previously identified crash blackspots;
- To identify the potential reasons behind the crashes;
- To formulate appropriate strategies for reducing crashes in the post lockdown scenario.

Methodology

A literature review was carried out to develop a research framework for the study. The crash data was collected from Kerala State Crime Record Bureau (SCRB) for the years 2018, 2019 and 2020 and the mobility data was collected from Google Community Mobility Reports for the entire district of Kerala for the year 2020. The crash data and mobility data were analysed. The crash data and mobility data were divided into three phases, namely Phase I, Phase II and Phase III. Phase I is the Pre-lockdown period spanning from 15th February 2020 to 21st March 2020, Phase II is the lockdown period spanning

from 22nd March 2020 to 31st May 2020 and Phase III is the post-lockdown period spanning from 1st June 2020 to 31st December 2020.

To investigate whether the crash and mobility changes during Phase I, Phase II and Phase III periods were significant, the two standard deviation band statistical analysis was used. Kendall rank correlation coefficient was used to examine the association between crashes and levels of mobility. Geospatial analysis was performed for identifying the crash hot spots and to understand the possible reasons for occurrence of crashes, even though traffic was low. Based upon the results obtained, suitable strategies were formulated for reducing the vulnerability of the locations for crashes in the post lock down scenario.

Analysis

The crash data for 2018, 2019 and 2020 were analysed. The fatality rate (fatalities per 100 crashes) and injury rate (injuries per 100 crashes) of 2018, 2019 and 2020 and month wise fatality rate of 2020 were determined. The fatality rate and injury rate of lockdown period and corresponding period of 2018 and 2019 were determined. The two standard deviation band analysis and Kendall rank correlation coefficient were carried out using crash and mobility data. Crash prone locations were identified as crash prone locations in the state of Kerala during the lockdown period and interventions were suggested.

Findings and Discussions

There is a significant decline in the absolute number of crashes in 2020 compared to the 2018, 2019 crashes. The increase in severity of crashes during lockdown period, indicate the possible effect of speed on the crashes due to low traffic volume. The Two standard deviation band analysis shows that Crash trends and mobility trends for Grocery and Pharmacy, Parks, Transit Stations and Work Places categories compared to baseline fell within the band in Phase III towards to end of the year 2020. Only Residential category showed a negative correlation with crashes while the all other categories, that is, Grocery and Pharmacy, Retail and Recreation Parks, Transit Stations and Work Places had positive correlation when Kendall Rank Correlation Coefficient analysis was carried out.

Crash prone locations during lockdown period were identified as the location where there is an accumulation of 2-3 crashes during lockdown period and is in the list of previously identified blackspot in 2019 (Blackspot identification conducted by NATPAC using 2016-2018 crash data). Appropriate interventions were suggested for reducing the vulnerability of the locations.

Conclusions

- The Two Standard Deviation Band Statistical Analysis shows that there exists a significant change in the crash and mobility trends in the lockdown and post-lockdown period when compared to the pre-lockdown period;
- From Kendall Rank Correlation Coefficient analysis, it can be seen that there is a correlation between the number of crashes and mobility trends;
- A total of 17 crash prone locations were identified and suitable countermeasures were suggested for the same.

16. Crash Prediction Modelling for Two-Lane Two Way Roads: a Case Study of Critical Road Stretches in Kerala

Date of start : April 2019
Date of completion : March 2022

Need and importance of the study

The WHO Report on Road Traffic Injuries for 2018 has listed Road crashes as the leading cause of death for the age group 5-29 years and a growing public health concern. The National and State Highways account for about five percent of the total roads in the country. According to the MORTH report 2019, NH‟s and SH‟s had the most number of deaths, i.e., 61% of the total deaths. Thus, the rate of crashes has increased. And also, only a few studies have been conducted so far in the stretch considered within Kerala. The crashes can be predicted by developing a crash prediction model. Crash Prediction Modelling can help to take the right decision in the direction of crash management i.e. to decide and implement remedial measures in the field of road safety.

Objectives and Scope

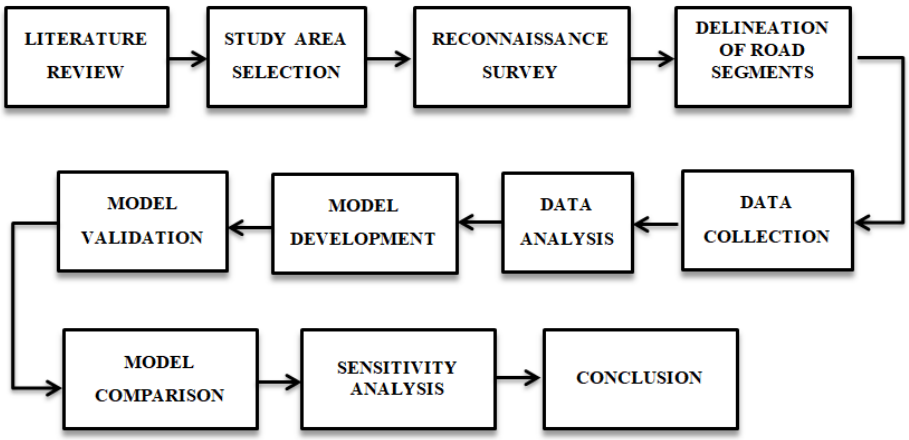
The objectives of this study are:

- To develop crash prediction models for two lane two way roads of Kerala;
- To consider various causative factors lead to crashes and its significance in various type of crashes;
- To compute crash modification factors for variables based on sensitivity analysis.

This study is conducted only for a particular road stretch of NH-66. Hence, the methodology adopted and findings from this study may be applicable to road networks under prevailing traffic and environmental conditions.

Methodology

The methodology proposed for developing a crash prediction model for NH-66 road stretch is given in the form of flow chart given below.



Data Collected

Data collected for the study is tabulated as shown in **Table 2.**

Table 2: Variables Considered for the Study

Road Data	Road Crash Data	Traffic Data
Inventory Survey Lane width Shoulder width Number of curves Number of bus stops Number of Pedestrian Crossings Number of Access roads Number of Junctions	**Police Records** Type of road and road crash Location, date and time Type and number of vehicles involved Number of persons injured or dead Pattern of collision Type of violation	**Manual Method** Classified volume count and spot speed conducted at the midblock sections
Subjective Rating Pavement condition Shoulder condition Quality of sign boards	**Vehicle Odometer** Chainage of road crash occurrence	

Analysis and Model Development

Preliminary analysis of the data was done to understand the relation between the variables considered. Crash data, Traffic data and road inventory were analyzed in MS Excel. Road stretch under consideration was segmented into 1km sections. The database consisted of details regarding roadway geometry and condition, crash data and traffic data. Latitudes and longitudes of the points were obtained from Google earth. The scatter plot matrix helps to identify the pattern in which the crash frequency is related to all the other variables. It can be seen that none of the variables exhibited a direct linear relationship with the crash. Thus, Spearman's rho correlation coefficient was estimated.

The total number of crashes is predicted using traffic volume and road data. Poisson regression model was developed using the collected data in SPSS. Models were developed using 80% of the collected data. Remaining 20% of the collected data was used for validation of the model. It can be seen that with increase in ADT and NJ, there is an increase in the total number of crashes. Crashes show a decreasing trend with increase in SW.

The Poisson Regression equation obtained is:-

C = EXP (3.256-(0.125*SW) + (1.9*(10^-5)*ADT) + (0.02*NJ))

Where, C – Total No: of Crashes, SW – Shoulder width

ADT – Average Daily Traffic, NJ – Number of Junctions

Conclusion

Crash prediction models are very good tools in the analysis of crashes. Crash prediction models offer an estimate of expected crash frequency as a function of traffic flow characteristics and roadway geometries. These models help to know the real causative factors behind the occurrence of crash. The major factors that contribute to road crashes are human behavioral factors, vehicle factors, traffic factors, roadway and environmental factors.

Future Course of Work

Data Collection for the remaining stretch need to be done. The process of studying the effects of output variable from the input variables of a statistical model is called sensitivity analysis. A sensitivity analysis will be conducted on the developed model. Crash modification factors will be computed for variables based on sensitivity analysis.

17.Assessment of Risk Potential of State Highways in Kerala

Date of start : April 2016
Date of completion : March 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. The pedestrians are more affected by road accidents compared to vehicle rider. The present study undergoes deep into the accident causative factors and have listed various causative factors for immediate correction. The International Road Assessment Programme (IRAP) as well as other mathematical tools have 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 road acts as a bypass to the NH and thus there has been heavy and increasing traffic on the road. Also the highway pass

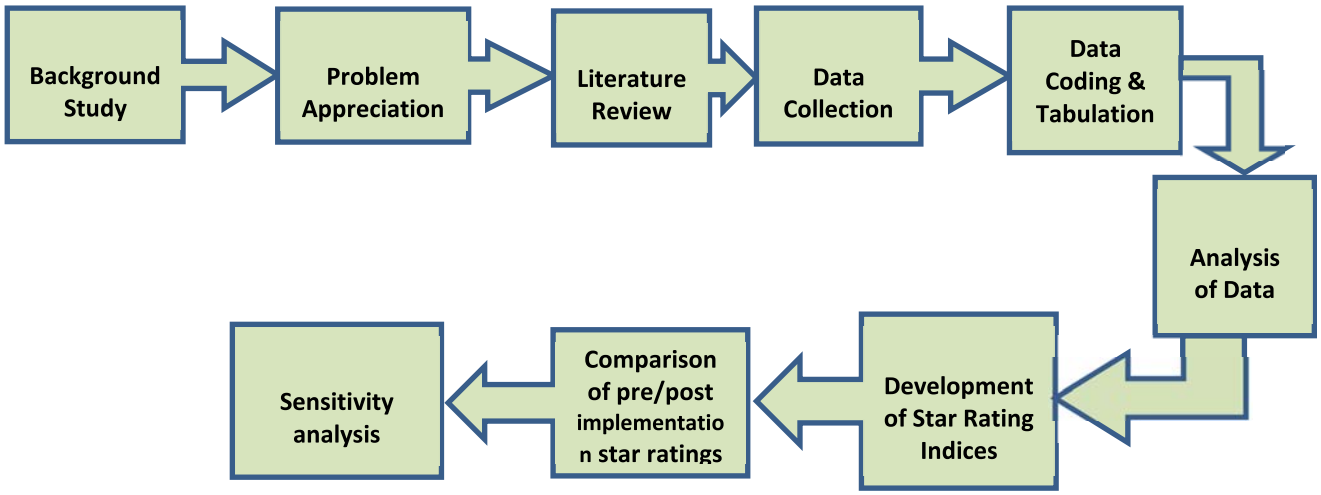
through densely populated semi-urban and rural areas and thus safety aspects are to be taken care of for the safety of road users as well as pedestrians.

Objectives and Scope

- To perform Road Safety Audit (existing roads) on the selected SH road;
- To generate the existing star rating indices in terms of safety to road users using iRAP methodology;
- To conduct safety evaluation of Safe Corridor Demonstration Project (SCDP) corridor – pre and post implementation of infrastructure development works.

The scope of the study is limited to the evaluation of SCDP corridor on SH1 from vettu road intersection near Kazhakkuttam to Adoor.

Methodology



Data Collection

The data collection provides a data-driven framework to identify key safety needs, guide investment decisions, and align and leverage collective resources. 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. Detailed collection has been completed through manual surveys and video graphic survey techniques. The road geometry and the location specific analysis has been done for every 100 m road stretch. The database consists of

details regarding roadway geometry and condition, crash data and traffic volume. Existing roads RSA Methodology and iRAP methodology have been followed as reference for data collection.

Data Analysis

Preliminary analysis of data has been performed to understand the relation between various variables. Preliminary analysis list out various factors which have contributed to road crashes in the past, as road crashes are multi-causative and it will be difficult to point out any one factor or some factors which are more critical than the others. Addressing least contributory factors will be time waste as well as non-economical, thus prioritization was done. Most vulnerable category of road users and their risk factors were assessed. Star ratings indices from the IRAP has been used as a benchmark in defining major concerns across the road network along with various mathematical modelling techniques. IRAP data analyses has been done using the IRAP India Vida software's and the obtained star ratings are compared with the star ratings derived prior to the improvement works.

Results

In this study an attempt has been made to examine the interrelationship among the different variables and various types of road crashes and to identify the most suitable model. iRAP methodology has been followed to generate star ratings and safe road investment plans. Comparison table showing the pre- post implementation star ratings for the SCDP corridor is given below.

