KSCSTE-NATPAC

ANNUAL REPORT 2017-'18

KSCSTE-NATPAC

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

KSCSTE - National Transportation Planning and Research Centre

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

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

I have great pleasure in presenting this Annual Report of NATPAC for the period 2017-18. This reporting period proved to be another remarkable year for NATPAC in its efforts to serve the country as a leading R&D Centre in the field of Traffic and Transportation. The major achievements of NATPAC are briefly outlined in this report.

NATPAC studied the impact of on street parking fee on travel behaviour of the people. The Centre brought out recommendations on various aspects of public bus transport including the infrastructural requirements, integration with other modes, essential safety appurtenances, ITS based facilities and other allied facilities, thereby arriving at typical layout designs for different scenarios of requirement and a model worksheet for bus terminal layout designs.

An easy-to-apply process which can be used by transportation professionals while estimating vehicular trip generation in built-up urban areas was evolved by NATPAC. At the instance of Town and Country Planning Department, GoK, the Centre carried out Traffic and Transportation studies for Kondotty Town and Tirurangadi Municipality in Kerala.

NATPAC is in the process of developing a traffic growth rate model for the National Highways in Kerala. An entry/exit plan for the proposed bus terminal at Kazhakkuttam considering the development plans of National Highway was formulated by NATPAC. At the instance of Kerala State Planning Board, NATPAC evaluated the feasibility of developing a pedestrian crossing facility under Public-Private Partnership (PPP) mode in Thiruvananthapuram. A feasibility study of the Thodupuzha – Ernakulam Suburban Highway was undertaken by the Centre.

The Centre is in the process of creating a Road Asset Management System (RAM) for selected network of roads. NATPAC investigated the various factors affecting tourist inflow to a tourist location and evaluated the effect of connectivity issues on the willingness of tourists to visit tourist destinations, both quantitatively and qualitatively.

NATPAC carried out the feasibility study for developing the coastal highway from Thiruvananthapuram to Kasaragod with minimum impact on the existing eco system. At the instance of Public Works Department, GoK, NATPAC conducted investigation works as part of preparing detailed project report of coastal highway in Thiruvananthapuram and Alappuzha districts.

Short term measures proposed by the Centre to improve the existing traffic congestions in Kozhikode City helps in relieving the traffic congestion. At the instance of Public works Department (PWD), Kerala, NATPAC prepared junction improvement design, pavement design and signal design of Kunnamkulam junction. A project report on ring road development for Kunnamkulam town was also prepared by the Centre.

A study for determining the suitability of Recycling of Asphalt Pavements in Kerala conditions was undertaken by the Centre. The feasibility of utilizing waste sand during Kaolin processing in soil stabilization was undertaken by NATPAC.

The main priority of our Traffic Safety Division is to reduce motor vehicle and pedestrian accidents through Road Safety Education Programmes. The proficiency of the newly installed

traffic signals at 12 junctions in Kozhikode City was assessed by the Centre. A detailed study was conducted by NATPAC to find the shortest path for the ambulances with accident victim to reach a hospital by taking the shortest path thus saving precious time. A road accident management system using Geospatial tools for Kerala was developed by the Centre. Road and traffic database for the roads in Kerala was also prepared by the Centre. Under the research scheme, NATPAC assessed risk potential of SH – 69, Thrissur to Kuttippuram stretch of State Highway in Kerala State and proposed road safety investment plans.

The Centre is continuously monitoring the crash scenario in Kerala by regularly undertaking on-the-spot investigation of accidents in the State and there by suggesting crash counter measures.

Water Transport is an inexpensive non-polluting and energy-efficient means of Transport. This will also give a boost to eco-tourism and commerce. NATPAC prepared DPR for development of inland waterway between Mahe river and Valapattanam river. The Centre is in the process of assessing the accident and safety aspects related to Inland Waterways in Kerala. Creation of a GIS database for inland waterways in Kerala is being done by NATPAC. The financial and technical feasibility of Sea cruise project between Kovalam and Kanyakumari was undertaken by the Centre.

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

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

The constant support and encouragement received from the Hon'ble Chief Minister of Kerala, Hon'ble Minister for Transport and Hon'ble Minister for Works are thankfully acknowledged. The continuous support obtained from the Executive Vice President of KSCSTE, Research Council and Management Committee of NATPAC has helped us to discharge our duties for the benefit of the Society. We look forward to an even better performance in the coming years. The support provided by the Scientists and Staff of the institute to the research activities need special mention. As we reflect on the past year, we also look to the future and the many opportunities that will come our way.

DIRECTOR

SUMMARY OF PROJECTS

1. Impact of On - Street Parking Fee on Travel Behavior - A Case Study of Selected Roads in Thiruvananthapuram

On street parking has turn out to a major problem in urban roads. There is an urgent need to regulate and mitigate the adverse impacts by means of parking planning and evolving appropriate parking management strategies. National Highway 66 is the main arterial road in Thiruvananthapuram City and provides access to a number of traffic generation/attraction points such as Public Offices, Banks, Commercial areas, transit stations etc. They attract huge number of private vehicles for employment and commercial purposes during most hours of the day. As a result intense on - street parking is observed along both side of NH 66 in Central Business District area. To regulate the on-street parking on NH 66, City Traffic Police, Thiruvananthapuram had introduced fee for on-street parking in the stretch from Kesavadasapuram to East fort. It is observed that there was a visible change in the parking characteristics on Kesavadasapuram - East fort section. In this context NATPAC took up a study to analyse the impact of introduction of on-street parking fee on the travel characteristics in the above stretch.

Scope and Objectives

The objective of the study was to study the impact of on street parking fee on travel behavior of the people, parking characteristics and traffic congestion. The scope of the study is limited to Kesavadasapuram - East fort stretch of NH 66 in Thiruvananthapuram city where the fee for on street parking is newly introduced.

Methodology

The methodology adopted for the study consisted of collection of necessary data through primary and secondary sources, and analysis of data to extract the necessary inputs for the study. The following tasks were carried out to achieve the above objectives of the study.

1. Assessment of parking parameters along the selected stretch to study the change in parking characteristics;
2. Interview of the road users at establishment along the corridor to study the change in Travel Characteristics;
3. Speed and Delay survey to assess the congestion level.

Study Stretch

MG road is the lifeline of Thiruvananthapuram city, passing through its central area. Major traffic generators like Chalai Market, Sree Padmanabha Swamy Temple, Government Secretariat, Office of Accountant General, City Bus Station, Ayurveda College, major Educational Institutions and a number of banks, commercial centres, shopping complexes, cine theatres, auditoriums etc. are located along or close to MG road. This, in turn, generates high parking demand along this road. In the absence of adequate off-street parking facilities, vehicles are parked haphazardly along the curb causing traffic congestion and hazards.

Total length of the study road is 3.4 kms running from Attakulangara to LMS with four lane divided carriageway. It has paved shoulder and footpath on both sides and paved shoulder is used for on street parking. Parking is earmarked for different categories of vehicles between Mele Pazhavangadi and Palayam and regulated by the deployment of parking wardens to collect parking fee from the vehicles.

Parking Characteristics of MG Road

The peak on street parking accumulation of the study area is estimated as 618 vehicles (486.3 equivalent car space (ECS)) including 314 two wheelers and 149 cars. The detailed data regarding peak parking accumulation of various stretches in MG Road is given in **Table 1**. In terms of vehicle composition, two wheelers contribute majority of on street parking.

Table 1: Peak parking accumulation of various stretches in MG Road

Homogeneous section	Length (m)	Peak parking time	Peak parking accumulation (ECS)	Total number of vehicles at peak parking time
LMS to War memorial	400	11.00	19.4	34
War memorial to VJT right	450	18.30	19.8	53
VJT to secretariat North gate	500	11.00	56.7	69
Secretariat North gate to Pulimoodu	500	18.45	84.0	44
Pulimoodu to QRS	200	16.15	93.5	85
QRS to Ayurveda college	250	17.15	22.65	61
Ayurveda college to Overbridge	300	11.45	20.95	52
Overbridge to Pazhavangadi	150	15.15	57.4	107
Pazhavangadi to SPT	250	16.45	74.1	51
SPT to Attakkulangara	400	17.00	37.8	62

As per the service level benchmark suggested by Ministry of Urban Development Government of India, on street parking fee need to be implemented and there should be differential system of parking fees. Land is precious and parking fee collected should reflect actual land value. Introduction of parking fee has resulted in shorter parking duration and increased parking turnover. Introduction of on street parking fee helped in bringing orderly parking maneuvers.

2. Integrated Designs for Public Bus Stands/Terminals in Urban Areas

NATPAC brought out some recommendations on various aspects of public bus transport including the infrastructural requirements, integration with other modes, essential safety appurtenances, ITS based facilities and other allied facilities, thus finally arriving at typical layout designs for different scenarios of requirement and a model worksheet for bus terminal layout designs. The methodology adopted for the study consisted of literature studies, reconnaissance surveys in major bus bays, bus stands and bus terminals, inventory surveys, secondary data collection from stake holders like the civil engineering and operational wings of KSRTC and other concerned officials, primary surveys and investigations in selected sample of Bus bays, Bus stands and Bus terminals, demand supply gap analysis of infrastructural requirements and assessment based on case studies and formulation of criteria and recommendations. Different strands considered under the purview of the study were:

Infrastructure Requirements

- Institutional Framework
- Location, Size and Spacing of facilities like Bus bays, Bus stands, Bus terminals
- Estimation of space requirements – this includes the criteria and general guidelines on Space allocation of Bus bays, Bus stands and Bus terminals
- Design of Facilities in Bus bays, Bus stands, Bus terminals
- Passenger handling facilities
- Bus servicing and maintenance facilities
- Parking facilities for Non-Motorized Transport (NMT) and Intermediate Public Transport (IPT)
- Pedestrian segregated facilities
- Safety Appurtenances and Security measures

- ITS based facilities like GPS Tracking and real time centralised monitoring, GPS based route guidance system, Travel information system for passengers, Fare collection systems – Electronic fare payment system, Incident Management System, Emergency response system
- Quality Assurance and Service Improvements

Integration with other modes including the features of interchange facilities and feeder service

- Preparation of typical layout designs
- Preparation of model worksheet for bus terminal layout design

Figure 1 gives an easy to apply expression for determining the number of bus bays corresponding to the peak hour bus trips in public bus stands.

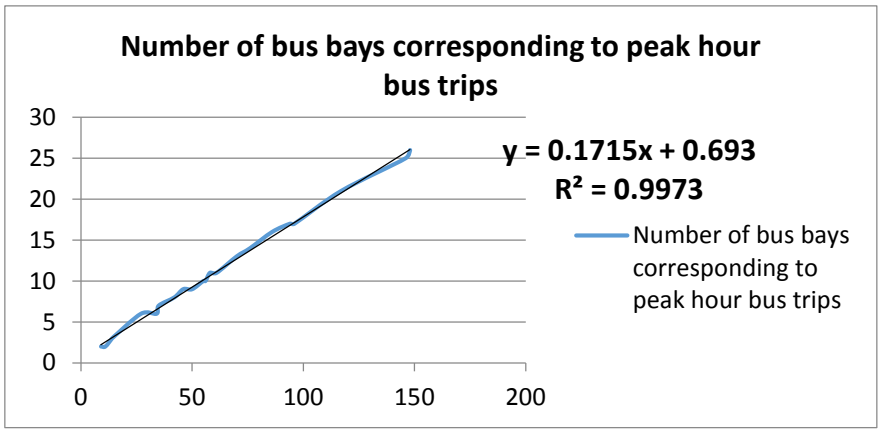


Figure 1: Bus bays corresponding to number of peak hour bus trips

Performance rating of bus stands facilities (User perception)

From the questionnaire survey conducted among the bus passengers in study locations in southern Kerala, performance rating was collected from the passengers for the amenities provided in the bus stand with a subjective rating score for the facility not available. The performance index was calculated for each of the bus stand under survey by using the five point scores given for various facility characteristics – Very Good-5, Good-3, Fair-2, Poor-1, Very Poor-0. Performance rating obtained is shown in **Table 2.**

Table 2: Performance index of bus stands in Southern Kerala

Sl No.	Name of bus stand	Performance index
1	Attingal	1.24
2	Nedumangadu	1.56
3	Palode	0.56
4	Vellanadu	1.28
5	Vithura	1.33

Typical lay out designs for bus stands/terminal

Typical layout designs for a well-equipped public bus stand/terminal were prepared for reference by user agencies which incorporate all the recommended components like adequate bus bays, turning radius requirements, entry/ exit widths required, passenger handling facilities, safe maneuvering measures to be taken care of, integration of bus stand with other modes, ITS applications for facility enhancement, safety appurtenances, pedestrian facilities etc.

3. Estimation of Trip Generation Rates for Different Land Uses

An important aspect of planning for new developments is to predict the amount of generated traffic. Trip generation provides the linkage between land use and travel. Determination of specific trip generation rates will help in site impact studies and regional planning studies. NATPAC carried out a study to evolve out an easy-to-apply process for use by transportation professionals when estimating vehicular trip generation in built-up urban areas, incorporating the effects of site-specific, local, and area-wide land use and transportation characteristics on estimates of vehicular trip generation.

Study Area

Different activity centres coming under the broad categories of varied land uses in Thiruvananthapuram Urban Area was considered in phase 1 of the study and Ernakulam Urban Area was taken up in phase 2.

Scope of Work

The phase 1 study involved the estimation of Trip Generation Rates of different activity centres under the broad categories of varied land uses like work centres, official complexes, shopping centers, institutional campuses, Industrial Land use and other land use developments in Thiruvananthapuram City. The study also provided a comprehensive urban trip attraction database of different activity centres.

Methodology

The methodology adopted for the study consisted of reconnaissance survey, general overview of the land use pattern, selection of proxy survey sites in the study area based on the specific land use, secondary data collection, primary surveys and data collection and data analysis.

Results and Findings

The data set were analysed to arrive at some findings pertaining to the following aspects of the study:

- A comprehensive trip generation database on different activity centres in urban area;
- Quantitative information on travel characteristics of urban land uses that could be used in traffic impact studies;
- Trip Generation Rates of different land uses like work centres, official complexes, shopping centers, institutional campuses and other land use developments;
- Peak hour person trip generation Rates and vehicle trip generation rates of different activity centres coming under various categories of land uses;
- Mode wise Peak hour vehicle Trip Generation Rates of different activity centres;
- Mode composition of Person trips (in percentage) at different activity centres;
- Categorised Peak Hour Vehicle Trip Generation Rate at different activity centres;
- Average Vehicle occupancy of different modes entering/exiting the activity centres.

Similarly, the results of trip rates are also being estimated for Ernakulam urban area. The parameters influencing the trip generation rates of different activity centres such as built up area of the activity centre, seating capacity etc were also being identified which will be further used for the modelling of trip generation rates for different activity centres.

The mode composition of person trips at various activity centres conforming to different land use were analysed to arrive at general trends prevalent in trip making for different purposes. The prevalent trend in mode share of person trips to different activity centres vary depending upon the type and utility of the activity centre/land use.

The study dealt with the estimation of trip generation rates for different activity centres conforming to varied land uses, the number of vehicles and people entering/exiting an activity

center per unit time. The trip generation rates were estimated based on the influencing parameters of the activity centre, like gross floor area, seating capacity of the activity centre etc.

The trip generation rates of various land uses or activity centres (trip rates/unit) estimated could be used for transportation impact analysis (evaluating the transportation impacts of proposed development projects in future) and for long range forecasting (evaluating the alternative transportation plans for future years), community level planning and in corridor studies.

The data base generated and findings of the study are being further analysed for formulating a model or trend in the trip generation rates of different activity centres coming under the broad categories of varied land uses.

4. Traffic and Transportation Study for Kondotty Town in Kerala

National Transportation Planning and Research Centre (NATPAC) carried out Traffic and Transportation Study for Kondotty Town in Kerala. Kondotty is a revenue village and municipality, and is also a developing town in the Malappuram district, Kerala, with an area of 30.93 sq.km, which is located near Calicut International Airport. Kondotty Municipality is newly constituted municipality by merging two grama panchayaths namely Nediyiruppu grama panchayath and Kondotty grama panchayath. Kondotty Taluk, with Kondotty as its headquarters, is declared as the seventh taluk in Malappuram district in December 2013.

National Highway 966, which connects Kozhikode with Malappuram and Palakkad passes through Kondotty. It is bordered on the east by Manjeri, Neerad to the north, Ramanattukara to the West, and on the south by Karipur.

Speed and delay characteristics: NH 966, SH 65 and Airport road were considered for speed and delay covering a length of 12.41km. Maximum average journey speed was observed on NH 966 between Pothuvettipara and Musliyarangadi on which maximum speed attained was 61kmph.

Traffic volume and capacity utilization: Star junction - Kondotty 17 junction on NH966 carried the peak hour traffic volume ranging between 4,215 Passenger Car Unit (PCU) followed by 3,961 PCU in the road stretch Star junction – Kuruppath junction on NH966. The Volume Capacity (V/C) value is maximum for road stretch between Kondotty 17 junction to Pandikadavu followed

by Pandikadavu to Airport Road junction on NH 966 and Airport Road junction on NH 966 to Neetanimal.

Parking: Parking of vehicles were found to be quite high at the road stretch of Thangals Road junction on SH to Chungam having an Equivalent Car Space (ECS) value of 54 followed by SBI to Preethi Silks (RHS) with 43 ECS. Two wheeler (511) parking is found to be high in the study area followed by car (319).

Since the International Airport is very near to Kondotty Town, the traffic and travel characteristics of airport traffic have an effect on future development of Municipality.

Inter-city passenger traffic: The O-D pattern of inter-city passenger traffic revealed that out of the 2,78,558 passenger trips, there were 1,02,213 external - internal trips, which constituted 37% of total trips. 35% of the total passenger trips was observed as internal – external trips. External – external trips accounted for about 29% of the total trips.

Inter-city goods transportation: A total of 25,826 tonnes of goods were transported through the town on a reference day. Truck carried the maximum goods (40%), followed by MAT carrying 38% of goods traffic and Mini Truck carrying 21%.

Inter-city vehicular movements: About 16,844 PCU, i.e. 21 percent of total traffic with their origin and destination points outside the Kondotty town are passing through the town. Out of these traffic, bulk movements were between Kozhikode and Palakkad (6,868 PCU) and also with Kozhikode and Manjeri route (3,783 PCU). Hence it is evident that about 21% of traffic is by-passable.

Traffic projection: National Highway 966 would be severely congested in the horizon year of 2037 with the anticipated traffic more than the capacity of the roads under "do-nothing option". The projection of traffic on the existing road network within the Central Business District (CBD) area implies that the existing road network would not be able to handle the traffic in the horizon year without up gradation of the transport infrastructure facilities. Augmentation of the capacity of the existing road network by strengthening/ widening and the construction of alternate link roads is a must considering the dramatic increase in the traffic volume.

Proposed Transport Development Plan:

The development strategy focuses on improving the transport network of Kondotty town in two phases namely;

i) Short and medium term improvement proposal

ii) Long term development schemes

Short term improvement proposals are those which can be implemented straight away on the field with minimal land acquisition and less investment. Medium term improvement proposals are those proposals which will take 2-3 years for the implementation. The proposals to be considered in those regards are junction improvement, provision of parking facilities, pedestrian facilities and road signages and traffic control devices.

Long term transport development plan are those schemes that are needed to meet the future transportation requirements of the town in the next 10 to 20 years. Development of missing link connecting the activity centres, widening of roads, development of ring roads, grade separated facilities and development of bus stand, vacant lands identified outside CBD for facilities like parking of trucks and heavy vehicles, etc will form part of the long term improvement proposals.

5. Traffic and Transportation Study for Tirurangadi Municipality

Tirurangadi Municipality is spread over an area of 17.73 sq.km with a population of 56632.

Speed and delay characteristics: The average speed during peak hour of all the roads taken together was 23 kmph, whereas during off peak hour was 31kmph. Maximum average journey speed during peak hour and off peak hour was observed in NH 66 (Pokiparamba to Kolappuram) with values of 38km/h and 42kmph respectively. State Highway from Palathingal to Kakkad is the slowest link in the study area where the journey speed during peak time is only 19kmph. Thrikkulam- Theyyala Road (Kodinji Road) is the next slowest link in the study area having 20 kmph journey speeds during peak time.

Capacity Utilization: It is seen that volume-to-capacity ratio (V/C Ratio) on NH-66 Kolappuram to Pokkiparamba is greater than 1.5 in the base year itself. The V/C ratio on many stretches of State Highways has crossed 1.

Parking: Of the 13 stretches where parking accumulation survey was conducted, parking of vehicles was found to be quite high on Chemmad Bus Stand Junction with 141 vehicles noticed at 11.45 AM, followed by 132 vehicles on Chemmad Muttichira Road Junction noticed at 11.15 AM.

Inter-city passenger traffic: An estimated 1,07,767 inter-city vehicle trips were performed in the study region on a reference day consisting of 34,330 car/van/jeep trips (32%), 18,854 auto rickshaw trips (17 %), and 49,938 two wheeler trips (46%).

Inter-city goods transportation: 34,145 tonnes of goods were transported through the town on a reference day. Trucks carried maximum goods (59%), followed by Multi - Axle Vehicle carrying 17% of goods and the remaining 24% by mini trucks and Goods Auto.

Traffic projection: All the major road corridors within the central area of the town would be severely congested in the horizon year with the anticipated traffic more than the capacity of the roads under "do-nothing option".

Transport Development Plan for Tirurangadi Town

NH66 is proposed to develop in 45m ROW with 4-lane dual carriageway and 5.5m service road on either side. Parappanangadi- Arecode (SH 65) is the foremost arterial road of the town and is proposed to develop in 15m ROW in Phase-I and need to be upgraded to four lane divided road with 23m ROW in Phase-II.

Developing an alternate east-west connectivity will serve as a bypass for SH65 in Tirurangadi and will reduce the mixing of intra-city and intercity traffic. The through traffic which has no purpose in the town and having its origin and destination lying outside the urban area are divertible to the bypass and will reduce the congestion in the core town. The new east-west corridor shall be developed as primary distributor in 18m ROW. The proposed east-west connectivity shall start from Karumbil on NH 66 and ends near Palathingal on SH65.

