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KSCSTE-NATPAC
National Transportation Planning and Research Centre
(An Institution of Kerala State Council for Science, Technology and Environment)
Sasthra Bhavan, Pattom Palace P.O, Thiruvananthapuram -695 004
www.natpac.kerala.gov.in
E-Mail:contactus.natpac@kerala.gov.in

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Message from the Director…

It is indeed my pleasure to present our Annual Report for the period 2015-'16 which reflects NATPAC's progress and achievements. This report gives an overview of the activities of NATPAC from April 2015 to March 2016. During this year, the Scientists of the Centre handled 23 R&D Projects and 39 Sponsored studies.

The R & D and Consultancy services were focused in the area of Traffic Engineering and Traffic Safety, Transportation Planning, Highway Engineering, Pavement Evaluation and Water Transport.

To ensure mobility needs of the goods and people in a safe and sustainable manner NATPAC prepared Comprehensive Mobility Plan for the cities of Thiruvananthapuram and Kozhikode. The Centre evaluated the effectiveness of queuing of buses on the performance of bus bays. The impact caused by the port development on the road sector in the hinterland areas of Vizhinjam was studied by NATPAC. To promote large scale use of greener transport modes in Kerala, NATPAC identified a possible road map for initial implementation of greener transport in campuses and major work Centres in the State. A pre-feasibility study has been carried out for ensuring round the clock connectivity from Wayanad to Mysore.

The periodic computation of cost of operation of public transport services such as Stage Carriages, Taxi, Auto, State Passenger Boat Services etc., would be helpful for Government in taking decisions on revision of fare.

NATPAC is in the process of developing a traffic growth rate model of the National Highways in Kerala. A perspective plan for National Highway Sections in Kozhikode division on a demonstration mode has been developed. The study for appraisal of the highways developed under Kerala State Transport Project (KSTP) helps in formulating deterioration models for the state roads.

The Centre explored the possibility of recycling the pavement materials extracted during maintenance and reconstruction of the pavement by using them after proper mix design. This will help in reducing the cost of construction and making the construction eco-friendly.

NATPAC managed to conduct a study on walkability in selected road corridors in Thiruvananthapuram and Ernakulam cities in Kerala and identified areas for improving the infrastructure. Study on pedestrian crossing and vehicle conflicts at selected road stretches in Malabar region has been carried out. The most hazardous stretch for pedestrians in Thiruvananthapuram city were identified by the Centre and accident predictive models for pedestrians were developed. Counter measures for the safety of the pedestrians were also proposed. The causative factors to selected road traffic crashes in Kerala were investigated by NATPAC in an ergonomic perspective.

Water Transport is an inexpensive, non-polluting and energy-efficient means of transport. Waterways have always been an important mode of transport in Kerala. This will also give a boost to eco-tourism and commerce. In Kerala it is still largely under-used. NATPAC assessed the utilization of waterways for navigation and put forward policy recommendations for developing this mode of transport in an efficient and sustainable manner.

Our Traffic Safety Division is dedicated to 'Driving Zero Fatalities to a Reality'. The main priority of this Division is to reduce motor vehicle and pedestrian accidents through Road Safety education programmes. NATPAC's traffic safety initiatives and programmes are designed to remind motorists of the importance of safe driving, road sharing and applicable state laws.

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 support received from the Hon'ble Chief Minister of Kerala, Hon'ble Minister for Transport, Hon'ble Minister for Health, Hon'ble Minister for Power and Hon'ble Minister for Works have been great driving force in our accomplishments. The constant support received from the Executive Vice President of KSCSTE, Research Council and Management Committee of NATPAC is gratefully acknowledged. The accomplishments over the past years and the work ahead depends on the support and contribution of our dedicated Staff. I am immensely grateful to our Staff whose energy and support sustain us. 'The Strength of the team is each individual member. The strength of each member is the team'.

Thank You and I look forward to another amazing year for NATPAC.

Dr. B.G.SREEDEVI
DIRECTOR

SUMMARY OF PROJECTS

1. Comprehensive Mobility Plan for Thiruvananthapuram and Kozhikode Cities in Kerala

Comprehensive Mobility Plan [CMP] is a technical document containing short, medium and long term schemes and action programs, to ensure mobility needs of the goods and people in a safe and sustainable manner, with the integration of land use and transport development. CMP is a pre requisite for availing financial grant for major schemes from Ministry of Urban Development [MOUD], Government of India.

NATPAC prepared the Final Report of CMP for the cities of Thiruvananthapuram and Kozhikode containing various short, medium and long term proposals for the development of transport sector in both the cities, at the instance of Kerala Rapid Transit Corporation Ltd. (KRTL), for review of the MoUD. The document was prepared in consultation with various stakeholders like people's representatives and officials involved in the development of transport sector like Municipal Corporation, PWD, NHAI, KSTP, IWAI, KRFB, Police, Town Planning, Water Authority, Electricity Board, premier academic institutions, Pollution Control Board, etc.

Thiruvananthapuram City

The study area comprised of Thiruvananthapuram Municipal Corporation, Neyyattinkara Municipality and eight adjoining panchayats *viz*. Mangalapuram, Andoorkonam, Vilappil, Vilavoorkal, Pallichal, Kalliyoor, Venganoor, and Balaramapuram covering an area of 374km² with a total population of 13.3 lakhs.

An urban transport model was developed for the study area (which was further divided into several zones) for replicating the existing transport scenario, and forecasting the travel demand in the planning period (for 2024and 2034). The model was built using the state of art software–CUBE. The trip generation model and trip attraction model developed for peak hour using multiple regression method is presented in **Table 1**.

Table 1: Trip end models developed for Thiruvananthapuram City

Region	Trip production model	Trip attraction model
Thiruvananthapuram	• Trip Production = 0.0579* Population+183	Trip Attraction = 0.4814 * Employment+103.94

Short term, medium-term and long-term proposals were recommended for the city of Thiruvananthapuram, based on the analysis of data collected from primary and secondary sources, and traffic demand predicted by the model for the horizon year (2034), covering a total cost of Rs 2302 crores, by integrating land-use characteristics and transport development, catering to the future traffic demand.

Table2: Anticipated Effectiveness of the Proposals

Scenario	Private vehicle share	Autorickshaw share	PT Share	Average Speed (kmph)
Base Year	50%	10%	40%	25
Do Nothing -2034	64%	14%	22%	22
Highway Improvements + Public Transport Improvements	39%	8%	53%	26

Kozhikode City

The study area comprised of Kozhikode Corporation, and four adjoining panchayats viz. Kadalundy, Feroke, Olavanna and Ramanattukara covering an area of 178km² with a total population of 7.6 lakhs. An urban transport model was developed for the study area (which was further divided into several zones) for replicating the existing transport scenario, and forecasting the developed transport model for peak hour using multiple regression method (**Table 3)**.

Table 3: Trip end models developed for Kozhikode City

Region	Trip production model	Trip attraction model
Kozhikode	Trip Production = 0.1132 * Population - 191.48	Trip Attraction = 0.5153 * Employment - 423.38

Table 4: Anticipated Effectiveness of the Proposals

Scenario	Private vehicle share	Auto rickshaw share	PT Share	Average Speed (kmph)
Base Year	51%	13%	36%	30
Do Nothing -2034	63%	18%	19%	21
Highway Improvements+ Public Transport Improvements	47%	8%	45%	27

Short- term, medium-term and long-term proposals were recommended for the city of Kozhikode, based on the analysis of data collected from primary and secondary sources,

and traffic demand predicted by the model for the horizon year (2034), covering a total cost of Rs 925 crores, by integrating land-use characteristics and transport development to catering to the future traffic demand. Long-term proposals were also recommended in the CMP, covering a total cost of Rs 7,981 crores.

2. Effect of Queuing of Buses on the performance of Bus Bays

Transit priority systems have the potential to improve transit performance and address capacity constraints by giving priority to transit movements over other traffic. Thiruvananthapuram city has synchronized signal systems. Since all the public transport buses follow the same route, same buses will be queued at all the intersections. The existing bus bays in Thiruvananthapuram city do not have the facility to hold all buses that are queued up. They interfere with the passing vehicles primarily while buses are maneuvered to pull into and out of the bus bays. There is a need to evaluate the effectiveness of queuing of buses on the performance of bus bays. A study was undertaken in this regard with the following objectives.

1. To study the influence of platoon movement of buses from signalized junctions to downstream bus bays on its capacity
2. To study the effect of stopping of buses above the designated capacity of the bus bay on the flow of traffic in the adjoining lane
3. To study the difficulties to the passengers due to stopping of buses at non-designated places and its effect on public transport patronage

NH 66, the main arterial road of Thiruvananthapuram City from Pattom to East Fort is taken as the study corridor. The most busy and congested stretch of MG Road is included in the study stretch. Various traffic surveys were conducted and the required data were collected. Data analysis was carried out and Modeling was done using the software VISSIM. The model simulates the flow of heterogeneous traffic over a specified length and width of the roadway incorporating different types of traffic maneuvers such as vehicular movement at specified speed, acceleration, deceleration, overtaking etc. The model is also capable of simulating the vehicular interactions associated with the bus bays. Passenger survey was also done to identify the difficulties and suggestions of the passengers.

Modeling of Ayurvedic College bus bay was done in VISSIM. Effect of location and bay length on performance of bus bay is studied for Ayurvedic College Junction. Queue length is the main parameter considered for the study. Simulation has been done for 3 different dwell times – 10s,20s,30s; 3 different lengths of bus stops – 18.9m, 25m, 30m; and 7 different positions – 5m, 10m, 20m, 30m, 40m, 50m, 60m.

The actual position of the bus bay at Ayurveda College is 10m from the intersection and the length of the intersection is 18.9m. The average dwell time of buses observed in the bus bay is found to be 20s. The result of simulation is presented in the table given below.

Table 5: Results of simulation

5m								
18.9m			25m			30m		
10s	20s	30s	10s	20s	30s	10s	20s	30s
90.856	101.29	167.13	84.73	91.303	101.34	82.264	86.536	90.718
10m								
18.9m			25m			30m		
10s	20s	30s	10s	20s	30s	10s	20s	30s
88.33	94.75	129.21	82.743	88.884	98.754	82.19	86.42	89.5
20m								
18.9m			25m			30m		
10s	20s	30s	10s	20s	30s	10s	20s	30s
87.202	93.565	111.08	82.565	88.41	98.38	82.108	86.373	88.573
30m								
18.9m			25m			30m		
10s	20s	30s	10s	20s	30s	10s	20s	30s
86.054	92.11	107.44	81.904	88.334	96.829	82.173	86.245	88.85
40m								
18.9m			25m			30m		
10s	20s	30s	10s	20s	30s	10s	20s	30s
85.32	91.63	103.76	81.5	85.02	91.43	80.9	87.552	87.85
50m								
18.9m			25m			30m		
10s	20s	30s	10s	20s	30s	10s	20s	30s
84.367	90.76	102.26	80.06	85.17	91.89	79.814	85.17	84.94
60m								
18.9m			25m			30m		
10s	20s	30s	10s	20s	30s	10s	20s	30s
77.92	79.58	99.44	77.92	78.2	88.53	76.43	78.14	84.63

3. Impact of Vizhinjam Deepwater International Multipurpose Port on Traffic and Transportation System

The Government of Kerala (GoK) through its special purpose government company (SPV) - Vizhinjam International Seaport Ltd (VISL), is developing deep water Multipurpose Greenfield Port at Vizhinjam in Thiruvananthapuram, capital city of Kerala. As the port develops, the local area will also get flourished based on the economic development by means of direct and indirect employment. Also the traffic pattern in the surrounding areas will get altered due to the new trips generated as a result of port development. Therefore, a far-vision transportation planning should be done to handle the growth in the traffic movement to ensure a smooth transportation system. NATPAC studied the impact caused by the port development on the road sector in the hinterland areas of Vizhinjam to develop a long term plan for a sustainable road development in the area.