Table 3: Pre-post implementation star ratings for SCDP corridor

Band	Vehicle occupant		Motorcyclist		Pedestrian		Bicyclist	
	Before work % Length	After work % Length	Before work % Length	After work % Length	Before work % Length	After work % Length	Before work % Length	After work % Length
5 Stars	0	54.98	0	10.45	0	19.78	0	0.75
4 Stars	6	36.57	0	57.34	0	43.28	0	5.85
3 Stars	40	8.08	13	31.22	0	32.34	1	67.79
2 Stars	17	0	36	0.12	1	4.1	7	25.12
1 Star	37	0.37	51	0.87	99	0.5	92	0.5
Total	100	100	100	100	100	100	100	100

Key Findings

- Comparison of pre-post construction star ratings shows that 85% of the road length has become safer for vehicle occupants, 65% road length has become safer for motorcyclists. 72% of safety improvement has resulted for the pedestrian category;
- Based on sensitivity analysis, it was analyzed that:
  - 15% increase in Average Annual Daily Traffic (AADT) can make 50% of road length unsafe for vehicle occupants;
  - 20% increase in AADT can make 66% of road length unsafe for vehicle occupants;
  - In the case of motorcyclists, 15% and 20% change in AADT can make 78% and 90% of road length in high risk category;
  - 20% change in AADT result in 88% of road length high risk for pedestrians;
  - 10% increase in posted speed limit can make 32% of road length to high risk category for vehicle occupants; (60kmph base line)
  - A posted speed of 80kmph can make 93% of road length to high risk category for vehicle occupants;
  - A posted speed of 70 and 80kmph can make 75% and 98% of road length to high risk category for motorcyclists.

18. Experimental Investigation on Porous Asphalt

Date of start : April 2016
Date of completion : March 2021

Need and importance of the study

Adequate drainage is a primary requirement for maintaining the structural soundness and functional efficiency of a road. Water in the asphalt surface can lead to moisture damage, modulus reduction and loss of tensile strength. Saturation can reduce the dry modulus of the asphalt, and the surface drainage is causing major distress in the pavement such as stripping and raveling etc. (IRC SP 42:2014). During monsoon, the functional requirements (good riding quality, sufficient skid resistance course) of the pavement in most of the cases are difficult to achieve. Porous Asphalt Mixes (PAM) are proposed to be a solution for

various issues such as hydro planning, reduction in the skid resistance of the pavement, splash and spray, and reduced glare from head lights in wet conditions.

So it is important to study the Porous Asphalt Mixes (PAM), particularly its structural and functional behaviour, so that PAM will be implemented widely in the major highways which will give improved functional requirements. It is the need of the hour to improve the research gap in the PAM concerning its functional issues such as loss in permeability and clogging due to dirt materials on the road surface. The international standards for mix design of PAM (i.e., ASTM D7064 and AASHTO PP 77) had not specified the test method that should be used to perform permeability.

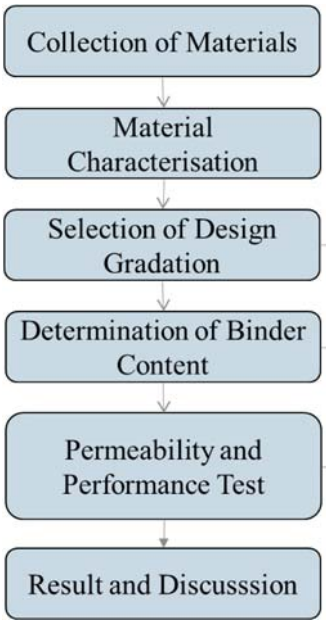
Scope and Objectives

The scope of the study is limited to the determination of performance of porous asphalt mixes made using Polymer Modified Bitumen-70 (PMB-70). Furthermore, the mix's performance was compared across different gradations (Type I and Type II) and compaction levels (35 and 50 Blows). The study aims to provide an initial framework for the porous asphalt mixes and performance measures.

The objectives of this 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 analyze the permeability and clogging behavior of porous mix;

Methodology



Conclusion

The clogging and declogging test is conducted for OGFC-50 blows and 35 blows mix with three different sizes of clogging material (Type A, B and C). Type A clogging material will not contribute to clogged condition (terminal clogged permeability of 8.7 m/day) during the lifetime of pavement as the particle size is too small which would be drained along with rainwater during service life. Type B clogging material could cause the clogged condition (terminal clogged permeability of 8.7 m/day) if regular declogging maintenance program is not carried out.

The clogging and declogging test results with Type C clogging material shown that clogging potential is moderate which could be conveniently restored to good permeability if declogging operations performed at regular intervals.

19. Evaluation of Moisture Susceptibility of Asphalt Mix Using Admixtures

Date of start : April 2020
Date of completion : March 2022

Need and importance of the study

As the moisture damage was the first distress identified in Hot Mix Asphalt (HMA), a significant effort has been made to define moisture susceptibility mechanisms. Therefore, moisture damage is a significant concern as it diminishes the performance and service life of pavement. This results in a huge maintenance and rehabilitation cost to the agencies. Moisture susceptibility can be identified by tests which illustrate the effect of moisture damage. Tests used to estimate moisture sensitivity can be classified into two general types: tests on loose mixtures and tests on compacted mixtures. In the first category, the results are mostly qualitative, and interpretation of the results becomes a subjective matter depending on the evaluator's experience and judgement. Loose mixture tests are best used for comparison between different aggregate–asphalt mixtures in terms of compatibility, strength of adhesion and stripping. Mixtures failing in these tests, on the basis of some established criterion, have the potential to strip and should be avoided. Tests in second category are conducted on laboratory-compacted specimens or field cores or slabs. The results can be measured quantitatively, which minimize subjective evaluation of test results (Solaimanian et al. 2003).

Scope and Objectives

The scope of the study is confined to assessment of moisture damage using bitumen grade VG 30. The major objectives of this study are:

- To understand the moisture susceptibility behaviour of the bituminous mix;
- To study moisture susceptibility by variation of air voids by Marshall compaction effect (temperature and compaction levels);
- To investigate the effect of additives on moisture susceptibility;
- To study the performance of mix in terms of tensile strength ratio, rut resistance and stability.

Tasks Involved

- Collection of materials such as aggregates, bitumen and admixtures;
- Determination of engineering properties of aggregates such as particle shape, strength, water absorption, abrasion test specific gravity;
- Determination of physical properties of asphalt as per IS:73-2013 which includes penetration, softening point (R&B), ductility and specific gravity;
- Selection of aggregate gradation in accordance with MORTH and design of mix using Marshall Method in accordance with MS-2 manual;
- Determination of volumetric properties of bituminous mix and Optimum Binder Content (OBC);
- Carry out performance test with and without admixtures for different compaction temperature and levels;
- Analysis of data.

Conclusion

One binder type VG 30 was incorporated into hot mix bitumen mixtures designed with one aggregate source. A total of 90 specimens were fabricated at different compatibility condition. The volumetric properties, mix characteristics, stability and indirect tensile properties of the mixtures were measured for evaluating the moisture susceptibility of the designed mix.

- The bulk density of the compacted mix was examined at different compatibility condition and it was observed that as the compaction levels decreases as the density of the mix decreases. The bulk density of the mix has a great impact on the compaction temperature and compaction levels;
- The maximum dry density of the loose aggregates from the designed mix seems to be unchanged. This is due to the fact that the compatibility of the asphalt mix does not have any cause on the maximum dry density;
- Stability of the design mix decreases as the compaction temperature and compaction level decreases in the case of two conditioning processes. The maximum stability was observed for the sample compacted at higher temperature.

- As compaction temperature changes from higher temperature to lower temperature, stability is decreased by 2% to 10%;
- All the asphalt samples are satisfying the minimum amount of 80% of Tensile Strength Ratio (TSR) and the stability ratio varies from 75% to 93%;

20. Study on the Influence of Different Types of Aggregate, Filler and Bitumen on Bituminous Mixture Performance and Properties

Date of start : April 2020
Date of completion : March 2022

Need and importance of the study

This study intends to suggest a climate resilient pavement surface course for Kerala.

Objectives and Scope

- To assess variation of volumetric properties, moisture susceptibility and rutting characteristics of bituminous mixtures, with respect to variation in aggregate properties from 7 different quarries and with respect to different filler materials, quarry dust and partial replacement of quarry dust with cement and lime, with respect to different binder types, VG 30 bitumen, NRMB 70 and PMB 70;
- To suggest a climate resilient pavement surface course for Kerala.

The scope of the study is limited to pavement surface layers only viz., Bituminous Concrete and Stone Mastic Asphalt. The conventional fillers viz., quarry dust, cement and lime are used for preparing BC Mixes and quarry dust and lime are used for preparing SMA mixes as per MoRTH recommendations.

Methodology

- Material Collection – Aggregates from 7 different quarries, VG 30, NRMB 70 and PMB 70 grades of bitumen and fillers;
- Test on Material Properties of VG 30, NRMB 70, PMB 70 bitumen and Aggregates;
- Aggregate Gradation of BC and SMA mixes;

- Marshall Stability Test on BC and SMA mixes using different grades of bitumen and fillers;
- Retained Marshall Stability and Indirect Tensile Strength Test at Optimum Bitumen Content;
- Determination of Rut Resistance using HamburgWheel Tracking device.

Interim Findings

- The Optimum Bitumen Content of samples prepared with NRMB 70 grade bitumen is less than samples prepared with VG 30 grade bitumen;
- The Optimum Bitumen Content of samples prepared by partially replacing quarry dust with cement and lime were more when compared with the samples prepared with quarry dust only and is independent of the grade of bitumen and aggregate source;
- The indirect tensile strength and retained marshall stability of mixes prepared by partial replacement of quarry dust with lime is more when compared with the other two fillers. The moisture susceptibility of mixes prepared with NRMB grade bitumen is less when compared with VG 30 grade bitumen;
- The rut resistance of mixes prepared with NRMB grade bitumen is more when compared with mixes prepared with VG 30 grade bitumen.

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

Date of start : April 2017
Date of completion : March 2022

Need and importance of the study

This study aims to propose a rehabilitation design methodology for the low volume roads in Kerala, based on the obtained DCPT values and the laboratory results of pavement layer parameters.

Objectives and Scope

- Comparison of overlay design of selected low volume roads using DCP Number method (DN method), DCP nomogram method, CBR method and deflection method;
- Determination of relationship between DCP value and Soaked CBR value of soil samples prepared in the laboratory;
- Determination of relationship between DCP value and Soaked CBR value for sub base and base layers.

The scope of the present study is limited to finding suitable DCP-CBR relationship of subgrade, sub base and base layers.

Methodology

- Collection of baseline data;
- Laboratory tests for determination of soil properties and CBR values;
- Traffic studies;
- Structural and functional evaluation of the pavements;
- Comparison of overlay design methods;
- Determination of relationship between DCP value and Soaked CBR value of soil samples at field density and 100%, 97% of maximum dry density;
- Determination of relationship between DCP value and Soaked CBR value of sub base and base layers.

Interim Findings

At the study stretches, traffic analysis was performed, and the condition was assessed using a visual observation method to determine the current functional condition of the pavement. The different surveys were conducted on the field and found the overlay design requirements and found that the methods were not comparable. As the different overlay design methods were not comparable, an attempt has been made to develop a suitable DCP-CBR relationship for various pavement layers. Dynamic cone penetration tests were done on the study stretches. On soil samples compacted to Maximum Dry Density and Field

Density, soaked CBR and unsoaked DCP tests were performed. The following findings were observed:

- Overlay design using DN method, nomogram, CBR value and based on deflection is done on the study stretches and it was found that the methods are not comparable;
- The BBD method completely disagrees with the results obtained from the other three methods for all the study stretches;
- From the regression analysis, there exists a relationship between soaked CBR and unsoaked DCP values for MI and MH soil and SM, GM and GC soil when analysed separately. The coefficient of determination (R^2) of MI and MH type soils were found to be more than SM, GM and GC soils. R^2 value of MI and MH type soil is 0.972 and that of SM, GM and GC type soil is 0.767. Also the standard error of the estimate in both the cases is less.

22. Study on the Strength Characteristics of Flexible Pavements in Water Logged Areas

Date of start : April 2019
Date of completion : March 2021

Need and importance of the study

This work determines regaining stability, tensile strength, and rutting resistance of the bituminous mix subjected to different inundation periods: 1, 3, 5 days from flood data acquired during the heavy rainfall periods in 2018 and 2019. The inundated samples are allowed to drain for a different period. This study aims to quantify the percentage of damage incurred on bituminous concrete layer due to prolonged inundation in terms of strength variations and performance variations.

Objectives and Scope

- To determine the effect of the inundation period on the stability, tensile strength and rutting of bituminous concrete mix;

- To determine the regained stability, regained tensile strength and regained rutting resistance of the pavement layers with time.