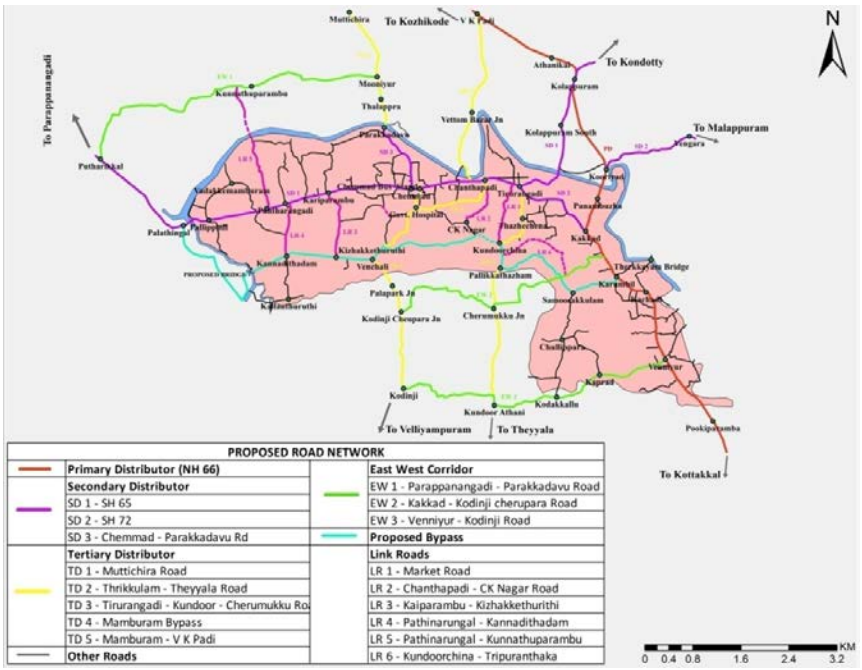


Figure 2: Proposed Road Network Plan for Tirurangadi Region

Conceptual Junction improvement proposals have been recommended for two major junctions viz. Chemmad junction and Tirurangadi junction to ensure the smooth flow of traffic through the junctions. Off-street parking lots on vacant plots have been identified to regulate on street parking on congested roads in CBD area. At-grade pedestrian crossing facilities in the form of zebra crossings have been proposed at all junctions to ensure the safe crossing of pedestrians. It is also recommended to provide footpaths with a minimum width of 1.8m on either side of the road stretches in the study area for the safe movement of pedestrians.

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

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

Tasks carried out

- Establishment of volume count stations;

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

Methodology

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

Data collection

Three locations situated in Southern Kerala, Central Kerala and Northern Kerala were selected for the primary data collection and four set of 7 days 24 hour classified traffic volume data were collected from each of these locations twice in a year. The locations selected for the data collection are Kalluvathukkal in NH 47 (NH- 66) at Kollam district, Paliyekkara in NH 47(NH 544) at Thrissur District and Mahe near Vadakara in NH 17(NH 66) at Kozhikode district. All the relevant secondary data were also collected.

Study duration

The study duration is five years and completed 3 years of the study.

Expected Outcome

As the rapid growth in the national economy boost the transportation demands, the importance of traffic demand prediction has significantly increased. This in turn helps for providing proper engineering design, evaluation of the economic and financial viability of transport facilities and planning. As part of the Study, a hybrid model of ARIMA and ANN will be developed to forecast the future traffic growth rate based on past trends of vehicular traffic, vehicular registration and various demographic and economic factors. The model developed is expected to be most efficient among the various traffic growth rate models.

7. Traffic Management Plan for the Proposed Mixed Use Residential Cum Commercial Development at Pangappara in Thiruvananthapuram

M/s. Spring Infradev Limited is planning to develop a residential apartment complex with commercial space at Pangappara in Thiruvananthapuram district. The proposed site shares its boundary with Kazhakoottam – Thiruvananthapuram MDR (Old NH 66) and the road at this location consists of a number of curves and also situated in a gradient. In this context, they approached NATPAC to prepare a traffic management plan for the area by considering the anticipated traffic from the proposed development.

Scope and Objectives

The scope of the study is to prepare a Traffic Management Plan for the road network in the Pangappara area by considering the proposed land use changes and the proposed road development plans. Main objective of the study is to assess the traffic impacts due to the proposed land use change.

Methodology adopted for the Study

- Assessment of existing conditions by studying site location and land use and existing road network characteristics;
- Assessment of traffic characteristics which includes traffic volume survey, pedestrian surveys and statistics of accidents;
- Assessment of traffic impact by accounting the proposed land use development and future traffic;
- Preparation of traffic management plan for mitigating the impact in the horizon years.

Recommendations

The proposed site has access to two roads in the area. One is Kazhakoottam – Kesavadasapuram – Thiruvananthapuram road and the other is Gandhipuram road. The weekday average traffic volume through Kazhakoottam – Kesavadasapuram – Thiruvananthapuram road was 23,039 PCU per day and the Gandhipuram road is carrying very less traffic. The peak hour traffic through the MDR is 1805 PCU and through the Gandhipuram road is less than 100 PCU. The trip generations from the site for the year 2020 was estimated as 868 vehicles at peak hour and these trips were distributed to the adjacent roads. The impact of traffic from the site was analysed by calculating the volume – capacity ratio and it was found that the traffic from the site will induce only 9 to 10 % impact on the traffic on MDR for the horizon years of 2030 and 2040, which is very minimum.

8. Access Options for the Proposed TRIDA Bus Terminal at Kazhakoottam

India's first technology park, Technopark is located near Kazhakkootam on National Highway 66 Bypass (NH 66), which connects Kazhakkootam on NH - 66 and Mukkola near Kovalam. The major share of public transport in Kazhakkoottam is contributed by bus transport. A well-equipped and competent bus terminal facility can mitigate the problems of passengers as well as other road users thus enhancing the overall mobility of the region. Hence Technopark handed over a portion of land to Trivandrum Development Authority (TRIDA) for developing a bus terminal, a significant element in the operation of bus services, at Kazhakkoottam. Proposed TRIDA bus terminal is situated in the eastern side of NH 66, which is 300 meters south of Kazhakkoottam Junction and 400 meters north of Technopark phase 1 Junction. Both the Central bus terminal at Thampanoor and City bus terminal at East Fort are located at a distance of 13 km from Technopark campus. The major intersections in the immediate vicinity of study stretch are Kazhakkoottam junction and Technopark junction and both are prone to carry traffic loads more than its capacity.

Scope and Objectives

The main objective of the study was to develop an entry/exit plan for the proposed bus terminal at Kazhakkuttam by duly considering the development plans of National Highway.

The flow pattern of the buses in the area under consideration was studied by NATPAC and revised the bus terminal layout by incorporating the proposed developments in the area. Different options

for the bus terminal were studied with circulation patterns and pros and cons of each options were worked out.

Conclusion

Flow pattern of existing buses were studied in detail and the bus terminal layout is revised by incorporating the additional land allotted for the bus terminal and recent developments in this area especially the improvement of National Highway 66 bypass. Two proposals are put forward along with its pros and cons for the consideration of the authorities. The proposal 2 with circulation plan 1, i.e. 'Improvement of Canal road and utilization of service road for the to and fro traffic of buses from the bus terminal' is recommended for implementation as a short/medium term solution even though the consultant have firm opinion that the construction of flyover is the sustainable solution for addressing present/future traffic problems persisting in the entire area.

9. Development of Foot Over Bridges and Subways under PPP Mode in Thiruvananthapuram

At the instance of Kerala State Planning Board, NATPAC evaluated the feasibility of developing a pedestrian crossing facility under Public-Private Partnership (PPP) mode in Thiruvananthapuram. The scope of the work is to carry out a detailed study on the development of foot over bridges and subways under PPP mode at three locations namely Medical College Junction, Cotton Hill School area and East Fort area in Thiruvananthapuram district.

The objectives of the study are:

- To study other modes of financing like Corporate Social Responsibility Schemes, advertising etc.;
- To suggest revenue models and different financial options;
- To identify relevant agencies in the State Government to implement the project;
- To outline the experiences in other parts of the country.

Methodology adopted for the study consisted of reconnaissance survey, secondary data collection, assessment of land availability at the project locations, development of different foot-over bridge/ramp options, rough cost estimate for the suitable option, assessment of technical, economic

and financial feasibility with comparison of revenue models and financial options, identification of implementing agencies and review of selected public infrastructure PPP projects across India.

An inventory survey was conducted to study the geometric features of the junction. Topography survey of the three locations was carried out to prepare a base map of the study location. Traffic and Pedestrian volume count survey were conducted to determine the peak traffic flow and to understand the Pedestrian – Vehicular conflicts thereby justifying the need of a Pedestrian crossing facility. The pedestrian traffic flow pattern in the junctions was also studied to arrive the pedestrian movement pattern around the locations. The major shortfall/problems in the existing locations were addressed.

Proposals

The observed PV2 values in all the roads were observed to be higher than the limiting value suggested in IRC103:2012. Hence it was recommended to provide a grade separated pedestrian crossing facility in all the three locations. Considering the traffic flow, prevailing terrain condition and the difficulty in relocation of existing utilities beneath the ground it was proposed to develop a pedestrian foot over bridge rather developing a subway in all the locations. In order to accommodate all types of pedestrians, escalators and elevators are proposed at all locations. Also, provisions of commercial spaces were proposed at some locations with the aim of making it as user friendly and to generate income.

The land requirement, the merits and demerits of the proposals were also analyzed. Tentative cost estimation for the above proposals has been worked out. The total civil cost calculated amounts to Rs. 37.98 crores and the yearly operation and maintenance cost amounts to Rs. 1.42 crores in all the three locations.

The Financial Analysis was carried out and found that the project qualifies for the investment in the form of grant wherein stable cash flows can be guaranteed and this could be tapped from the potential investors or group of investors as part of the new concept of CSR or through the government fund alone by utilizing the funds from the infrastructure development agencies like Kerala Road Fund Board (KRFB)/ Kerala Infrastructure Investment Fund Board (KIIFB).

10. Mode Choice Analysis of non-work trips in Thiruvananthapuram City

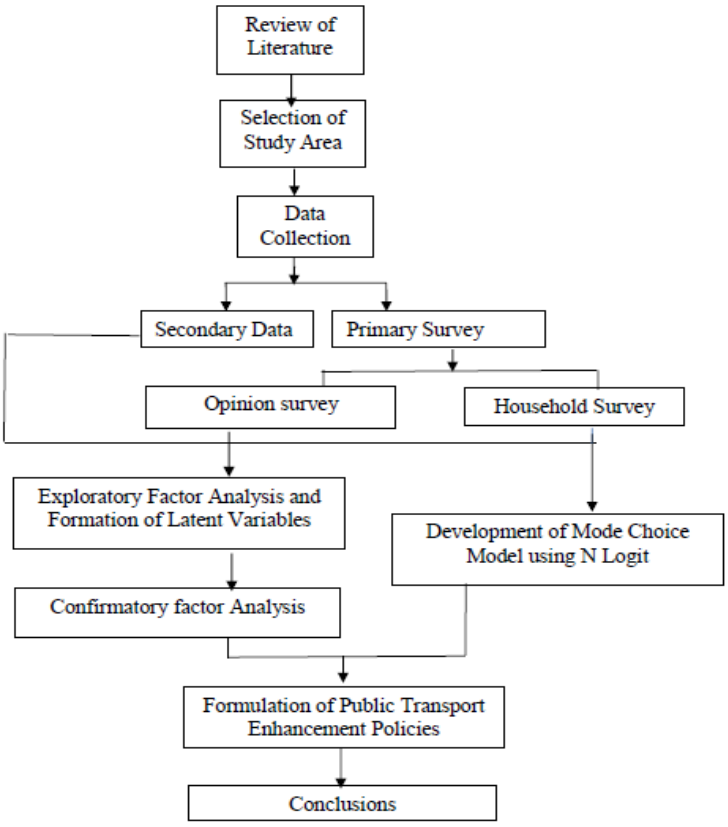
Mode choice behaviour of commuters plays an important role in transportation planning decisions. NATPAC identified major factors influencing mode choice and developed mode choice models using N Logit and formulated policies for enhancing patronage in public transport system.

Scope and Objectives

The scope of the study is limited to Thiruvananthapuram city. This study focused only on non-work trips. It enables to understand travel demand behaviour of trips and constraints that commuters face. The main objectives of the study were:

- To identify the various characteristics and attribute variables that influence the mode choice behaviour of commuters in Thiruvananthapuram city;
- To identify the major latent variables influencing the mode choice behaviour of commuters by conducting Exploratory Factor Analysis and Confirmatory Factor Analysis;
- To develop a mode choice model by considering both socio-economic variables and characteristic variables;
- To formulate policies for enhancing ridership in public transport system.

Methodology



Conclusions

The study identified various characteristic variables and socio economic variables that influence the mode choice of commuters travelling in Thiruvananthapuram city. The following were the major conclusions identified in the study:

- It was observed that majority of the male commuters were relying on two wheeler as the major mode of travel while the majority of female commuters relied on bus for their travel. Another major observation was that commuters belonging to the highest income category relied on private vehicles ie, car and two wheeler for their travel whereas majority of the commuters using bus belonged to the low income group.
- Exploratory factor analysis using varimax rotation was conducted on the data collected using opinion survey and the rotated component matrix revealed an existence of four latent variables with Eigen value greater than 1. The four latent variables thus identified

were: service characteristics, concern about money, operational characteristics and ridership attributes.

- A multinomial logit model was developed using the N Logit software for the commuters who chose car, two wheeler, auto and bus as their modes of travel. Utility equations were developed separately for each category of commuters and those significant variables affecting the mode choice decision of commuters were identified.
- It was found that the mode choice behaviour of the car users mainly depended on the travel time, travel cost, household size, vehicle ownership and trip distance whereas choice made by the two wheeler users relied on the travel time, travel cost, vehicle ownership and trip distance
- The major factors affecting the decision made by the commuters using auto as their mode of travel were travel time, travel cost, household size, monthly income, vehicle ownership and trip distance while the bus users considered travel time, travel cost, gender, vehicle ownership and trip distance as relevant factors for their travel decision.
- Parking regulations must be strictly enforced at the crowded locations either by limiting the number of vehicles that could be parked or reducing the duration for which a vehicle could be parked. Such a policy would attract more commuters.

11. Thodupuzha - Ernakulam Suburban Highway

Government of Kerala has furnished a proposal for the feasibility study for the development of Thodupuzha – Ernakulam Suburban Highway in Kerala. The scheme aims to develop a new road alignment with good, efficient and easy connectivity between Thodupuzha and Ernakulam. Public Works Department, Government of Kerala has entrusted National Transportation Planning and Research Centre to carry out feasibility study of the Thodupuzha – Ernakulam Suburban Highway.

Scope and Objectives

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

- To assess the demand of providing a new road;
- To identify and assess the existing shortest routes connecting Thodupuzha - Ernakulam and thereby analyzing the scope of developing them;

- To identify other feasible alternative in the form of new road alignments between Thodupuzha – Ernakulam;
- To compare the identified alignments on a technical, economical, social and environmental friendly basis and thereby suggesting a best feasible alignment.

Methodology

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

The final selection of the road sections considered for developing into a highway will be based on the multi selection criterion listed below:

i. Evaluating the terrain along the existing road and the alternative routes;
ii. Feasibility in developing the alignment as per the design criteria;
iii. Existing or potential agricultural activities;
iv. Connectivity with market centres;
v. Existing social services and facilities;
vi. Number of people/buildings affected;
vii. Land acquisition.

Preparation of detailed engineering/structural design of the highway does not form part of the study.

Work Status

- Completed Primary and Secondary data collection which includes Reconnaissance, Road inventory, Pavement condition, Traffic Surveys;
- The existing shortest routes connecting Thodupuzha – Ernakulam was identified;
- Submitted final report;

- Two alignment options were designed connecting the identified shortest routes for a design speed of 80kmph and for 30mtr ROW;
- Comparative analysis of the two newly developed shortest alignments with the existing alignment was done based on the financial feasibility.

12. Study on Pricing of Container Trailer Services Plying at Vallarpadam

The Cochin International Container Trans-shipment Terminal (ICTT), commonly known as the Vallarpadam Terminal, is a container trans-shipment facility which is part of the Cochin Port in Kochi, India. A major issue that the container transport industry face today at Vallarpadam is the lack of a proper freight pricing policy. NATPAC verified the operating cost to suggest the operating costs and minimum freight rate on scientific basis which in turn help to sustain the freight transport industry at Vallarapdam.

Scope and Objectives

The scope of the study is limited to the trailers operating and plying at Vallarpdam ICTT. The study will cover all aspects of container trailer operation with an objective to determine the operating costs. The main objectives of the study are:

- To study the operational characteristics of the container trailers;
- To compute appropriate operating cost and fixation of minimum freight rate for 20 feet and 40 feet trailers plying at Vallarpadam.

Findings

A structured questionnaire was designed to carry out the survey and to collect a comprehensive database. The database to be generated from the survey includes information of product life, operating costs etc. The data collected was further analysed to find the cost behaviour for arriving the operating cost. The detailed analysis was done only on TATA vehicles. As per the questionnaire survey the total operating cost/km and minimum freight rate for 20 feet and 40 feet trailers has been worked out. To arrive at the standard cost for operations, the cost tables were developed by thorough analysis of important components of the trailer by studying the product life cycle. These were done for material and labour maintenance cost elements systems. Standard costing practices as per Cost Model is applied for the determination of freight rates.

As per the cost tables the following cost/km and minimum freight rate has been worked out:

Vehicle Type	Minimum Rate up to 40kms (In Rupees)	Cost per kilometre (In Rupees)
20 ft Double Axle Haulage Trucks (25 MT)	5517.00	64.38
20 ft Multi Axle Trailer (31,35,37 MT)	5625.00	67.21
20 ft Triple Axle (40 MT)	5771.00	70.22
40 ft Double Axle (35 MT)	7033.00	73.34
40 ft Multi Axle (40 MT)	7360.00	75.62

13. Planning and Development of Transport Network Connecting Potential Tourist Destinations

NATPAC investigated the various factors affecting tourist inflow to a tourist location and evaluated the effect of connectivity issues on the willingness of tourists to visit tourist destinations, both quantitatively and qualitatively. Kozhikode district in Kerala that comprises of geographical features such as coastal area, hilly terrain and plain terrain was chosen as the study area. Reconnaissance survey was conducted in order to identify the explored and unexplored tourist destinations and a total of 56 tourist destinations were identified. Out of these locations, 15 highly potential unexplored locations were selected to conduct detailed study. Secondary data were collected from each tourist locations that included road inventory, ticket charges, working time, average tourist inflow, etc. A detailed questionnaire survey was conducted on these locations and issues faced and associated suggestions by the tourists and also the improvement measures on each tourist location were tabulated.

The data obtained from the detailed questionnaire survey and the secondary data were combined and rectification measures required for exploring each of these identified unexplored tourist location were prepared. The existing network connecting the tourist destinations was studied and improvements required were identified. In areas where there are missing links, suitable alternative modes were identified. Suitable strategies were formulated for developing a tourist circuit which has got a good inter-connectivity between the various destinations.

The potential tourist demand is calculated based on three aspects as follows;

1. Base year tourists: This corresponds to the existing condition and considers the number of tourists who visit the places in the base year.

2. Recurring tourists: Tourists, who have heard about these locations and who have already visited the location, but are not interested to visit again. It is assumed that this proportion of tourists will visit the location again with the rectification measures demanded.

3. Induced demand: Proportions of people who have interested in the type of tourist location but were not aware of the existence of such places were determined. Based on the preference made by the corresponding sample, the induced tourist traffic to the unexplored places is determined.

Total Demand: Total anticipated demand of tourists is obtained by adding these three categories for the base year. This demand is forecasted for the year 2030.

Improvement of Connectivity

Data analysis revealed that a tremendous increase in tourists can be expected after implementing improvement measures. So legitimate connectivity upgrades were suggested for every one of these unexplored areas. Likewise the spots where the sign boards are to be put were additionally recognized.

Development of Tourist Circuits

Identified unexplored and explored tourist locations were classified into 4 circuits/clusters as per their relative locations with each other. By using these circuits/clusters, the tourists can plan to visit many tourist sites within a short period of time in a maximum efficient manner.

Conclusion

Study infer that most of the highly tourism potential locations remain unaware to the public and the right way development and upliftment of these unexplored places can influence the economy of the state in a good manner. The major reason for the stagnation of the development activities and the response from the public is mainly the poor accessibility and lack of awareness. While conducting the questionnaire survey, it was observed that, the tourists who have already visited the unexplored tourist centres were not willing to visit again due to poor connectivity and poor maintenance of basic amenities. After applying the rectification measures, this present scenario was expected to change and the increase in tourist inflow is found to be 300 to700%. An increase in traffic volume for a period of 10 to 15 years were evaluated for forecasting the impact due to the application of the rectification measures.

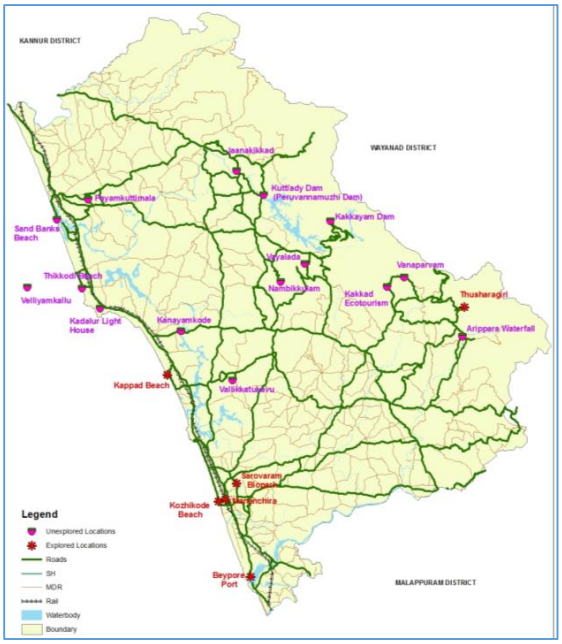


Figure 3: Explored and unexplored tourism locations in Kozhikode District along with connectivity patternlocations in

14. Feasibility Study for the Development of Coastal Highway in Kerala

A highway along the coastal belt of Kerala extending from Thiruvananthapuram in the south to Kasaragod in the North, with approximately 600 km length, has been a matter of discussion for the last few decades. The project first began with a study conducted by the National Transportation Planning and Research Centre in 1993.