The scope of the study was limited to the proposed Vizhinjam harbour and the surrounding hinterland areas in 10km radius. The hinterland area includes the main urban centres such as Poovar, Kaliyikkavila, Parassala, Neyyattinkara, Balaramapuram and Kovalam. The main objectives of the study were:

- To identify and assess the existing traffic flow and road condition in the important roads in the hinterland areas;
- To forecast the amount of traffic generated during the construction and operational phases;
- To establish a trip distribution pattern in the road network for the generated port traffic during the construction and operational phases;
- To determine the improvements that are necessary to accommodate the new development thereby to ensure safe and reasonable traffic conditions on streets after the development is complete;
- To develop an action plan to mitigate the impacts caused by the Vizhinjam port on the Transportation system.

Reconnaissance survey was conducted to study the details of existing rod network on the hinterland areas. The roads that will have a possible impact due to the Vizhinjam traffic were identified. **Figure 1** shows the study area and road networks. Traffic surveys such as volume count survey, road/bridge inventory were conducted in the

identified road stretches. Secondary data about the projected cargo traffic and the employment activities were gathered from the Vizhinjam port authority. Data from previous studies was collected for determining the commodity distribution pattern. The data collected were analyzed to know the existing condition of the roads with respect to relevant IRC standards. The traffic data was forecasted by following the four step model of trip generation, trip distribution, and mode choice and trip assignment. Finally, the forecasted traffic is assigned on the road networks to quantify the impact considering each phase of port operation and suitable action plans were framed.

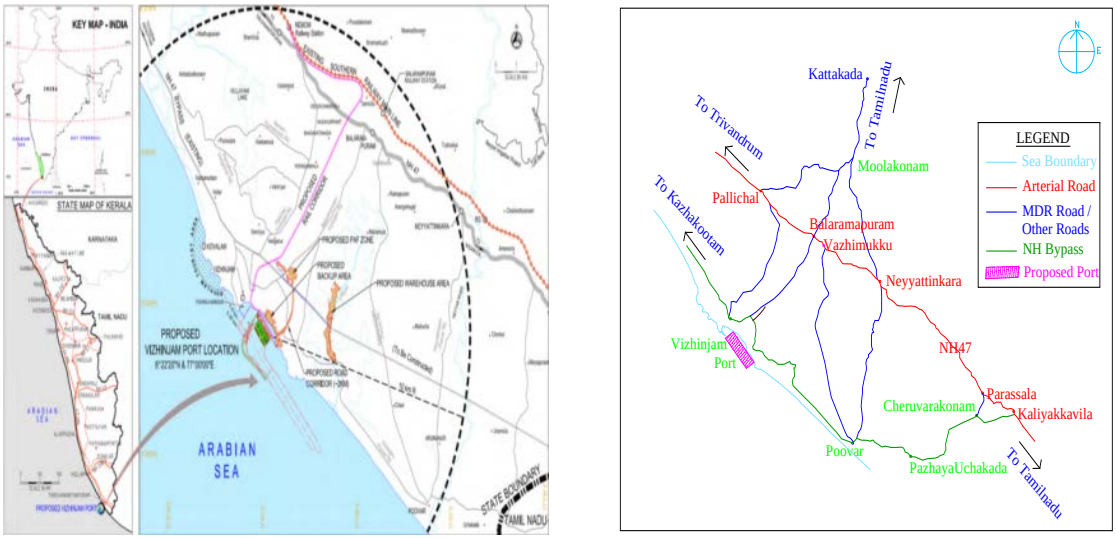


Figure 1: Study Area and Road Networks

Action plans were framed based on the stage-wise port development and operation during the years of 2020, 2030 and 2040.

Immediate Action Plans

- Widening of the existing NH66 from Kaliyakkavila to Thiruvananthapuram from 2 lane carriageway to 4 lane carriageway with good service road. This will ease the free flow traffic by reducing the v/c ratio from 2.85 to 1.19 at Vazhimukku to Balaramapuram and from 1.8 to 0.75 at Kaliyakkavila to Parassala;

- The existing road from Vizhinjam – Balaramapuram – Moolakonam and Parassala – Cheruvarakonam is an intermediate lane which needs to be widened for 2 lane traffic to achieve a better level of service;

- The major traffic flow is found in the NH66. The major junctions with high urban hub are found to be at Pallichal, Vazhimukku, Balaramapuram, Neyyattinkara and Kaliyakkavila. In all these locations an average road width of 7.5m is observed with no/partial shoulder. Hence as an immediate action junction improvement is to be done at following road crossings listed in **Table 6.**

Table 6: Junctions to be improved

Sl. No	Name of the Junction	Intersection Type	Cross road Detail
1	Pallichal	Y	LHS leads to Moolakonam
2	Vazhimukku	Y	RHS to Poovar
3	Balaramapuram	4 arm	RHS to Vizhinjam LHS to Moolakonam
4	Neyyattinkara	4 arm	RHS to Vizhinjam LHS to Moolakonam
5	Kaliyakkavila	Y	RHS to NH bypass

During Phase I Implementation (2020)

- Widening the NH66 bypass (Kaliyakkavila – Mullur – Kovalam – Thiruvananthapuram) from 2lane to 4 lane;
- Increasing the capacity of Cheruvarakonam to Parassala road from intermediate lane to 2lane.

During Phase II Implementation (2030)

- Development of Ring road from Mangalapuram to Vizhinjam as proposed in the Comprehensive Mobility Plan for Thiruvananthapuram;
- Widen the 2lane road from Vizhinjam to Kattakada to a 4lane road.

During Phase III Implementation (2040)

- Upgradation of the existing NH66 bypass to six lane road;
- As the entire NH66 will be mostly urbanized, additional land acquisition to widen this road is difficult and hence alternate way of cargo movement by increasing the rail network and frequency is a feasible solution;
- Improvement of waterway network;
- Development of Mass transit system along the urban corridors to entertain the use of public transport;

4. Assessment of Annual Potential Collection on a Proposed Toll Plaza on NH - 966A in Kochi

At the instance of National Highways Authority of India (NHAI), Kochi, NATPAC carried out traffic survey to assess the annual toll collection potential at the proposed toll plaza at Ponnarimangalam on NH-966 A between Vallarpadam and Kalamasserry in Ernakulam district, Kerala. NATPAC carried out seven-day traffic surveys at the specified location and one-day origin-destination survey.

Estimation of annual toll collection: It is inferred that a sum of Rs**15.40** crores can be realized from vehicles passing through Ponnarimangalam in an year after accounting for seasonal variation, administration charge of 10% and contractor's profit of 5% as per the format provided below.

Table 7: Annual Toll Collection Potential

Sl. No.	Type of Collection	Amount in Rupees
a	Annual daily collection	5,21,786.00
b	Annualized expected collection	19,04,51,890.00
c	Effect of seasonal variation	1,03,60,884.00
d	Total collection (b-c)	18,00,91,006.00
e	Add effect of traffic growth at 7% (on d)	_____
f	Net expected collection	18,00,91,006.00
g	Less administration charges (10% of f)	1,80,09,101.00
h	Net expected potential collection (f-g)	16,20,81,905.00
i	Less contractor's profit @5% (on h)	81,04,095.00
j	Final Annual potential collection	15,39,77,810.00

5. Traffic Analysis Report for Three Locations on NH 47 and NH 47B near Nagercoil in Tamil Nadu

At the instance of Project National Highways Authority of India (NHAI), Nagercoil, NATPAC conducted classified traffic volume count surveys at the following three locations on NH 47 and NH47 B in Tamil Nadu.

(i) Puliyoorkurichi (Ch 626/000) on NH 47 between Kaliyikkavila and Nagercoil

(ii) Pottayadi (Ch 646/000) on NH 47 between Nagercoil and Kanyakumari

(iii) Viswasapuram (Ch 11/000) on NH 47B between Nagercoil and Kavalkinar

24 hours survey was conducted continuously for seven days in the study area. Traffic volume data compiled from the field was converted into Passenger Car Unit (PCU) using conversion factors suggested in the guidelines of IRC 64-1990.

Results of the traffic surveys analysis:

Average Daily Traffic (ADT) observed at Puliyoorkurichi survey station is 36,599 PCU, ADT at Pottayadi is 9,876 PCU and that of Viswasapuram is 20,941 PCU. Average Annual Daily Traffic (AADT) which takes into account the seasonal variation of traffic in a year is expected to be +/-10% of the ADT.

The base year traffic volume is projected for a horizon period of 20 years using growth rate method. Studies conducted by NATPAC over a period of time reveals that traffic on national highways is growing at a rate ranging between 3 to 7 percent per annum. A realistic growth rate of 5% per annum is taken during 2015-2025 and a reduced rate of 4% per annum during 2025-2035. It could be seen that the traffic volume will increase by 2.41 times in 20 year period.

Based on the analysis of existing and projected traffic volume passing through the three survey stations, inferences regarding capacity utilization of roads on which the survey locations lie were evolved with regard to adequacy of the existing road width to cater to the existing as well as projected traffic on the road network.

Road section-wise inferences:

Kaliyikkavila-Nagercoil section of NH 47: Puliyoorkurchi survey location lies between Kaliyikkavila (Tamil Nadu/ Kerala State Border) and Nagercoil on NH 47. The road stretch passes through Kanyakumari District of Tamil Nadu state for the entire length. Major settlements that come in this corridor are Kaliyikkavila, Kuzhithurai, Marthandam, Swamiyarmadam, Thakkalai, Parvathipuram, and Nagercoil.

The road has a two lane carriageway with a carrying capacity of 15,000 PCU as per IRC 64-1990. As the existing traffic volume (36,599PCU) exceeds the carrying capacity of 15,000 PCU, the road stretch needs to be widened to six-lane divided carriageway or else, a bypass needs to be constructed.

A study report of NHAI, Nagercoil, reveals that 80% of the traffic passing through the survey location is bypassable traffic. In such a case, a bypass of four-lane divided carriageway is to be warranted immediately as it will have a minimum traffic of 29,279 PCU in the base year itself. As the maximum capacity of a four lane road is 35,000 PCU as per IRC guidelines, the bypass should be widened to six lanes to cater the projected traffic of 48,000 PCU by the year 2025.

Nagercoil – Kanyakumari section of NH 47: Pottayadi survey location lies between Nagercoil and Kanyakumari on NH 47. The road stretch passes through Kanyakumari District of Tamil Nadu State for the entire length. The road has a two lane carriageway with a carrying capacity of 15,000 PCU as per IRC Guidelines. At present, the existing traffic volume of 9,876 PCU is below the carrying capacity of 15,000 PCU and by the year 2025, the traffic volume is expected to increase by 16,086 PCU and exceed the carrying capacity. Hence, the road stretch needs to be widened to four-lane by the year 2025.