The scope of the work is limited to the surface layer of the pavement. The test samples include mix-preparation for Bituminous Concrete (BC).

Methodology

- Collection and characterisation of materials such as aggregate and bitumen;
- Determination Optimum Bitumen Content and control mix preparation with Marshall procedure to compare the stability variation of conditioned samples;
- The following curing conditions are applied: 1,3 and 5 days curing with 25 degree Celsius to simulate the flood conditions and the samples with the curing condition are tested to determine the stability variations with the unconditioned sample (immediate draining condition);
- The respective samples with the applied curing conditions are allowed to drain for some time (say 1, 3, 5, 8 days, etc.) and stability is determined and comparison of regained stability with that of control mix and Marshall criteria is done;
- The wheel tracking test is also done with 3000 passes of the wheel to compare the rutting of conditioned mixes with the control mix;
- The moisture susceptibility of the BC mix is determined using Indirect Tensile Strength;
- The performance characteristics of the mix with the highest inundation period (3 days) are compared based on Marshall Stability, Indirect Tensile Strength and Rutting.

Findings and Discussions

The Marshall stability, rutting, tensile strength and TSR were completed for the highest inundation period of 3 days. These results for immediate, 3 days, 5 days, 8 days and 10 days draining of water along with that of control mix is compared and consolidated. The immediate traffic after the flood will lead to distresses in the road and reduction of life of pavement. (3 days inundation period). There should be time for draining of water from the

pavement layers to regain the stability of pavement and thus can save the life of the pavement by applying load restrictions as per the following results:

- 75 to 95 percent regaining of stability is possible with 8 to 10 days draining of water under the no-load condition as per 1, 3, and 5-days inundation period;
- The moisture damage is reversible by at least 85 percent after draining water for 8 to 10 days under no-load condition;
- The regaining of rutting resistance from 90 percent to full recovery is in 8 to 14 days.

Conclusions

Considering the critical condition of inundation of 3 days, the regaining of Marshall Stability, rutting, tensile strength and TSR parameters up to minimum is 5 days and maximum is 8 days. The restriction of heavy vehicles in this period of 5 – 8 days is applicable in the respective stretches of inundated flexible pavement.

Recommendations and future scope

A restriction of heavy vehicles for the regaining time of a minimum of 8 days and a maximum of 14 days is possible in the respective stretch of roads. The future scope of the study is to develop a pavement deterioration model for Kerala.

23. Resource Mapping of Road Construction Materials in Kerala – Phase II

Date of start : April 2019
Date of completion : March 2021

Need and importance of the study

Mapping of resources helps to determine the source, distance, quantity, and quality of resources. The mapping of aggregate resources will also help in understanding the accessibility and size of the quarry.

Objectives and Scope

- To examine the aggregate properties of materials obtained from licensed quarries and check their suitability in different pavement layers with MORTH and MORD;
- To project the quarry details and aggregate properties into geo-referenced maps in the GIS platform and attach attributes.

The scope of the project is limited to Southern Kerala districts of Thiruvananthapuram and Kottayam and Central Kerala district of Thrissur.

Methodology

- Study area selection;
- Collection of details of quarries in study areas from Department of mining and geology, Government of Kerala;
- Quarry visit for collection of aggregates and Questionnaire survey;
- Laboratory tests on Aggregates;
- Evaluation of engineering properties of the materials suitable for road construction with reference to MORTH and MORD specification;
- Determination of suitability of aggregate in the pavement layers;
- Mapping of aggregates.

Findings and Discussions

The aggregates of 5 quarries do not conform to MORTH criteria in Thiruvananthapuram district. The samples of 2 quarries do not satisfy MORD criteria in Thiruvananthapuram district. The aggregates from 4 quarries do not conform to MORTH criteria in the Kottayam district. All 37 quarries satisfy MORD criteria in the Kottayam district. There are 4 quarries in Thrissur which cannot be used in any bituminous layers. They can be used only in the WBM-sub-base layer. All 21 quarries in Thrissur satisfy MORD criteria. GIS mapping includes the quarry details, aggregate test results, and suitability in different pavement layers. The current datasets include the shape files of Thiruvananthapuram, Kottayam and Thrissur except soundness tests. The soundness tests for Thrissur and Kottayam are ongoing.

Interim Conclusions

The highest proportion of quarries in the three districts are within 1 km from the road having less than 100 tonnes average daily production using jaw crusher and operational for all months as per the questionnaire data. The percent of quarries suitable in the BC, DBM, and BM bituminous pavement layers are 70 percent in Kottayam, 37 percent in Thiruvananthapuram, and 33 percent for Thrissur as per MORTH. The percent of quarries suitable in the 25 mm SDBC and BM bituminous pavement layers are 81 percent in Kottayam, 52 percent in Thrissur, and 50 percent for Thiruvananthapuram. Kottayam excels the other quarries in the MORTH and MORD criteria.

Recommendations and future scope

The future scope of the study is database creation with datasets of quarries from all districts of Kerala.

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

Date of start : April 2018
Date of completion : March 2021

Need and importance of the study

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, CBR test and UCS test;

- To evaluate the effects of the shredded plastic fibres on the engineering properties such as permeability, shear strength and compressibility of soil.

The scope of the study is limited to addition of different sizes of shredded plastic waste namely 4.75mm, 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

- Characterization of two soil types;
- Examination of compaction behaviour by conducting Modified Proctor compaction tests and unconfined shear strength by conducting unconfined compression tests on the soil mixed with shredded plastic waste so as to assess the strength of the mix and reach at an optimum amount and size of shredded waste plastic;
- Carrying out consolidation test to obtain the degree of consolidation and hydraulic conductivity of the mix;
- Carrying out triaxial shear tests to obtain the shear parameters.

Work done

- Collected soil and pulverized it to obtain soil passing 425µ sieve;
- Basic characterization of soil was carried out (index properties, compaction characteristics, soil classification);
- Shredded plastic waste and segregated them to obtain plastic of size 4.75 mm, 2.36 mm, 1.18 mm, 0.6 mm and less than 0.6 mm;
- Carried out compaction tests on four soil types with shredded plastic waste of different percentages(0.1%, 0.2%, 0.5%, 1%, 2%) and different size (4.75 mm, 2.36 mm, 1.18 mm, 0.6 mm, 0.6 mm passing) to arrive at optimum plastic-soil mix;
- Carried out unconfined compressive strength (UCS) tests at Maximum Dry Density (MDD) and Optimum Moisture Content (OMC) of different mixes with standard size specimens to get the shear strength parameters;
- Conducted consolidation tests on soil samples with different plastic proportion and analysed the permeability and consolidation characteristics;

- Evaluated the microstructure of stabilized and unstabilized soil using scanning electron microscopy (SEM) analysis;
- Carried out UCS tests at MDD and OMC of different mixes with larger specimens to get the shear strength parameters;
- Conducted permeability and consolidation tests on soil samples with different plastic proportion.

Conclusions

- Shredded waste plastic in soil can improve the strength of soil when added in the optimum amount;
- The effect of shredded waste plastic on soil is influenced by various factors such as size and percentage of shredded waste plastic, soil particle size;
- The addition of finely shredded waste plastic covers (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 and CH soils both compaction parameters and UCS 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%;
- The coefficient of consolidation Cv increased with addition of plastic indicating the increase in rate of consolidation and so the settlement occurs at faster rate for those samples. Random fibre inclusion resulted in increasing stiffness of the samples and subsequently reduced the consolidation settlements;
- Studies show that 0.6 mm sized plastic added at 0.1% can be considered as optimum amount required for stabilizing MH soil;
- The improved soil properties on addition of finely shredded waste plastic covers suggest their potential application in soil stabilization and in eliminating the problem of waste disposal. Further research including its effect on drained shear strength is advisable for its more effectiveness.

25. Evaluation of Warm Mix Asphalt Mixes with the Addition of Recycled Asphalt Pavements

Date of start : April 2018
Date of completion : March 2021

Need and importance of the study

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

- Mix design by Marshall method;
- Preparation of WMA-RAP (10%, 20% and 30%) surface mix;
- Performance evaluation by testing rutting, tensile strength and moisture susceptibility tests.

Work done during 2018-2020

- 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% 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;
- Collected RAP from Ulloor-Akkulam (UA) road;
- Characterised the RAP-The RAP obtained from UA road was 6 years of age. The gradation of the RAP sample collected was found out. Virgin binder required for different percentages of RAP, so that the mix satisfied the requirements for OBC was also found;
- Conducted mix design for HMA-RAP mixes using VG 30 by conducting Marshall Stability test. Obtained optimum binder content for RAP percentages of 10%, 20% and 30%;
- Carried out performance evaluation of WMA-RAP mixes by carrying out indirect tensile strength (ITS) test, Rut tests and moisture susceptibility tests.

Conclusions

- The Marshall Stability and retained stability values showed slight reduction for sasobit mixes compared to HMA mixes for some mixes but the values were well above the specified values of 9 kN in MORTH;
- The evotherm mixes showed better performance compared sasobit mixes;
- The ITS_{dry} and ITS_{wet} for mixes were greater than the recommended values of 225 kPa and 100 kPa respectively;
- The retained stability ratio and tensile strength ratio was lower for WMA mixes compared to HMA mix 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;
- Hence dosages of 3% sasobit and 0.4% evotherm can be taken as the optimum dosage for this BC mix;

- Addition of 10% of RAP brought out considerable increase in Marshall Stability value and ITS value. For WMA-RAP mixes the stability increased even for 30% RAP;
- The WMA- RAP mixes with sasobit and evotherm showed almost same increase in stability value for 20% and 30% RAP in the mix;
- Addition of 10% RAP showed 17% to 30% increase in ITS value for the mixes and the major increase was seen in the case of WMA-RAP specimens;
- There was reduction in the TSR value for VG 30 mixes but for WMA-RAP specimens there was 2% to 7% increase in TSR especially for mix with sasobit;
- Rut depth was lowest for WMA-RAP specimen with 3% sasobit.

Since the mixing and compacting temperature can be reduced by 20 oC 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.

26.Study on Roughness of City Roads in Thiruvananthapuram

Date of start : May 2020
Date of completion : July 2020

Need and importance of the study

At the insistence of Kerala Road Fund Board, NATPAC has conducted Road Roughness and Deflection studies on selected city roads coming under Thiruvananthapuram City Road Improvement Project towards the periodic assessment of road condition.

Objective of the Study

The objective of the work is to evaluate the functional and structural performance of pavement by conducting roughness and deflection surveys in the selected city roads. The scope of the work is limited to conducting the roughness survey using Fifth wheel bump integrator and deflection test using Benkelman Beam Deflection apparatus in the selected arterial roads in the Thiruvananthapuram city.

Methodology

Fifth Wheel Bump Integrator (FWBI) equipment was used for conducting Road Roughness survey and Benkelman Beam Deflection (BBD) equipment was used for conducting deflection survey. The surveys were conducted on a normal day conforming to the survey procedures in IRC: SP: 16:2019 *(Guidelines for Surface Evenness of Highway Pavements)* for Roughness measurement and IRC: 81-1997 *(Guidelines for Strengthening of Flexible Pavements using Benkelman Beam Deflection Technique)* for Deflection measurements.

Result

The result shows that international roughness index (IRI) values for the test road section vary from 2.005 m/km to 3.543 m/km. Based on the obtained roughness value, riding comfort for most of the survey corridors vary from 'Good' to 'Average' surface condition except three 'Poor' stretches which indicates that the riding comfort of road stretches in poor category needs to be improved by means of overlay. The deflection values of the study corridors vary from 0 mm to 0.51 mm. This implies that the study corridor belongs to 'reasonably strong' category and have adequate structural strength to carry the traffic load.

27. Preparation of DPR for Development of Waterway Between Mahe and Valapattanam River

Date of start : October 2017
Date of completion : Progressing

Need and importance of the study

In order to develop a seamless connectivity of the West Coast Canal from Kovalam to Hosdurg, a connectivity between Mahe River and Valapattanam River has to be established where no water bodies are present for waterway connectivity by way of three artificial cuts.

Objective of the Study

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

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 required 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 length for each of these cuts is 10.54, 0.85 and 16 km respectively.

Design standards adopted

As per the 'Inland Waterways Authority of India (Classification of Inland Waterways in India) Regulations, 2006', the waterways are classified as Class I, II, III, IV, V, VI and VII for safe plying of self-propelled vessels up to 2000 tonnes Dead Weight Tonnage (DWT) and tug-barge formation in push-tow units of carrying capacity up to 8000 tonne. The present study, adopted the standards adhering to the Class 1 waterway in phase 1 of development and class 3 waterway in Phase 2 of development.