At the instance of the Honorable Minister for Public Works and Registration, Government of Kerala, NATPAC has carried out the feasibility study for developing the coastal highway from Thiruvananthapuram to Kasaragod with minimum impact on the existing eco system.

Scope and Objectives

The scope of the study is to establish a feasible route for ensuring continuity of Coastal Highway stretching from Thiruvananthapuram to Kasaragod. The main objective of the study was to assess

the techno - economic feasibility of the identified Coastal Highway route with minimum impact on eco-system.

Methodology

The methodology adopted for the study consisted of reconnaissance survey, identification of alternative options, detailed road inventory study, traffic surveys, social and environmental impact assessment, preparation of cost estimate, evaluation of alternatives and economic and technical feasibility analysis.

Coastal Highway Routing

The alignment traverses through the entire nine coastal districts in Kerala viz., Thiruvananthapuram, Kollam, Alappuzha, Ernakulum, Thrissur, Malappuram, Kozhikode, Kannur and Kasaragod and extented about 590 km. Existing roads are utilized to the maximum extent and new roads were suggested at missing links. For the Coastal Highway, wherever the alternatives are available, as an initial strategy the routes are finalized by considering three factors.

- **Nearness to Sea -** The more the nearer the route is to the coastal region, the more it is preferable;
- **Length of the Alternatives -** The alternative that reduces the total distance is preferable;
- **Number of buildings affected -** The alternative that warrants acquisition of minimum number of buildings is preferable.

Bridges are also proposed at many locations for ensuring the continuity of the alignment. Detailed surveys were conducted for identifying the possible links which could be developed as coastal highway. Alternative options have been suggested for few stretches and final alignments were confirmed in consultation with the client. It is recommended that 12 m RoW with carriageway of 7 m width can be adopted as a standard for the coastal highway. However, as per the local site conditions, the carriageway width and RoW can be limited to 5.5 m and 8 m, if the improvement necessitates large quantity of land acquisition/resettlements.

15. Investigation works of Coastal Highway - Alappuzha and Thiruvananthapuram District

With the rapid growth in urbanization, the need to improve connectivity and development of new transportation facilities have increased manifold. Due to scarcity of land, especially in Kerala, the development of adequate number of new roads has been sacrificed except improving certain shoulders within existing alignments. As part of preparing detailed project report of coastal highway in Thiruvananthapuram and Alappuzha districts, Public Works Department, Government of Kerala approached NATPAC for conducting investigation works.

The following tasks were set as part of the study:

- Reconnaissance survey;
- Inventory survey;
- Benkelman Beam Deflection (BBD) Survey on the project roads;
- Classified traffic volume survey to assess the distribution of traffic and also to ascertain the number of vehicles to be considered for the design purpose;
- Collection of soil samples from the site and testing;
- Preparation of base plan by conducting total station survey;
- Geometric design of alignment;
- Analysis of data;
- Preparation of investigation report and drawings

Alappuzha District

Alappuzha is rich with beautiful beaches like Punnapra, Alappuzha, Thumboly, Marari, Arthungal, Thaikkal, Anthakaranazhi etc. Developing connectivity to these beaches is important considering the preference given by foreign tourists to Alappuzha as a holiday destination.

The Coastal Highway in Alappuzha district starts from Valiazheekkal and ends at South Chellanam. In Alappuzha district, the proposed Coastal Highway traverses purely through existing roads and traversed through plain terrain.

Existing pavement investigations, traffic studies, soil investigation and Geometric design were conducted along the proposed route of coastal highway alignment in Alappuzha district. The

characteristic deflection obtained was less than 0.9638mm which is in between Vadapozhi palam to Alappuzha bypass. From soil investigation, it is observed that Optimum Moisture Content (OMC) varies from 7.5% to 20.4% across the road corridor and the Maximum Dry Density (MDD) varies from 1.698g/cc to 2.443 g/cc. The CBR values range from 7.2 % to 38.5%. In the study route the soil type is varying from poorly graded sand to poorly graded sand with silty fines. Since some portions of coastal highway alignment is passing very near to sea and there is no sufficient sea wall to protect the highway from sea attack, it is suggested to provide sea wall protection as and where needed.

Thiruvananthapuram District

Thiruvananthapuram, the capital of Kerala is located in the Southern tip of the state. So the coastal connectivity through this region is much more important than any other state in Kerala. Thiruvananthapuram is rich with beaches like Kovalam, Varkala, Shangumugham, Vizhinjam etc. These well-known tourist beaches in Thiruvananthapuram is contributing heavily to the economy for the district as well.

In Thiruvananthapuram district, the proposed Coastal Highway starts from Poovar junction on Poovar -Vizhinjam road and ends at Kappil bridge on Puthoor-Varkala road. Most of the road links in Thiruvananthapuram district is having fair to good surface condition and there are no missing links. The total length of Coastal Highway in Thiruvananthapuram district is 78 km. In the section from Kovalam to Thiruvallom, the coastal highway alignment is along the National Highway (NH 66) and will be constructed and maintained by National Highway authority of India (NHAI).

Existing pavement investigations, traffic studies, soil investigation and Geometric design were conducted for the Coastal Highway alignment, from Poovar to Kovalam and Thiruvallom to Kappil in Thiruvananthapuram district in accordance with IRC and MoRTH specifications. Pavement evaluation was carried out using BBD and the characteristic deflection varied from 0.1229 mm to 1.1215 mm. From soil investigation, it is observed that the Optimum Moisture Content (OMC) varies from 9.15% to 19.3% across the road corridor and the Maximum Dry Density (MDD) varies from 1.732 g/cc to 2.111g/cc. The CBR values range from 5.5% to 25.3%.The soil type is varying from poorly graded sand to clayey sand.

16. Short Term Traffic Improvement Measures for Kozhikode City Roads

At the instance of Traffic Police Department, Kozhikode, NATPAC studied the existing problems of intersections and suggested short term measures to improve the existing traffic congestions in Kozhikode City. Short term measures were proposed by the Centre to relieve the traffic congestion in Kozhikode city for the following intersections.

1. Arayidathupalam
2. Areekad Junction
3. Karaparambu Junction
4. Kottuli Junction
5. Mankavu Junction
6. Meenchanda Junction
7. Rajaji Junction
8. Palayam Junction

17. Improvement of Kunnamkulam Junction

Kunnamkulam, situated in the Thrissur District, is one of the major junction where two state highways, SH 50 and SH 69 intersect. It is around 23 km away from Thrissur City and 10 km away from Guruvayoor. SH 69 starts from Thrissur and ends at Thrikkanapuram and SH 50 starts from Chavakkad and ends at Vadakkancherry, intersecting at Kunnamkulam to form a heavily operated intersection. At the instance of Public Works Department (PWD), Kerala, National Transportation Planning and Research Centre undertake the tasks of junction improvement design, pavement design and signal design of Kunnamkulam junction.

Scope and Objectives

The scope of the study is confined to the improvement designs for Kunnamkulam Junction including pavement design, traffic signal design and geometric improvement designs. The broad objective of the study is to develop and improve Kunnamkulam junction incorporating a pavement rehabilitation strategy.

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

surveys. The approaching arms at Kunnamkulam junction is having inadequate width for the approach lanes ranging from 10m to 15m and there is insufficient turning radius at the corner curves. The junction is devoid of proper channelization of traffic. All this leads to a chaotic traffic situation at Kunnamkulam junction.

Intersection Improvement Proposals for Kunnamkulam

Kunnamkulam junction is designed as a time separated or signalised intersection taking due care of the safe manoeuvrability of all the road users. The existing roadways in Kunnamkulam have to be widened especially at the corner curves of the intersection for the smooth flow of the traffic. This is essential to maintain the entry/exit radius of the curves and the entry/exit angles. Four lane carriageways with a central median of 1.5m width are proposed for all the arms at the intersection. Paved footpath of 2m width with segregation by railings is proposed to be provided over covered drains. Channelising island is provided on all the arms to allow for the free left movements. An additional two lane roadway is provided to facilitate the continuous and free left turning manoeuvre of traffic exiting from Pattambi arm and destined towards Vadakkancheri direction. Comparatively higher volume of turning traffic occurs in this direction comprising of a good fraction of two wheeler traffic. To segregate and facilitate this movement a channelizing island is provided at this location. A corner curve with 25m radius is provided here. A methodical alteration has been recommended on the Vadakkancheri arm approaching the intersection with a bigger channelizing island to avoid the likely conflicts created by the right turn traffic from Thrissur arm to Vadakkancheri arm. This right movement which is a comparative low volume is prohibited by the provision of this channelizing island.

Appropriate traffic management measures are incorporated in the design to enable safe and continuous movement for all road users. As a change in traffic flow pattern and magnitude is expected with the imminent developments like junction improvement and ring road development, the traffic signal phase timing has to be reworked and updated based on the traffic scenario post the junction improvement.

A detailed survey has been carried out in order to assess the pavement deficiencies of roads in Kunnamkulam junction. A 50 mmm thick overlay is suggested over the existing pavement based on the deflection and layer details collected from the field.

Table 3: Proposed layer thickness for junction improvement

Condition of pavement	Pavement Layers (mm)				
	BC	DBM	WMM	GSB	Total
Overlay for Existing pavement	50	-	-	-	50
New construction	50	95	250	200	595

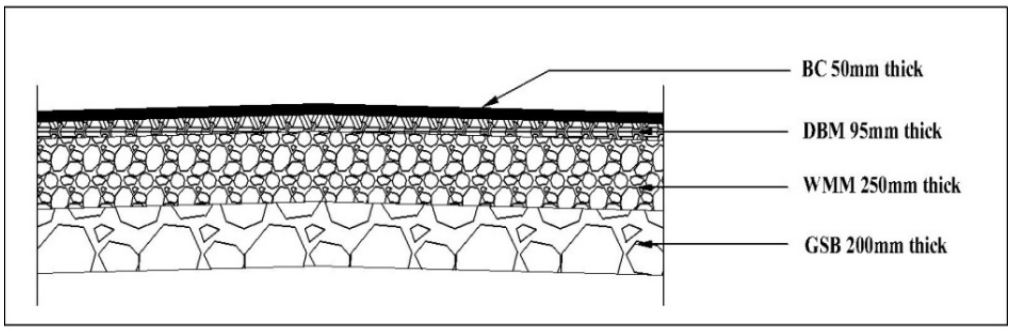


Figure 5: Pavement Layer Composition

The pavements are highly susceptible to the climate and traffic loading. Hence deflection tests may be conducted further and obtained a new thickness, if the implementation is extended more than 6 months or any seasonal changes occurs. Also new pavement is suggested for the development of bell mouths, if any. It is hoped that the design provided will enable the pavement to sustain against the existing and the future traffic load in the Kunnamkulam junction.

18. Development of Ring Road for Kunnamkulam Town

Kunnamkulam junction, the central point of Kunnamkulam municipal town is the intersection point of two major roads namely; Chavakkad – Vadakkanchery road (SH 50) and Thrissur and Kuttippuram road (SH 69) passing within the city limits which contributes substantially to the inter-city traffic. It is a four- arm busy intersection handling considerable through and turning movements of traffic. Congestion in vehicular movements at this junction affects the entire road system surrounding the junction. It is crucial to find an alternative route or a proper solution to resolve this problem. As there are limitations in the scope for road widening, development of ring road around the city is expected to reduce the pressure on the urban streets of the town. A ring road can assist in reducing traffic volumes in the urban centre, such as by offering an alternate route around the town for drivers who do not need to stop in the urban core.

At the instance of Public works Department (PWD), Kerala, National Transportation Planning and Research Centre has undertaken the task of preparing a project report on ring road development for Kunnamkulam town. The design and drawings are prepared by NATPAC and the cost estimate for the project road was undertaken by PWD.

Background of the Study

The total length of the proposed ring road for Kunnamkulam town is about 6.2 km. The alignment starts at a point 1.8 km away from the Kunnamkulam junction towards Pattambi side at chainage00+000(node 1) near Shine builders consultancy and passes through the Byju road (the reach between Pattambi and Vadakkanchery), the reach between Vadakkanchery -Thrissur road, reach between Thrissur - Guruvayur road and from there a new alignment runs parallel to a waterbody/ thodu through an existing land use of paddy fields further crossing another road at a distance of 1.4km from node 11 and to join the starting node, thus completing a closed ring.

Ring Road Alignment Details of Kunnamkulam Town

The potential advantages of developing a ring road for Kunnamkulam is in diverting the through traffic and thereby decongesting the urban centre. The Kunnamkulam ring road alignment bypasses the busy junction of Kunnamkulam. The proposed alignment of ring road lies inside the Kunnamkulam municipality area. The alignment starts at geo coordinates 10°39'53.00"N 76°4'28.39"E (Node 1) on NH 69 and passes through plain and rolling terrains. The alignment encounters with few cross roads, paddy fields and canals. The ring on existing roads ends at Node 11 (end point of T K Krishnan Road forming T Junction in front of the thodu). Then this node connects to the starting node (Node 1 on SH69, Near Shine builders consultancy).

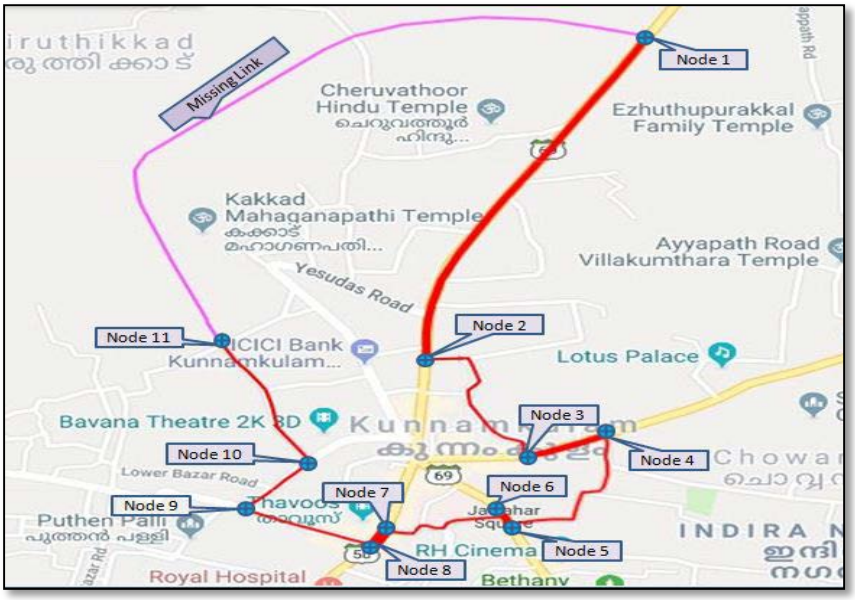


Figure 6: Map showing the alignment of proposed ring road of Kunnamkulam town

The development of ring road is envisaged to assist in reducing the traffic volume in the urban centre by offering an alternate route around the town for those who do not need to stop in the urban centre. The proposed ring road is expected to divert the through traffic from the local traffic thereby relieving congestion of the urban centre.

19. Installation and Testing of Traffic Signals at Twelve Junctions in Kozhikode City

Kerala Road Fund Board (KRFB) has completed installation of traffic signals at the following 12 junctions in Kozhikode City:

1. Stadium Junction
2. Puthiyara Junction
3. Kalluthankadavu Junction
4. Eranjipalam Junction
5. Karaparambu Junction
6. Vellimadukunnu Junction
7. Kovoor Junction
8. NH Bypass (Nethaji) Junction
9. Pushpa Junction
10. Mankavu Junction
11. MCC Junction- Kannur Road
12. MCC Junction - Wayanad Road

The signals were installed by M/s UCCIDP, the concessionaire for the project and they requested the District Police Chief, Kozhikode City for issuing them Certificate of Testing and Commissioning. In this regard, the District Police Chief sought the services of NATPAC in testing the proficiency of the newly installed traffic signals. Accordingly joint site visit of the newly installed signals was conducted by NATPAC along with Kozhikode City Traffic Police and Officials of UCCIDP on 20th October 2017 and recommended improvement measures for the above intersections.

20. Determination of Shortest Path for Emergency Vehicle to Accident Hotspots using Geo-Informatics Technology - A Case Study of Ernakulam District

NATPAC conducted a detailed study to find the shortest path for the ambulances with accident victim to reach a hospital by taking the shortest path thus saving precious time.

Scope and Objectives

The scope and objectives of the study are:

- Identify and display hospital locations and accident hotspots;
- Shortest path with optimized route to transport victims from accident hotspots.

Methodology

Geospatial technology in general and Geographical Information System (GIS) in particular has significant role in the analysis of accident black spots and network based analysis. The present study analyzed the data regarding the accidents that occurred in Ernakulam district by using Accident Severity Index (ASI) method suggested in NHAI (ToR) and methodology proposed by MoRTH. Location of accident black spots and hopsital locations were identified by GPS survey in the district along with travel time for the selected main roads within the district. All the data were consolidated within the GIS platform to derive results to obtain the above mentioned objectives.

Study findings

Study area was divided into three zones and first, second and third order accident locations were plotted using ArcGIS 10.3 software **(Figure 7).** Network analysis was performed based on the travel time collected from field survey and historical dataset. The study shows shortest path between any accident spot and hospital location. **Figure 8** shows an example of shortest route

between two locations. The detailed route description is also shown in the software along with route generation.

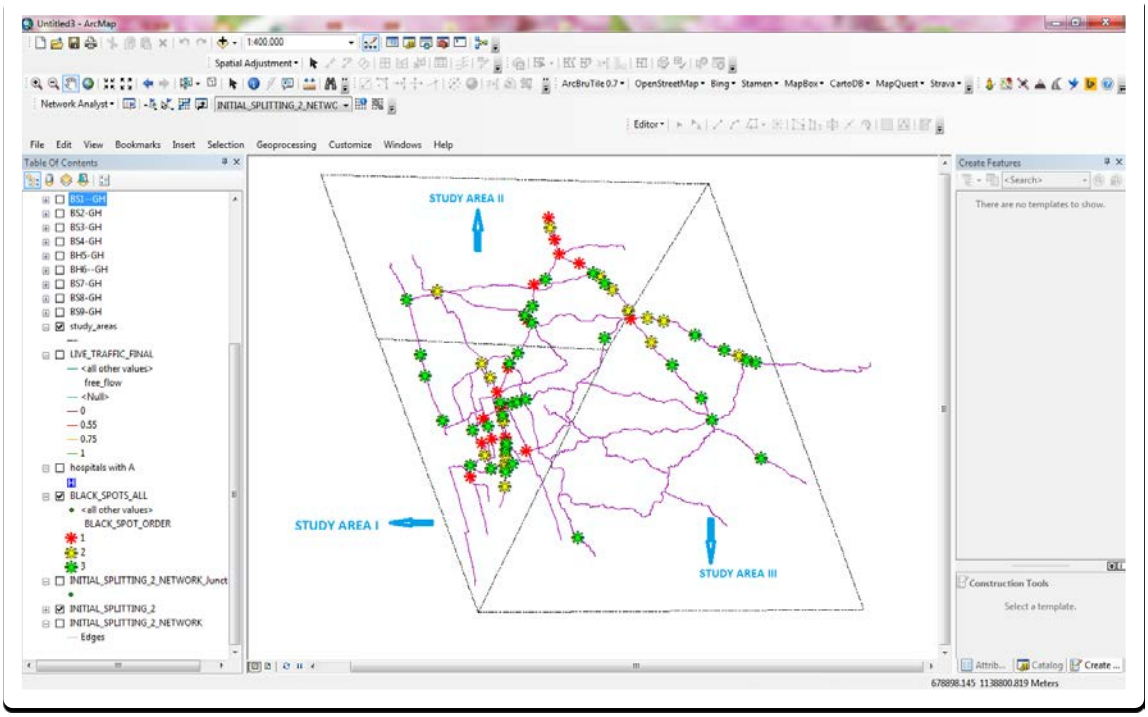


Figure 7: Accident Black Spots

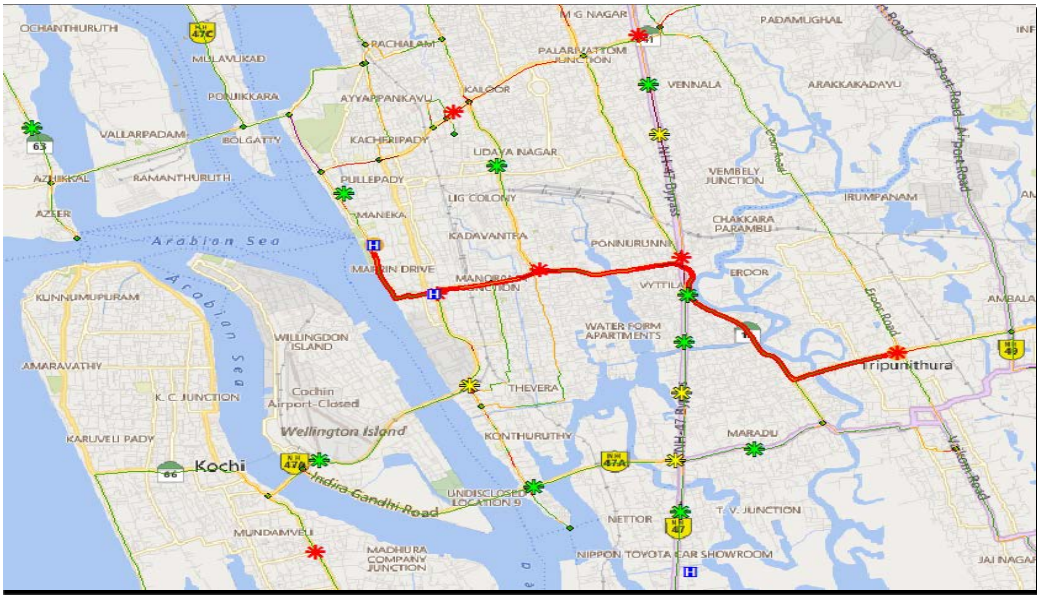


Figure 8: Optimized route from an accident black spot to the hospital

21. Web GIS based Road Crash Information System

Traffic safety awareness and enforcement are gaining greater relevance in recent times. For successful implementation of road safety activities, availability of data is the cornerstone and is essential for the diagnosis of the road crash problem and for monitoring road safety efforts. NATPAC carried out a study to develop a road accident management system using Geospatial tools for Kerala.