Nagercoil – Kavalkinar section of NH 47B: Viswasapuram survey location lies between Nagercoil and Kavalkinar on NH 47B. The road stretch originates from Kanyakumari District of Tamil Nadu state and terminates at Tirunelveli District. The road has a two lane carriageway with a carrying capacity of 15,000 PCU as per IRC Guidelines. As the existing traffic volume of 20,941 PCU exceeds the carrying capacity of 15,000 PCU, the road stretch needs to be widened to four-lane divided carriageway or a bypass needs to be considered. As per a report prepared by NHAI, Nagercoil, 45% of the traffic passing through the survey location consists of bypassable traffic with interactions between Kaliyikkavila side and Kavalkinar side. Hence, if a bypass for NH 47 between Kaliyikkavila and Nagercoil is considered, the above bypass can be extended to cover this bypassable traffic also.

The existing road, however, needs to be widened to four-lane divided carriageway by the year 2025 as the traffic volume is expected to increase to 17,056 PCU by that period even after the bypassable traffic is diverted to the proposed bypass.

6. Traffic Analysis Report for One Location on NH 47 near Balaramapuram in Kerala

At the instance of Project Implementation Unit, National Highways Authority of India, Thiruvananthapuram, NATPAC conducted classified traffic volume count surveys at Balaramapuram (Ch 582/000) on NH 47 in Kerala. The surveys were conducted from 00.00 Hrs on 04.10.2015 to 24.00 Hrs on 10.10.2015 continuously for seven days. Traffic volume data compiled from the field were converted into Passenger Car Unit (PCU) using conversion factors suggested in the guidelines of IRC 64-1990: Guidelines for Capacity of Roads in Rural Areas.

Average Daily Traffic (ADT) observed at Balaramapuram survey station is **32,547 PCU.** Average Annual Daily Traffic (AADT) which takes into account, the seasonal variation of traffic in a year is expected to be +/-10% of the ADT.

The base year traffic volume is projected for a horizon period of 20 years using growth rate method. Based on the analysis of existing and projected traffic volume passing through the survey station, inferences regarding capacity utilization of roads on which the survey location lie were evolved. They pertained to the inadequacy of the existing road width to cater to the existing as well as projected traffic on the road network as briefed below;

Balaramapuram survey location lies between Thiruvananthapuram and Kaliyikkavila (Tamil Nadu/ Kerala State Border) on NH 47. The road stretch passes through Thiruvananthapuram District of Kerala State for the entire length. The corridor has mixed rural and urban populations. Major settlements that come in this corridor are Thiruvananthapuram, Balaramapuram, Neyyattinkara, Parassala and Kaliyikkavila.

The road has two lane carriageway with a carrying capacity of 15,000 PCU as per IRC 64-1990: Guidelines for Capacity of Roads in Rural Areas. As the existing traffic volume of 32,547PCU exceeds the carrying capacity of 15,000 PCU and is very close to the six lane capacity of 35,000 PCU, the road stretch should have a four-lane divided carriageway and needs to be widened to six lanes immediately.

Otherwise, considering the fact that about 50% of the traffic passing through the survey location consists of bypassable traffic (as per rough estimate by NATPAC) with the trip ends lying at Thiruvananthapuram and beyond on the north and Kaliykkavila and beyond on the south and the traffic passes through thickly populated as well as high end commercial areas, a bypass will be ideal. The bypass will cater to the diverted traffic from the existing NH as well traffic diverted from existing road between Mukkola and Kaliyikkavila. Traffic study conducted by NATPAC in 2015 reveals that 12,220 PCU of traffic is plying on the road between Mukkola and Kaliykkavila and 60 % of this traffic would get diverted through the proposed bypass. In addition, an International Deepwater Multipurpose Seaport is being constructed at a cost of more than Rs 6,000 crores at Vizhinjam which is located at the close vicinity of the proposed bypass. The port would be operational before 2025 and is expected to generate considerable traffic

on the bypass. Considering all these factors, the proposed bypass should have a four lane road width immediately as it will have base year traffic of 23,728 PCU and should be widened to six lanes before the year 2025 to cater to the projected traffic of 38,650 PCU in 2025. Simultaneously, the existing NH needs to be widened to four lanes immediately as there will be a net traffic of 16,273 PCU still plying on the existing NH.

7. Rationalisation of Public Transport Routes in Thiruvananthapuram

Public transport system in Thiruvananthapuram, includes KSRTC, KURTC and private buses operating in designated routes. At present, there are about 1429 buses available in the city with a total of 1385 services made by them along the corridors. Huge traffic delays and inappropriate bus timings during peak hours have been posing serious challenge for the public transport users. This study aims to rationalize the public transport bus routes in the city. This includes optimization, rescheduling and extension of existing routes, introduction of new routes etc.

The major objectives of the study are as follows:

- To identify major mobility corridors in Thiruvananthapuram city;
- To study the existing characteristics of Public Transport buses in Thiruvananthapuram city;
- To assess the existing public transport demand along various mobility corridors;
- To rationalize the public transport routes in the city.

The scope of the study is limited to the major mobility corridors in Thiruvananthapuram city where the ordinary, city fast, low floor A/C, low floor non A/C and private buses operate. Based on the existing passenger demand and importance of road, nineteen major mobility corridors originating from East Fort to different parts of the city were identified. Each of these mobility corridors were divided into different homogeneous sections with uniform characteristics for detailed analysis.

The main sources of secondary data were the KSRTC and private bus operators. Operational details of buses were collected from all the twenty depots under Thiruvananthapuram revenue district. Details regarding the number of buses operating,

route details, duty schedule, frequency, journey time, capacity, existing ridership based on ticket sales, revenue etc were collected.

Primary data collection was done by conducting occupancy survey of the buses at important locations to know the existing demand in the selected homogeneous sections for all the major mobility corridors. In bus survey was conducted on all the selected corridors to collect travel characteristics such as delays, travel time and passenger service time etc for different types of public transport services. A passenger opinion survey was done by using stated preference survey questions designed and prepared for a sample size of 200 bus users.

Different operational characteristics of public transport such as route length, existing journey time, existing average speed, and average service time per passenger were analysed. Average mode share of public transport services on major mobility corridors was estimated and found that ordinary city services account for the greater proportion i.e, about 42%.

Passenger demand was calculated for the different corridors based on the occupancy rates and existing number of trips. Maximum passenger demand was observed along "East Fort – Nedumangad" corridor (39,930), followed by "East Fort – Pravachambalam – Balaramapuram" corridor (37,580). Based on the existing number of trips and the average occupancy, the existing supply was calculated. The bus demand to supply ratio was estimated for each corridor.

Based on the occupancy fixed, existing passenger demand and headway, the number of trips was optimised for each time period of the day. Assuming lay over time as 10% of running time, the entire bus routes were rationalised. As a result of rationalisation, a reduction in 10% of the bus trips was seen. A sample scheduling for the mobility corridor East Fort to Vizhinjam was also done.

8. Feasibility Study for Constructing Valiyazheekkal Bridge across Kayamkulam Canal in Kollam and Alappuzha Districts

At the instance of PWD, Roads and Bridges, NATPAC conducted traffic assessment for the construction of the 840m long Valiyazheekkal Bridge across Kayamkulam lake connecting Kollam and Alappuzha districts. The proposed bridge is expected to promote tourism in the area apart from giving a face lift to the most untouched beautiful beaches of Azheekkal and Valiyazheekkal.

NATPAC conducted detailed site investigation along the proposed coastal highway from Thottappally to Karunagappally. It was found that the coastal highway from Karunagappally to Thottappally can be effectively utilized as a parallel road to NH-66, by constructing a bridge at Valiyazheekkal across Kayamkulam Kayal. This will also act as a Bypass to major activity centers such as Karunagappally, Oachira, Kayamkulam and Harippad Towns located along busiest NH-66.

The total length of the road from Lalaji Junction to Thottappally via Valiyazheekkal Bridge and through the existing NH 66 is about 38 km. The major link roads connecting the coastal highway from Azheekal and Oachira and from Valiazheekal and ONK Jn. Kayamakulam are about 8km. The average carriage width of existing road from Lalaji Junction to Thottappally is about 5m and is completely built –up residential area.

In order to assess the likely traffic passing through the proposed bridge, traffic surveys were conducted in the influence area of the project which included classified volume count survey and origin destination survey. Based on the analysis of data, traffic potential on the bridge was estimated and projected for various horizon years using suitable growth factors. Three types of vehicular movements comprising of the diverted traffic, induced traffic, and generated traffic are expected to ply along the Valiyazheekkal Bridge.

Projected traffic through Valiyazheekkal Bridge: The base year traffic has been projected for next 20 years using a growth rate of 3%**.** It is expected that the traffic would increase to 10,698 PCU in 2025 and 14,377 PCU in 2035.

The proposed Valiyazheekkal Bridge across Kayamkulam Lake will provide the missing link along the coastal highway connecting Kollam and Alappuzha districts. This will come as a relief to the severely congested NH 66 for which the proposed connectivity will serve as a parallel road. Tourism promotion, development of fishing harbor, Azheekkal beach, and safe journey to millions of devotees of Matha Amrithanandamayi are the other benefits of the proposed bridge. The coastal road between Karunagappally and Thottappally is expected to carry a traffic volume of 7,960 PCU in the base which would increase to 14,377 PCU within the next 20 years. If the coastal highway from Thiruvananthapuram to Kozhikode is completed out of which Ponnani to Vengalam stretch of about 71km (Tippu Sulthan road) has already been completed, nearly half of traffic plying through NH will be diverted through this coastal road. Completion of coastal highway is very much needed to decongest the National Highways.

As per IRC 64:1990 guidelines for capacity of roads in rural areas, the capacity of a single lane road is 2,000 PCU in plain areas, while that of intermediate road is 6,000 PCU and two lane road is 15,000 PCU.

Considering the above factors, the construction of two lanes Valiyazheekkal Bridge is important since it is supported by traffic potential and the coastal highway has to be developed as a two lane road in a phased manner throughout the State. The proposed coastal highway also has the potential to function as a Tourist Corridor exploring the scenic backwaters of the area.

9. Traffic Impact Study for proposed Lulu Complex at Aakkulam on NH bypass in Thiruvananthapuram City

By the side of the NH bypass near Aakkulam where there is a toll plaza, Lulu International Shopping Mall Private Ltd, is constructing a Shopping complex cum Hotel and Convention Centre. The area around the proposed Lulu Mall along the bypass is fast developing into a major residential cum commercial area and the commissioning of the proposed mall will accelerate the process of commercialisation. When this development becomes operational, it is expected to have some impact on the adjoining road network and would affect the traffic plying on it. In this regard, Lulu has requested

NATPAC to prepare a traffic impact study to address the likely traffic problems which may arise when the Lulu Mall becomes operational.

The Shopping Centre will consist of Lulu Hypermarket, Lulu Department Store, Lulu Electronic store, Mall, Shops, Restaurants/Café, Gym, Theatre etc. The Hotel, Convention Centre and Owner's Suite would be housed in a separate building. In addition to the basement parking area, an eight floor Multi Level Car Parking (MLCP) facility will be built which together can accommodate a total of approximately 2,600 cars. Thus parking provided is more than what is required as per the 1999-Kerala Municipal Building Rules.