For ensuring the connectivity between Mahe River and Valapattanam River, alignments for the artificial cuts were prepared from the various options, 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 were given more priority in finalizing the alignment. Also, project components were identified and listed based on the preliminary studies. The Land acquisition proposal were prepared and submitted to the client. Preliminary design of second cut is completed and for the design of first and second cut, preparation of DPR is under progress.

28. Preparation of DPR for Development of Waterway Between Kovalam – Akkulam Section – Phase I

Date of start : April 2018
Date of completion : March 2021

Need and importance of the study

Kerala Waterways and Infrastructure Limited (KWIL), formed by the Government for the development and rejuvenation of Kovalam- Kasaragod waterway has entrusted NATPAC to undertake the study for improvement of Kovalam - Kollam Stretch of the T.S canal for Inland Navigation, Tourism and Recreational Purpose. The phase 1 consists of development of waterway between Kovalam – Akkulam section. The major objective of the study is to develop the waterway between Kovalam and Kollam in order to ensure sustainable transport for inland navigation.

Study Area

The study area stretches from Kovalam to Akkulam reach of the Parvathy Puthanar, which is about 16.50 km and runs almost parallel to Sea and NH bypass road. The waterway is passing through Panathura, Edayar island, Moonattumukku, Poonthura, Vallakadavu, Trivandrum airport, Vempalavattom and ends at Akkulam lake.

The methodology of the study includes detailed canal inventory, secondary data collection, topographic survey, hydrographic survey, socio-economic survey. Water samples were collected from 9 locations where there is change in the characteristics and were tested in the laboratory. A financial appraisal is carried out with the objective of determining scenario under which a project would achieve the greatest financial return – thereby making it as an attractive investment proposition to all concerned. Quality management Plan was prepared and SWOT Analysis was carried out.

29. Maintenance and Sustainable Management of Waterway – a Case Study – Parvathy Puthanar

Date of start : October 2017
Date of completion : Progressing

Need and importance of the study

Parvathy Puthanar canal is currently not navigable. The excessive dumping of waste and weed growth are the key issues to be addressed. Once the canal is made navigable, regular maintenance work has to be carried out in order to have uninterrupted service through the canal.

Objectives and Scope

The main objectives of the study are:

- To monitor the condition of the waterway in terms of infrastructure, water quality and waterway operation through continuous data collection;
- Suggest maintenance and management system for Parvathy Puthanar;
- Assess the present situation and suggest improvements and maintenance needs;
- Maintain a proper database of the collected details for further analysis and decision making in GIS.

The scope of the study is limited to the maintenance and management of Parvathy Puthanar.

Methodology

The methodology adopted includes a detailed canal inventory survey, collection of data related to present condition of the canal, water quality monitoring at selected locations, details of waste management in the study area, and study of weed growth rate in the canal. The collected data were analyzed to find out the existing problems and to assess the development strategy and future development potential of the canal.

Conclusions

Various improvement proposals were suggested for Parvathy Puthanar, such as cleaning of canal, dredging, cutting of filled portion of canal, bank protection, cutting trees and reconstruction of cross structures. Also improvement proposal for surrounding places of

canal such as installation of septic tank and laying sewage system for households, providing community bins on both sides along the Parvathy Puthanar and installation of Aero Bins for solid waste management were suggested.

For efficient operation of waterway, maintenance of waterway is proposed. The waterway maintenance services also include dredging activities, the fairway monitoring and surveys conducted to support the maintenance activities. Navigability of a waterway also depends on the functioning of its infrastructures such as locks. If no attention is paid to the canal system, weeds may grow and the problem of siltation may arise. The most important is the existence of a navigable channel in the water body (river, estuary, canal etc.) of sufficient depth and width, which is to be maintained with adequate water for navigation all-round the year.

A guideline was prepared for sustainable maintenance and management of waterway based on the study. The guideline aims to improve the quality of maintenance and management of waterway in an economic way as part of integrated planning. The guideline include the details of periodic surveys and inspections to be done, maintenance procedure to be adopted and decisions to be taken to go for repair and replacement.

The study tries to re-establish the inland water transport. The main constraint is the waste management. Once the waste disposal issue in the study area is solved, the nutrients on the canal water will reduce and thereby the aquatic weeds would also reduce. Later periodic maintenance has to be carried out. This would ensure uninterrupted service through waterways.

30. Database Creation Management for Inland Waterways in Kerala using GIS

Date of start : April 2016
Date of completion : March 2021

Need and importance of the study

NATPAC has been actively involved in many projects in the field of Water Transportation. 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 available with respective persons related to the projects, but these are not accessible easily for further use as these data are not compiled and stored properly. So it is proposed to create and update a GIS based database management system to compile, store and analyse waterway related data.

Objectives and Scope

The main objectives of the study are:

- To compile the available data related to inland waterways in Kerala;
- Create and manage an inland waterway information system using GIS;
- Updation of waterway data.

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

Methodology

The methodology adopted for the database creation in GIS includes collection of primary and secondary data, data compilation, field verification and updating and database creation in GIS.

Database Creation

District wise database was created. The features created in the database are administration boundary, road network, rail network, land use, water body, waterway routes, location of jetty, cross structure, width and depth of waterway, cable crossings, drain joining, bank protection, water quality, ferry operations and major industries. The values are entered into corresponding feature attribute table.

Survey of industries was conducted for GIS database creation. Details of industry such as geo coordinates, raw material procured, origin, quantity of raw material, finished goods, quantity and destination of finished goods, number of employees and turnover were collected. Geo coordinates was used to create point feature for industries and collected data were entered into attribute table.

This GIS database can be used in future for various studies conducted by NATPAC, research students and planners for various purposes. To analyse an existing waterway or proposed waterway this GIS database is very useful. The present condition of any stretch of waterway such as location and number of jetties, cross structures, cable crossings, maximum, minimum and average depth and width of waterway etc. are available in the database. Also the locations of industry and tourism centers are available in the GIS database. By analyzing these details the possible diversion quantity of raw material and finished goods from nearby industries into the waterway can be easily assessed. The demand for tourist and passenger boat operation is also included as per data availability. All the essential data for the planning, development or design of a waterway is easily available from this GIS database.

31.Study on Accidents and Safety Aspects related to Inland Waterways

Date of start : April 2016
Date of completion : March 2021

Need and importance of the study

Though IWT sector is economically viable, this mode of transport is ridden with tragic accidents every year, incurring a heavy loss of human lives and property. Environmental conditions, nature of operations, human error (crew and passengers) and lack of safety standards, etc., pose a number of risks to safety of passengers and vessels. The accident rates are high and need to be focused to minimize the accidents. With the development of technology and public awareness, it is the time demand issue to mitigate the risk involved in passenger vessel operations to minimize accidents. This study has been conducted to analyse the causes of recent accidents related to waterways, assess various risks in the waterways and to suggest measures for improving the safety. The study also aims to examine the existing rules and trainings related to inland waterways in safety aspect.

Objectives and Scope

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 causes 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.

The Scope of the study is limited to accidents and other safety related aspects of the inland waterways of Kerala.

Findings and Discussions

This study analyzed the existing rules, regulations and training in IWT sector in India. And it is found that waterway sector lacks safety regulations and standardization in the courses. However it is very difficult to standardize rules for waterways as in other modes of transport, because the waterway condition and passenger characteristics vary from state to state. Hence prime responsibility to build standards and regulations rests in the hands of state authority. In Kerala, Kerala Inland Vessel rule (KIV 2010) governs the registration, construction and operational standards of vessels. However no particular standards are available for boat operation and waterway navigational aids.

The study developed a model to convert all the qualitative factors related to waterway safety and risk into actual numbers through a waterway risk assessment model. Seven waterway routes were identified for the study and Vytila- Kakkand section was found to be the most risky waterway section and major attention need to be given to the particular section.

There is no standard rescue operation available in this country when some accidents occur in waterway sector. This study suggests some guidelines for safe waterway operation. Guidelines for training in IWT sector which includes minimum eligibility, competence and syllabus for different grades of people operating inland vessels in Kerala were also suggested. Finally guidelines for waterway safety audit were also prepared. So far there were no guidelines in India available on how to conduct waterway safety audit. So it is very essential to develop one for the future use. Thus this study tried to analyse various aspects of accidents and safety issues in inland waterways.

EXTENSION SERVICES

1. CTSEM 2020

KSCSTE-National Transportation Planning and Research Centre (KSCSTE-NATPAC) in collaboration with College of Engineering Trivandrum (CET) organised the 7th Conference on Transportation Systems Engineering and Management (CTSEM 2020) during December 29-30, 2020 on virtual platform. CTSEM provided an opportunity for the students, research scholars and transportation professionals to present their work and network with the peers; learn about advancements and applications in their fields; minimise the duplication of research efforts and to arrive at future directions for research.

The conference was inaugurated by Shri.Pinarayi Vijayan, Hon'ble Chief Minister of Kerala. Hon'ble Minister for Higher Education Dr. K. T. Jaleel delivered the presidential address and Hon'ble Minister for Co-operation, Tourism and Devaswom, Shri. Kadakampally Surendran delivered the keynote address. The inaugural programme was followed by the Keynote sessions by eminent experts and Technical Sessions. The Keynote sessions comprises 13 Technical speeches delivered by eminent experts across the globe in Transportation Systems Engineering and Management. 67 Technical papers were presented.

2. Road Safety Month – 2021

KSCSTE-NATPAC observed 'Road Safety Month – 2021' by organizing a series of activities from 18th January 2021 to 17th February 2021. The theme of this year's Road Safety Month was "Sadak Suraksha – Jeevan Raksha".

Activities conducted by KSCSTE-NATPAC during Road Safety Month 2021:

Due to the Covid-19 pandemic, KSCSTE-NATPAC observed Road Safety Month 2021 through online platform. The Centre conducted various Road Safety Awareness activities and Road Safety Training Programmes for different target groups such as students from schools and colleges and general public. For the first time NATPAC organised the Road safety month throughout the state and participations were received from 14 districts in Kerala as well as other States/UTs. The competitions were conducted on the following broad themes:-

1. Painting (Water colour/Oil paint/Pencil drawing/Crayon)
2. Story writing
3. Slogan creation
4. Logo creation
5. Mono-act
6. Short films
7. Mime-Drama
8. Poem writing
9. Photo contest
10. Virtual quiz
11. Article/Essay Writing

Road Safety awareness programmes conducted in connection with Road Safety Month:-

- Interview given by Shri. Sanjay Kumar V.S, Senior Scientist, NATPAC on Red FM channel 94.3 on 20th January 2021.
- Two webinars - "Awareness on Road Safety" on 30th January 2021 and "Youth & Road Safety" on 13th February 2021 in association with KPM Model School, Kollam. The technical sessions were handled by Shri. Ebin Sam, Scientist, NATPAC and Shri. Jegan Bharath Kumar, Scientist, NATPAC. Around 70 students, teachers and parents participated in the awareness class.

- "Road Safety Awareness for Students and Youth" through online platform on 4th February 2021. The technical session was handled by Dr.Mohammed Najeedb, Dy. Transport Commissioner (Rtd.). Around 150 participants attended the programme.
- "Road Safety Awareness Program for Officials and Communities" in association with CRPF, Pallippuram on 10th February 2021. Prof. (Dr.) Samson Mathew, Director, KSCSTE-NATPAC inaugurated the programme. The technical sessions were handled by Shri. B.Anish Kini, Scientist, NATPAC and Shri. Arun Chandran, Scientist, NATPAC. Around 110 officials attended.

Inaugural address by Prof. (Dr.) Samson Mathew, Director, KSCSTE-NATPAC

In the valedictory session held on 17th February 2021 Presidential Address was given by Shri. T Elangovan, Executive Director, KRSA and Valedictory Address by Dr. Rajasree M.S, Vice Chancellor, APJ Abdul Kalam Kerala Technological University. Two road safety awareness

films were produced by NATPAC during Road Safety Month 2021 titled "Distraction is Extraction" and "Hands free is not Risk free" directed by Shri.Venu Nair. The films were released by Shri M Jayachandran, film score composer, singer and musician in the valedictory session. The Road Safety Awareness Activity winners were published during the valedictory session. 80 participants won the cash prizes and certificates of achievement and 70 participants won the certificate of appreciation at various levels and activities.

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.

As due to the outbreak of Covid pandemic, during the year 2020 – 21, only three programmes were conducted at the KSCSTE-NATPAC office, *K Karunakaran Transpark*, Aakkulam, Thiruvananthapuram. Ninety three drivers got benefitted from the course and are successfully endorsed to operate vehicles carrying dangerous and hazardous goods.