Scope and Objectives

The scope and objectives of the study are:

- Analyze accident data for each district in Kerala to demarcate the accident black spots;
- Develop an Accident Information System in GIS environment using Geoinformatics tools for the State which will highlight the vulnerable locations along with remedial measures to improve them.

Status of Work

Study was initiated during the financial year 2017 – '18. The study requires the secondary accident data from State Crime Records Bureau (SCRB). As per the new guidelines of MoRTH the accident reporting format is improved and data collection, reporting and publishing of the data has changed. The consolidated data will be made available during this financial year. The study will utilize the new data for the information system development.

Meeting with KSTP official and Mr. Sony Thomas, Consultant, World Bank was undertaken to seek their ideas and suggestion regarding the Accident Information System. Their suggestions will be incorporated in the study. Web based GIS system development is initiated.

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

NATPAC is developing a GIS – based comprehensive road and traffic database for the roads in Kerala. The study can be further extended to prepare database pertaining to road accidents, pavement management system, Traveller/Tourist Information System etc for the entire state.

Scope and Objectives

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

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

Methodology

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

Findings

Primary data of earlier studies conducted by NATPAC during 2011 - 2015 were collected for the major districts in Kerala, namely Thiruvananthapuram, Ernakulam, and Kozhikode. Road inventory and traffic data for preparing database was extracted from the study reports and were compiled. Road inventory and traffic data compiled were coded and converted into attribute dataset for further development of geo database. Primary road inventory data which includes chainage, width of roadway elements, type of roadway elements, carriageway width, type of land use, length of road, traffic regulation, etc were compiled. Primary traffic data such as intensity of vehicular traffic, pedestrian traffic intensity, speed and delay, parking accumulation and duration etc were compiled.

Road network map was developed with the help of various secondary sources namely, Survey of India maps, PWD maps, AutoCAD maps, Image maps, Google maps, Arc Server Maps and open street maps. Road network map for the study was developed with help of data collected from various sources. Scale of the map is proposed to be 1:1000 and would be randomly field verified with the DGPS station points established across the State by NATPAC.

Figure 9 shows the road network map developed for Thiruvananthapuram district.

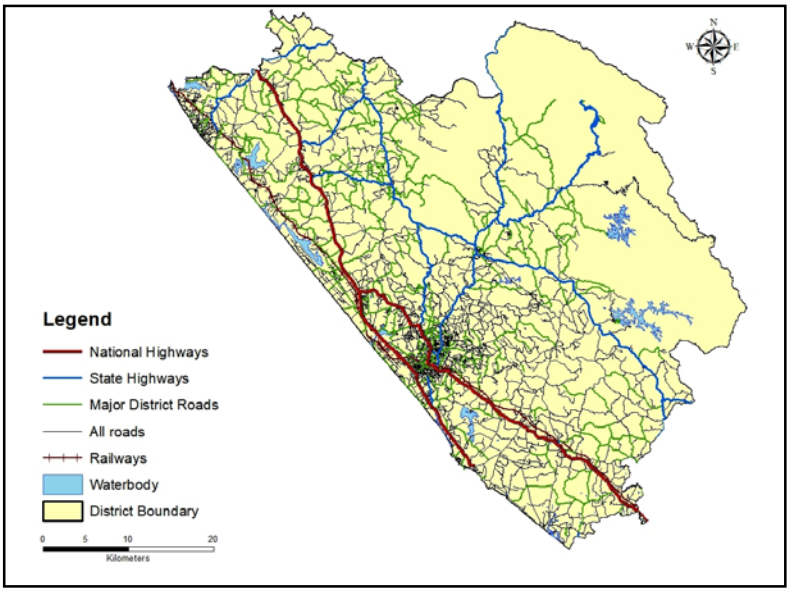


Figure 9: Road Network Map developed for Thiruvananthapuram District

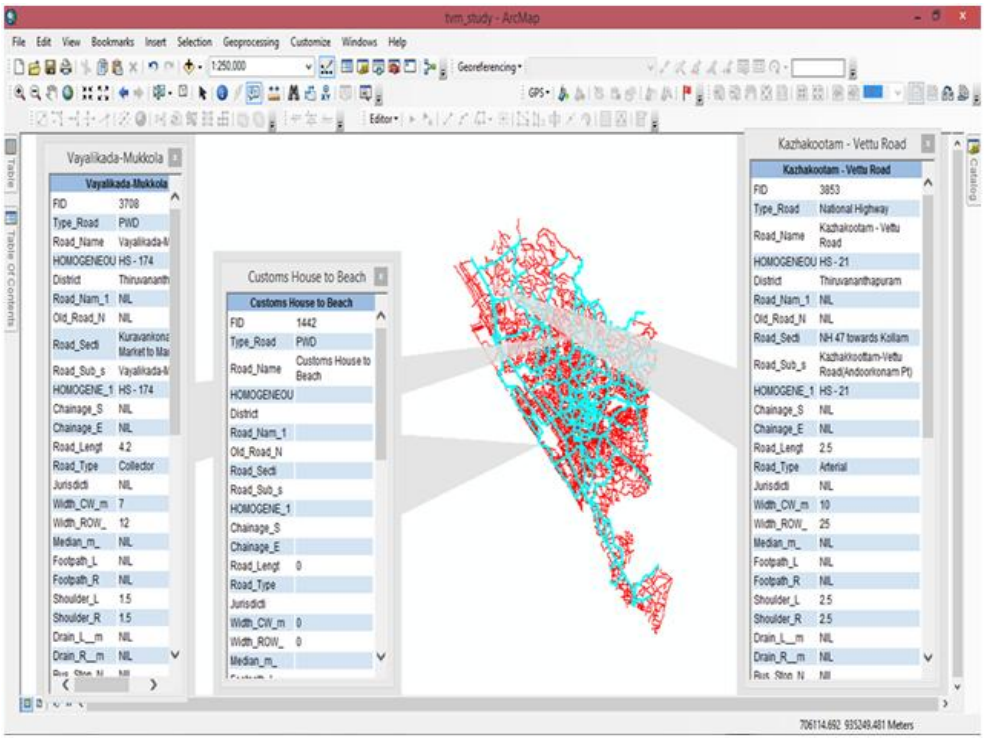


Figure 10: Road Inventory Database (Thiruvananthapuram)

It is envisaged to conduct periodic updation of GIS database comprising of traffic, road network, transportation network and crash spots. Road and traffic database developed in GIS can be retrievable for various analytical and research purposes. GIS-based Road Information and Management System can serve as an effective workable model for governing bodies of

organizations and can go a long way in not only enabling policy makers, but also solving the problems of spatial data.

23. Road Safety Cell: Impact of Road Safety Initiatives

Government has been taking many initiatives to control road crashes and reduce crash risk exposure on the major roads in Kerala. Various agencies and departments such as Public Works Department (NH and R&B), Police, Motor Vehicle Department, Kerala Road Fund Board, Kerala Road Safety Authority, District Road Safety Council, Local Self Government Department, Social Welfare Department etc. are engaged in implementing various projects/activities on road safety. Much financial expenditure (with budgetary support) has been made by various departments and agencies in the state on road safety related activities during last few years. However no evaluation or impact assessments have been attempted so far on these expenditures.

In this context, a study to evaluate the impact of various Road Safety activities undertaken by various agencies and departments is necessary to formulate an action plan for implementation in the state.

Scope and Objectives

The scope of the study will be limited to selected road stretches in Kerala. The objectives of the study are:

- To evaluate and categorize various road safety initiatives - Engineering - undertaken on selected road stretches by different agencies;
- To evaluate its impact on road safety and monitor its effectiveness;
- To improve accuracy and confidence of predictions of the treatment's effectiveness in subsequent applications;
- To suggest most suitable and practical ways to bring down road crashes in Kerala, with respect to the categorized road safety initiatives.

Findings

Karamana - Pravachambalam road stretch of length 5.5km was considered as study stretch. Pre implementation crash data for three years and post implementation crash data for two years for the study stretch were collected from the study stretch. In study stretch, 387 accidents occurred

during last two years ie, after widening (2016-2018) - resulting in 33 fatal accidents, 317 grievous injury accidents and 37 minor injury accidents and during pre-implementation stage (2012-2014), 289 accidents occurred of which 23 were fatal accidents, 211 were grievous injury accidents and 48 were minor injury accidents.

Road inventory and traffic data for the Karamana - Pravachambalam road stretch has been completed for the year 2017-18. Traffic data and crash data for the year 2018 will be collected and Road Safety activities/works carried out by various departments/agencies will be assessed and evaluated.

24. Assessment of Risk Potential of State Highway - 69 (Thrissur to Kuttippuram)

Even after improving the road infrastructure with huge investments, the accidents and related fatalities and financial losses are increasing year by year. It is hence highly desirable to critically examine the existing road networks to determine the level of safety assured for their users and ultimately to generate a safe road investment plan to logically perform necessary amendments to enhance the overall safety of road users. In this context, NATPAC as part of the plan program during the year 2017-18 has embarked on assessing risk potential of a case study project namely SH – 69, Thrissur to Kuttippuram stretch of State Highway in Kerala State and to propose road safety investment plans.

Need for the Study

Thrissur district has been of concern with the road traffic accidents as the accidents seem to have increased every year. The selected road SH – 69 is one of the most accident prone roads in the district as it acts as a bypass to the NH carrying heavy and increasing traffic on the road. Also the highway pass through densely populated semi-urban and rural areas and thus safety aspects are to be taken care of for the safety of road users as well as pedestrians.

Objectives

- To analyze the total number of road accidents in the stretch during last 5 years;
- To find the risk prone locations and detailed study of the location for finding the causative factors;

- To analyze the existing road geometry and road furniture (Street lights, crash barriers etc) and to suggest corrective measures;
- To give the star rating to the different sections of the road and to identify the least star rated stretches and quantify the deficiencies;
- To analyze the pedestrian safety aspects by finding the pedestrian volume at main intersections, near to schools and hospitals and to match with the existing pedestrian safety measures;
- To generate a crash prediction model by various mathematical techniques and to find the correlation of different road factors with the number of accidents.

Data collection

The data collected provides a data-driven framework to identify key safety needs and guide investment decisions. The purpose of the data collection process is to find the main problems faced by the road user and quantifying them for reducing fatalities and serious injuries. Data collection was done manually as well as through video graphic methods. The road geometry and the location specific analysis were done for every 100 m road stretch. The database consisted of details regarding roadway geometry and condition, crash data and traffic volume. IRAP listed checklists were also used as a reference for the data collection and local interviews were conducted along the main junctions to find the location specific problems.

Plate 1 (a)

Plate 1 (b)

Plate 1 (c)

Existing Safety Issues

Results

IRAP data analyses has been done using the IRAP India Vida softwares and are cross checked with the manually modeled factors to find the relation between the rating of roads and the main

influencing factors. IRAP study carried out on the stretch suggested the vulnerability of the road as most of the road networks have poor value for user safety. Majority of the junctions and midblock have a score of 1 star for pedestrians and two wheelers indicating the danger aspects for the mentioned category of road users. The width of the road also has been below standards on certain locations making it extremely hard to incorporate the traffic volume coming that way.

Suggested countermeasures

Various countermeasures were put forward for improving the safety aspect of the roads such as improving delineation, provision of pedestrian facilities, traffic calming measures, improvement of street lighting, clearing of road side hazards etc. **(Table 4)**

Table 4

Sl. No.	Countermeasure	Location
1	Delineation with median barrier	Entire Stretch
2	Curve Delineation Improvement	Major Curves along the stretch
3	Sight Distance (Obstruction removal)	Locations with heavy vegetation
4	Footpath provision	Near School zones in the stretch
5	Pedestrian Fencing	Near School zones in the stretch
6	Traffic Calming	Near School zones in the stretch
7	Intersection Delineation and Signing	All Intersections
8	Footpath provision driver side (adjacent to road)	Entire study stretch except at locations Kunnamkulam where provisions are provided already
9	Footpath provision passenger side (adjacent to road)	Entire study stretch except at locations at Kunnamkulam where provisions are provided already
10	Shoulder rumble strips	Entire Stretch
11	Street lighting (Mid-block)	Entire Stretch
12	Parking improvements	Idappal, Changaramkulam, Kunnamkulam, Kechery and Kaiparambu
13	Improvement of delineation	Entire Stretch
14	Street lighting (Pedestrian Crossing)	Entire Stretch

A total of 280 Fatal and Serious Injuries can be saved by implementing the above mentioned countermeasures. Star rating score of the stretch after implementing countermeasures have shown improvement. The benefit cost ratio is also in favourable of the iRAP and so the proposal is worthy to the implemented. The pedestrian and motor cycle safety has been improved to a very little extent but not worthy to be called as a safe stretch unless various long term measures are implemented.

25. Investigation of Major Accident Spots, Causative Analysis and Mitigate Measures

As part of the plan programme of the Centre, NATPAC is continuously monitoring the accident scenario in the State by regularly undertaking on-the-spot investigation of recent accidents in the State, analysing the causative factors and suggesting accident counter measures.

Objectives

The main objectives of the study are:

- To analyse the traffic police data, and information given in FIR and identify the causes of accident;
- To undertake the context analysis of accident reports as published in local newspaper;
- To undertake accident reconstructive study for selected major accidents that took place in Kerala, and there by identify major, minor and contributory causes of accidents.

Methodology

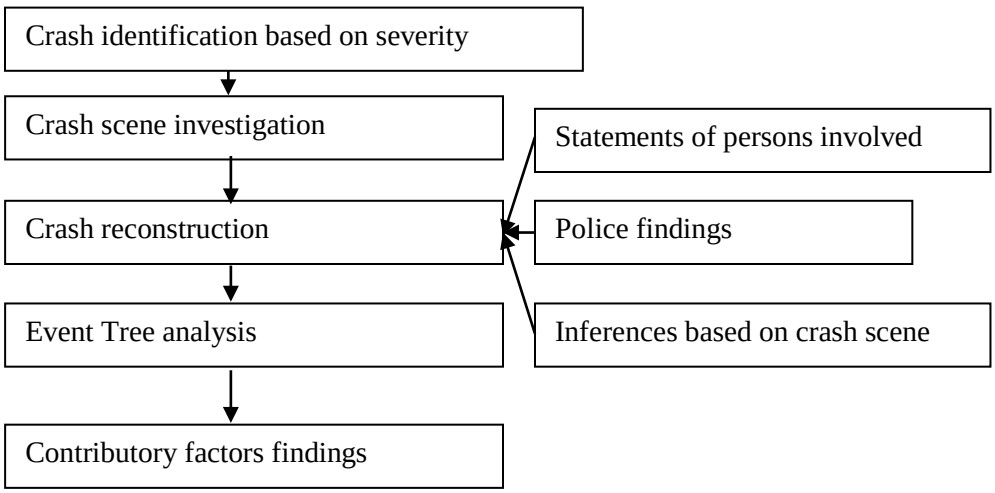


Figure 11: Investigation flow chart

Accident causative factors can be broadly classified into following six groups to be abbreviated as TRAVEL:

Traffic related (T)

Road related (R)

Accident Victim (Passenger, driver, other road user i.e. human) related (A)

Vehicle related (V)

Environment related (E)

Legal (Acts and Rules) related (L)

Table 5 provides a systematic classification of factors which may cause an accident. Road related factors are the most important factors which determine the accident risk. Elements of road geometry require careful design and take longer time to implement.

Table 5: Factors which may cause an accident

Traffic related (T)	Road related (R)	Accident Victim related (A)		Vehicle related (V)	Environment related (E)	Legal related (L)
		Driver related	Other road user related			
Traffic volume	Number of lanes	Age	Age	Type of vehicles	Temperature	Parking rules
Speed	Width of roadway	Education	Sex	Vehicle load	Humidity	Overtaking rules
Traffic mix	Width of shoulder strips	Training	Education	Width of vehicles	Precipitation	Traffic regulation
Separation of opposing traffic	Vertical curvature	Experience	Knowledge of traffic rules	Length of vehicles	Time, day and month	Traffic enforcement
Pedestrian traffic	Width of median	Physical fitness	Socio-economic conditions	Braking system	Population density	Insurance and compensation rules
Slow moving traffic	Sight distance	Monocular vision	Psycho-social behavior	Quality of vehicle body	Road side lighting	Others
Lighting conditions	Grade level profile	Side vision Dynamic vision	Others	Quality of tube and tyres	Traffic noise	
Traffic sign and markings	Radii of horizontal curves	Color blindness		Height of vehicle	Natural obstruction	
Others	Clearness of obstacles on shoulders	Night vision Others		Use of electronic indicators	Others	

Detailed investigation relating to human, road and environmental factors are analyzed in detail and various short term measures are suggested to the local authorities for improvement. Most of the accidents are caused due to human errors only, of which overtaking has been the single most reason for majority of accidents. Straight stretches with ample visibility have contributed to more fatalities

due to increased sight distances and higher operating speed. Vehicle incompatibility has also been a factor, as fatalities and grievous injuries are more in case of such accidents.

Major recommendations/suggestions evolved through the study are related to infrastructure, road safety education, issues requiring policy initiatives and enforcement. It is anticipated that, by implementing the recommendations, the incidence and severity rate on the analysed road segments can be reduced considerably.

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

NATPAC is conducting a study to create a Road Asset Management System for the selected network of roads in Kerala to achieve desired level of service with minimum financial cost. Road Asset Management (RAM) is the process of application of engineering, financial and management practices to optimize the level of service outcome in return for the most cost effective financial input. Scope of the work is limited to National Highways, State Highways and Major District Roads (MDR) in the selected district of Kerala.

Study Area

The study area selected was Thrissur district of Kerala state. Through reconnaissance survey a road network is selected for the study, which includes one NH, three SHs and two MDRs. The National Highway and State Highways selected are NH 66, SH 51, SH 61 and SH 75. The MDRs selected for the study are Peringotukara-Kaanjany-Chavakkadu road and Cherpu-Thriprayar road. The selected roads are interconnected and form a good road network, with a total length of 165 km. Pavement Condition Survey was carried out for the entire road network at an interval of 100m on each lane and Pavement Condition Index (PCI) was calculated. After that, roughness of entire road network was measured and the data was represented in terms of IRI. Traffic volume survey was carried out at various locations in the road network for a period of 24 hours on a normal working day.

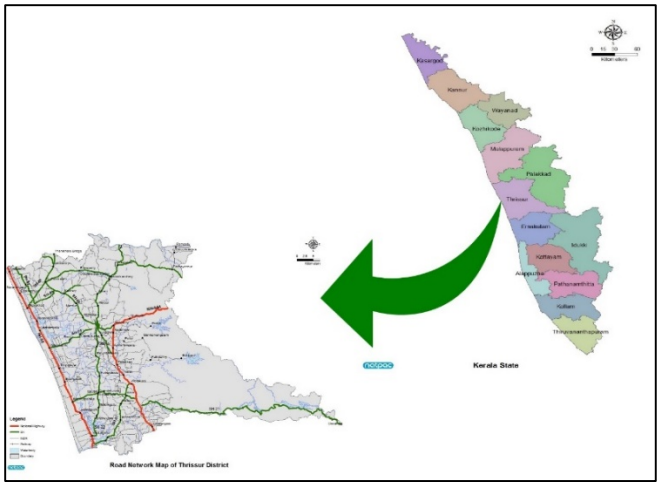


Figure 12: Road Network Map of Thrissur District

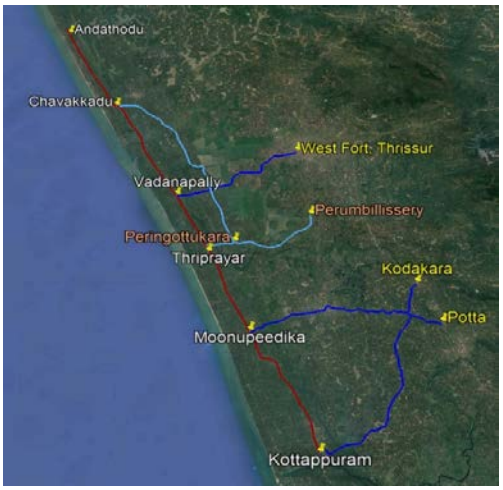


Figure 13: Road Network Selected for the Study

Homogenisation of Road Network and Demarcation of Control Sections

The road network is divided in to 28 homogeneous sections based on the Pavement Condition Index (PCI), International Roughness Index (IRI) and Daily traffic volume. Control sections of length 1000 m were demarcated within each homogeneous section for structural and functional performance evaluation. A total of 29 control sections were demarcated within the road network. Structural and functional performance evaluations were done on control sections through Benkelman Beam Deflection (BBD) technique, roughness test and detailed pavement condition survey.

Collection of Details of Cross Drainage Structures and Road Inventory

Details of cross drainage structures such as location and type, geometric details and present condition were collected and tabulated for the road network. Inventory data was collected for the entire road network and was tabulated. This data mainly consist of Road ID (road name, location, nodes etc.), geometry (length, width etc.), furniture (location, type, and condition), environment (terrain, rainfall) and drainage (type, location and condition).

Data Analysis

To obtain the performance rating of the control sections, the PCI and IRI value of the control sections were compared with the standard values as per the prevailing codes of practice such as American Society for Testing and Materials (ASTM D 6433-07) and Indian Road Congress (IRC) respectively. From the analysis, it was observed that based on PCI, most of the control sections

have good or satisfactory rating. The remaining control sections have fair or poor rating. Based on the IRI values, it was observed that most of the control sections are in average condition while some are in poor condition. The characteristic deflection obtained for all the control sections are normal and the values are less than 1mm, except for one control section.