To assess the traffic volume plying on the NH 66 bypass, traffic volume count survey was conducted. Traffic volume of 37,000 Passenger Car Unit (PCU) is plying through Aakkulam on NH bypass. More than 50% of vehicles were found to be cars, followed by 34% of two wheelers. All goods vehicles together were only eight percent. The highest hourly traffic volume of 2,691 PCU was observed between 18.00 hrs and 19.00 hrs. Traffic survey conducted at Venpalavattom intersection reveals that the junction handled a peak hour traffic volume of 4,338 PCU between 09.00 hrs and 10.00 hrs in the morning and 3,959 PCU in the evening between 03.30 pm and 04.30 pm. Similarly Kuzhivila junction handled peak hour traffic volume of 2,454 PCU between 09.00 am and 10.00 am in the morning and 2,786 PCU in the evening between 05.30 pm and 06.30 pm.

Figure 2: Site Location of Lulu Mall cum Hotel and Convention Centre

Kerala State Road Transport Corporation (KSRTC) has set up a terminal (Anayara-Veli) about 45m south of Lulu Mall site. The terminal would be functional soon with 20 buses which would be operated to locations like Kazhakkoottam, Pothencode, Venjaramoodu, Karikkakom Temple, Oruvathil Kotta, Attingal etc. In addition to these, all State run buses operating on that stretch would enter this terminal.The road, NH 66 bypass, in front of the site is being widened to 2+2 lane carriageway with service lanes on either side.

The Future traffic on NH Bypass will be the summation of existing bypass traffic applied with 5% growth rate per annum and traffic from other major developments like:

- Big I Mall (15,300 sq m of Commercial development);
- Plaza Centres Mall (92,937 sq m of Office; 81,784 sq m of Commercial and 20,446 sq m of Hotel space);
- Mall of Travancore (65,056 sq m of Commercial development).

The Trip generation surveys conducted at Lulu Mall Ernakulam was used to estimate the traffic generated by the proposed Lulu Mall at Thiruvananthapuram. Therefore the design traffic was obtained by the summation of estimated peak hour development

traffic along with future background traffic for the year 2019-20 when the development would be operational. The design traffic is given in **Table 8.**

Table 8: Peak Hour Design Traffic in 2019-20

Peak period	Towards Kazhakkoottam	Towards Kovalam	Total	
			Vehicles	PCUs
Weekday AM	2297	4651	6948	6205
Weekday PM	2366	4506	6871	6188
Weekend AM	1715	4960	6674	5810
Weekend PM	1965	4250	6215	5625

The peak hour design traffic is highest in the morning which constitutes to around 6,948 vehicles (6,205 PCUs). This traffic is used to determine the Level of Service (LOS). The Road Link LOS is given in **Table 9**. As seen from Table, the future Level of Service of the NH 66 Bypass is upgraded from LOS F to LOS E.

Table 9: Level of Service of NH 66 Bypass based on IRC 106-1990

Venpalavattom to Kuzhivila Stretch	Traffic Volume (PCU)	Capacity (PCU)	Volume to Capacity Ratio	Level of Service (LOS)
Existing (2015-16)	2691	1500	1.79	F
Future (2019-20)	6205	900+ 4*1200 +900	0.94	E

For reducing traffic congestion on NH 66 Bypass, the concept plans for two options have been developed. The two options are: (1) Hammerhead median opening and (2) signalized intersections. The Hammerhead median opening is desirable as it works on the principle of merging and diverging causing minimum control delay to the through traffic. While this option gives advantages initially, it may become difficult to regulate when the traffic grows in the future.

In such a scenario the Synchronized Signals at the three intersections (Venpalavattom Junction, proposed KSRTC Intersection and the proposed signal in front of exit gate of LuLu Mall) would be a better option even if it gives rise to stopped delay. Synchronizing these three signals would ensure that a vehicle would have to stop only at one signal and would get a green signal at the other two. The above projections and proposals prepared are subject to the relocation of the existing toll booth to another location beyond KSRTC terminal at Anayara for which approval from NHAI is awaited.

10. Traffic Survey near Aakkulam Toll Plaza on NH – 47 in Thiruvananthapuram

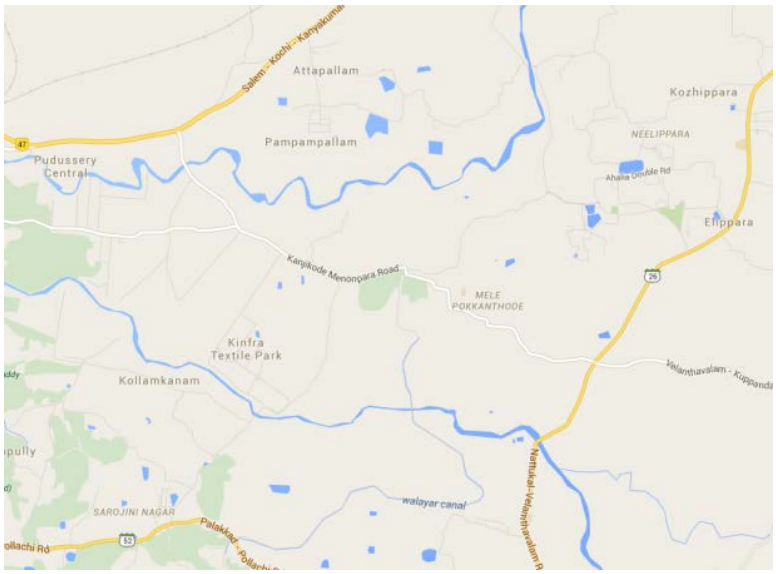
At the instance of National Highways Authority of India (NHAI), Thiruvananthapuram, NATPAC carried out traffic survey near Aakkulam on NH 47. Classified volume count survey was conducted manually by trained enumerators for seven days continuously starting from 0.00 Hrs – 24.00 Hrs. Data collected was analysed to study daily variation and hourly variation of traffic, traffic composition and Average Daily Traffic (ADT) at the survey location. Average daily traffic (direction wise in terms of vehicles and Passenger Car Unit) are presented in **Table 10.**

Table 10: Average Daily Traffic in both Directions

Description	Direction	Total
ADT (Vehicles)	To Kazhakkuttam	19,356
	To Kovalam	18,418
	Combined	37,774
ADT (PCU)	To Kazhakkuttam	18,648
	To Kovalam	18,203
	Combined	36,851

11. Traffic Calming Study of KINFRA Textile Park, Palakkad

KINFRA Integrated Industrial and Textile Park is located about 5km from Palakkad town on Kanjikkode-Menonpara road. The Park covering an area of 163.58 acres focuses on manufacturing, textiles, garments and general industries. The park has a good and wide internal road network which connects various industrial units located within the park to the Kanjikkode-Menonpara road. The vehicles plying on the internal roads, in the absence of adequate traffic calming measures, resort to



over speeding. In this regard, KINFRA has requested NATPAC to conduct a study in the campus and suggest appropriate traffic calming measures to improve road safety within the campus.

Scope of the study was confined to the KINFRA Integrated Industrial & Textile Park situated at Kanjikode and the road network in its vicinity. The main objectives of the study were:

- To understand the present traffic conditions within the industrial park
- Determine the traffic characteristics in the park after completion of the proposed expansion
- Analyse the road traffic characteristics and network conditions with respect to road safety
- Recommend short term and long term measures to improve road safety
- Arrive at block cost estimates of the recommended measures

Secondary data was collected from the main gate register with regards to the traffic entering the campus for a week. The register classified entries as Company Staff, Material, Visitors and Interview Candidates. Traffic surveys like Road Inventory, Classified Turning Movement Count, Pedestrian count, Classified Spot Speed were carried out to ascertain existing traffic entering/exiting the campus, spot speeds of the vehicles plying in the campus etc.

Road Inventory survey was carried out to find the width of the carriageway, shoulder, footpath and distance to electric posts/other hazards.Morning Peak hour turning movements at Kanjikode-Menonpara road leading towards Kinfra Textile Park are shown in **Figure 3.** The labels are given in the format "Number of vehicles (Number of PCUs)".Traffic studies revealed that the Level of Service (LOS) on Kanjikode-Menonpara road is LOS-B while that inside the campus is LOS-A.

Pedestrian counts to and from the KINFRA Park during the morning and evening peaks were taken to understand the travel patterns by walk in the vicinity of the campus. Studies shows that only 173 people entered the park between 8.00am and 9.00am in the

morning and nearly same number of people exited from the Park in the evening between 5.00PM and 6.00PM.

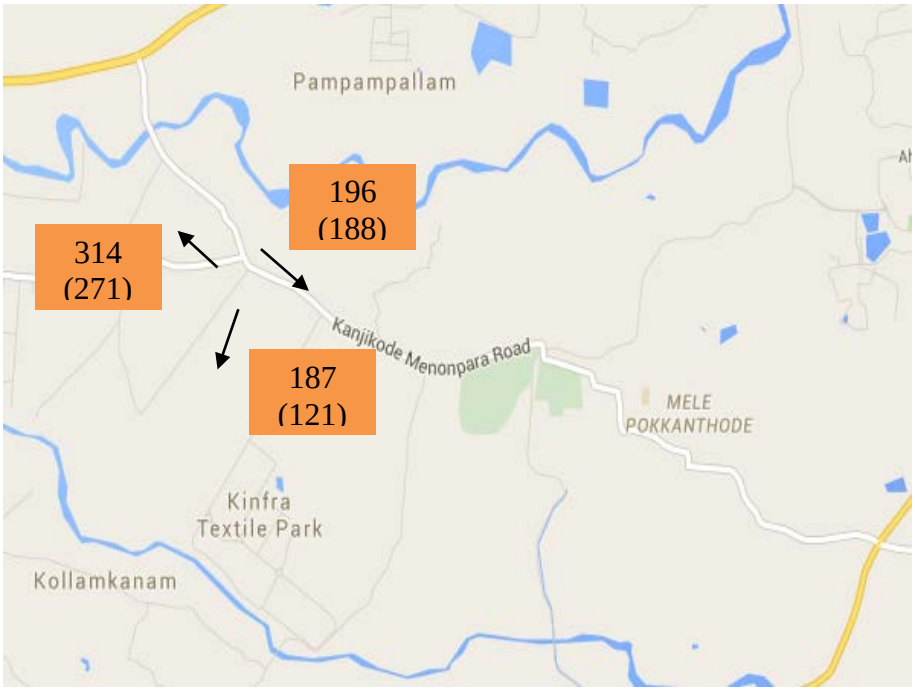


Figure 3: Turning Movement at entry of KINFRA Park (morning peak hour)

Spot speed of vehicles plying on the Avenue was recorded using a radar gun between 2.00 PM and 5.00 PM. The results show that average speed is maintained by each vehicle category as well as the 85th percentile speed is determined.

Table 11: Classified Spot Speeds on Avenue road

Category of vehicle	Average speed (kmph)	85th Percentile speed (kmph)	Maximum Speed (kmph)
Two Wheeler	46	58	86
Auto rickshaw	44	47	49
Car	54	68	83
Goods Auto	45	45	45
Light Commercial Vehicle	55	67	71
2 Axle Truck	51	57	62
Multi Axle Truck	49	59	64
Bus	50	50	50

A traffic growth rate of 5% is applied to the background traffic taking into account the attractiveness of the Industrial belt owing to its close proximity to commercial cities like Coimbatore and Tirupur. The internal traffic is assumed to grow double the present day traffic as almost 50% of units are functional within the campus and the remaining would be operational by 2017.