Date	Number of drivers Participated
15/12/2020 – 17/12/2020	26
17/01/2021 – 19/01/2021	33
22/03/2021 – 24/03/2021	34
Total	**93**

4. Training Programmes Conducted

a) In-house Training/Invited Expert Talk

Sl. No.	Details of Training	Date
i.	Technical presentation on 'Scanning Total Station-Trimble SX10' used in Topographic Surveys, Roadway/Corridor Surveys, Volumetric Surveys, Infrastructure Surveys, Utility Survey, and Forensics/crash scene investigation, by Shri Aswin, Manager-Pan India	08.01.2021

b) Road Safety Training for Various Target Groups

Sl. No.	Details of Training	Date
i.	Road Safety Awareness - training at Police Academy (2 half day sessions)	29.11.2020 – 30.11.2020
ii.	Road Safety Awareness - training at Y's Men International Club. 250 participants across Kerala	01.12.2020
iii.	'Emergency operations in relation with accidents on goods vehicles handling hazardous materials'at Police Training College	01.01.2021

5. Programmes Organised

To honour the services rendered by Dr.B.G.Sreedevi, Chief Scientist and former Director of NATPAC who retired from the service on 31st May 2020, KSCSTE-NATPAC conducted an online panel discussion on 'Data Driven Road Safety Management 'on 28th May 2020.

Moderator of the panel discussion was Prof. (Dr.) Samson Mathew, Director, NATPAC and had other eminent personalities in the Transportation domain as panellists. Around 160 participants including Scientists, Engineers, Academicians, Researchers, Students and Young Professionals attended the discussion.

Technical Presentations

Sl.No.	Name/Designation	Topic
1	Shri.T.Elangovan, Executive Director, KRSA	Overview of Road Crash Scenario
2	Dr.M.V.L.R Anjaneyulu, Professor, NIT Calicut	Engineering Measures to Enhance Road Safety
3	Dr.A.Veeraragavan, Professor, IIT Madras	Traffic Calming Measures
4	Dr.M.Satyakumar, Professor, MBCET	Quantification and Analysis of Blind-spots for Light Motor Vehicles
5	Dr.Tom V Mathew, Professor, IIT Palakkad	Surrogate Safety Meausres

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

Name of Programme	Organised by	Date (s)	Venue	Participants
Seminars/Conferences				
International Conference on Materials Mechanics and Management (IMMM2020)	College of Engineering Trivandrum	05.03.2020-07.03.2020	Trivandrum	V S Sanjay Kumar
Environmental Leadership and Life Skills for Women Scientists	Indian Institute of Forest Management	26.10.2020-30.10.2020	Online	Salini P N
Community Resource Management for Women Scientists	Indian Institute of Forest Management	23.11.2020-27.11.2020	Online	Salini P N
International Conference on Transportation Planning and Implementation Methodologies for Developing Countries (TPMDC)	IIT Bombay	10.12.2020-11.12.2020	Online	V S Sanjay Kumar
7th Conference on Transportation Systems Engineering and Management (CTSEM 2020)	NATPAC & College of Engineering Trivandrum	29.12.2020-30.12.2020	Online	Scientists of NATPAC
Workshops				
"Scientific Writing"	ISRO	31.03.2021	Online	Saran M S
Training Programmes				
5 days training course on Statistics and SEM	IMT Hyderabad	27.04.2020 – 31.04.2020 & 01.05.2020 – 05.05.2020	Online	Shaheem S
Training course on AMOS	Oriental University, Indore	19.05.2020 – 23.05.2020	Online	Shaheem S
Digitalization: Catalyst for Post COVID Construction Recovery	Ananya Narain, Akhilesh Srivastava, Varunkumar Sagarkar, B P Awasthi – Geospatial Media.	18.06.2020	Online	Saran M S
Training program on Operation, Maintenance and Tolling of Highways	Indian Academy of Highway Engineers (IAHE), Ministry of Road Transport and Highways, Govt. of India	27.07.2020-01.08.2020	Online	V S Sanjay Kumar

Recent Advances in Pavement Material Testing and Design	Misrimal Navajee Munoth Jain Engineering College,Chennai	17.08.2020-22.08.2020	Misrimal Navajee Munoth Jain Engineering College,Chennai	JeganBharath Kumar A
21 Days Online GIS Training Program using QGIS	Department of Geography, School of Earth Sciences, Central University of Karnataka, India	07.09.2020-27.09.2020	Online	V S Sanjay Kumar
Short term Training Programme on 'Tools for Transportation Data Analysis and Modelling'	Centre for Transportation Research, Dept. of Civil Engineering, NIT Calicut	18.03.2021-23.03.2021	Online Event from NITC	Salini P N, Arun Chandran, Anish Kini B
Webinars				
Geovision Webinar "Bring together your office and field staff with ArcGIS Apps"	ESRI India	14.05.2020	Online	Saran M S
BIGRS IndiaRAP Webinar: World Bank and iRAP helping save lives on Indian roads"	Bloomberg Philanthropies	02.06.2020	Online	Saran M S
Optimize your operations for business success with ArcGIS Network Analyst	ESRI India	24.06.2020	Online	Saran M S
Smart Pavement Inspection " Bump Recorder"	Bump Recorder co. ltd. Tokyo Japan	30.07.2020	Online	Wilson K C R Chandra Prathap
Protective Coatings for Concrete	KHRI	01.08.2020	Online	R Chandra Prathap
Road Rehabilitation Technologies	Wirtgen India Pvt.Ltd	08.08.2020	Online	Wilson K C R Chandra Prathap Dr. Salini U
Digital solution for Infrastructure – Modern practices	IEDC Civil – Marian Engineering College	29.08.2020	Online	Wilson K C
Analyze Multidimensional data in ArcGIS Pro and ENVI	ESRI India	01.10.2020	Online	Saran M S
Driving Urban Resilience with 5G+Geospatial	Gary Brantley, Commissioner & CIO City of Atlanta USA and Henrik Aagaard Johanson Senior Adviser, Program Manager Smart Region, The Capital Region Denmark	14.10.2020	Online	Saran M S

Webinar on Setting up an Urban Management Centre (UMC)	Institute of Management in Government (IMG), Thiruvananthapuram, Kerala	15.10.2020-16.10.2020		Salini P N Wilson K C
Geosynthetics in Pavements	Maccaferri	11.09.2020-12.09.2020		Wilson K C Dr. Salini U
Geosynthetics in Pavements	Maccaferri	11.09.2020-12.09.2020		Wilson K C Dr. Salini U
Journey to Safety Webinar Series	Indian Road Safety Campaign		Online	V S Sanjay Kumar
Webinar series - Travel in Cities	SVNIT, Surat Smart City and IUT (India)		Online	V S Sanjay Kumar
Webinar series	Indian Concrete Institute		Online	V S Sanjay Kumar
Webinar Series	UNRSC		Online	V S Sanjay Kumar

7. 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
ToCH college of Engineering	B Tech (Civil)	Shaheem.S	4	Mode choice analysis for Kochi metro
Jyothi Engineering College, Thrissur	M.Tech Thesis (Tptn.)	V S Sanjay Kumar	1	Development of trip attraction models for the core area of Thiruvananthapuram city
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech Thesis (Tptn.)	V S Sanjay Kumar	1	Development of Pavement Maintenance Management system for National Highways
National Institute of Technology Tiruchirappalli	M.Tech Thesis (Tptn.)	V S Sanjay Kumar	1	Development of Commuter Mode Choice Model using traditional and latent class approaches
Jyothi Engineering College, Thrissur	M.Tech (Tptn) - Internship	V S Sanjay Kumar	2	
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Tptn) - Internship	V S Sanjay Kumar	1	
Mar Baselios College of Engineering and Technology, Thiruvananthapuram	B.Tech (Civil)	V S Sanjay Kumar Ebin Sam	1	Identification and Analysis of crash prone intersections in Karamana – Pravachambalam Road Stretch
Jyothi Engineering College, Thrissur	M.Tech Thesis (Tptn.)	Subin B	1	Safety Evaluationof Two Lane, Two way road stretches in Kerala

Rajiv Gandhi Institute of Technology, Kottayam	M.Tech Thesis (Tptn.)	Subin B	1	Development of Crash Prediction modelling for NH 66 from Thiruvananthapuram - Alappuzha
St Gits College of Engineering, Kottayam	B. Tech (Civil)	Subin B	1 group	Assessment of Risk Potential of State Highways using iRAP
Jyothi Engineering College, Thrissur	M.Tech Thesis (Tptn.)	Subin B	1	Assessment of Risk Potential of State Highways using iRAP
Rajiv Gandhi Institute of Technology, Kottayam	M Tech (Tptn.)	Subin B	1	Crash Prediction modelling of Two – Lane Two – Way Roads in Kerala
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Tptn)	Salini P N	1	Estimation of Capacity and LOS of a signalised Intersection
Jyothi College of Engineering	M.Tech (Tptn) - Internship	Salini P N	1	Studies on Traffic Flow at Signallised Intersections
Indian Institute of Information Technology and Management-Kerala	M Sc Thesis	M S Saran	1	Accident black spot analysis and Accident prediction
Indian Institute of Information Technology and Management-Kerala	M Sc Thesis	M S Saran	1	Landslide Susceptibility Mapping using Weighted Overlay Method in GIS
Jyothi Engineering College, Cheruthuruthy	M Tech Thesis	Sabitha N M	1	A Sustainable Approach to Freight Transportation through Inland Waterways
Rajiv Gandhi Institute of Technology, Kottayam	M Tech Thesis	Sabitha N M	1	Mode Shift Behaviour of Commuters due to the Introduction of new Waterways
Goverment Engineering College, Thrissur	M Planning Thesis	Sabitha N M	1	Planning Strategies for Water Based Development - A case of Parvathi Puthanar Canal
Jyothi Engineering College, Cheruthuruthy	M.Tech - Internship	Sabitha N M	1	Maintenance and management of Inland Waterways in Kerala – A case study of Parvathy Puthanar
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech - Internship	Sabitha N M	1	Development of waterway in Kovalam Akkulam and Inventory survey of canals in Kochi
Rajiv Gandhi Institute of Technology, Kottayam	M Tech	Wilson K C		Effect of charcoal coconut shell ash in bituminous concrete mix
Jyothi Engineering College,Cheruthuruthy	M Tech	Wilson K C		Traffic prediction modelling for major highways in Kerala
Jyothi Engineering College,Cheruthuruthy	M Tech	Wilson K C		Traffic Impact Analysis for the Development of Shopping Mall in a Town Center
Vidya Academy of Science and Technology	B Tech	Wilson K C	1 group	Moisture susceptibility of Bituminous concrete
Jyothi College of Engineering	M.Tech	Arun Chandran	1	Assessing the Role of Feeder Services in Post Covid Scenario
Jyothi College of Engineering	M.Tech	Arun Chandran	1	Performance Analysis of Toll Plazas using queuing theory

College of Engineering Thiruvananthapuram	B Tech	Arun Chandran	1	Evaluation of SCDP Corridor
Jyothi College of Engineering, Thrissur	M.Tech	Arun Chandran	1	Impact of Integrated Feeder Services for Improving public transport patronage
Jyothi College of Engineering, Thrissur	M.Tech	Arun Chandran	1	Application of Queuing theory on Performance of Toll Plaza
Jyothi Engineering College	M. Tech Thesis	R Chandra Prathap	1	Study on Strength Variations and Performance characteristics of Subgrade and DBM mix Subjected to Inundation
Rajiv Gandhi Institute of Technology	M. Tech Thesis	R Chandra Prathap	1	Resource mapping and study on the influence of aggregate mineralogy on its physical properties
Vellore Institute of Technology	B.Tech	R Chandra Prathap, Dr. Salini U	1	Mapping of Aggregate Resources in Thrissur District of Kerala
MVJ College	Internship	R Chandra Prathap	1	Modified Thickness for Coir Geotextile Reinforced LSGD Roads of Kasargode District, Kerala
Rajiv Gandhi Institute of Technology, Kottayam	M. Tech Thesis	R Chandra Prathap	1	Evaluation of Moisture Susceptibility on WMA RAP Asphalt Mixtures
MVJ College	M. Tech Thesis	R Chandra Prathap	1	Sustainable Flexible Pavement Design for Low Volume Roads using Coir Geotextiles
Jyothi College of Engineering, Thrissur	Internship and M.Tech Thesis	B Anish Kini	1	Traffic Signal Optimization for enabling Emergency Vehicle Priority using Micro-simulation
National Institute of Technology, Tiruchirappalli	M.Tech	B Anish Kini	1	Impact of implementing two-wheeler boxes at signalized intersections under mixed traffic conditions
Jyothi College of Engineering	M.Tech	B Anish Kini P N Salini	1	Queue Dissipation Time and Travel Time Estimation model for Emergency Vehicles under Pre-emption control
Jyothi College of Engineering, Thrissur	M.Tech	B Anish Kini	1	Priority based Traffic Signal Optimisation and Simulation of Emergency Vehicle
MVJ College of Engineering, Bangalore	M.Tech	B Anish Kini	1	Analysis of Pedestrian-vehicle Interactions at Mid-block Crossings on Two-lane Two-way Road
National Institute of Technology Tiruchirappalli	B.Tech (Internship)	Sanjai.R.J,	1	A Quick Overview Analysis on the impact of Transport Sector in Kerala due to COVID-19 using Secondary Sources of Information
Jyothi Engineering College, Thrissur	M.Tech	Dr.Samason Mathew Sanjai.R.J	1	Operational Efficiency of Road transportation: An empirical analysis of Passenger Buses