Summary

An initial reconnaissance survey was conducted and a road network was selected for the study. Then the road network was divided into 28 homogeneous sections and control sections were demarcated in the homogeneous sections. Structural and functional performance evaluation was carried out in each control section. Then road inventory data and details of cross drainage structures were also collected. The collected data is properly tabulated and stored for further analysis.

Plate 2
Deflection Measurement

27. Evaluation of Moisture Susceptibility of Asphalt Mixtures

Moisture susceptibility is the loss of strength in bituminous mixtures due to the presence of excess moisture content. Moisture damage to the mix may occur in two ways. First, moisture content may decrease the bonding between binder and aggregate and next, the presence of moisture may modify the rheological properties of the binder thereby weakening the bituminous mix. Moisture damage is a significant concern as it diminishes the performance and service life of pavement. NATPAC focuses on the different grades of bituminous mixes susceptible to moisture content.

Scope and Objectives

The scope of the work is limited to various grades of bituminous mixes.

The following objectives were set as part of the study:

- To determine the moisture susceptibility behaviour of bituminous mixes;
- To evaluate the moisture damage by different air void distribution;
- To investigate the effect of moisture damage using additives;
- To compare the performance of different mixtures.

MATERIALS

Aggregates

Gradation

Crushed stone aggregates were used in the study for producing asphalt mixtures. The aggregate gradation and physical properties of aggregates are shown in **Figure 14** and **Table 6** respectively.

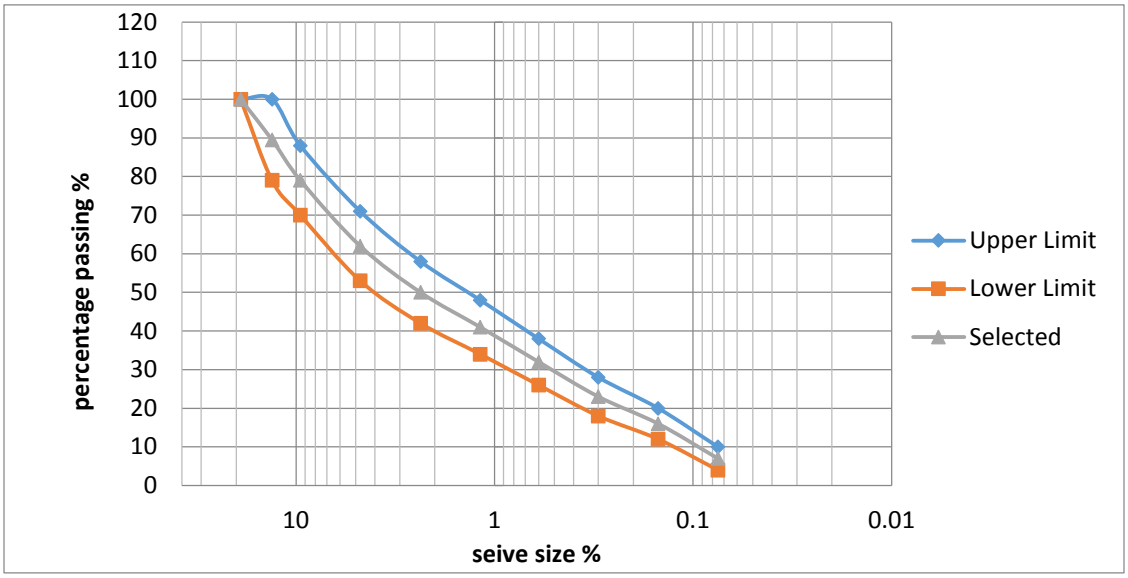


Figure 14: Adopted Aggregate Gradation

Table 6: Physical Properties of Selected Aggregates

Property	Test	Results	Specification Limits
Particle shape	Combined flakiness and elongation index	10.58%	Max. 35%
Strength	Aggregate impact value	21%	Max. 24%
Water absorption	Water absorption	0.29%	Max. 2%
Abrasion Test	Los Angeles abrasion test	25%	

The properties of selected bitumen grade VG-30 for the study is examined for its various physical strength **(Table 7).**

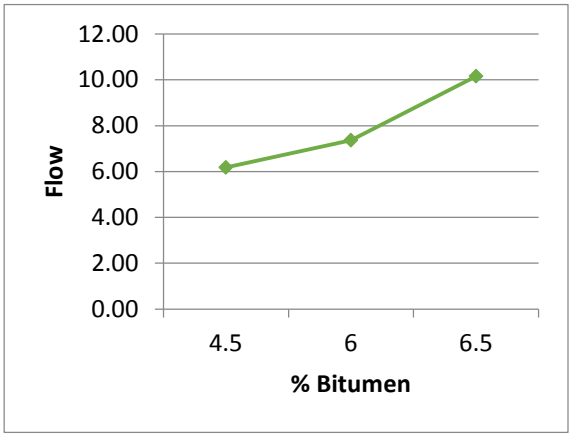
Table 7: Physical Properties of Asphalt as per IS: 73-2013

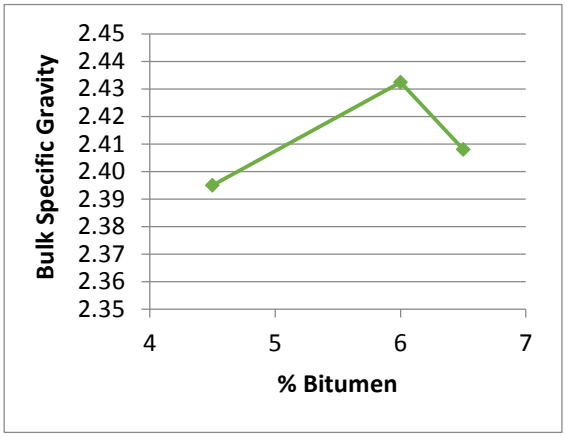
Parameter	Method of Test	Specification IS 73:2013	Typical Quality
Penetration at 25°C,100g,5s,0.1mm	IS 1203	Minimum 45	53.3
Softening point (R&B) in °C	IS 1205	Minimum 47	49
Ductility at 25 °C, cm, after thin film oven test	IS 1208	Minimum 40	92

EXPERIMENTAL METHODS

Mixture design

The bitumen mixture (BC-II) was designed for hot mix mixtures using Marshall method as per Asphalt Institute MS-2. The design graphs are shown in **Figure 15** where the narrow range of 5.4-5.85% asphalt content is found to satisfy the MoRT&H criteria. Hence, as per MoRT&H specification the minimum bitumen content requirement of 5.3% was selected as optimum bitumen content (OBC) and the same OBC was used for producing HMA mixture. The volumetric properties of the design mixture are also evaluated along with Marshall parameters as specified by IRC: SP: 101-2014 to assess compactability.





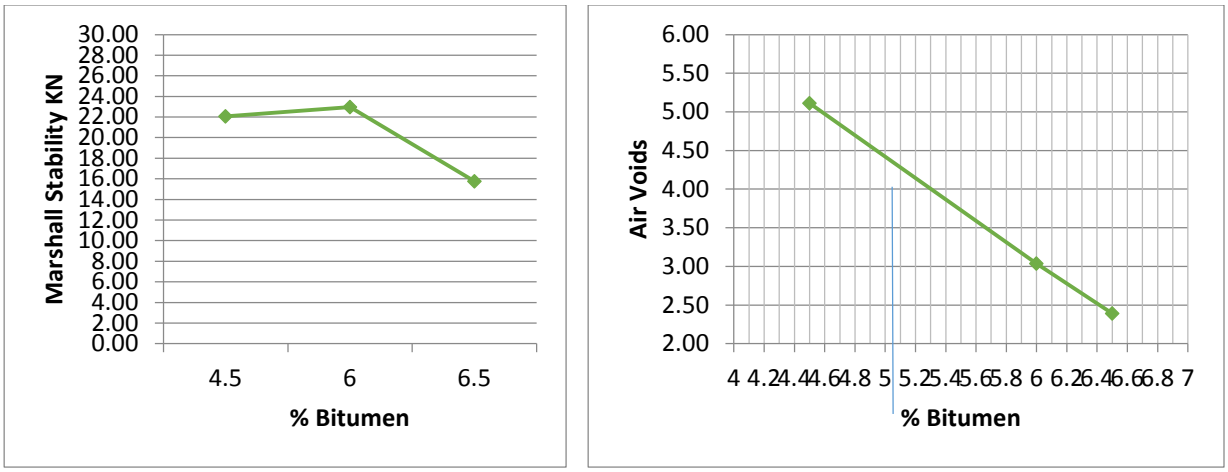


Figure 15: Design Graph of Optimum Moisture Content

The quantitative tests to evaluate the moistures susceptibility shall be done for the bituminous mix such as indirect tensile strength and stability. The effect of compactibility shall be checked with the bituminous mixtures for its behavior towards moistures susceptibility.

28. Study on Conservation of Natural Resources by Recycling of Asphalt Pavements

Reclaimed Asphalt Pavement (RAP) is a recycling technique in which the aggregate and binder that are milled out from the deteriorated pavements will be make use of by mixing it with the Hot Mix Asphalt (HMA) in such a proportion so that, the mix should get the required strength and performance. The use of RAP in pavement construction enhances a huge number of benefits which includes economic savings and environmental benefits. RAP is a useful alternative to virgin materials because it reduces the use of virgin aggregate and the amount of virgin asphalt binder required in the production of HMA. The use of RAP also conserves energy, lowers transportation costs required to obtain quality virgin aggregate, and preserves resources.

Scope and Objectives

The scope of the study is limited to the RAP which will be collected from two roads (Pippinmoode-Peroorkada road and Ulloor - Akkulam road) in Kerala. The RAP samples collected will be of different age so as to study the effect of aging on the properties of HMA-RAP mix. The study is limited to surface course. The RAP collected from Ulloor – Akkulam road is shown in **Plate 3.**

Plate 3: RAP collected from Ulloor – Akkulam road

The following objectives were set as part of the study:

- To prepare HMA mixes containing 10 - 30% RAP content with VG 30 binders;
- To compare the mix design for HMA having RAP of different age;
- To evaluate the performance of the mixes based on indirect tensile strength test and moisture susceptibility test.

Study findings

The RAP of different ages were obtained from Pippinmoode - Peroorkada (PP) road and Ulloor - Akkulam (UA) road. The RAP obtained from PP road was 2 years of age and from UA road was 4 years of age. The degradation occurred in the surface course due to aging is visible in their gradation. The amount of binder in the RAP was 4.8% for UA road and 5% for PP road and the binder was VG 30 in both roads. The Optimum Binder Content (%) and Indirect Tensile Strength (dry) of HMA-RAP mixes using RAP from both roads for different percentages of RAP were also determined to study their performance.

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

- The optimum binder content decreased with the increase in RAP content while it increased with increase in age of RAP;
- With the addition of RAP the Indirect Tensile Strength (ITS) strength increased for both the RAPs irrespective of their age;
- Mixes with higher aged RAP showed higher ITS value but were susceptible to higher moisture damage compared to the mixes with lower aged RAP;

- The Tensile Strength Ratio (TSR) value decreased with increase in RAP content making the mix more susceptible to moisture damage, so maybe an anti-stripping agent needs to be used.

29. Study on the Utilisation of Waste Sand in Soil Stabilisation

Stabilization of problematic soils using waste materials is a solution to waste disposal and can be cost effective as well as sustainable. English Indian Clays Ltd, one of the largest clay producers, generates huge amount of waste sand during Kaolin processing and poses the problem of disposal of this waste. A study was undertaken by NATPAC on the feasibility of utilizing this waste material in improving the properties of soil. The chemical (lime) treatment of this soil sand mix may improve its properties further.

The following objectives have been set for the study:

- To study the effectiveness of industrial wastes such as waste sand in stabilizing weak soil;
- To characterize the soil and waste sand from EICL;
- To arrive at an optimum amount of waste sand which can partially replace the soil;
- To stabilize the soil-waste sand mixture by treating with lime.

Methodology adopted for the study

The waste sand and soil were characterised and appropriate amount of waste sand was mixed with soil to find the change in its parameters. Atterberg limits, Compaction parameters, Unconfined Compression Strength (UCS) and California Bearing Ratio (CBR) values of both soil and soil-sand mixes were studied. The optimum waste sand percentage was obtained and later effects of lime on it were also studied.

The properties of soil and waste sand were studied and characterised. The soil was partially replaced by waste sand and various properties were studied in order to know the effects. From the compaction and CBR test results it can be concluded that the optimum soil-sand mix for this soil is 50% sand and 50% soil which satisfy the MORTH 2013 specification for using the mix as subgrade or embankment fill. Further tests were carried out on the soil- sand mix after treating them with lime.

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

- The maximum dry density of soil-sand mix improved and optimum moisture content decreased with the replacement of soil by waste sand;
- The CBR value of soil-waste sand mix showed improvement. Hence the optimum soil-sand mix adopted for this soil is 50% sand and 50% soil taking into account the improvement in properties of the mix;
- Addition of 1% lime to soil - waste sand mix resulted in good Maximum Dry Density (MDD) and gave highest UCS value;
- The UCS value after 7 days curing showed remarkable improvement due to the pozzolanic action of lime;
- It can be concluded that the waste sand locally available in Kerala can be utilized in partially replacing the highly compressible soil found in Kerala.

30. Study on the Geometric Design and Vehicle Operating Cost on Hill Roads

Geometry is one of the factors that control the speed of vehicles and consequently, the accident occurrence. For a particular geometric feature there will be an adverse variation in the speed for different category of vehicles. NATPAC has studied the speed variation of different classes of vehicles corresponding to the geometric variation in hill road especially at sharp curve location.

Scope and Objectives

The scope of the study is limited to the roads passing through hilly terrains of Kerala.

The main objectives of the study are:

- To determine the various geometric parameters those affect the speed selection in hilly area;
- To determine the speed variation for the different classes of vehicle;
- To develop speed models relating the identified geometric elements with speed for different categories of vehicle.

Methodology adopted for the study consisted of review of earlier studies, selection of study corridor, data collection, data analysis, model development and validation.

Summary and Findings

The road stretch selected for the study is the SH-2 connecting Thiruvananthapuram with Thenmala. It is a two lane State Highway road passing through hilly terrain. Twelve curve locations with varying radius of curve and varying gradient is identified for the study. Spot speed data were collected at the beginning of curve and also in the midpoint of curve. The speed data were collected for different categories of vehicle which includes small car, large car, bus, two wheeler, passenger auto rickshaw, goods auto rickshaw, LCV passenger and Goods, 2-Axle, 3-Axle, Multi Axle Vehicle, etc.. Geometric data such as radius of curve, gradient, super elevation, sight distance and overtaking characteristic of vehicle were also recorded in each of the survey locations. Statistical data analysis was carried out on the collected speed data to determine the existence of speed variation between the vehicle categories and between curve locations.

Operating Speed models for different classes of vehicles at mid-curve sections for two lane rural highway is developed. The independent variable used to predict operating speed is the radius of curve, gradient, super elevation, sight distance and the curve length. The Operating speed models were developed considering various scenarios. It is observed that the R-Square value for the models developed for different category of vehicle varies from 0.4 to 0.7, which is statistically a below average value. The accuracy of the model could be increased by increasing the number of curve points. The model developed in this study could be used to predict the operating speed at sharp curve locations (i.e, Radius<100m) only.

31. Pavement Rehabilitation Design Based on Dynamic Cone Penetrometer Test

Dynamic Cone Penetrometer Test (DCPT) is the most versatile, rapid evaluation method currently available for use in determining subgrade properties and is the best suited alternative method for California Bearing Ratio (CBR) test. It is a Non-Destructive testing method for evaluation of the structural strength of pavement layers.

Need for the Study

The increasing demand for ensuring the desired level of serviceability of road infrastructure facilities emphasize the need for addressing road maintenance and rehabilitation problems in the existing road network. The existing methods for structural evaluation of pavements are time

consuming and demands significant effort. By adopting DCPT method, the strength of each layer of pavement can be obtained easily with less effort. NATPAC is conducting rehabilitation study for the appraisal of the low volume roads in Kerala using DCPT values. Successful completion of this study will allow road construction engineers to assess subgrade adequacy with a relatively quick, easy-to-perform test procedure and avoiding time-consuming testing.

Scope and Objectives

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

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

The study stretch includes selected low volume roads in Kerala. Selected roads in the Trivandrum and Alappuzha were taken for the study.

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

Work Status

The proposed study period is 5 years and completed one year of the study. DCP test were conducted on selected low volume roads in Adimalathura- Chowara, Onnampalam-Chilakoor, Edathuva- Champakulam, Kidangara-Kannadi, Poopali-Champakulam, Poopali –Kainakary and Mancompu- Champakulam respectively along with sample specimens of soil and pavement layers. Road inventory and condition survey of these roads were also done for the structural and functional evaluation of the pavement. Traffic volume count was also conducted by manual

counting method. The study area stretches were selected on the basis of geographical and traffic parameters.

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

32. Development of Waterway between Mahe and Valapattanam

The decision of developing the waterway through the entire length of the state is taken by the Government of Kerala considering the potential of waterway for freight movement, passenger movement and tourism. The waterway stretch from Kollam to Kottappuram (National Waterway -3) has been developed, which covers a distance of 205 km and runs almost parallel to the coast line of Kerala. The seamless connectivity of the West Coast Canal from Kovalam to Hosdurg will be possible only if connectivity is established between Mahe River and Valapattanam River where there is a missing link.

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

Tasks carried out as part of the study

- Reconnaissance survey and joint inspection with officials of KWIL and Inland Navigation Departments for finalizing the best possible alignment for the uncut portions;
- Inventory surveys;
- Preparing the Land Acquisition plans;
- Traffic studies;
- Data analysis;
- Preparation of preliminary designs and cost estimates;
- Financial analysis and preparation of DPR.

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 are 9.25, 0.85 and 15 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.

Alignment selection criteria

The factors considered for the selection of alignment is as follows:

- Utilizing available rivers/ thodu/ canal thereby reducing the land acquisition;
- Minimum resettlement;
- Maximum usage of low lying area;
- Smooth alignment with less curves;
- Minimum high elevation/tunneled portions in the alignment;
- Lesser proximity to the High-Tension Lines;
- Availability of water;
- Little usage of cultivated area;
- Minimum impact to environment.

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. The preparation of DPR is under progress.

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

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

Scope and objectives

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

Methodology adopted for the study

Methodology adopted for the study consisted of literature review, analysis of accident data, review of rules related to waterway, conducting stakeholders meeting, questionnaire survey for passengers and crew, waterway safety audit, preparation of disaster management plan for accidents in waterways, study of effectiveness of training programs, conducting safety awareness programs and preparing materials for creating awareness, preparation of hand books and best

practice manuals for users of waterway and suggesting improvements to waterways for safe navigation.

Data analysis and findings

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

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

Status of study

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

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

Introduction

NATPAC had conducted many studies related to the inland waterways throughout Kerala and collected data regarding the existing waterway infrastructure. But all these data are not yet compiled into a common database to access them easily. It is proposed to compile all data related to water transport and tourism in Kerala and create a GIS data base to store and retrieve data for future reference. This will make valuable information accessible quickly.

Scope and objectives

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

The objectives of the study are:

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

A database in GIS platform is created for the data management and updation. Web GIS platform may be developed for this purpose. Collaboration with Bhuvan team (NRSA) was also proposed by signing a MoU. It is proposed to develop a Windows based Web GIS system with all other components as open source.

Web GIS server components

The following are the components of Web GIS server;

- **Database Server:** The database server may have a file based system or Relational Database Management System (RDBMS) based or a combination of files and RDBMS.
- **GIS or Map Server**: Map server or GIS server is a software package or program, which is responsible for rendering the GIS data into web browser.
- **Application Server:** An application server is software which provides customized software applications.
- **Web Server:** A web server is a computer program which uses the client/server model and the World Wide Web's Hypertext Transfer Protocol (HTTP), serves the files that form web pages to web users.

35. DPR for Integrated Urban Regeneration and Water Transport System in Cochin

NATPAC identified the best method to revive the urban area in and around the canals passing through Kochi City based on waterway transportation oriented development and by boosting tourism related activities. The Centre reviewed the existing traffic scenario of Kochi, to assess the potential for improving accessibility through canals, urban regeneration through improving the public amenities and living condition of people and the related environment by effective waste management system and creating new infrastructure and evaluates the financial viability of the project.

Study Area

The canals identified for the present study are Edappally Canal (11.23 km), Thevara – Perandoor Canal (11.15 km), Chilavanoor Canal (9.88 km), Thevara Canal (1.405 km) and Market Canal (0.664 km). Edappally Canal, Thevara - Perandoor Canal and Chilavanoor Canal are three major canals in Kochi City aligned in the North - South direction. The development of these canals will facilitate passenger movement through waterways between metro stations and metro waterway, in addition to augmentation of tourism potential of Kochi City.

Data sources

Secondary data collection was done from various sources including previous study reports and from several agencies. A detailed inventory study was conducted to assess the present condition of the canal. The topographic survey was conducted along the canal stretches and its adjacent area up to 40m on both sides from the centerline of canals for preparing the base map of the study area. The existing bed profile of the canal and water level were collected at 100 m interval. Socio-economic Survey was done through a detailed questionnaire survey. Water samples were collected and were tested in the laboratory. The litho maps of the study area were collected from the Department of Survey and Land Records and were combined and the topographic survey data were superimposed on it to get the alignment of the canal. The proposed 16.5m waterway along with buffer zone is also demarcated to identify the land to be acquired.

Pitfalls in planning/ design

The major objective of this study is to ensure mobility and accessibility by providing the identified routes in Phase I as feeder routes to the Kochi metro stations and at the same time prioritise canal development by phasing out land acquisition and modification of structures in the thickly populated narrow sections. So viable routes for development of navigation in all five canals are identified for development in Phase I. Waterway routes passing through back waters surrounding the main land is proposed to be developed by Kochi Metro Rail Ltd. (KMRL) as water metro. But these routes are not directly connecting to metro stations. The Kochi metro is crossing these canals in 5 locations and each of these locations have metro stations also. So by developing both ends of these canals, metro stations can be connected with the water metro routes. Another major constraint for developing the canals is the railway lines crossing the canals at six locations. Railway marshalling yard is present at the middle portion of Thevara - Perandoor canal and Chilavanoor canal. Increasing the height of bridges at some of these sections is possible as per railway engineers and a request was given to railway for detailed site visit and checking for possibility of reconstruction/modification of bridges.