The level of service provided by the existing road network is estimated for future traffic scenario and is LOS B in the year 2015 and 2016 and LOS C in the year 2017. It is found that even after the campus becomes fully operational, the LOS would be within acceptable limits.

The parking requirement for the existing buildings inside the campus is worked out on the assumption of 10 square metre per employee. The built up area is calculated from the number of employees working/ estimated in each unit.

The traffic calming techniques/measures like speed breakers, signs, markings, channelizing islands, pedestrian facilities and geometric corrections and junction improvements are also suggested for KINFRA Park. Cost estimate for proposed traffic calming measures have been worked out based on Delhi Schedule of Rate, 2014. The cost estimates add up to a gross total ofRs81.31 lakhs.

12. Traffic Improvement Plan for Chamravattom Junction

Chamravattom Junction in Ponnanni Municipality, Malappuram district of Kerala is a five arm intersection in Kanyakumari- Panvel National Highway (NH66, Old NH 17). NH 66 crosses Edappal- Ponnanni Road at this junction and Ponnanni -Tirur Road originates from this junction thus forming a five arm intersection. Signal system is there for controlling the traffic. Ponnanni –Tirur Road meets National Highway at acute angle making the junction a complex one. The accident rate observed at this junction is on alarming side.

The purpose of the study was to assess the adequacy of existing road infrastructure and transport facilities available at the intersection and prepare sustainable junction improvement plan for Chamravattom junction taking into consideration of the future year traffic. Various tasks were carried out comprising of the reconnaissance surveys, review of development proposals, various primary surveys for data collection and analysis of the comprehensive data to arrive at appropriate improvement proposals.

Plate 1 (a) ***Plate 1 (b)***

Chamravattom junction

From the traffic volume survey conducted at the junction it is observed that:

- Peak Hour of the day is observed during 16:30-17:30 Hrs with a traffic volume of 3861 PCU
- 51 % of total number of vehicle plying through the junction during peak hour is two-wheeler (2271 Vehicles) followed by 17% each share for Car and Auto Rickshaw
- Among the 20 movements considered for the study, straight movement in Ponnanni- Edappal road has the highest share of 25% (974 PCU) while the share of right turn traffic constitute 27%, out of which Kochi-Edappal, Kozhikode-Ponnanni, Tirur-Ponnanni are having share of 8%,7%,7% respectively
- Evaluation of the capacity of road is carried out for the base year and horizon year -2030 and the Volume to Capacity ratios were found to be greater than 1 for Ponnani, Tirur and Edappal arms

Three options were suggested for the traffic improvement of Chamravattom Junction. The land acquisition associated with this was also detailed out. Two link roads namely minor link road and major link road connecting Kozhikode arm of the National Highway with Ponnanni- Tirur Road at 130m and 300m respectively were suggested in option 1. Meanwhile in option 2, a traffic island of elliptical shape is proposed at the junction. As per option 3, a link road connecting Kozhikode arm and Tirur arm is provided at 130m from the junction near the culvert. The geometric features of the three options are designed and detailed drawings are prepared.

Land acquisition required for implementing the development plan is also reported. The National Highway is having a carriage way of 30m and the land acquisitionrequired on NH is very minimal. Major portion of land acquisition fall in Ponnani arm and Edappal arm of the junction.

13. Traffic Improvement Schemes for Kazhakkoottam Area in Thiruvananthapuram City

Kazhakkoottam is a major suburban area of Thiruvananthapuram Capital city and considered as the gateway to the city. With close proximity to Technopark and location of various educational institutions, Kazhakkoottam has grown by leaps and bounds over the years and has become the centre of severe traffic problems. At the instance of the Mayor of Thiruvananthapuram Corporation, NATPAC carried out a detailed traffic study to identify the problems witnessed in Kazhakkoottam area.The study was aimed at suggesting short and long term traffic improvement schemes as a traffic solution.

NATPAC recommended traffic improvement measures for Kazhakkoottam Town road starting from Kazhakkoottam bypass Junction to AJ hospital Junction via the Market thereby tackling the traffic congestion issues and problems related to parking.

Inspite of being a one way Street, the existing traffic scenario along Kazhakkoottam town road was found to be quite unpleasant and severely affected by traffic congestion during peak hours, due to parking problems. The practical capacity of the town road is getting reduced substantially due to haphazard on street parking. Criss-cross movements of pedestrians all along the road are another major traffic hindrance causing traffic congestion. Inadequate carriageway width at some locations also creates bottlenecks leading to longer queue of vehicular traffic during peak hours.

Without proper traffic improvement measures, three major intersections located along the Town road is facing chaotic situation due to conflicting movements of traffic fuelled by parking and pedestrian activities. Location of bus stop on the carriageway creates major traffic bottlenecks at the Town junction.

Primary surveys were carried out to assess road network characteristics, and the quantum of traffic plying along the road, and across the intersections. Parking and pedestrian demand in the study area were assessed to estimate the demand supply gap.

Topographic surveys were carried out to prepare the base plan of the town road and adjoining intersections to propose suitable traffic management measures. Investigations were done on the road network characteristics and the existing scenario was precisely plotted. The peak hour traffic flow and the peak hours were appraised. The peak traffic

flows and volume capacity ratio of the link roads were estimated and it was found that the practical capacities on concerned roads are markedly reduced due to the identified site specific issues. Parking accumulation and duration were assessed by conducting the surveys.

Short term measures suggested includes enforcement of one way system, restrictions on turning movement, closing of some side streets, improvements of existing road and intersections, provisions of parking areas and bus bays etc. Medium term solution proposed includes removal of encroachments, road widening, construction of multilevel automatic parking complexes, new roads, missing links etc. Detailed design drawings were prepared to propose short term improvement measures for Kazhakkoottam study area and the related land acquisition plan was also strategized.

14. Public Transit System for Last Mile Connectivity to Major Work Centres – A Case Study of IT Campuses in Kerala

The IT campuses of Technopark in Thiruvananthapuram and Infopark at Kakkanad are two major work centres in Kerala both of them being major trip attraction centres as well. NATPAC identified a possible road map for initial implementation of greener transport in campuses and work centres and *ipso facto* leading to large scale use of greener transport modes in the state.

The travel behavior and choice of commuters were studied in detail. The potential demands of the passenger traffic and mobility requirements of employees and visitors within the campus for their last mile connectivity to the work centre were assessed based on the data collected by primary surveys. The feasibility of deploying various feeder services for the work centre campuses was ascertained and the fleet requirement was also estimated. The mode choice analysis of the users was done in detail after conducting user preference surveys. The study highlighted the need for providing better means for last mile connectivity in the work centre campuses. The user preference for last mile connectivity was found out and mode choice models were attempted to evaluate the behavior of commuters of the work centre campus to choose the particular mode. Also it is inferred that by and large the last mile connectivity of the work centre campus has to be improved adequately. A preference survey was conducted to determine which transport mode is preferred by the employees of IT campuses for their

first mile or last mile connectivity. The opinion survey of Technopark employees revealed that the most preferred mode for last mile connectivity is KSRTC feeder bus followed by solar vehicles and Personal Rapid Transit (PRT). From the user preference survey in Infopark campus, the feeder bus service was selected as the first option by 45.29% and Solar vehicle and PRT were selected as first option by almost equal number of people.

The traffic and travel characteristics of the employees of IT parks were obtained and analysed further for the design of fleet for first and last mile connectivity in both the IT campuses.

Main parameters that influence the traveler to choose a mode are waiting time, travel time and travel cost. As the waiting time, journey time or travel cost of the mode increases, they are less preferred. Waiting time influences the mode preference more than the other two parameters. Also factors such as age, distance, monthly income, gender, education, etc. influence the mode choices. As the monthly income increases, the chance of choosing a mode also increases. Low and medium income groups predominantly use bus as the mode of transport. The high income groups use car. The need of public transport is high as more employees belong to low and medium income groups and they use public modes. Employees who did not own any vehicles use buses mostly. Company cabs and trains were also used by them for connectivity. Most of the employees who owned both type of vehicles use bikes more than cars and buses.

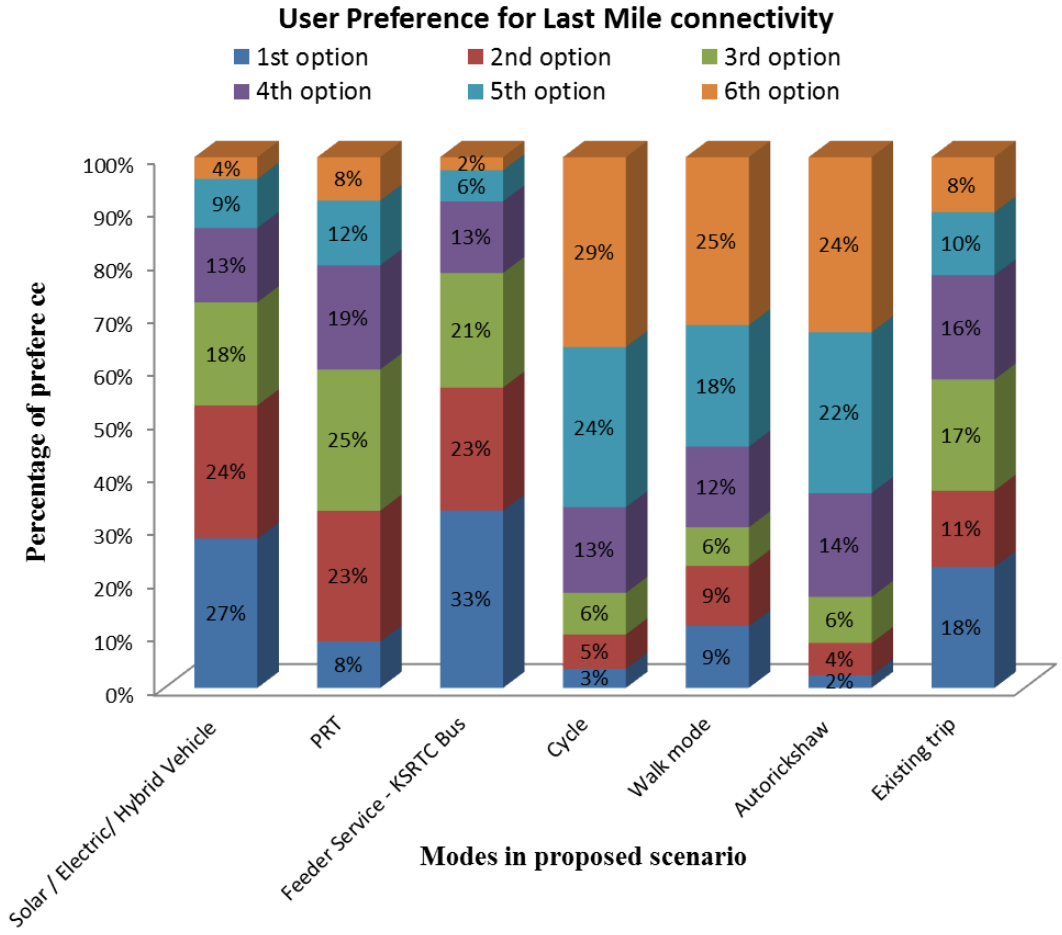


Figure 4: User preference of Technopark employees for last mile connectivity

Plate 2
Route proposed for last mile connectivity to Infopark by solar vehicle

Plate 3
Typical solar vehicle that could be used for last mile connectivity

- It was observed from the analysis of travel characteristics at IT campuses that the largest commuter share comes from the age group of 18 to 30 years followed by 31 to 45 years
- It was inferred from the analysis that as income increases willingness to shift decreases. Level of education was also found significant in affecting travel mode choice but results are mixed
- The average trip length of last mile trip of the employees is 2.3km while that of the main segment of their work trip is 12.36km. Meanwhile the average travel cost of last mile trip is Rs28 and that of their main trip is only Rs15.7. This is quite contrasting that the travel cost per km run of last mile trip is more than 9 times that of main and longer segment of their work trip
- It is inferred that by and large the last mile connectivity of the work centre campus has to be improved adequately by providing reliable and sustainable services

In the existing scenario, employees spend around 2.8 times the cost of their main trip to carry out the last mile trip. This situation further encourages the use of personalized modes of transportation. This finding highlights that there is an urgent need for enhancing the last mile connectivity of the region by reliable and sustainable means to bring in savings to social economy as well.