8. *Presentation of Papers in Seminars/Workshops*

Sl. No.	Author(s)	Paper details	Date
i.	Salini P N, AnishKini, Gopika Mohan	*'Effect of Two-wheelers and Cars on Saturation Flow and Capacity at Signalised Intersections in Heterogeneous Traffic Conditions'*. 13th International Conference on Transportation Planning and Implementation Methodologies for Developing Countries (TPMDC) 2020, organised by IIT Bombay. Published in proceedings	10th-11th December 2020
ii.	V S Sanjay Kumar, Abin Joseph	*'A Quick Response Model for Predicting Pavement Condition Index'*. 13th International Conference on Transportation Planning and Implementation Methodologies for Developing Countries (TPMDC), organised by IIT Bombay.	10th-11th December 2020
iii.	Silpa Sekhar, B AnishKini, Salini P N, Vincy Verghese	*'Queue Dissipation Time and Travel Time Estimation Model for Emergency Vehicles under Pre-Emption Control'*. National Conference on Resilient Infrastructure (NCRI 2020), jointly oraganised by KHRI and IIT Palakkad. Published in proceedings	16th-18th Decembe 2020
iv.	B Anish Kini, B K Bhavathrathan, Tom V Mathew	*'Travel preferences and Work from Home preferences in the face of lockdown: Observations from an online survey in Kerala'*. National Conference on Resilient Infrastructure (NCRI) 2020, organised by IIT Palakkad and KHRI	17th -18th December 2020
v.	Salini P N, Saran M S, Sabitha N M, Sreeja S S	*'Planning for Resilient Transport Infrastructure for Disaster Prone Areas- Case study of Munnar Town'*. International Conference ICETEST (International Conference on Emerging Trends in Engineering Science and Technology), organised by GEC Thrissur.	17th -19th December 2020
vi.	Sherin N S, Salini P N, Dr. Ajitha T	*'Performance Analysis of Signalised Intersection post an Infrastructural Improvement'*. Presented in 7th Conference on Transportation Systems Engineering and Management (CTSEM 2020), organised by KSCSTE-NATPAC in collaboration with College of Engineering, Trivandrum. Published in proceedings, ISBN 978-81-942768-3-8	29th - 30th December 2020
vii.	Ebin Sam, Angel Maria Mathew, V S Sanjay Kumar	*'Macroscopic Assessment of Road Safety Scenario in Kerala During Covid-19 Lockdown'*. 7th Conference on Transportation Systems Engineering and Management (CTSEM 2020), organized by KSCSTE-National Transportation Planning and Research Centre (KSCSTE-NATPAC) in collaboration with College of Engineering Trivandrum (CET).	29th - 30th December 2020
viii.	V S Sanjay Kumar, ShabanaYoonus MVLR Anajneyulu	*'A Macroscopic Assessment of the Urban Transport Scenario in Thiruvananthapuram'*. 7th Conference on Transportation Systems Engineering and Management (CTSEM 2020), organized by KSCSTE-National Transportation Planning and Research Centre (KSCSTE-NATPAC) in collaboration with College of Engineering Trivandrum (CET).	29th - 30th December 2020

ix.	B Subin, Jubin Jacob Sam, Akshara S	*'Assessment of Risk Potential of State Highways using iRAP Methodology'.* 7th Conference on Transportation Systems Engineering and Management (CTSEM 2020), organized by KSCSTE-National Transportation Planning and Research Centre (KSCSTE-NATPAC) in collaboration with College of Engineering Trivandrum (CET).	29th - 30th December 2020
x.	Mohit Singh Parihar, V Sunitha, Jegan Bharath Kumar A	*'Investigation of Moisture Damage of Hot Mix Asphalt using Artificial Neural Network'.* Proceedings of 7th Conference on Transportation Systems Engineering and Management (CSTEM-2020), organized by KSCSTE-NATPAC & College of Engineering Trivandrum, pp 67.	29th -30th December 2020
xi.	Arun Chandran, Arul Jose, Vincy Varghese	*'Accessing Role of Public Transport in Post Covid Scenario – A Literature Review'.* 7th Conference on Transportation Systems Engineering and Management (CTSEM 2020), organized by KSCSTE-National Transportation Planning and Research Centre (KSCSTE-NATPAC) in collaboration with College of Engineering Trivandrum (CET).	29th -30th December 2020
xii.	A Nanditha, V S Sanjay Kumar, K Athiappan	*'Investigation on Various Land-Use Factors that Influence Trip Attraction'.* National Conference on Cost Effective Civil Engineering Practices for Rural and Urban Infrastructural Development in association with International Journal of Scientific Research in Civil Engineering, 7(1), 54-61	8th – 9th January 2021

Papers Published in Referred Journals

- **V S Sanjay Kumar, Saleel K, Teena John**, "*Planning and Development of Transport Network Connecting Potential Tourist Destinations*". Indian Highways, Vol.48, (5), May 2020.
- **Salini P N, Saran M S, Sabitha N M, Sreeja S S,** *"Planning for Resilient Transport Infrastructure for Disaster Prone Areas- Case study of Munnar Town".* Published in IOP Conference Series - Journal of Material Science and Engineering (*Scopus Indexed*), Vol.1114, 012019.
- **Salini P N, B G Sreedevi, Sam Ebin,** *"Resource Mapping of Highway Materials along with their Characteristic Properties and Desirability".* Mathew T., Joshi G., Velaga N., Arkatkar S. (eds) Transportation Research. Lecture Notes in Civil Engineering, Springer, Vol 45, page 709-723 (2020).
- **Ardra S Krishna, P N Salini, Jomy Thomas,** *"Estimating Modal Shift of Home-Based Work Trips due to the Development of Kochi Metro and Reduction in Fuel Consumption*

and Emissions". Mathew T., Joshi G., Velaga N., Arkatkar S. (eds) Transportation Research. Lecture Notes in Civil Engineering, Vol 45. Springer, page 229-242 (2020).

- **Sanjai.R.J, "***Study on Driving Behaviour of Public Transport Drivers in Kerala".* International Journal of Engineering and Technologies, Vol.19, page1-9.

9. *Invited Talks/Media Interactions*

Shaheem S

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Road safety treatment for SCDP corridor'*	Online webinar, Mount Zion College, Chengannur	13.08.2020

V S Sanjay Kumar

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Identification of crash blackspots and prioritization using GIS'* (Online session)	Part of STTP on "Safety Measures in Transportation Systems", organized by Muthoot Institute of Science and Technology, Ernakulam.	27.05.2020 - 28.05.2020

Salini P N

Invited Talks

Sl. No.	Topic/Particulars	Venue/Event	Date
1	Delivered a talk in one of the technical sessions	Part of STTP on "Safety Measures in Transportation Systems", organized by Muthoot Institute of Science and Technology, Ernakulam	27.05.2020 – 29.05.2020
2	*'Appropriate uses of Bitumen in Road Projects'*	Indian Oil Corporation Limited (IOCL) for B.Tech and M.Tech students of CET (Online Event)	March 2021
3	*'Basic Concepts in Pavement Construction '*	For PWD Engineers at KHRA	March 2021
4	*'Road Safety Auditing of Rural Roads'*	For LSGD Engineers, organized by KILA	May 2021

Ebin Sam

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Identification of crash blackspots and prioritization using GIS'* (Online session)	Part of STTP on "Safety Measures in Transportation Systems", organized by Muthoot Institute of Science and Technology, Ernakulam.	27.05.2020 - 28.05.2020

Jegan Bharath Kumar A

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1	*'Youth & Road Safety'*	KPM Model School, Pullichira, Mayyanad, Kollam	13.02.2021

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

SALINI P N

- Member of committee constituted by KSCSTE to prepare document specifying the guidelines to be followed for green auditing of colleges– Submitted a report for Module on Transportation
- Member of committee constituted by KSCSTE in association with Dept. of Science & Technology, New Delhi for the preparation of a baseline format on mapping of S & T needs- Kerala

B ANISH KINI

- Member of Committee constituted by Police Department for Technical Evaluation for the project - Implementation of integrated digital traffic enforcement system in Kerala

11. *Achievements/Awards*

SALINI P N

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

12. *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
13. Distraction is Extraction
14. Hands free is not Risk free

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. കാൽനടയാത്രക്കാർക്കുള്ള സുരക്ഷാമാർഗരേഖ
26. സ്കൂൾകുട്ടികൾക്കുള്ള റോഡ് സുരക്ഷാധിഷ്ഠിത ബോധവത്കരണം
27. പപ്പു ഉറങ്ങുകയല്ല
28. സുരക്ഷിതമായ സൈക്കിൾ സവാരി
29. സുരക്ഷിത പാർക്കിംഗ്
30. റോഡിലെ ഭാഷയുടെ അക്ഷരമാല
31. റോഡ്സുരക്ഷാമുദ്രാവാക്യങ്ങൾ
32. റോഡ്ഗതാഗത നിയന്ത്രണ ചട്ടങ്ങൾ
33. ലെയിൻ അധിഷ്ഠിതഡ്രൈവിംഗും റോഡ്സുരക്ഷയും
34. പ്രതിരോധാത്മക ഡ്രൈവിംഗ്
35. റോഡ്സുരക്ഷയും യുവജന നേതൃത്വ പരിപാടികളും
36. ഇരുചക്ര വാഹനമോടിക്കുന്നവർക്ക ഒരു കൈപുസ്തകം
37. ചരക്ക്വാഹനങ്ങൾക്കുള്ള റോഡ് സുരക്ഷാസഹായി
38. പ്രതിരോധാത്മക ബസ്ഡ്രൈവിംഗും റോഡ്സുരക്ഷയും
39. റോഡപകടങ്ങൾ തടയുന്ന തിനുള്ളമാർഗങ്ങൾ
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, നേരെഓടിക്കൂ, നേരായവിധം ജീവിക്കൂ
29. ശ്രദ്ധയുള്ളിടത്ത് സുരക്ഷ ഉ
30. പാഞ്ഞു പോകരുത്, പ്രാണൻ എടുക്കരുത്
31. സുഗമമായ പാത നിങ്ങളുടെ മാത്രംസ്വന്തമല്ല

Calenders

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

Leaflets

1. Who is Walking on the Wrong Side
2. Police Hand signals
3. Safe and Correct Ways of Parking
4. Protect your Child from Injury
5. Spot the Hidden Dangers
6. Two Wheeler Driving
7. Follow this Simple Kerb Drill
8. School Safety – A Checklist for Parents
9. Understanding Traffic Rules and Regulations (English & Malayalam)
10. Don't Be Rash and End in Crash (English & Malayalam)
11. Helmets (English & Malayalam)
12. Golden Rules for Defensive Driving (English & Malayalam)
13. Untied Duppatta/Saree – Risks and Remedies (English & Malayalam)
14. Safe Travel by Bus
15. Safe Bus Driving
16. Safe Car Driving
17. Safety Precautions for Two-Wheeler Drivers
18. Safe and Responsible Parking
19. Traffic Control Devices
20. Don't find out the hard way…
21. Trains of thought- Use Extreme caution when crossing
22. Trains of thought- Safety Slogans - Just Think

23. Trains of thought- Safety Slogans - Just Think over these
24. Railway level Crossings- Safety Tips for Vehicle Drivers
25. Safe Crossing of Railway Tracks-Tips for Pedestrians and Cyclists
26. Railway Level Crossing- Safety Tips for School Buses
27. Railway Level Crossing- Safety Tips for Truck drivers
28. സുരക്ഷിത ഇരുചക്രവാഹന സവാരി
29. രാത്രികാലറോഡപകടങ്ങൾ എങ്ങനെ ഒഴിവാക്കാം
30. സുരക്ഷിതയാത്രയ്ക്കുള്ള മാർഗ നിർദ്ദേശങ്ങൾ
31. പ്രതിരോധാത്മകഡ്രൈവിംഗ്
32. റോഡ്സുരക്ഷയും 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 ിയെകുറിച്ചുള്ള ചില ചിന്തകൾ
20. റെയിൽവെലെവൽ 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