Proposed developments

In order to develop the canals to a sustainable waterway, certain improvement proposals are charted out which is to be implemented. 15.98 acres of land is to be acquired in Phase I and 45.49 acres in second phase. Slum removal and tourism related infrastructure development are also proposed. An effective waste management system with proper solid waste and sewage disposal system was also proposed. The cost estimated for improvement of canal with 16.5m fairway for Phase I is Rs. 739.52 crores and for Phase II is Rs. 625.64 crores.

The connectivity of people residing in the area will be increased along with the recreational and other facilities. To conclude, the study establishes that the project is to be implemented without any further time lapse in view of tourism development, environmental uplift, improving urban mobility by facilitating first mile/ last mile connectivity, congestion reduction on roads and enhancing the utility of the available resources.

36. Feasibility Study and Preparation of Detailed Project Report on Sea Cruise Service between Kovalam and Kanyakumari

The Directorate of Ports, is involved with the development of sustainable port development and tourism projects. It has conceived a Sea cruise project, to showcase the untapped potential of the world famous tourist's destinations in Kovalam and Kanyakumari. In this context, National Transportation Planning and Research Centre (NATPAC) undertook the task of determining the financial and technical feasibility of the project.

The objectives of the study are:

- To identify the suitable navigational route and estimate the developmental works required to be taken up;
- To identify a suitable location for construction of jetties at Kovalam and Kanyakumari;
- To study the infrastructural facilities requirement such as jetties, waiting rooms, parking spaces, refreshment stalls, etc and ascertain whether sufficient land is available for providing the same;
- To evaluate the road connectivity between each of the jetties and the tourist centres in the hinterland;
- To study the characteristics of the tourists visiting study area;
- To assess the potential demand for the proposed cruise for both domestic and international tourists and passenger movement;
- To suggest suitable cruise vessel for operation in the above route;
- To assess the trip-turnaround time in order to workout capacity utilization;
- To identify the market risks involved, and to workout market feasibility;
- To identify local community issues and determine the social impact;
- To estimate the net annual revenue over cost and thereby determining the viability of the project;
- To suggest suitable subsidy/ concession measures to be given to the operator including Viability Gap Finance (VGF) for a PPP model;
- To assess the technical and financial feasibility;
- To prepare the organisational setup for project implementation.

Tourist Characteristics

To examine the characteristics of tourists visiting Kovalam and Kanyakumari, opinion survey was carried out among 303 tourists from Kanyakumari and 316 tourists from Kovalam. In case of Kanyakumari, 89% were tourists and 11% were passengers. About 95% of the tourists were interested in cruise services in which 64% opt for passenger mode and 30% interested in cruise mode. The two-way voyage from Kovalam to Kanyakumari and then back to Kovalam was interested by 53% of the tourists, while the one way was preferred by 42%. Roll on and Roll off facility was preferred by 62% of the tourists. In case of tourists from Kovalam, 91% are tourists and 9% are passengers. The tourist from other parts of India constitutes to 90% and the international tourists forms 10%. As a whole 85% are interested in cruise service, in which 63% prefer cruise mode and 33% prefer passenger mode. About 67% preferred for two way voyage, whereas 28% preferred for one way voyage. As far as the Ro-Ro facility was concerned, 68% preferred for the facility and 18% disliked the facility.

Navigational aspects

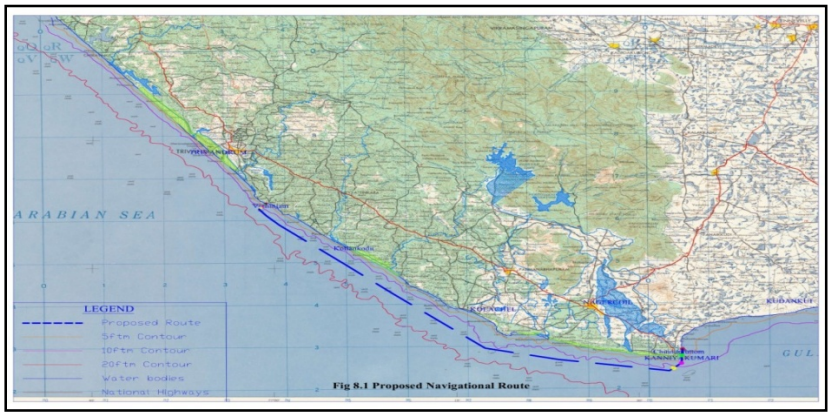


Figure 16: Proposed Navigational Route

The ideal zone for navigation is the channel, which provides a depth of 20 m or 20+ m. Both constructive and destructive waves are relatively less at the depths above 20 m. The operation cost, the comfort of passenger and other cruise operation factors are fulfilled when vessel operation is at this depth. The suggested depths of 20 m will be available between 1.1km (at the Vizhinjam side) to 4.6km (at the Chinnamuttom side) from the coast. The navigational route for the cruise service from Vizhinjam to Chinnamuttom proposed for a length of 81.1km. The

proposed cruise line route is designed based on the reference from map NC-43-16 of series U502 prepared by Army map service, Corps of Engineers, US Army, Washington D.C.

37. Laboratory Tests on Pavement Materials

a) Test on M-Sand Elastic recovery mould

M/s Poabs Granites (P) Ltd approached NATPAC for conducting Grain size analysis for three sets of M-Sand and Plastering Sand samples. The samples supplied at the Highway Engineering Laboratory has been tested according to IS 2720 (Part 4) -1985 specifications and the results were submitted to the client.

b) Test on Bitumen to identify the grade :

The Executive Engineer, Kottayam Municipality requested NATPAC to test the VG 30 Bitumen being used for their road developments. Tests were carried out on the sample of Bitumen VG 30 received in the Highway Engineering lab according to IS 73:2013 specifications and the tests include penetration, softening point, ductility absolute and kinematic viscosity and solubility in trichloroethylene. The given samples did not satisfy the requirements as per the standards due to impurities present.

EXTENSION SERVICES

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

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

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

A total of 21 programmes were completed this year at the NATPAC office, *K Karunakaran Transpark*, Aakkulam, Thiruvananthapuram as per the following schedule.

Date	Number of drivers Participated
11/04/2017	63
03/05/2017 - 05/05/2017	25
03/05/2017	13
16/05/2017	30
02/06/2017	12
05/07/2017 – 07/07/2017	32
05/07/2017	5
07/08/2017	27
28/08/2017 –30/08/2017	31
30/08/2017	17
14/09/2017	31
26/09/2017-28/09/2017	18
28/09/2017	11
27/10/2017	20
17/11/2017	9
27/11/2017-29/11/2017	27
29/11/2017	10
22/12/2017	33
22/02/2018	20
13/03/2018	39
28/03/2018	19
Total	**492**

Plate 6
Participants with NATPAC Officials (5th – 7th July 2017)

2. Training to Junior Sub Inspectors of Police on 'Identification of Dangerous and Hazardous Goods and Dealing with Emergencies'

NATPAC in association with Kerala Police organised a one day training programme on 'Identification of dangerous and hazardous goods and dealing with emergencies' to Junior Sub Inspectors. The programme was formally inaugurated by Shri. Manoj Abraham IPS, IG of Police on 1st July 2015 at Sasthra Bhavan, Pattom.

Two programmes were completed during this period as listed below.

- Thiruvananthapuram District at Conference Hall, District Police Chief Office, Thiruvananthapuram - 04.04.2017 (72 Police Officers participated)

- Thrissur District at Seminar Hall, Ramavarmapuram - 22.06.2017 (123 Sub Inspectors and 35 Police Drivers participated)

3. Road Safety Training Programme for Ambulance Drivers

NATPAC organised training programme for ambulance drivers by considering the fact that driving an ambulance requires above average driving abilities. One day training to ambulance

drivers was conducted on 10th January 2018 at Police Club, Kozhikode. 87 ambulance drivers participated.

Plate 7
Participants with NATPAC Officials

4. Road Safety Youth Leadership Programme

NATPAC launched a State-wide programme to train Young Volunteers in Road Safety and related aspects. The Centre conducted one programme at Malabar Christian College, Kozhikode on 17th January 2018, which was participated by around 200 students.

Plate 8
Shri A Pradeep Kumar, MLA inaugurating RSYLP at Malabar Christian College, Kozhikode

5. Safe Road to School

NATPAC in association with Kerala Road Safety Authority organised one day programme on 'Safe Road to School' (SRS) at the following two schools.

Sl. No.	Details of Place, Venue and Participation	participants	Date
1.	Rajiv Gandhi National School, Malayil near Malayinkeezhu, Kollodu	100 students	22.09.2017
2.	Govt. Model Higher Secondary School, Kozhikode	215 students	18.01.2018

6. Training Programmes Conducted

a) In-house Training

Sl. No.	Details of Training	Date
i.	One day refresher training on 'MATLAB' by CoreEL Technologies to Scientists	30th August 2017

b) Road Safety Training for Various Target Groups

Sl. No.	Details of Training	Date
i.	Road Safety Education Programme for students as part of Summer School Camp at State Central Library, Thiruvananthapuram. 400 students participated.	27th April 2017
ii.	Training on Road Safety for NCC Cadets at St.Thomas College, Kozhencherry, Pathanamthitta.	28thApril 2017
iii.	Road Safety Education Programme for high school students in association with Institute of Engineers (India) at Visvesaraiyya Bhavan, Thiruvananthapuram.	2nd May 2017
iv.	Road Safety Awareness Programme for driving test candidates at Vyapara Bhavan Hall, Ponkunnam.	7th May 2017
v.	Road Safety and First Aid Training Programme in association with WHO, INDUSEM, AIIMS & INDUSEM/EMA member medical colleges in India at Thrissur.	13th May 2017
vi.	Road Safety and First Aid training programme for Junior Red Cross cadets and counselors in Thrissur at Town Hall, Thrissur. 738 JRC Cadets and 44 counselors participated.	26.07.2017 – 28.07.2017
vii.	Training on Road Safety for the seventh batch Excise Drivers at State Excise Academy and Research Centre, Thrissur.	07.12.2017– 08.12.2017

viii.	Training on Road Safety to the Police Trainees at Kerala Police Academy. 385 police driver trainees and 600 women police battalion trainees participated.	06.02.2018 – 09.02.2018

7. Exhibitions

1. Road Safety Exhibition and audio-visual programmes in connection with Indian Science Congress 2017, Thirupathi, 1st July 2017.
2. Road Safety Exhibition and audio-visual programmes in connection with 105th Indian Science Congress, Chennai, 11th -17th October 2017.
3. Road Safety Exhibition and audio-visual programmes in connection with 30th Kerala Science Congress at Government Brennen College, Thalassery, Kannur, 28th -30th January 2018. NATPAC got First Place in the category of KSCSTE Institutions.

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

Name of Programme	Organised by	Date (s)	Venue	Participants
Seminars/Conferences				
Consultative meeting on the status of SAPCC updation for the Climate Change Cell Focal Team Members (CCCFTM)		09.10.2017	Thiruvananthapuram	Jegan Bharath Kumar A
10th Urban Mobility India (UMI) Conference cum Exhibition and CODATU XVII Conference	Institute of Urban Transport	04.11.2017 – 06.11.2017	Hyderabad International Convention Centre	V S Sanjay Kumar Sabitha N M K C Wilson Arun Chandran R Chandraprathap
National Seminar on 'Geospatial Information Systems: Emerging Trends and Utilities'		14.12.2017 – 15.12.2017	Inter University Centre for Geospatial Information, Science & Technology, University of Kerala	Ebin Sam
Civil Engineering Advancement Sustainable Infrastructure Development and Environment (CEASIDE -2018)		18.01.2018-20.01.2018	Government Engineering College, Thrissur	Sanjai R J
Workshops				
Geospatial Technology for Development Planning and Governance	Centre for Environment and Development	22.05.2017	PWD Rest House, Thiruvananthapuram	M S Saran
Regional Advocacy meeting on Road safety Motor vehicle (Amendment) Bill 2017	Centre for Environment and Development	14.07.2017	Thiruvananthapuram	Anish Kini
One-day workshop	National Institute of Personnel Management (Trivandrum Chapter)	26.09.2017	Thiruvananthapuram	Veena S Mohammed Nazerudheen
National Workshop on Planning and Design of Urban Roads and Streets	Indian Roads Congress	07.10.2017 – 08.10.2017	India Habitat Centre, New Delhi	V S Sanjay Kumar Sabitha N M K C Wilson R Chandraprathap

Workshop on Road Safety	MoRTH and KRSA	11.10.2017	Thiruvananthapuram	Ebin Sam
Workshop on ' Environmental Issues of Monroethuruthu Island & Sustainable Solution'	Department of Environment and Climate Change	19.02.2018	Kollam	Shaheem S Salini P N
National Information system for Climate and Environment Studies (NICES) Data Products		26.02.2018	NIT, Calicut	Sabitha N M
Erudite Scholar – in – Residence workshop on "OGC – Standards Background – Theory – Practice" by Prof. Dr. Ing. Franz- Josef Behr, Stuttgart University of Applied Sciences, Germany	Sponsored by Kerala State Higher Education Council	05.03.2018- 06.03.2018	University of Kerala , Thiruvananthapuram	M S Saran
Training Programmes				
Two days Training Programme on E-Office	IMG, Thiruvananthapuram	June 2017	IMG, Thiruvananthapuram	NATPAC Staff
Bhuvan Overview	National Remote Sensing Centre (NRSC), ISRO, Hyderabad, Govt of India	29.06.2017 – 30.06.2017		Sabitha N M Ebin Sam
Management Development Programme (MDP)	Kerala State Council for Science, Technology & Environment (KSCSTE)	07.08.2017 – 11.08.2017	IIMK Campus, Kozhikode	V S Sanjay Kumar
One day training program	National Institute of Personnel Management (Trivandrum Chapter)	22.11.2017	Thiruvananthapuram	P N Salini
GIAN Course on "Pavement Preservation and Environmental Impact Assessment of Recycled Materials in Pavement Management"	IIT Madras	04.12.2017- 09.12.2017	IIT Madras, Chennai	V S Sanjay Kumar K C Wilson R Chandraprathap Salini U
Planning, Design & Construction of Intersections & Interchanges	Sardar Vallabhai National Institute of Technology, Surat & IIT Mumbai	17.12.2017	IIT Mumbai	P N Salini Ebin Sam Jegan Bharath Kumar A

Management Development Programme (MDP) "Leadership Essentials and Strategic Insights"	Kerala State Council for Science, Technology & Environment (KSCSTE)	18.12.2017 – 22.12.2017	IIMK Campus, Kozhikode	B Subin M S Saran B Anish Kini
Three day short term course on "Modelling Transport in Smart City Context"	Transportation Engineering Research Centre, Dept of Civil Engg, College of Engg,Trivandrum	14.03.2018-16.03.2018	Thiruvananthapuram	Shaheem S P N Salini Arun Chandran Anish Kini
Capacity building program on Sustainable Urban Transport	Institute of Management in Government (IMG), Thiruvananthapuram in collaboration with Ministry of Housing and Urban affairs, GOI	21.03.2018-23.03.2018		M S Saran

9. Guidance to Students' Internships/Project Work and Thesis

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

Name of the Institution	Course	Guide	No.of Students	Topic
Amal Jyothi College of Eng. & Technology	B.Tech (Civil)	Shaheem S T Ramakrishnan	3	Traffic and Transportation study for Kattappana Town
College of Engineering, Thiruvananthapuram	M.Tech (Tptn.)	V S Sanjay Kumar	1	
Viswajyothi College of Engineering and Technology, Vazhakkulam, Thodupuzha	B Tech (Civil)	P N Salini	4	Traffic and transportation planning studies for a town
SCMS School of Engineering and Technology	B.Tech (Civil)	P N Salini	4	Integrated designs for a Bus Terminal
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Tptn.)	P N Salini	2	Development Plan for an Integrated Parking System at Medical College
Indian Institute of Information Technology and Management Kerala (IIITMK)	M.Sc Geoinformatics	M S Saran	1	Spatial Analysis of Accident Black Spots in Thiruvananthapuram District
Indian Institute of Information Technology and Management Kerala (IIITMK)	M.Sc Geoinformatics	M S Saran	1	Identification of Shortest Path for Tourist Places in Thiruvananthapuram using GIS Based Network Analysis

Indian Institute of Information Technology and Management Kerala (IIITMK)	M.Sc Geoinformatics	M S Saran	1	Spatio-Temporal Change Detection in Vembanad-Kol Wetlands
Sree Buddha College of Engineering, Pathanamthitta	B.Tech Civil)	Sabitha N M	4	Study on Development of Edappally Canal
UKF College of Engineering, Parippally	B.Tech Civil)	Sabitha N M	4	Study on improvement of Kollam-Varkala waterway for tourism and passenger transport
SriVellappally Natesan College of Engineering, Mavelikkara	B.Tech Civil)	Sabitha N M	4	Study on accidents and safety aspects related to Inland Waterways
Sree Budha college of Engineering	B.Tech Civil)	Wilson K C		Pavement performance of State Highway 1
Sree Budha college of Engineering	B.Tech Civil)	Wilson K C		Performance of roads in water logged areas
TKM college of Engineering	B.Tech Civil)	Wilson K C		Traffic management plan for Techno city
ACE College of Engineering	B.Tech (Civil)	Arun Chandran		Traffic and Transportation study for Piravam
Mount Zion College of Engineering, Pathanamthitta	B.Tech Civil)	Ebin Sam	4	Road Safety impact study and road safety audit on Karamana - Pravachambalam stretch on NH-66
Rajadhani Institute of Engineering and Technology	B.Tech Civil)	Ebin Sam	4	Traffic Safety Analysis using GIS
Gurudev Institute of Science & Technology, Kottayam	B Tech (Civil)	Jegan Bharath Kumar.A	5	Road Safety Improvement for road section from Ulloor to Kuzhivilla on NH-66 Bypass
Sarabhai Institute of Science and Technology, Thiruvananthapuram	B Tech (Civil)	Jegan Bharath Kumar.A	6	Performance of soil blended with waste plastic
Mar Athanasius College of Engineering, Kothamangalam	B Tech (Civil)	Jegan Bharath Kumar.A	3	Preparation of Detailed Project Report of Kochi Canals
Mar Athanasius College of Engineering, Kothamangalam	B.Tech Civil)	Prasanth.G Jegan Bharath Kumar.A	4	Study on Operation of Sea Cruise service between Kovalam and Kanyakumari
Sri Vellappally Natesan College of Engineering Kattachira, Pallickal Mavelikara	B.Tech Civil)	Prasanth.G Jegan Bharath Kumar.A	3	Study on Operation of Sea Cruise service between Kovalam and Kanyakumari
Mar Athanasius College of Engineering, Kothamangalam	B.Tech Civil)	Jegan Bharath Kumar.A	3	Preparation of Detailed Project Report of T-P Canal
Regional Institute of Technology, Kottayam	M.Tech (Tptn.)	Chandra Prathap R		Analysis on Cost Variations of Flexible Pavements subjected to Overloaded Trucks
Saintgits College of Engineering, Kottayam	B.Tech Civil)	B Anish Kini	4	Crowd Management at Erumeli

St Thomas Institute for Science and Technology, Trivandrum	B.Tech (Civil)	B Anish Kini	5	Junction Improvement study for closely spaced staggered intersections
Sreebudhha College of Engineering, Pathanamthitta	B.Tech (Civil)	Sanjai R J	5	Impact of Road Safety Initiatives – A case study of selected stretches of Thiruvananthapuram CBD
College of Engineering, Thiruvananthapuram	MBA	Sanjai R J	1	Ongoing activities of NATPAC