15. Feasibility of Volvo Operating Centre on Chala Bypass in Thiruvananthapuram City

Thiruvananthapuram Development Authority (TRIDA) proposes to establish a Volvo Operating Centre in 5.5 acres of land owned by TRIDA at Chala near Attakulangara – Killippalam Bypass and entrusted NATPAC the task of assessing the viability of Volvo bus operating centre along with other components like conventional centre and commercial blocks in the proposed location. The scope of the study is limited to the number of Volvo buses operating from Thiruvananthapuram central area. The main objectives of the study are:

- Assessment of the existing number of Volvo buses operating from Thiruvananthapuram city to different destinations;
- Estimation of the future demand for the next 20 years;

- Conceptual layout design for the Volvo bus operating centre;
- Assessing the feasibility of establishing a Volvo bus operating centre within the available land at Chala.

Major operators of Volvo bus services from Thiruvananthapuram were found by surveys and primary and secondary data collection. The potential demand for the Volvo bus operating system is the prerequisite for planning and designing of the infrastructure and is estimated by considering both the existing and future demands. The pattern of arrival, departure and idle parking of the buses were found out and the peak periods and peak hour traffic was estimated. **Table 12** depicts the future demand of Volvo bus operation.

Table 12: Demand Assessment for Future Years

Design period *(years)*	**Projected Year**	**No of Volvo bus operations per day**	**No of Volvo buses in peak time interval *(30 min)***	**No of bays required *(with service time of 15 min)***
0	2015	56	12	6
5	2020	65	14	7
10	2025	75	16	8
15	2030	87	19	9
20	2035	101	22	11

Layout of the Volvo bus operating centre was prepared taking care of the human accessibility as well as better circulation of the buses housed in it. The bus terminal design was adapted to facilitate the mobility of various types of users including differently abled people. The following aspects were incorporated in the alternative designs prepared.

- Integration with other modes for first and last mile connectivity;
- Segregated parking facilities;
- Auto rickshaw and taxi stand;
- Pedestrian sidewalk and crossing;
- Universal accessibility.

The proposed layout designs for the Volvo bus terminal consists of multi-storied complex with facilities for parking bays for 16 buses at a time in the ground level and other floors are occupied by commercial. While the bus-bay is proposed in the middle, a multi-level parking is provided in the northern part of the plot, and entrance building in the southern side which comprise of lobby, ticketing area, information centre, waiting

area, restaurant, Volvo bus office and toilet area. Taxi and auto stand along with garage and fuelling pump is on the western side of the plot.

Each level of the multi-level parking area can cater 164 four wheelers and 96 two wheelers. Ramps are proposed for entry/ exit of parking vehicles for each floor. Taxi and auto stand can cater 20 taxis and 19 autos at a time. Drop-off area is given in the front area where all vehicles can drop-off passengers or shoppers. Stair and lifts are provided in the commercial and parking block.

Based on detailed inventory of Volvo buses operating from the central area of Thiruvananthapuram city, the existing demand of the buses have been worked out as 56 which has been projected to 101in the horizon year of 2035. Three alternative designs of bus terminals have been proposed for the identified location which also incorporates commercial areas within the available land. Adequate open spaces have been provided to allow for future expansion also. A total of 16 bus bays have been demarcated in the alternative design options of the proposed Volvo bus operation centre which can satisfactorily meet the demand for the next 20 years as well.

16. Pre-feasibility Study of establishing Round the Clock Connectivity in the Forest Section of NH 766

Bandipur Tiger Reserve is located in the south Indian state of Karnataka. A large number of animals had been killed in road accidents due to night-time traffic through National Highway 766 and 67 that pass through Bandipur Tiger Reserve. To prevent road kills of rare wildlife, the Honourable High court of Karnataka has imposed restriction for Vehicular traffic in Bandipur National Park (BNP).

Because of the night journey ban in Bandipur National Park, round the clock connectivity is lost between Sulthan Bathery and Mysore. An alternate road has been proposed from Kalpetta to Mysore via Mananthavadi, Kattikkulam, Kutta, Gonikuppal, Hunsur. The journey through this road is more by 50km from Kalpetta to Mysore. The usefulness of this road is very limited for people residing in Sulthan Bathery and adjoining areas. At the instance of Public Works Department and Kerala Road Fund Board NATPAC carried out a pre-feasibility study for ensuring round the clock connectivity from Wayanad to Mysore.

NATPAC identified various alternatives for enabling the connectivity and the merits of each alternative is assessed taking into consideration of social, environmental and financial aspects. Scope of the study was confined to technical and environmental feasibility of the identified alternatives.

After satellite image study and reconnaissance survey, five alignment options were considered. Detailed inventory survey was carried out along the identified alignments using handheld GPS. The alignment options considered are given in **Figure 5.**

- **Option 1&2** considers constructing an elevated corridor in the forest section along the existing NH 766 alignment. Constructing a tunnel in the forest section along the National Highway alignment is considered in option 2. For option 1 and 2, detailed inventory of the alignment is carried out from Kalpetta (Ch.71/500 of NH 766) to Begur College Junction (Ch.169/500 of NH 766) having a total length of 141 Km. The approximate cost of constructing an elevated corridor in the forest section for a length of 26 km will be Rs1820 Crores. Constructing tunnel by cut and cover method as per option 2 for the same length will cost nearly Rs10,920 Crores.

- **Option 3** is as an alternative to existing National Highway 766 from Sulthan Bathery to Begur, and the length from Kalpetta to Mysore through this alignment is 142km. This alignment starts at Moolankavu near Sulthan Bathery on NH 766 (Ch.100+600) and ends at Begur College Junction. (Ch.169+500 of NH 766) in Chamrajnagar district of Karnataka. This alignment is in conjunction with the proposed rail connectivity from Nanjangodu- Bathery- Nilambur and the length of road to be developed is 69 km. An elevated corridor of 21km length across the forest is also a part of this option. The cost of development is Rs393.56 Crore, elevated structure isRs1452.92Crore and Land Acquisition (LA) cost is Rs1.3Crore.

- **Option 4** suggested by the local authority of Mullankolly starts from Chungam near Sulthan Bathery on NH 766 (Ch. 97+900) to Mysore. The alignment passes through Mullenkolly, Padichira, Begur, Sargur and Handpost. The length from Kalpetta to Mysore through this alignment is 158 Km. This alignment passes through the side of Kabani Reservoir and has an elevated corridor of 8.2 km length across the forest section. The development cost of this alignment is Rs711.4 Cr, elevated structure is 574 Crore and LA cost is Rs6.88 Crore.

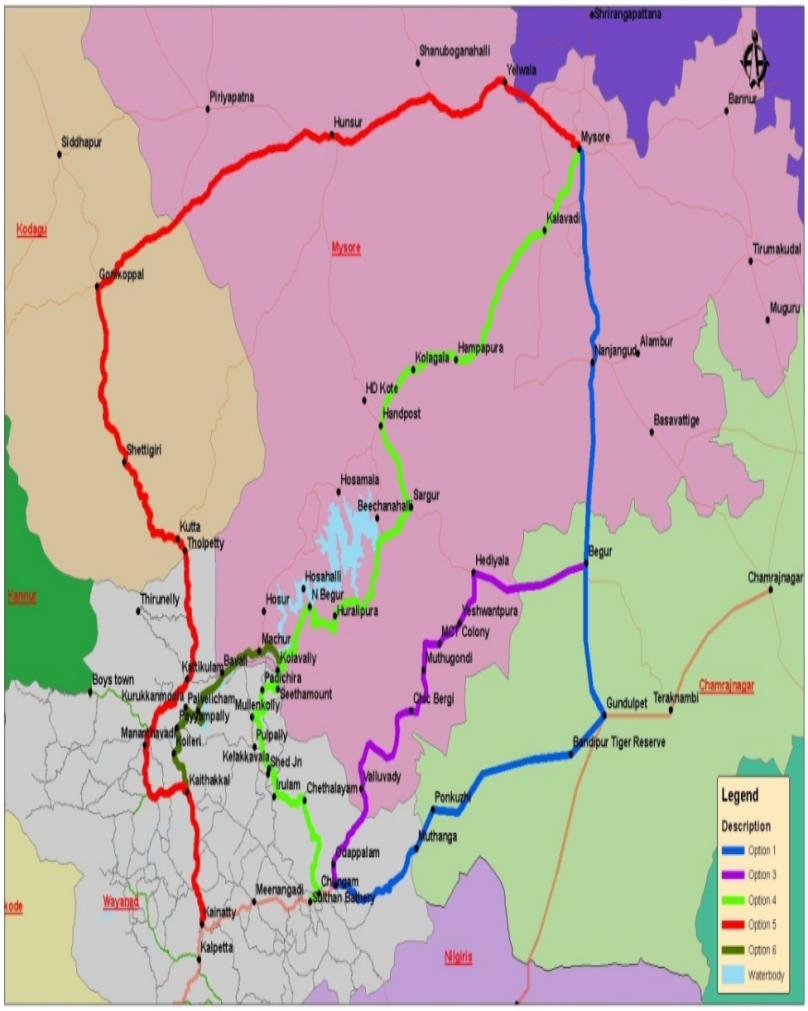


Figure 5: Key Plan of Alignment options

- **Option 5** is proposed by the Government of Karnataka as an alternative route to Mysore and Bangalore. It starts from Kainatty near Kalpetta on National Highway 766 (Ch.75+700), pass through Mananthavadi, Kutta, Gonikoppal, Hunsur and ends in Mysore. Karnataka forest land is very minimal along this alignment. The length of this alignment is 50km more (from Kozhikode to Mysore) compared to NH 766. The development cost is Rs 506.87 Crore and LA cost is Rs10.46 Crore.

- **Option 6** is evolved from the suggestion of local people around Palvelicham. This option starts from Kaniatty near Kalpetta pass through Kaithakkal, Koyileri, Palvelicham, Bavali and reaches the banks of River Kabani at Machur and crosses Kabani River and joins with alignment 4 from Mullenkolly via Padichira. Distance

from Kalpetta to Mysore via this alignment is 141 km. The development cost is Rs 743.15 Cr, elevated structure Rs 587.3 Crore and LA cost Rs17.23 Crore.

Traffic studies were also carried out at Muthanga as well as Kattikkulam for assessing the rerouted / re-scheduled trips. A total of 1,812 passengers (113 Vehicles) are found to have rerouted the journey to Kutta-Gonikoppal road during night time. Number of passengers who have rescheduled their trip through Muthanga to avoid night ban of traffic was estimated to 964 (261 vehicles).