26. പത്തിനും പതിനഞ്ചിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേ ി രക്ഷിതാക്കൾക്ക്എന്തുചെയ്യാം -1
1. പത്തിനും പതിനഞ്ചിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേ ി രക്ഷിതാക്കൾക്ക്എന്തുചെയ്യാം-2
2. അഞ്ചിനും പത്തിനുംഇടയ്ക്ക് വയസ്സുള്ളകുട്ടികൾക്ക്വേ ിരക്ഷിതാക്കൾക്ക്എന്തുചെയ്യാം -1
3. അഞ്ചിനും പത്തിനുംഇടയ്ക്ക് വയസ്സുള്ളകുട്ടികൾക്ക്വേ ി രക്ഷിതാക്കൾക്ക്എന്തുചെയ്യാം-2
4. അഞ്ചിനും പത്തിനുംഇടയ്ക്ക് വയസ്സുള്ളകുട്ടികൾക്ക്വേ ിരക്ഷിതാക്കൾക്ക്എന്തു ചെയ്യാം-3
5. റോഡ്മുറിച്ചു കടക്കുമ്പോൾ1
6. റോഡ്മുറിച്ചു കടക്കുമ്പോൾ2
7. റോഡ്മുറിച്ചു കടക്കുമ്പോൾ3
8. ചിലറോഡ് സുരക്ഷാ പ്രവർത്തനങ്ങൾ1
9. ചിലറോഡ്സുരക്ഷാ പ്രവർത്തനങ്ങൾ2
10. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേ കാര്യങ്ങൾ 1
11. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേ കാര്യങ്ങൾ 2
12. റോഡ്സുരക്ഷയെകുറിച്ച് അറിഞ്ഞിരിക്കേ മറ്റ്കാര്യങ്ങൾ 1
13. റോഡ്സുരക്ഷയെകുറിച്ച് അറിഞ്ഞിരിക്കേ മറ്റ്കാര്യങ്ങൾ 2
14. നിങ്ങളും റോഡ്സുരക്ഷിതത്വവും 1
15. നിങ്ങളും റോഡ്സുരക്ഷിതത്വവും 2
16. ക്രോസിംഗ് ഡ്രിൽ 1
17. ക്രോസിംഗ് ഡ്രിൽ 2
18. യാത്ര ചെയ്യുമ്പോൾ ശദ്ധിക്കേ കാര്യങ്ങൾ
19. സിഗ്നൽലൈറ്റുകൾ
20. സൈക്കിൾസവാരി ചെയ്യുമ്പോൾ
21. റോഡിൽ നടക്കുമ്പോൾ
22. Protect your life with seat belt and helmet
23. സുരക്ഷിതമായി ബസ്സിൽ യാത്ര ചെയ്യുന്നതിന് ചില നിർദ്ദേശങ്ങൾ
24. 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

KSCSTE - National Transportation Planning and Research Centre (KSCSTE - 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, Planning and Economic Affairs Department, Govt. of Kerala	-	Member
15.	The Vice Chancellor, Cochin University of Science and Technology	-	Member
16.	The Vice Chancellor, Kerala Agricultural University	-	Member
17.	The Director, Vikram Sarabai Space Centre, Thiruvananthapuram	-	Member
18.	The Director, NIIST, Thiruvananthapuram	-	Member
19.	The Director, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram	-	Member
20.	The Member Secretary , KSCSTE (nominated by Government)	-	Member
21.	Director, JNTBGRI, Palode, Thiruvananthapuram	-	Member
22.	Executive Director, NATPAC, Thiruvananthapuram	-	Member

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

ii. Executive Committee of KSCSTE

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

iii. Research Council of NATPAC

1.	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 (Scientific & Technical)	-	Shri.Subin B, Senior Scientist
	-	Shri.D.Shaju, Section Officer
Public Information Officer (Administration)		
Asst. Public Information Officer	-	Smt Arya S K, 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. *Complaint Committee to prevent sexual harassment of working women at work place of KSCSTE-NATPAC*

Smt.P N Salini, Sr.Scientist	-	Presiding Officer
Shri.Wilson K C, Sr.Scientist	-	Member
Smt. Bindu S R, Asst.Registrar (Accounts)	-	Member
Smt. Arya S K, Assistant - II	-	Member
Adv. Rajeswari R K	-	External Member

d. *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.AnishKini, Jr.Scientist Smt.Veena K S, Jr.Scientist (Convenor)

General Administration

Research Council Meeting

The Research Council met on 27th and 28th November 2020 (23rd RC) and 29th March 2021 (24th RC) at KSCSTE-NATPAC under the chairmanship of Dr. A U Ravi Sankar.

Management Committee Meeting

The Management Committee was held on 25thAugust 2020 (34th MC) and 22nd January 2021 (35th MC) at KSCSTE-NATPAC under the chairmanship of Director, NATPAC.

Other NEWS

- IIT Palakkad recognised KSCSTE-NATPAC as Research Centre to enable employees for external Ph.D registration so as to promote professional upgradation of Scientists/Technical staff.

- 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. The first 15 day certification course on Road Safety Audit and other road safety related aspects was conducted from 09 – 24 December 2020.

- KSCSTE-NATPAC observed the Constitution Day at 11 am on 25th November 2020.

NATPAC STAFF –AS ON 01.04.2021

Sl.No.	Name		Designation
Prof.(Dr.) Samson Mathew		-	Director
Scientific Staff			
1.	Shaheem S	-	Principal Scientist
2.	V. S.Sanjay Kumar	-	Senior Scientist
3.	B.Subin	-	Scientist
4.	P. N. Salini	-	Scientist
5.	M. S. Saran	-	Scientist
6.	N.M.Sabitha	-	Scientist
7.	K. C.Wilson	-	Scientist
8.	Arun Chandran	-	Scientist
9.	Veena K.S.	-	Jr. Scientist
10.	S. Ebin Sam	-	Jr. Scientist
11.	A. Jegan Bharath Kumar	-	Jr. Scientist
12.	R. Chandra Prathap	-	Jr. Scientist
13.	Dr.U. Salini	-	Jr. Scientist
14.	B. AnishKini	-	Jr. Scientist
Technical Staff			
15.	V. G. Sasi	-	Technical Officer Grade -4
16.	M.S. Radhakrishnan	-	Technical Officer Grade -4
17.	E. P. Surendran Pillai	-	Technical Officer Grade -3
18.	R. J. Sanjai	-	Technical Officer Grade -2
19.	Deepa Radhakrishnan	-	Technical Officer Grade -1
20.	R. RadhakrishnanThampi	-	Technical Assistant Grade-3
21.	Shyama C.	-	Jr.Library Assistant Grade-2
Administrative Staff			
22.	K.GeorgeKoshy	-	Registrar Grade - 2
23.	Suresh Kumar S	-	Deputy Registrar
24.	Reshmy R S	-	Assistant Registrar Gr-1
25.	Bindu S R	-	Assistant Registrar Gr-1

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 – 2
30.	Maya Devi M.	-	Assistant Grade – 2
31.	Veena S	-	Assistant Grade – 2
32.	Muhammed Naserudeen C	-	Assistant Grade – 2
33.	Sangeetha T.S.	-	Assistant Grade – 2
34.	Lajila K.B.	-	Stenographer Grade – 2
35.	A.Praveen Kumar	-	Clerical Assistant Grade -2
36.	G.Ragesh	-	Driver Grade - 3
37.	A.Somaraj	-	Driver Grade - 3
38.	Surendran Kulangara	-	Driver Grade – 3
39.	Shijil P. R.	-	Driver Grade – 2
40.	S. Jayakumar	-	Office Attendant Grade-5
41.	A.Anil Kumar	-	Office Attendant Grade -3
42.	Athira S.Kumar	-	Office Attendant Grade -2
43.	Bharat Menon	-	Office Attendant Grade - 1

JOINING

Bharat Menon
Office Attendant - 1
Joined on 2nd November 2020

RETIREMENTS

Shri.K M Syed Mohammed
Principal Technical Officer
Superannuated on
30th April 2020

Shri.T Ramakrishnan
Technical Officer - V
Superannuated on
31st May 2020

Dr.B G Sreedevi
Chief Scientist
Superannuated on
31st May 2020

Shri.G Suresh Kumaran Nair
Office Attendant – IV
Superannuated on
31st May 2020

Shri. Sukhdev Kolay
Junior Assistant
Superannuated on
31st March 2021

RESEARCH STUDIES UNDERTAKEN DURING 2020-'21

Sl.No.	Code	Project
1	Plan-363	Pavement Rehabilitation Design based on Dynamic Cone Penetrometer Test (DCPT)
2	Plan-364	Experimental investigation on Porous Asphalt Mix
3	Plan-365	Influence of randomly distributed shredded waste plastic on shear strength and hydraulic conductivity of cohesive soil
4	Plan-366	Evaluation of Warm Mix Asphalt Mixes with the addition of RAP
5	Plan-367	Resource Mapping of road construction materials in Kerala -Phase II
6	Plan-368	Study on strength characteristics of Flexible Pavement in Water-logged areas
7	Plan-369	Maintenance and Sustainable Management of a Waterway - A Case Study of Parvathy Puthanar
8	Plan-370	Database Creation and Management for Inland Waterways in Kerala Using GIS – Phase III
9	Plan-371	Study on Accidents and Safety Aspects Related to Inland Waterways
10	Plan-372	Road Asset Management for National Highways and State Highways in Kerala
11	Plan-373	Web-GIS based Road Crash Information System
12	Plan-374	Utilization of Geoinformatics Tools for development of comprehensive road network for Kerala State
13	Plan-375	Resilient Transportation Planning for Disaster prone areas – A case study of Munnar Town
14	Plan-376	Field Evaluation of Indo-HCM for Signalised Intersections in Kerala
15	Plan-377	Preparation of Evacuation Plan for regions vulnerable to isolation during Natural Calamities
16	Plan-378	ITS Applications in Enhancing the Transport Infrastructure
17	Plan-379	Development of GIS-based Road and Traffic Database for Kerala
18	Plan-380	Periodic Updation of Price Indices for Different Public Transport and Freight Operations
19	Plan-381	Investigation of Major Accident Spots, Causative Analysis and Mitigative Measures
20	Plan-382	Assessment of Risk Potential of SH in Kerala State: A Case Study of Selected SH in different parts of Kerala
21	Plan-383	Overtaking Behaviour of Drivers – A Case Study on Selected Roads in Kerala
22	Plan-384	Crash Prediction Modelling of Undivided Two-Lane Two-Way Road Networks in Kerala
23	Plan-385	The influence of aggregate, filler and bitumen on SMA mixture properties
24	Plan-386	Evaluation of Moisture Susceptibility of Asphalt Mix Using Admixtures
25	Plan-387	Development of Integrated Land Use Transport Model for Thiruvananthapuram
26	Plan-388	Enhancement of Public Transport Services in Thiruvananthapuram City
27	Plan-389-1	Assessment of Changes in Trip Characteristics of commuters due to COVID-19 in Kerala
28	Plan-389-2	Economic performance of road transportation sector in Kerala due to Covid-19 - Macro level reform measures
29	Plan-389-3	Road Safety scenario in Kerala during Covid 19 lockdown

31	Plan-389-4	Evaluation of Air quality and traffic charectroistics during Covid 19 lockdown period
32	Plan-389-5	Traffic study at Enchakkal Jn. on NH 66 in Thiruvananthapuram
33	Plan-389-6	Lulu mall - Traffic impact study
34	Plan-389-7	Road Inspection - Elamkulam
35	Plan-389-8	Development of Cherthala - Kottayam Tourist Highway
36	Plan-389-9	Scientific placement of pedestrian crossings in Trivandrum city

CONSULTANCY/SPONSORED PROJECTS IN 2020-'21

Sl.No.	Code	Project	Sponsored by
1	C 01115	Feasibility of Ernakulam – Thodupuzha suburban highway	PWD Road, Painavu
2	C 01117	Preparation of Detailed Project Report for Development of Inland Waterway between Mahe River and Valapattanam River	Kerala Waterways & Infrastructure Ltd. (KWIL)
3	C 00918	Integrated development of Coastal highway with cycle track	Kerala Infrastructure Investment Fund Board (KIIFB)
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 02419	Feasibility study of installing traffic signals at Pathirappally junction in Alappuzha district	Alappuzha District Road Safety Council
7	C 00419	Improvement proposal for 75 accident black spots in Kerala State	Kerala Road Safety Authority (KRSA)
8	C 00220	Monitoring & Evaluation of Adoor – Kazhakkoottam Safe Corridor Demonstration Project of Kerala State Transport Project II	Kerala State Transport Project (KSTP)
9	C 00320	Calculation of Lead Measurement Between Selected Quarry and Stockyards	HOWE Engineering
10	C 00820	Road Safety Audit for 410.65 km KIIFB funded roads in Kerala	Kerala Infrastructure Investment Fund Board (KIIFB)
11	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*	
12	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 March 2021

Liabilities	Sch No	As at 31 March 2021	As at 31 March 2020	Assets	Sch No	As at 31 March 2021	As at 31 March 2020
		₹	₹			₹	₹
Reserves & Surplus	4	8,35,67,258	8,98,41,124	Property, Plant & Equipment	1	8,35,67,258	8,98,41,125
Building Fund Account	5	2,66,79,019	2,66,79,019	Work in Progress	1	4,43,322	4,43,322
Current Liablities	6	88,95,847	92,39,692	Current Assets	2	8,25,84,494	9,11,40,265
Unspent balance	7	3,15,29,803	3,65,15,786	Loans & Advances	3	2,39,37,614	2,12,05,748
Corpus fund	8	3,98,60,760	4,03,54,839				
Total		**19,05,32,688**	**20,26,30,460**	**Total**		**19,05,32,688**	**20,26,30,460**

The accompanying notes form an integral part of the financial statements

For National Transportation Planning and Research Centre

Asst. Registrar (Finance) Registrar (I/C) Director

Place : Thiruvananthapuram
Dated :01-12-2021

In terms of our report attached.