10. Presentation of Papers in Seminars/Workshops

Sl. No.	Author(s)	Paper details	Date
i.	Salini P N, Anish Kini B, Shaheem S, Dr.B G Sreedevi	*"Potential of Sustainable Options for Last Mile Connectivity to Work centre Campuses"*. Proceedings of the 4th Conference on Transportation Systems Engineering and Management (CTSEM 2017), organised by Anna University, Chennai	12/05/2017-13/05/2017
ii.	Sabitha N M, Dr.B G Sreedevi, V S Sanjay Kumar	"*The Role of Waterways in Sustainable Urban Transport - a Case Study of Puthenthodu Canal in Thrissur, Kerala*". Proceedings of the 4th Conference on Transportation Systems Engineering and Management (CTSEM 2017), organised by Anna University, Chennai	12/05/2017-13/05/2017
iii.	K C Wilson, V S Sanjay Kumar, P N Salini, Anjin Ajay	"*Investigation and Design of Pavement of Purakkad-Pathirapally stretch of NH 66 in Alappuzha, Kerala"*. Proceedings of the 4th Conference on Transportation Systems Engineering and Management (CTSEM 2017), organised by Anna University, Chennai	12/05/2017-13/05/2017
iv.	Jegan Bharath Kumar A, Salini.U, V S Sanjay Kumar	"*Pavement Rehabilitation and Improvement Strategy in State Highway-A case study of Malappuram Region"*. Proceedings of the 4th Conference on Transportation Systems Engineering and Management (CTSEM 2017), organised by Anna University, Chennai	12/05/2017-13/05/2017
v.	Anish Kini B, Salini P N, V S Sanjay Kumar, K C Wilson	"*Traffic Crashes and Safety prioritization of Roads for Implementation of Road Safety Measures*". Proceedings of the 4th Conference on Transportation Systems Engineering and Management (CTSEM 2017), organised by Anna University, Chennai	12/05/2017-13/05/2017
vi.	Chandra Prathap.R, Shahul Hameed P K Jegan Bharath Kumar A Syed Mohammed	*"Study on Impact of Vehicle Overloading on National Highways in Varying Terrains"*. Proceedings of 4th Conference on Transportation Systems Engineering and Management (CTSEM 2017), organised by Anna University, Chennai	12/05/2017-13/05/2017
vii.	V S Sanjay Kumar, Suby Charles, Wilson K C	"*Level of Compliance of Seat Belt Usage in Selected Cities of Kerala*". Proceedings of the 3rd International conference on Materials Mechanics and Management (IMMM 2017), organised by College of Engineering, Trivandrum	13/07/2017 - 15/07/2017
viii.	Sabitha N M, Dr.B G Sreedevi, V S Sanjay Kumar	"*Feasibility Analysis for Waterway Development – A Case Study of Canals in Thrissur, Kerala*". Proceedings of the 3rd International conference on Materials Mechanics and Management (IMMM 2017), organised by College of Engineering, Trivandrum	13/07/2017 - 15/07/2017

ix.	Ebin Sam, Dr.B G Sreedevi	*"Identification and prioritization of accident black-spots in Ernakulam district"*. International Road Federation Middle East and North Africa (IRF MENA) Regional Congress and Exhibition at World Trade Centre, Dubai, UAE. Published in the proceedings.	29/10/2017 – 31/10/2017
x.	P N Salini, Anish Kini B, Dr.B G Sreedevi, Shaheem S	"*Sustainable Public Transit System for Last Mile Connectivity to Major Work Centres and the Mode Choice of Employees*", International Road Federation (IRF) World Road Meeting 2017 at Delhi (Knowledge Park II, Greater Noida). Published in the proceedings.	14/11/2017 - 17/11/2017
xi.	M S Saran	*"Spatial Analysis of Accident Black Spots in Thiruvananthapuram District"*, National Seminar on "Geospatial Information Systems: Emerging Trends and Utilities" at Inter University Centre for Geospatial Information Science and Technology, University of Kerala, Karyavattom Campus, Thiruvananthapuram.	14/12/2017 - 15/12/2017
xii.	P N Salini, Dr.B G Sreedevi, Ebin Sam S	"*Resource Mapping of Highway Materials along with their Characteristic Properties and Desirability"*, 4th Conferenc Transportation Research Group of India (CTRG**)** at IIT Bom Published in conference compendium.	17/12/2017 – 20/12/2017
xiii.	P N Salini, Ardra S Krishna, Jomy Thomas	Poster titled *"Possible Modal Shift of Home-based work trips due to the development of Kochi Metro and reduction in fuel consumption and emissions*", 4th Conference of Transportation Research Group of India (CTRG**)** at IIT Bombay. Published in conference compendium. ***Awarded the Best poster certificate.***	17/12/2017 - 20/12/2017
xiv.	Ancy Santhosh, Ebin Sam, Dr.Bindhu B K	*"Pedestrian Accident Prediction Modelling - A Case Study In Thiruvananthapuram City"*, 4th Conference of Transportation Research Group of India, organized by Indian Institute of Technology, Bombay and Sardar Vallabhbhai National Institute of Technology Surat at IIT Mumbai.	17/12/2017 - 20/12/2017
xv.	Jegan Bharath Kumar A, T Ramakrishnan	*"Assessment of walkability and pedestrian level of service in two cities of Kerala"*, 4th Conference of Transportation Research Group of India, organized by Indian Institute of Technology, Bombay and Sardar Vallabhbhai National Institute of Technology Surat at IIT Mumbai.	17/12/2017 - 20/12/2017
xvi.	Remjish R S , Shaheem S	*"Comparison of Demographic Features, Urban Form and Travel Characteristics"*, International conference on emerging trends in Engineering, Science and Technology 2018 at Government Engineering College, Thrissur. Published in the proceedings.	17/01/2018 - 19/01/2018
xvii.	Gopika Mohan, Shaheem S	*"Development of Accessibility for Proposed LRT System in Thiruvananthapuram city"*, International conference on emerging trends in Engineering, Science and Technology 2018 at Government Engineering College, Thrissur. Published in the proceedings.	17/01/2018 - 19/01/2018

xviii.	Sreelekshmi S , Shaheem S	*"Integration of Multi-Modal Transit System for urban areas – A case study of Cochin city"*, International conference on emerging trends in Engineering, Science and Technology 2018 at Government Engineering College, Thrissur. Published in the proceedings.	17/01/2018 - 19/01/2018
xix.	Remjish R S, Shaheem.S	Poster titled *"Growth of urban travel form – A case study of Thiruvananthapuram City"*. 30th Kerala Science Congress, organised by Keraka State Council for Science, Technology & Environment (KSCSTE) in association with CWRDM at Government Brennen College, Thalassery, Kannur. Published in the proceedings.	28/01/2018 - 30/01/2018
xx.	Ardra S Krishna, Salini P N, Manupriya K, T Ramakrishnan	Poster titled *"Traffic and Travel Characteristics of a Small Sized Town – Harippad - a case study"*. 30th Kerala Science Congress, organised by Keraka State Council for Science, Technology & Environment (KSCSTE) in association with CWRDM at Government Brennen College, Thalassery, Kannur. Published in the proceedings.	28/01/2018 - 30/01/2018
xxi.	Shaheem.S Aarsha S Hari	"E*valuation of Urban transport service level benchmarks of major Cities in Kerala"*. National Environment and Climate Change Congress 2018 (NECCC-2018), organized by Directorate of Environment and Climate Change (DoECC), Govt of Kerala at Energy Management Centre (EMC) Thiruvananthapuram.	20/03/2018-22/03/2018
xxii.	Salini P N, Arun Chandran, Manupriya K Ardra S Krishna	"*Potential of Non Motorised Transport in Sustainable Development Plan for Towns"*. National Environment and Climate Change Congress 2018 (NECCC-2018), organized by Directorate of Environment and Climate Change (DoECC), Govt of Kerala at Energy Management Centre (EMC) Thiruvananthapuram.	20/03/2018-22/03/2018
xxiii.	Jegan Bharath Kumar A, T Ramakrishnan	*"Development of Mobility in Varkala"*. Ist National Environment and Climate Change Congress - 2018 (NECCC-2018) organized by Directorate of Environment and Climate Change (DoECC), Dept. of Environment, Govt. of Kerala at Energy Management Centre (EMC) Thiruvananthapuram.	20/03/2018-22/03/2018
xxiv.	V S Sanjay Kumar, Vishnu Mohan, Salini.U	*"Development of Pavement Design Strategy for Rural Roads"*. Proceedings of International Conference on Advances in Engineering and Technology, India.	

Papers Published in Referred Journals

- **B G Sreedevi**, **Salini P N, "***Pavement Performance Studies on Roads Surfaced Using Bituminous Mix with Plastic Coated Aggregates"*, International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Vol.6 (Special Issue 4), March 2017.

- **Wilson K C, Salini P N, B G Sreedevi**, *"Limited Use Road Over Bridges for Light vehicles in Lieu of Low Train Vehicle Unit Level crossings*", Indian Highways, Vol.45 (4), April 2017, P.P 35-47.
- **M S Saran,** "*Evaluation of accident black spots on roads using Geoinformatics tools in Kozhikode district, Kerala*", Journal of Geomatics, Vol.11 (2), October 2017, P.P 218-223.
- **B G Sreedevi, "***Road safety in Kerala, A perspective from NATPAC"*, Indian Highways, Vol.45 (11), November 2017, pp 47-52.
- **Neena M Joseph, Basil Jolly, Gayathry N P, Harikrishnan.S, Joseph Roy, Salini P N,** *"Link Volume and Capacity Utilisation of Roads in Kondotty Town"*, International Research Journal of Engineering and Technology (IRJET), Vol.05, (02), February 2018.
- **Salini, U, B G Sreedevi, Remjish R S, Anoop T V**, "*Use of Coir Fibre in Stone Matrix Asphalt for Pavement Construction*", Indian Journal of Geosynthetics and Ground Improvement, (2018) 7(1), pp.28-34.

11. *Invited Talks/Media Interactions*

Dr. B G Sreedevi

Media Interactions

Sl. No.	Topic	Media	Date
1.	*'Discussion on Kochi Metro'*	Manorama Channel	10/05/2017
2.	*'Comment on License Suspension and Road Safety'*	All India Radio	29/05/2017
3.	*'Discussion on Kochi Metro'*	'Samvadam' in Doordarshan	16/06/2017
4.	*'Discussion on Light Metro'*	'Varthamanakalam' in Doordarshan	19/06/2017
5.	*'Effect of rain on road safety'*	All India Radio	28/06/2017
6.	*'Waterway Development for Kerala'*	Discussion in Malayala Manorama	08/08/2017
7.	*'Inland Waterway development'*	Asianet	September 2017
8.	*'Coastal Highway Development'*	Asianet	September 2017
9.	*'Hill Highway Development'*	Asianet	September 2017

10.	*'Discussion on Waterway Development'*	All India Radio	06/09/2017
11.	*'Discussion on Coastal Highway and Hill Highway Development'*	'Varthamanakalam' in Doordarshan	12/09/2017
12.	*'KSTP Roads'*	Asianet	12/10/2017
13.	*'Comment on Accident Abatement Measures for Kerala'*	All India Radio	28/11/2017

Invited Talks

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Road infrastructure development'*	Keynote address at NCTT 2017 organised by Civil Engineering Department, College of Engineering, Thiruvananthapuram	21/07/2017
2.	*'Integration of urban road infrastructure'*	Training Programme organised by Institute of Urban Transport (IUT), Chennai	27/07/2017
3.	*'Urban Transportation Planning and Management'*	Training Programme organised by Institute of Urban Transport (IUT), Chennai	27/07/2017
4.	*'Walkability in Kochi'*	Workshop organized by ESAF, Kochi	10/08/2017
5.	*'Transportation scenario of Kollam'*	Technical Presentation at Bishop Jerome College of Technology, Kollam	14/08/2017
6.	*'Need for Mass Transportation - an analysis'*	Technical Presentation at Sasthra University, Thanjavore	08/09/2017
7.	*'Transportation Development in Kerala, Opportunities and Challenges'*	Technical Presentation at St. Thomas Institute of Technology, Trivandrum	27/09/2017
8.	*'Transportation problems of Alappuzha'*	Discussion organized by Alappuzha Municipality	23/10/2017
9.	Session Chair	Renewable Energy Congress, 2018, organized by CED and ANERT, Trivandrum	26/02/2018
10.	Session Chair	National Environment and Climate Change Congress, 2018, organized by DoECC, Trivandrum	20/03/2018
11.	*'Integration of urban road infrastructure'*	Training Program organized by Institute of Urban Transport (IUT), Trivandrum	22/03/2018

Shaheem S

Media Interactions

Sl. No.	Topic	Media	Date
1.	*'Deep Focus'* regarding Road Safety in Kerala	Media One	10/01/2018
2.	'Varthamanakalam' regarding Road Accident Studies done in Kerala	Doordarshan	23/01/2018
3.	*'Vartamanakalam'*	Doordarshan	09/03/2018

V S Sanjay Kumar

Invited Talk

Sl. No.	Topic	Venue/Event	Date
1.	*'Impact of proposed Vizhinjam International Seaport on Road Transportation'*	Workshop for Vizhinjam Port Area Development held by Vizhinjam International Seaport Limited at Thiruvananthapuram	19/05/2017

M S Saran

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'GIS in Infrastructure'*	Key note Address in the Technical Session in the National Seminar on "Geospatial Information Systems: Emerging Trends and Utilities" at Inter University Centre for Geospatial Information Science and Technology, University of Kerala, Karyavattom Campus, Thiruvananthapuram	14/12/2017 – 15/12/2017

Sabitha N M

Media Interactions

Sl. No.	Topic	Media	Date
1.	*'Padhathi Swapnangal'*	Asianet News programme	

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Environmental and Social Issues'*	Talk delivered as faculty to the '30th Capacity Building Programme on Sustainable Urban Transport' of The Ministry of Urban Development, Government of India at the Anna Institute of Management, Chennai	26/07/2017 – 28 /07/2017
2.	*'Environmental and Social Issues'*	Talk delivered as faculty to the '35th Capacity Building Programme on Sustainable Urban Transport' of The Ministry of Urban Development, Government of India at ATI Campus, Mysuru	31/01/2018 – 02/02/2018
3.	*'Environmental and Social Issues'*	Talk delivered as faculty to the '38th Capacity Building Programme on Sustainable Urban Transport' of The Ministry of Urban Development, Government of India at Institute of Management in Government, Thiruvananthapuram	21/03/2018 – 23/03/2018

Ebin Sam

Invited Talk

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	*'Identification of Blackspots'*	Talk delivered as part of Jnana Lecture series organised by Association of Civil Engineers (ACE), Department of Civil Engineering, Federal Institute of Science and Technology at Angamaly, Ernakulam	25/09/2017
2.	*'Public Transport' and 'Knowledge Management Centre'*	Talk delivered as faculty to the '35th Capacity Building Programme on Sustainable Urban Transport' of The Ministry of Urban Development, Government of India at ATI Campus, Mysuru	31/01/2018 – 02/02/2018

B.Anish Kini

Invited Talk

Sl. No.	Topic	Venue/Event	Date
1.	*'Public Transport and Knowledge Management Centre'*	Talk delivered as faculty to the '38th Capacity Building Programme on Sustainable Urban Transport' of The Ministry of Urban Development, Government of India at Institute of Management in Government, Thiruvananthapuram	21/03/2018 – 23/03/2018

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

Dr. B. G. SREEDEVI

- Official Member, Board of Directors of Kerala State Road Transport Corporation (KSRTC), Government of Kerala
- Official Member, Board of Directors of Kerala Urban Road Transport Corporation
- Expert member for the selection of G M, DGM for Kerala Road Fund Board (No. 3071/ EL/ KRFB/2016 dtd. 19-6-2017)
- Member, Technical Committee for scrutiny of DPR for Alappuzha City Road improvement project. (GO (Rt) NO:1090/2017/PWD dtd 26-7-2017)
- Member, Expert committee for review of TRDCL claims of City Road Improvement Project (GO (Rt) No: 1674/2017/PWD dtd. 10-11-2017)
- Member of consultative committee, Transportation Engineering Research Centre(TRC), College Of Engineering, Trivandrum

P. N. SALINI

- IRC Membership (Roll No M– 32094)
- Membership in Institute of Urban Transport (India) - Membership No M–1493

WILSON K. C.

- Technical Member – Kerala Road Safety Authority

EBIN SAM

- Life Member, Indian Roads Congress (e-LM 100932)
- Kerala Economic Association - Life Membership
- Life Member, Indian Society of Remote Sensing (L-4790)

13. *Achievements*

P. N. SALINI

- Received gold medal and cash award with certificate of merit for securing first position in '*Transport Economics and Management diploma course examination, 2017*' conducted by Institute of Rail Transport, New Delhi, India.

14. *Road Safety Education Materials*

Films

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

Booklets

1. Safe Road to School (English & Malayalam)
2. Preventing Accidents
3. Two Wheeler Driving Manual
4. Road Safety Manual for Goods Vehicle
5. All about Lane Driving and Road Safety
6. Safe Cycling
7. Autorickshaw Driving Manual (English & Malayalam)
8. Defensive Driving
9. Teacher's Manual (English & Malayalam)
10. Safe Community Programme for Panchayats (English & Malayalam)
11. Helping Road Accident Victims (English & Malayalam)
12. Rules of Road Regulations,1989
13. On Car and Safe Driving
14. Defensive Bus Driving and Road Safety Guide
15. Road Safety Slogan
16. Vehicle Upkeep and Safety

17. Alphabets of Road Language
18. Road Safety Quiz
19. Safe and Responsible Parking
20. Road Safety and Youth Leadership Programmes
21. Safety Rules for Railway Level Crossing and Around Tracks
22. Safe and Secure Travel by Train
23. Driver's Guide (Malayalam)
24. Formation and Activities of Road Safety Cell in Schools (Malayalam)
25. കാൽനട യാത്രക്കാർക്കുള്ള സുരക്ഷാ മാർഗരേഖ
26. സ്കൂൾ കുട്ടികൾക്കുള്ള റോഡ് സുരക്ഷാധിഷ്ഠിത ബോധവത്കരണം
27. പഷ്പു ഉറങ്ങുകയല്ല
28. സുരക്ഷിതമായ സൈക്കിൾ സവാരി
29. സുരക്ഷിത പാർക്കിംഗ്
30. റോഡിലെ ഭാഷയുടെ അക്ഷരമാല
31. റോഡ്സുരക്ഷാ മുദ്രാവാക്യങ്ങൾ
32. റോഡ് ഗതാഗത നിയന്ത്രണ ചട്ടങ്ങൾ
33. ലെയിൻ അധിഷ്ഠിത ഡ്രൈവിംഗും റോഡ് സുരക്ഷയും
34. പ്രതിരോധാത്മക ഡ്രൈവിംഗ്
35. റോഡ് സുരക്ഷയും യുവജന നേതൃത്വ പരിപാടികളും
36. ഇരുചക്ര വാഹനമോടിക്കുന്നവർക്ക് ഒരു കൈപുസ്തകം
37. ചരക്ക് വാഹനങ്ങൾക്കുള്ള റോഡ് സുരക്ഷാ സഹായി
38. പ്രതിരോധാത്മക ബസ് ഡ്രൈവിംഗും റോഡ് സുരക്ഷയും
39. റോഡപകടങ്ങൾ തടയുന്നതിനുള്ള മാർഗങ്ങൾ
40. വാഹനങ്ങളുടെ പരിപാലനവും സുരക്ഷയും

Student Badges

1. Be Careful and Be Safe
2. Don't Be Safety Blinded Be Safety Minded
3. Follow Traffic Rules and Be Safe
4. You Can't Fix Your Brain at a Body Shop – Buckle Up!
4. Road Safety is a Mission, Not an Intermission
5. Before Crossing Stop! Think! Then Act
6. Kindness is Giving the Right of Way
7. Look Carefully and Drive Safely
8. Be smart, think, then Start
9. Leave sooner, drive slower, live longer
10. Drive as if every child on the street were your own
11. Be careful and be safe
12. At work at play let safety lead the way
13. Safety is a simple ABC- Always Be Careful
14. Safety on road, Safe tea at home
15. The safe way is the best way
16. While Driving Put off Mobile! Put on Seat Belt!
17. Better to Arrive Late Than Never

18. Courtesy and Common Sense Promote Road Safety
19. നിൽക്കൂ!ശ്രദ്ധിക്കൂ!റോഡ് മുറിച്ച് കടക്കൂ!
20. സൂക്ഷിച്ച് വാഹനമോടിക്കൂ, റോഡിലെ തിരക്കിൽ നിങ്ങളുടെ കുട്ടികളും ഉണ്ടായിരിക്കാം
21. വേഗതയിലല്ല സ്മാർട്ടാകേണ്ടത്, സുരക്ഷയിലാണ്
22. ശ്രദ്ധിച്ച് നോക്കൂ, സുരക്ഷിതമായി ഡ്രൈവ് ചെയ്യൂ
23. സുരക്ഷിതത്വം മഹത്വമാണ്
24. വീഥിയിലൂടെ വേഗത വേണ്ട
25. ശ്രദ്ധിക്കൂ സുരക്ഷിതരായിരിക്കൂ
26. അശ്രദ്ധ അപകടമാണ്
27. നേരത്തെ ഇറങ്ങൂ, നേരെ ഓടിക്കൂ, നേരായവിധം ജീവിക്കൂ
28. ശ്രദ്ധയുള്ളിടത്ത് സുരക്ഷ ഉണ്ട്
29. പാഞ്ഞു പോകരുത്, പ്രാണൻ എടുക്കരുത്
30. സുഗമമായ പാത നിങ്ങളുടെ മാത്രം സ്വന്തമല്ല

Calenders

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

Leaflets

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

23. Trains of thought- Safety Slogans - Just Think over these
24. Railway level Crossings- Safety Tips for Vehicle Drivers
25. Safe Crossing of Railway Tracks-Tips for Pedestrians and Cyclists
26. Railway Level Crossing- Safety Tips for School Buses
27. Railway Level Crossing- Safety Tips for Truck drivers
28. സുരക്ഷിത ഇരുചക്രവാഹന സവാരി
29. രാത്രികാല റോഡപകടങ്ങൾ എങ്ങനെ ഒഴിവാക്കാം
30. സുരക്ഷിത യാത്രയ്ക്കുള്ള മാർഗനിർദ്ദേശങ്ങൾ
31. പ്രതിരോധാത്മക ഡ്രൈവിംഗ്
32. റോഡ് സുരക്ഷയും മുതിർന്ന പൗരന്മാരും
33. അമിത വേഗതയും അപകടസാധ്യതകളും
34. സുരക്ഷിത പാർക്കിംഗ്
35. സുരക്ഷിത ബസ് യാത്ര
36. ബസ് യാത്രയിൽ/കാൽനടയാത്രക്കാർ
37. ഡ്രൈവർമാർ/അമിത വേഗത
38. സ്ക്കൂട്ടർ/മോട്ടോർ/ഹെൽമെറ്റ് ധരിക്കൂ
39. മൊബൈൽഫോൺ/സീറ്റ് ബെൽറ്റ്
40. ആട്ടോറിക്ഷയിൽ/മദ്യപിച്ച്
41. റോഡിൽ എങ്ങനെ സുരക്ഷിതരാകാം