Comparative scoring system is adopted for evaluating the alternatives. Options were given scores for each evaluation parameter, based on the quantified virtue of each alternative. The weightages given for each parameter are Total Length (20), Forest land affected (35), LA & RR Cost (20), Construction Cost (25). The summary of evaluation of alternate alignment options are given in **Table 13.**

Table 13: Evaluation of Alternate Alignment Options (Weightage)

Parameters		Option1	Option 2	Option3	Option 4	Option 5	Option 6
Total Length	Km	141.00	141.00	142.10	157.76	191.7	141.03
	Weightage	20.00	20.00	19.85	17.87	14.16	20.00
Forest land affected	Ha	5.20	5.20	28.16	19.33	14.89	14.47
	Weightage	35.00	35.00	6.46	9.42	12.22	12.58
LA & RR Cost	In Cr.	-	-	30	89	143	260
	Weightage	20.00	20.00	0.66	0.22	0.14	0.08
Construction Cost	In Cr.	1820	10920	1846.48	1285.40	506.87	1330.45
	Weightage	6.96	1.16	6.86	9.86	25.00	9.52
Score		81.96	76.16	33.83	37.37	51.52	42.18
Overall Rank		1	2	6	5	3	4

As per the evaluation process, alignment option 1 was ranked first as it is affecting only the minimum forest land and number of buildings. According to this option, an elevated corridor needs to be constructed over the existing National Highway for a length of 26km and is having the minimum LA & RR costs. The cost of constructing elevated corridor is worked out as 1,820 Crores INR. Even though the construction cost is high compared to option 4, 5 & 6, this option gets maximum weighted score for the parameters concerned.

Hence in order to have round the clock connectivity through NH766, it is recommended to construct an elevated highway through the forest stretch. However considering the regional development, options 4 and 5 also can be considered for development.

17. Periodic Updation of Price Indices for Different Public Transport Operations

The periodic computation of cost of operation of these public transport services such as Stage Carriages, Taxi, Auto, State Passenger Boat Services etc. is helpful to take appropriate decision whenever fare revision matter is taken up. A study was undertaken with the following objectives.

i. To compute a price index for different operations for understanding the periodical movement of prices of vehicle operating cost and other inputs for different types of public transport operations;

ii. To assess the expenditures (fixed & variable cost) of different types of public transport operations;

iii. To determine the fare structure of various category of services of concerned public transport operations and establish unit operating cost of various types of services.

Methodology

i. Updation of Price Index for Stage Carriage Operation(PISCO) table by assessing the variable cost components such as fuel, lubricants, tyre and tube, spare parts and maintenance and fixed cost components such as crew wages, tax, insurance, capital and depreciation etc. on various time period in 2015-16;

ii. New cost index was adopted for computing price indices for boat operation, PIARO and PITO.

Findings

Price Index for Stage Carriage Operation (PISCO)

Since the last fare revision in May 2014, the price of diesel, lubricants, tyres and certain other spare part items have been fluctuating continuously. The diesel price alone was the major fluctuating factor. The price of the diesel in February 2015 was Rs.50.91 per liter, then it suddenly increased to Rs.57.04 per liter in July 2015 and then there was a dip in November 2015 to Rs.51.36 per liter and now it increased to Rs.52.56 per liter. The percentage growth in the PISCO estimated a variation of 4.11 percent in the variable cost and 6.96 percent in the fixed cost between February 2015 and March 2016. The overall price index for the stage carriage operation showed a variation of 5.34 percent during the period.

Price Indices for Autorickshaw Operations (PIARO)

NATPAC tried to work out the new operating cost for Autorickshaws. Bajaj RE models were selected for Autorickshaws in Petrol, Diesel and CNG. It has been observed from the field study that CNG model is practically nil compared to petrol and diesel models. Further there is a significant shift from petrol models to diesel models.

Table 14: Cost Chart for Different Types of Autorickshaws

Models	Fixed Cost (in Rs)	Variable Cost (in Rs)	Total Cost/km (in Rs)
Petrol	5.594	7.306	12.900
Diesel	5.162	5.207	10.369
CNG	5.222	4.542	9.764

Price Indices for Taxi Operations (PITO)

Typical HM Ambassador Classic 2000 model was selected. The variable cost works out to be Rs.8.03/km (fuel, material variable cost and labour costs) and the fixed cost works out to Rs.5.09/km and the total cost of operation is Rs.13.12/km.

18. Urban Travel and Traffic Flow Characteristics in Kerala- Development of Quick Response Travel Demand Estimation Techniques

Travel demand forecasting plays an important role as a major contributor to the planning tools used in evaluating alternatives. The conventional four step travel estimation procedures have been simplified to provide quick response to transportation planning needs. The simplified technique known as Quick Response Travel Demand Estimation Technique utilizes secondary information as basic input and with easy to apply transferable parameters.

Study Area and Database

Database is developed from the results of various traffic and transportation studies conducted by National Transportation Planning and Research Centre (NATPAC) and other Government agencies. The study deals with development of the trip generation models for small and medium towns, having population less than 1,00,000 in Kerala using the available data base. The simplified technique of Quick Response Travel Demand Estimation reduces the requirement of primary data collection through costly

Surveys by using minimal data, with easily available planning inputs and hence making cost effective.

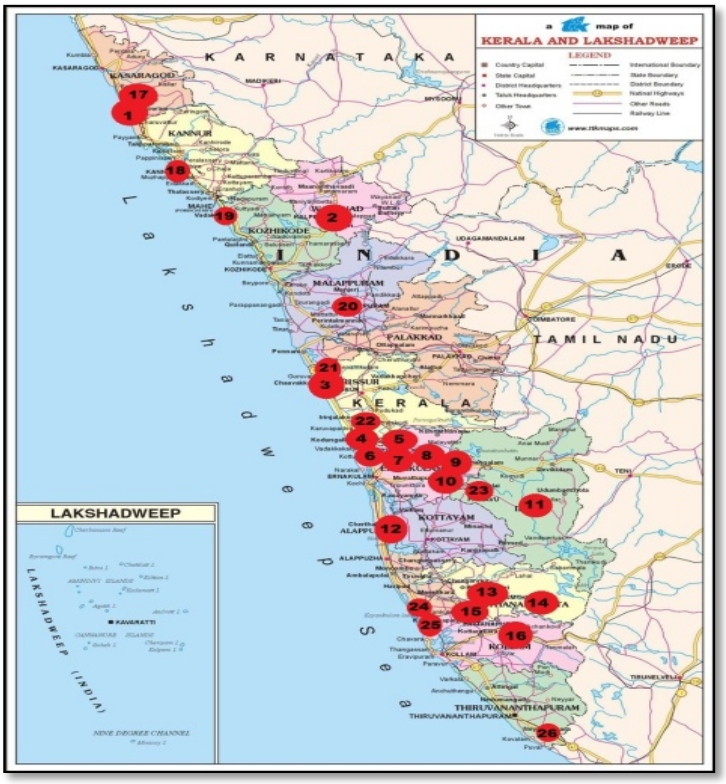


Figure 6: Database

Scope and Objectives

The scope of the study is confined to 26 urban areas in Kerala having population less than 1,00,000, compiled from the traffic and transportation study reports done in NATPAC in past 10 years for nearly 50 towns. The main objective of the study is development and validation of a trip generation model for the identified towns in Kerala using "quick-response" concept.

- To study and understand the traffic and travel characteristics of various sized urban areas;
- To correlate the above characteristics according to population and demographic features;
- To identify the secondary and transferable parameters influencing trip generation;
- To generate trip generation models using quick-response concept ;
- To conduct model performance evaluation upon similar towns.

Methodology

The methodology adopted for the study includes the following steps: (1) Data compilation (2) Analysis of data (3) Identification and selection of transferable parameters (4) Model development and (5) Evaluation of formulated models. Based on the analysis of compiled data, the independent variables selected for model development include census population, motor able road length, per capita vehicle ownership (total, transit and non-transit), and volume of vehicles. The variables were selected for model formulation after checking the correlation statistics as well.

Model Development

Easy to apply, transferable trip generation models were developed to estimate intercity total person trips, intercity transit person trips and intercity non transit person trips, all exclusive of non motorized modes, using regression analysis for which independent variables are chosen in such a manner that they are secondary in nature and transferable within towns of similar demographic features. Multiple linear and non linear regression models were formulated to estimate intercity person trips. The intercity passenger trip whether total, transit or non transit depends upon various variables like population density, motor able road length, per capita vehicle ownership etc.

The models developed could be of much help to improve the trip generation estimation in travel demand forecasting in small and medium towns that may have insufficient resources to conduct field surveys. The methodology put forward is applicable and transferable to other towns with similar demographic features.

19. Improvement Proposal for the Nizari Junction at Ramanattukara

Nizary Junction **(Figure 7)** which is 1.5km away from Ramanattukara, Kozhikode is formed by the intersection of NH 17 and the road from Ramanattukara Junction. The junction is formed by a minor slow moving carriageway with a major fast moving carriageway (NH 17). The traffic volume handled by Kozhikode road is high and has led to congestion disturbing the free flow. Frequent accidents at this place make the road unsafe for the users and pose a threat to the local people living around the location. With the aim of reducing congestion at Nizari Junction, NATPAC undertook a study and prepared an improvement proposal.

Reconnaissance survey was conducted by NATPAC officials at the study area. The traffic from minor road is separated by traffic islands. It is observed that the junction lacks proper merging and diverging lanes to separate the turning movement traffic. Also a topography survey was conducted to get the existing details of the road and to provide an improvement proposal. A turning movement count survey was conducted to determine the total traffic handled by the junction. During the peak hour a total of 2556 PCU vehicles are plying through the junction.

Figure 7: Aerial View of Nizary Junction

As the traffic flow is heavy it is proposed to improve the junction as per the IRC and MORTH specifications. The design has been finalized to ensure minimum land acquisition. The key features of the Junction Improvement includes:

- Widening of existing two lane traffic movements at the junction location to four lane divided traffic movement;
- Provision of proper island to channelize the traffic movement in the junction;
- Provision of merging and diverging lanes so that the straight moving traffic is not affected by the turning traffic;
- Provision of pedestrian crossings and footpath for the local pedestrian movement.