For Mohan & Mohan Associates
Chartered Accountants
FRN:002092S

MOHAN & MOHAN ASSOCIATES * CHARTERED ACCOUNTANTS * Reg. No: 002092S TRIVANDRUM

R Suresh Mohan
Partner
M.No.013398

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 March 2021

Expenditure	Sch No	Year ended 31 March 2021	Year ended 31 March 2020	Income	Sch No	Year ended 31 March 2021	Year ended 31 March 2020
		₹	₹			₹	₹
To Infrastructure Strengthening (Plan)	12	2,44,56,101	1,94,22,196	By Grant from Government of Kerala	9	6,71,52,579	6,46,71,626
To Infrastructure Strengthening (Non Plan)	13	26,50,344	48,31,277	By Other Receipts	10	53,51,422	41,17,056
To Salaries and Allowances (Non Plan)	14	4,53,97,556	4,45,35,209	By Depreciation written back	1	64,82,600	75,86,896
To Depreciation	1	64,82,600	75,86,896	By Income from Consultancy Project	11	69,65,848	73,43,764
To Consultancy Project Expenses	15	69,65,848	73,43,764				
Total		8,59,52,449	8,37,19,342	Total		8,59,52,449	8,37,19,342

The accompanying notes form an integral part of the financial statements

For National Transportation Planning and Research Centre

Asst. Registrar (Finance) Registrar Director

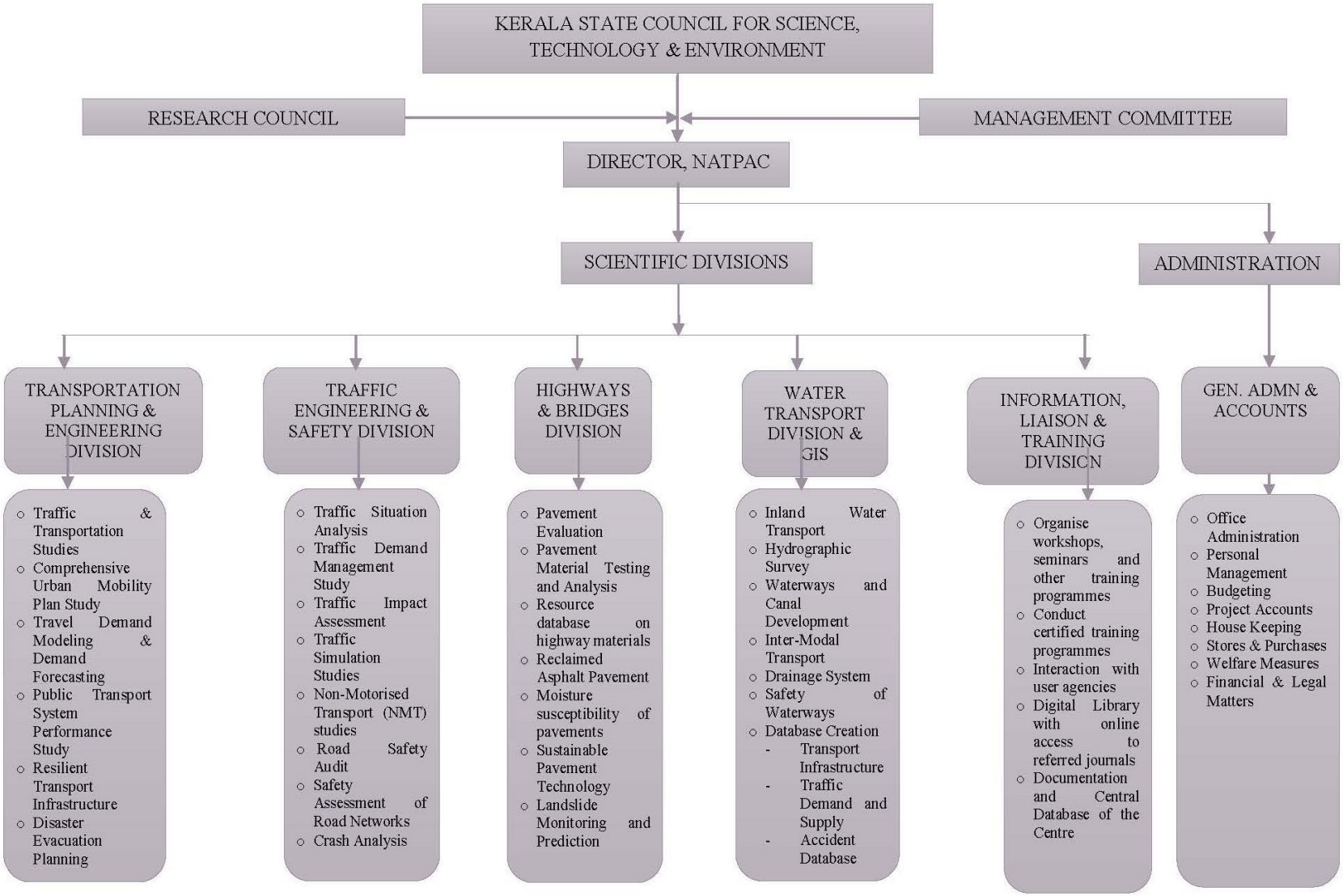
Place : Thiruvananthapuram
Dated : 01-12-2021

In terms of our report attached.
For Mohan & Mohan Associates
Chartered Accountants
FRN:002092S

MOHAN & MOHAN ASSOCIATES * CHARTERED ACCOUNTANTS * Reg. No: 002092S TRIVANDRUM

R Suresh Mohan
Partner
M.No.013398

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


KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY & ENVIRONMENT
RESEARCH COUNCIL
MANAGEMENT COMMITTEE
DIRECTOR, NATPAC
SCIENTIFIC DIVISIONS
ADMINISTRATION
TRANSPORTATION PLANNING & ENGINEERING DIVISION
TRAFFIC ENGINEERING & SAFETY DIVISION
HIGHWAYS & BRIDGES DIVISION
WATER TRANSPORT DIVISION & GIS
INFORMATION, LIAISON & TRAINING DIVISION
GEN. ADMN & ACCOUNTS
Traffic & Transportation Studies
Comprehensive Urban Mobility Plan Study
Travel Demand Modeling & Demand Forecasting
Public Transport System Performance Study
Resilient Transport Infrastructure
Disaster Evacuation Planning
Traffic Situation Analysis
Traffic Demand Management Study
Traffic Impact Assessment
Traffic Simulation Studies
Non-Motorised Transport (NMT) studies
Road Safety Audit
Safety Assessment of Road Networks
Crash Analysis
Pavement Evaluation
Pavement Material Testing and Analysis
Resource database on highway materials
Reclaimed Asphalt Pavement
Moisture susceptibility of pavements
Sustainable Pavement Technology
Landslide Monitoring and Prediction
Inland Water Transport
Hydrographic Survey
Waterways and Canal Development
Inter-Modal Transport
Drainage System
Safety of Waterways
Database Creation
- Transport Infrastructure
- Traffic Demand and Supply
- Accident Database
Organise workshops, seminars and other training programmes
Conduct certified training programmes
Interaction with user agencies
Digital Library with online access to referred journals
Documentation and Central Database of the Centre
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)
K. KARUNAKARAN TRANSPARK, Aakkulam,
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Phone: 0471-2779200

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

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West Hill P.O, Kozhikode.
Pincode: 673005, Phone: 0495 - 2385505

KSCSTE - NATPAC

ANNUAL REPORT 2020- '21

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

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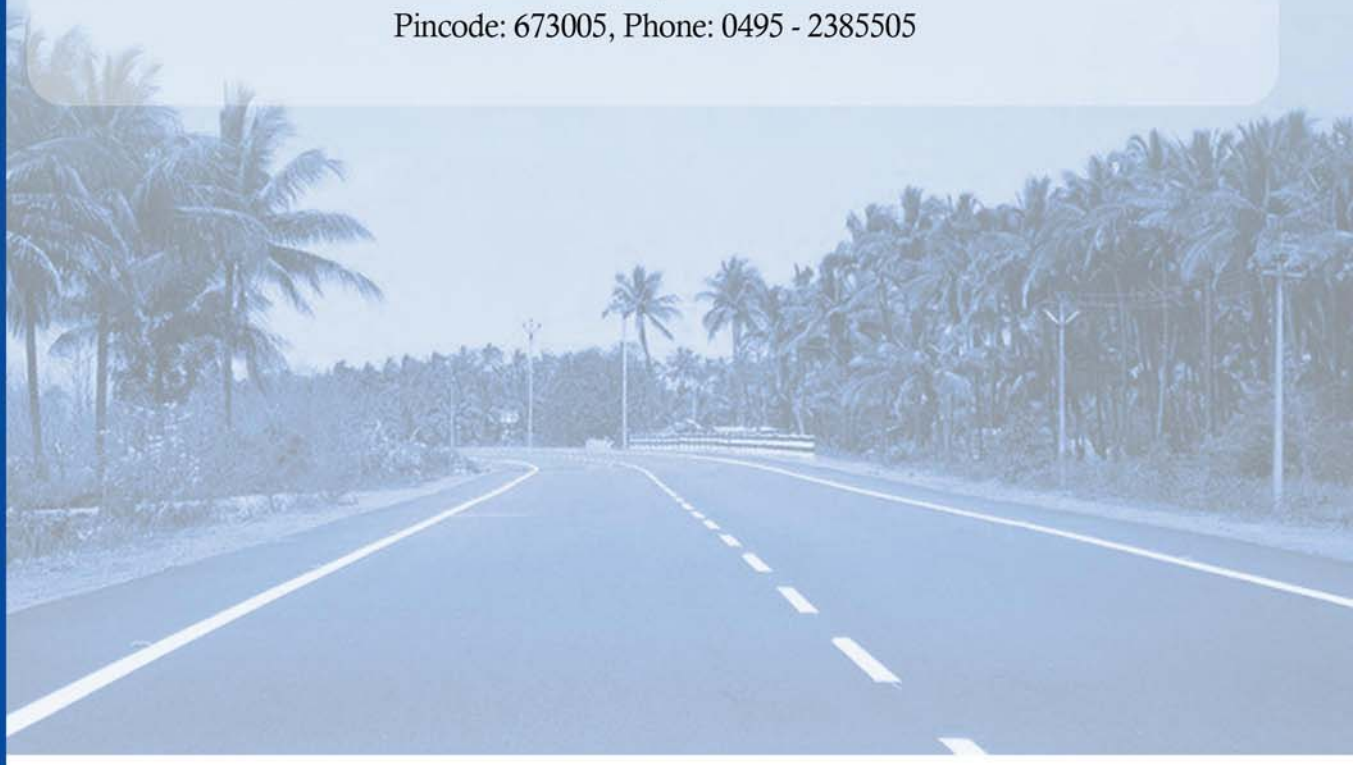

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