Display Boards

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

Road Safety Posters

1. പത്തിനും പതിനഞ്ചിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം1
2. പത്തിനും പതിനഞ്ചിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം2
3. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം1
4. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം2
5. അഞ്ചിനും പത്തിനും ഇടയ്ക്ക് വയസ്സുള്ള കുട്ടികൾക്ക് വേണ്ടി രക്ഷിതാക്കൾക്ക് എന്തു ചെയ്യാം3
6. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ1
7. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ2
8. റോഡ് മുറിച്ചു കടക്കുമ്പോൾ3
9. ചില റോഡ് സുരക്ഷാ പ്രവർത്തനങ്ങൾ1
10. ചില റോഡ് സുരക്ഷാ പ്രവർത്തനങ്ങൾ2
11. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേണ്ട കാര്യങ്ങൾ1
12. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേണ്ട കാര്യങ്ങൾ2
13. റോഡ് സുരക്ഷയെ കുറിച്ച് അറിഞ്ഞിരിക്കേണ്ട മറ്റ് കാര്യങ്ങൾ1
14. റോഡ് സുരക്ഷയെ കുറിച്ച് അറിഞ്ഞിരിക്കേണ്ട മറ്റ് കാര്യങ്ങൾ2
15. നിങ്ങളും റോഡ് സുരക്ഷിതത്വവും 1
16. നിങ്ങളും റോഡ് സുരക്ഷിതത്വവും 2
17. ക്രോസിംഗ് ഡ്രിൽ 1
18. ക്രോസിംഗ് ഡ്രിൽ 2
19. യാത്ര ചെയ്യുമ്പോൾ ശദ്ധിക്കേണ്ട കാര്യങ്ങൾ
20. സിഗ്നൽ ലൈറ്റുകൾ
21. സൈക്കിൾ സവാരി ചെയ്യുമ്പോൾ
22. റോഡിൽ നടക്കുമ്പോൾ
23. Protect your life with seat belt and helmet
24. സുരക്ഷിതമായി ബസ്സിൽ യാത്ര ചെയ്യുന്നതിന് ചില നിർദ്ദേശങ്ങൾ
25. സിഗ്നൽ ലൈറ്റുകൾ കാൽനടയാത്രക്കാരുടെ ശ്രദ്ധയ്ക്ക്

INFRASTRUCTURE

1. Testing Facilities and Equipments

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

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

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

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

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

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

2. *Library and Information Services*

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

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

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

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

ORGANISATION

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

I. KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY AND ENVIRONMENT

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

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

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

ii. Executive Committee of KSCSTE

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

iii. Research Council of NATPAC

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

iv. Management Committee of NATPAC

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

v. Information Officers as per the Right to Information Act

Public Information Officer (Technical)	-	Shri D.Robinson Sr.Principal Scientist (Till 30.11.2017) Shri.Shaheem S, Principal Scientist (From 01.12.2017)
Public Information Officer (Administration)		Shri K Mohanakumar Deputy Registrar (Finance) (Till 31.12.2017) Shri.D.Shaju, Section Officer (From 01.01.2018)
Asst. Public Information Officer	-	Smt T S Sangeetha, Assistant
Appellate Authority, RTI Act	-	Director

vi. Internal Committees

a. Library Committee

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

b. Purchase Committee

Shri D Robinson, Sr.Principal Scientist	-	Chairman (Till 24.11.2017)
Dr.B.G.Sreedevi, Chief Scientist	-	Chairperson (From 24.11.2017)
Shri K Mohana Kumar, Deputy Registrar	-	Member (Till 30.10.2017)
Shri S Shaheem, Principal Scientist	-	Member
Shri.Kalaiarasan, Scientist	-	Member (Till 30.10.2017)
Shri.George Koshy K, Registrar	-	Member

c. Grievance Redressal Committee

Shri K George Koshy, Registrar	-	Chairman
Shri D Robinson, Sr.Principal Scientist	-	Member
Shri K Mohanakumar, Deputy Registrar	-	Member

Shri T Ramakrishnan, Technical Officer V	-	Member
Shri K C Wilson, Scientist	-	Member
Smt. T S Sangeetha, Assistant Grade-1	-	Member-Convenor

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

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

e. Editorial Board

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

General Administration

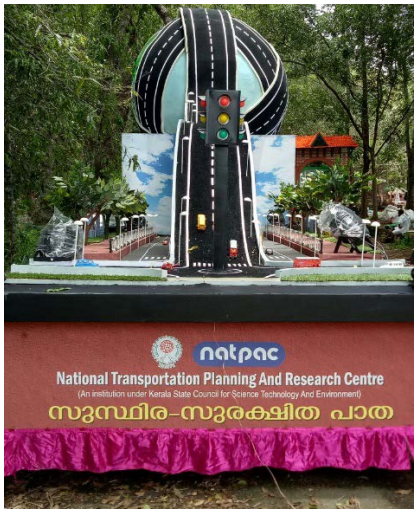
Research Council Meeting

The 19th meeting of the Research Council was held on 8th and 9th April 2017 at NATPAC under the chairmanship of Prof. (Dr.) Veeraraghavan.

Other NEWS

- Onam celebration on 31st August 2017 at K Karunakaran Transpark.

- NATPAC took part in Onam pageantry organised by Tourism Department, Government of Kerala on 9th September 2017. The theme of the float was 'Sustainable – Safe Transportation'. The Centre won 2nd prize in the category Public Sector Undertaking.



- NATPAC received Urban Mobility Award for SOFT (Save Our Fellow Traveler) program organized by Urban Mobility India at Hyderabad, 4th to 6th November 2017.

- NATPAC observed the Constitution Day on 27th November 2017. Shri.George Koshy, Registrar, NATPAC read the preamble of the Constitution to the staff of NATPAC.

- Human Rights Oath taking ceremony was conducted in NATPAC at 11 am on 11th December 2017. Dr.R Prakashkumar, Director (i/c) delivered the oath to the staff of NATPAC.

- The Republic Day celebration on 26th January 2018 at K Karunakaran Transpark.

NATPAC STAFF –AS ON 01.04.2018

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

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

RETIREMENTS

Shri T Mohan
Technical Assistant - 3
Superannuated on
30th April 2017

Shri K Devadethan Nair
Technical Officer - 3
Superannuated on
30th September 2017

Shri D Robinson
Senior Principal Scientist
Superannuated on
30th November 2017

RESIGNATION

Shri K Mohanakumar
Deputy Registrar (Finance)
Superannuated on
31st December 2017

Shri P Kalaiarasan
Scientist
Resigned on
8th August 2017

RESEARCH STUDIES UNDERTAKEN DURING 2017-'18

Sl.No.	Code	Project
1	Plan-262	Development of traffic growth rate model for NHs in Kerala
2	Plan-263	Investigation of major accident spots, causative analysis & mitigative measures
3	Plan-264	Assessment of Risk Potential of SH in Kerala State: a Case Study of Selected SH in Central Kerala
4	Plan-265	Development of GIS-based Road and Traffic Database for Kerala
5	Plan-266	Study on Accidents and Safety Aspects Related to Inland Waterways
6	Plan-267	Database Creation and Management for Inland Waterways in Kerala Using GIS – Phase II
7	Plan-268	Estimation of Trip Generation Rates for Different Land Uses
8	Plan-269	Periodic Updation of Price Indices for different public transport & freight Operations
9	Plan-270	Study on Conservation of Natural Resources by Recycling of Asphalt Pavements
10	Plan-271	Cost of Road Accidents in the state of Kerala
11	Plan-272	Preparation of Comprehensive Mobility Plan for Medium Sized Cities in Kerala
12	Plan-273	Soil Modification by Partial Replacement of Soil by Waste Sand, a By-product of Kaolin Extraction
13	Plan-274	Determination of Shortest Path for Emergency Vehicle to Accident Hotspots using Geo-informatics Technology- a case study of Ernakulam District
14	Plan-275	Development of Accident Information System Highlighting Accident Black Spots for the State of Kerala
15	Plan-276	Study on Estimation of Carbon Credit for West Coast Canal in Kerala
16	Plan-277	Impact of Emitted Heat from Flexible Pavement on Ambient Air Temperature
17	Plan-278	Planning and Development of Transport Network Connecting Potential Tourist Destinations
18	Plan-279	Road Asset Management for National Highways and State Highways in Kerala
19	Plan-280	Evaluation of Moisture Susceptibility of Asphalt Mixtures
20	Plan-281	Study on the Geometric Design and Vehicle Operating Cost on Hill Roads
21	Plan-282	Impact of on-street parking fee on Travel Behaviour- A case study of selected roads in Thiruvananthapuram
22	Plan-283	Pavement Rehabilitation Design Based on Dynamic Cone Penetrometer Test (DCPT)
23	Plan-284	Mode choice Behaviour of Non-work Trips in Medium Sized Cities
24	Plan-285	Integrated Designs for Public Transit Terminals in Urban areas
25	Plan-286 - 1	Traffic studies for Medical College area
26	Plan-286 - 2	Enhancing Road Safety with Adaptive Traffic Signal System-Demonstration cum Implementataion
27	Plan-286 - 3	Accident mitigation study on Pampady stretch of NH183, Kottayam

28	Plan-286 - 4	Road Safety measures for Road section from Kottamukku junction to Kovalam Road
29	Plan-286 - 5	Study on Failure of Roads in Kuttanad Region
30	Plan-286 - 6	Traffic management and beautification schemes for major locations in Kannur and Thalasserry Towns
31	Plan-286 - 7	Road safety measaures for Pilathara – Pappinisserry road in Kannur district
32	Plan-286 - 8	Traffic Studies for Thalassery Town
33	Plan-286 - 9	Designing of Model Road Safety Corridor on Pilathara Pappinnissery KSTP road in Kannur district
34	Plan-286 - 10	Preparation of Intersection improvement plan for important junctions in Dharmadam Constituency

CONSULTANCY/SPONSORED PROJECTS IN 2017-'18

Sl.No.	Code	Project	Sponsored by
1	C 00216	Design of implementation of Road Safety and Traffic Management Schemes for selected road stretches in Gurgaon	Maruti Suzuki Foundation
2		Design and implementation of road safety measures/ study of 45km NH48 in Gurgaon district	Maruti Suzuki Foundation
3	C01016	Economic feasibility of constructing flyovers at Pattom, Ulloor and Sreekaryam junctions in Thiruvananthapuram	Delhi Metro Rail Corporation (DMRC)
4	C 01116	Economic feasibility of constructing flyovers at Thampanoor city in Thiruvananthapuram	Delhi Metro Rail Corporation (DMRC)
5	C 01216	Feasibility study for the development of coastal highway in Kerala	Public Works Department (PWD)
6	C 01716	Development of Foot Over Bridges and subways under PPP model in Thiruvananthapuram	Kerala State Planning Board
7	C 00117	Feasibility study and preparation of Detailed Project Report on Sea Cruise service between Kovalam and Kanyakumari	Director of Ports
8	C 00217	Integrated urban generation and water transport system in Cochin – DPR study	Kerala Shipping and Inland Navigation Corporation Ltd (KSINC)
9	C 00317	Functional classification of roads in urban areas	
10		Traffic Management Schemes for Kozhikode city roads	
11		Access Options for the Proposed TRIDA Bus Terminal at Kazhakoottam	
12	C01115	Feasibility of Ernakulam – Thodupuzha suburban highway	Public Works Department (PWD)

13	C00417	DPR preparation of coastal highway – Investigation works in Alappuzha and Thiruvananthapuram	Public Works Department (PWD)
14	C00617	Traffic management plan for M/s. Spring Infradev ltd.	
15		Cross flyovers for Technopark from NH Bypass – Drawing preparation	
16	C01116	Feasibility of Widening Existing Flyover and Constructing new Flyover at Thampanoor in Thiruvananthapuram City	Delhi Metro Rail Corporation (DMRC)
17	C 00817	Preparation of detailed project report for the development of Inland waterways between Kovalam to Kollam	Kerala Waterways & Infrastructure Ltd. (KWIL)
18	C00717	Traffic Survey at Ch km 18/250 between Thiruvallom and Vazhamuttom and at Ch 6/500 and 8/500 on NH 66 in Thiruvananthapuram	National Highways Authority of India (NHAI)
19	C00917	Pavement design for LSGD roads in Kasaragode	LSGD, Kasargode
20	C01017	Study on Roughness of City Roads in Thiruvananthapuram – TCRIP	Kerala Road Fund Board (KRFB)
21	C01117	Preparation of Detailed Project Report for Development of Inland Waterway between Mahe River and Valapattanam River	Kerala Waterways & Infrastructure Ltd. (KWIL)
22	C01217	Traffic and crowd management for Munnar town during Kurinji season 2018	Tourism Promotion Council
23	C01417	Parking policy for Thiruvananthapuram Corporation area	Regional Town Planning Office
24	C00118	Road Safety Treatment for Adoor and Kazhakkoottam stretch of M C Road in Kerala State as part of Safe Corridor Demonstration Project (SCDP)	Kerala State Transport Project (KSTP)
25	C 00115	Training on Safe Transportation of Hazardous Goods	
26	"	Identification of dangerous and hazardous goods and dealing with emergencies	

Projects Sponsored by Kerala Road Safety Authority (KRSA) RP **00115**

i.	Safe Community Programme at Panchayath Level
ii.	Safe Road to School (SRS) Programme
iii.	Accident Surveys and Analysis
iv.	Impact of speed governors on the safety of heavy vehicles and fuel efficiency
v.	Level of compliance of seat belt usage in selected cities of Kerala
vi.	Development of GIS based Road Safety Data Base Management System
vii.	Application of Intelligent Transport Systems (ITS) for enhancing Road Safety in Kerala
viii.	Accident Reconstruction Studies of Selected Fatal Accidents
ix.	Pedestrian crossing and vehicle conflicts – A case study of selected road stretches in Malabar Region
x.	Road Safety Workshop, Seminars and Training Programmes for drivers, public, traffic police, driver training colleges etc.
xi.	Production and free distribution of Road Safety Education/Awareness Materials like: Films, Road Safety Education Books and Leaflets, Sticker, Badges, Calenders, Display Boards, Banners etc.
RP 00315	Teachers Training Programme – Phase II

NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE, TRIVANDRUM
(A unit of Kerala State Council for Science, Technology & Environment. Govt. of Kerala)
Balance Sheet as at 31st March 2018

(in Rs.)

Liabilities	Sch No	As at 31.03.2018	As at 31.03.2017	Assets	Sch No	As at 31.03.2018	As at 31.03.2017
Reserves & Surplus	4	1,65,24,658	1,81,18,721	Fixed Assets	1	1,65,24,658	1,81,18,721
Corpus fund		4,75,18,286	4,62,23,479	Work in Progress		4,43,322	4,43,322
Current Liablities	5	76,06,383	53,99,573	Current Assets	2	3,96,41,392	15,90,41,607
Unspent balance	6	(1,67,74,457)	9,91,32,508	Loans & Advances	3	10,53,05,098	9,83,10,231
Building Fund Account	4	10,70,39,600	10,70,39,600				
Total		**16,19,14,470**	**27,59,13,881**	**Total**		**16,19,14,470**	**27,59,13,881**

Significant Accounting Policies and Notes to Accounts 14

as per our report of even date attached.

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

Rajeev.R
Partner
Membership No. :211277

For National Transportation Planning and Research Centre

Dy. Registrar (Finance) i/c Registrar Director

VARMA & VARMA THIRUVANANTHAPURAM CHARTERED ACCOUNTANTS

Place : Thiruvananthapuram
Dated : 22.10.2018

NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE, TRIVANDRUM

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

Income & Expenditure Account for the year ended 31/03/2018

(in Rs.)

Expenditure	Sch No	Year ended 31.03.2018	Year ended 31.03.2017	Income	Sch No	Year ended 31.03.2018	Year ended 31.03.2017
To Infrastructure Strengthening (Plan)	10	12,63,49,331	1,65,05,577	By Grant from Government of Kerala	7	17,80,91,281	3,34,72,804
To Infrastructure Strengthening (Non Plan)	11	81,63,900	73,01,484	By Other Receipts	8	69,26,061	3,53,63,741
To Salaries and Allowances (Plan)	12	-	-	By Depreciation written back	1	37,49,838	40,97,755
To Salaries and Allowances (Non Plan)	13	5,05,04,111	4,50,29,484	By Income from Consultancy Project	9	2,66,76,526	1,80,02,781
To Depreciation	1	37,49,838	40,97,755				
To Consultancy Project Expenses		2,66,76,526	1,80,02,781				
Total		**21,54,43,706**	**9,09,37,081**	**Total**		**21,54,43,706**	**9,09,37,081**

Significant Accounting Policies and Notes to Accounts 14

For National Transportation Planning and Research Centre

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

Dy. Registrar (Finance) i/c

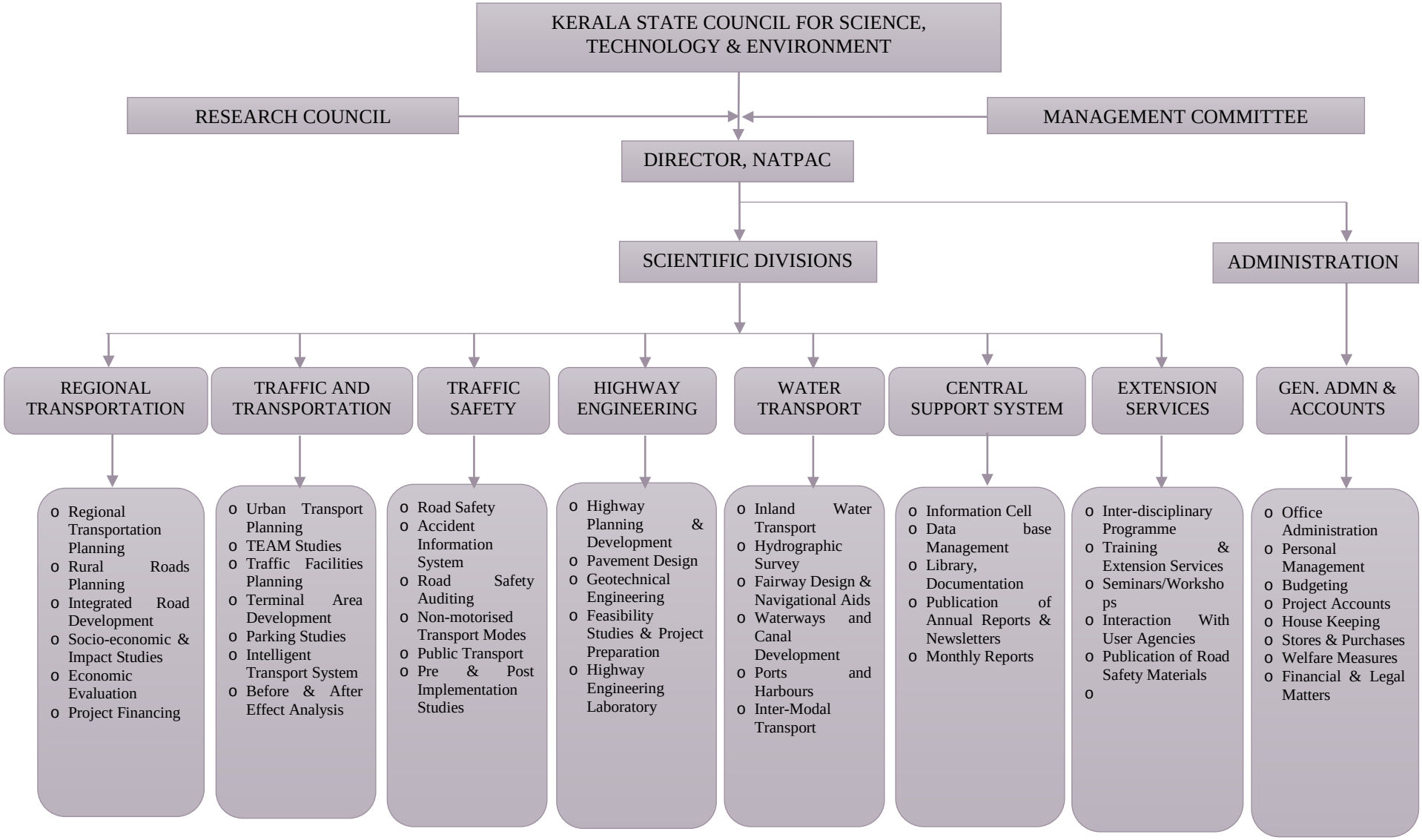
Registrar

Director

Rajeev.R
Partner
Membership No. :211277

VARMA & VARMA THIRUVANANTHAPURAM CHARTERED ACCOUNTANTS

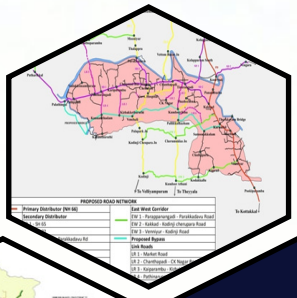
Place : Thiruvananthapuram
Dated : 22.10.2018

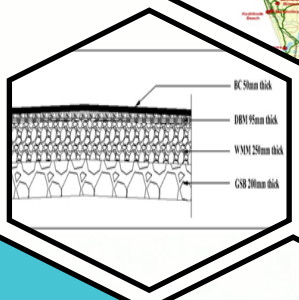

KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY & ENVIRONMENT
RESEARCH COUNCIL
MANAGEMENT COMMITTEE
DIRECTOR, NATPAC
SCIENTIFIC DIVISIONS
ADMINISTRATION
REGIONAL TRANSPORTATION
TRAFFIC AND TRANSPORTATION
TRAFFIC SAFETY
HIGHWAY ENGINEERING
WATER TRANSPORT
CENTRAL SUPPORT SYSTEM
EXTENSION SERVICES
GEN. ADMN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

KSCSTE - National Transportation Planning and Research Centre

(An Institution of Kerala State Council for Science, Technology and Envioronment)
K. KARUNAKARAN TRANSPARK, Aakkulam,
Thuruvikkal P.O, Thiruvananthapuram, Pincode: 695031
Phone: 0471-2551282 / 2554467 / 2553701
E-mail: contactus.natpac@kerala.gov.in, Web: www.natpac.kerala.gov.in

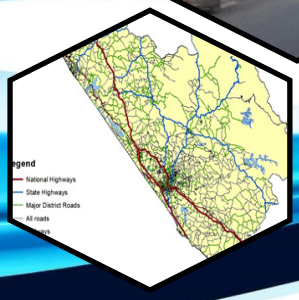
REGIONAL CENTRE (KOZHIKODE)
1/1076(c), Kanakalaya Bank Cross Road,
West Hill P.O, Kozhikode.
Pincode: 673005, Phone: 0495 - 2385505









natpac
KSCSTE-NATPAC

KSCSTE - National Transportation Planning and Research Centre

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

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

(An Institution of Kerala State Council for Science, Technology and Environment)
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E-mail: contactus.natpac@kerala.gov.in, Web: www.natpac.kerala.gov.in