The details showing the Junction Improvement Plan is shown in **Figure 8.**

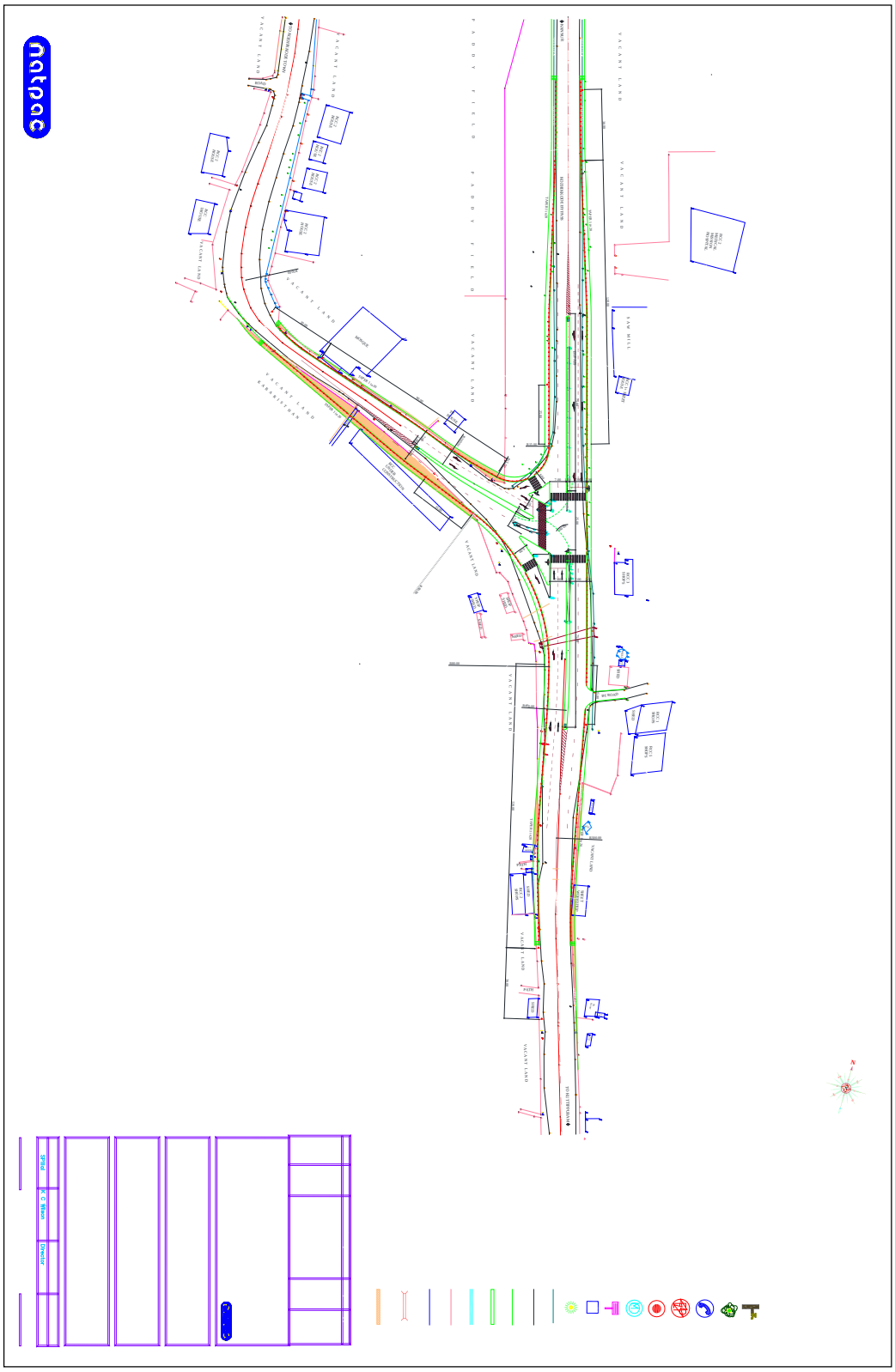


Figure 8: Improvement Plan for Nizary Junction

20. Economic Proposal for Temple Road at Cyber park in Kozhikode

Cyber Park is located on the NH 17 bye-pass road connecting Kochi in the South to Mumbai. A design and alignment for the temple access road was proposed by M/s N.M Salim & Associates and NATPAC technically evaluated the same. The scope of the study is confined to design of new alignment for the temple road (460m) in Cyber Park.

Objectives

- To prepare economic and feasible alignment design for the temple road;
- To estimate the detailed cost for the new alignment;
- Preparation of technical specifications for the temple road construction.

In order to propose an alternative or feasible road access to temple in Cyber Park, a site visit was carried out. After examining the site topography survey was recommended for better design options for the access road to the temple located in Cyber Park. A detailed topography survey was carried out and detailed alignment design was proposed for temple road. Cost estimation for the temple road was also worked out.

The temple to which the road access has to be designed is located at the vicinity of Kozhikode Cyber park campus. The road access to the temple starts from the existing underpass leading towards the entrance of the temple. The new road alignment is expected to connect the temple from the existing underpass. The level difference between the underpass and the ground level is around 8m.The existing terrain is hilly varying from 8m near the underpass to 34m at temple. The length of the stretch is about 500m.

A detailed topographic survey was done along the study stretch for the purpose of obtaining a base plan and existing profile of the alignment and thus to enable the geometric design. The new alignment was proposed on the green field of the Cyber Park close to the boundary to connect the temple from the existing vehicle underpass inside Cyber Park. The road access to the temple starts from the existing vehicle underpass that is running from the NH to the Cyber Park.

New Alignment design

The carriageway width of 5m wide is proposed with side drain and electrical duct on either side. The minimum and the maximum radius of the curvature for the proposed alignment vary from 20m to 100 m and the maximum slope adopted is the exceptional gradient for hilly terrain of 7%. The right of way is about 7.25m. Footpath is around 0.9m in LHS and 1.35m in RHS which serves as utility drain cum footpath.

The cost estimation and bill of quantities for the temple road was worked out in accordance with 'Analysis of rates 2014' by Government of India. The Bill of Quantities (BOQ) was divided into two sections Part I & Part II. In Part I the items included in the estimation are the site clearing and grubbing: Earth work comprises both excavations for roadway as well as drains and embankment construction, excavation for structures, boundary stones and retaining wall. In Part II, the items included in the estimation are the Pavement layer construction comprising of granular subbase layer, wet mix macadam and bituminous layers, surface and sub surface drains, sign boards, crash barrier, road markings and street lighting.

21. Preparation of Detailed Road Network Map for Kerala Using GIS, Remote Sensing and GPS

NATPAC aimed at creating a detailed road network data using Geo Informatics tool for Thiruvananthapuram district in Kerala.

Scope and Objectives of the Study:

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

Thiruvananthapuram district was taken up for the study. Remote sensing, GPS and GIS were used to prepare the road network map of the study area. Public Works Department

(PWD) road network map created by NATPAC during 2011 was taken as the base map for updating. Road pertaining to the district which were not available in the original dataset were updated using the online resources, viz ESRI web portal, Google Earth, Google Maps and Open Street maps. Road names, road type, type of surface and carriageway width were the attribute information added to the road dataset. Road stretches which lacked this information were marked and maps were prepared highlighting them. Field updating using handheld GPS device was undertaken to obtain the missing data. Survey team traversed through all the major roads in the district except narrow lanes. Attribute data were collected and GPS tracks were enabled for easy verification at later stage. Data collected in GPX format using GPS was imported using EasyGPS software and converted to shape files, the native ArcGIS format. These files were exported to KML format and added to the Google Earth for verification and updating. New roads plotted using GPS which were not discernible in Google Earth were created and attribute data updated. The KML files were exported back to ArcGIS vector data format, topological errors were removed and the data finalized. The generated data will be highly beneficial for user agencies like PWD, Police and Health Department.

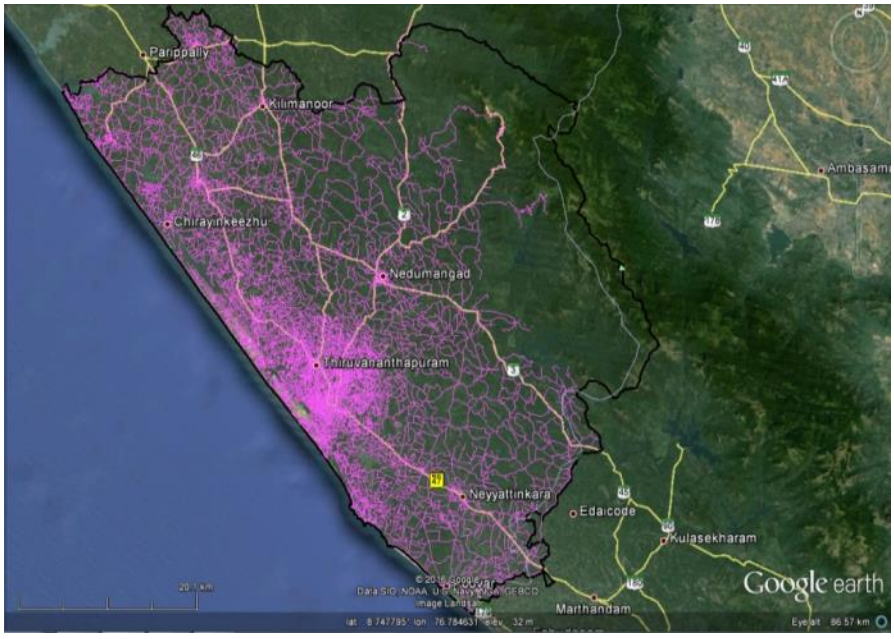


Figure 9: Updated Road Network of Study Area

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

NATPAC is developing a traffic growth rate model for the National Highways in Kerala. The methodology adopted for the study consisted of establishment of volume count stations, establishing relationships between the collected data and socio economic indicators and development of a suitable model for traffic growth rate using suitable techniques.

Three locations situated in southern Kerala, middle Kerala and northern Kerala were selected for the study. The locations selected for the study are Kalluvathukkal in NH 47 (NH- 66) at Kollam district, Paliyekkara in NH 47(NH 544) at Thrissur District and Chombalanear Vadakara in NH 17(NH 66) at Kozhikode district. The existing road in Kalluvathukkal and Chombala is two- lane with paved shoulder and that in Paliyekkara is four-lane with service road.

- Two sets of 7 days 24hrs classified traffic volume data were collected from each of the locations. All the relevant secondary data were also collected;
- Primary data collection is 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, per capita income, Gross State Domestic Product/ Net State Domestic Product (GSDP/NSDP), agriculture, industries, other services;
- The data collected through primary and secondary data collection is analysed under two domains: traffic data analysis and socio economic data analysis.

The various techniques available for developing a model for traffic growth rate are identified and the most suitable method is utilized for deriving a model for traffic growth rate for the NH in Kerala.

The data collected from the three study locations were analysed and percentage variation of maximum and minimum vehicular traffic with respect to average traffic was obtained.

Findings:-

- Maximum traffic was observed on Saturday at Kalluvathukkal and Paliyekkara and on Thursday at Chombala;

- In Kalluvathukkal the traffic volume ranges from 22993 to 30674 and the percentage variation of maximum and minimum traffic with respect to the average traffic is 11.25 and 16.61 respectively. The traffic volume ranges from 50284 to 60341 and the percentage variation of maximum and minimum traffic with respect to the average traffic is 8.82 and 9.32 respectively in Paliyekkara. The traffic volume ranges from 20149 to 25718 in Chombala and the percentage variation of maximum and minimum traffic with respect to average traffic is 12.89 and 11.56 respectively;

- Traffic volume on all the roads are more than its capacity

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. It is proposed to establish three permanent volume count stations in the State. The data collected will be utilized and correlated with various socio-economic indicators to arrive at a traffic growth rate model applicable to NHs.

23. Strategic Plan for the Development of National Highway Network in Kerala Kozhikode Division

NATPAC developed a perspective plan for National Highway sections in Kozhikode division on a demonstration mode. The corridors include NH 66 from Idimoozhikkal to Poozhithala (75.30 km) including the bypass section from Nisary junction to Vengalam and NH 766 from West Hill to Wayanad District border near Vythiri (53.30 km).

The methodology adopted for the study consisted of reconnaissance survey, demarcation of study stretches and homogeneous sections, collection of secondary data, conducting primary surveys including road inventory and traffic surveys, data analysis, estimation of traffic demand for the horizon year and preparation of transport development plan in a phase-wise manner.

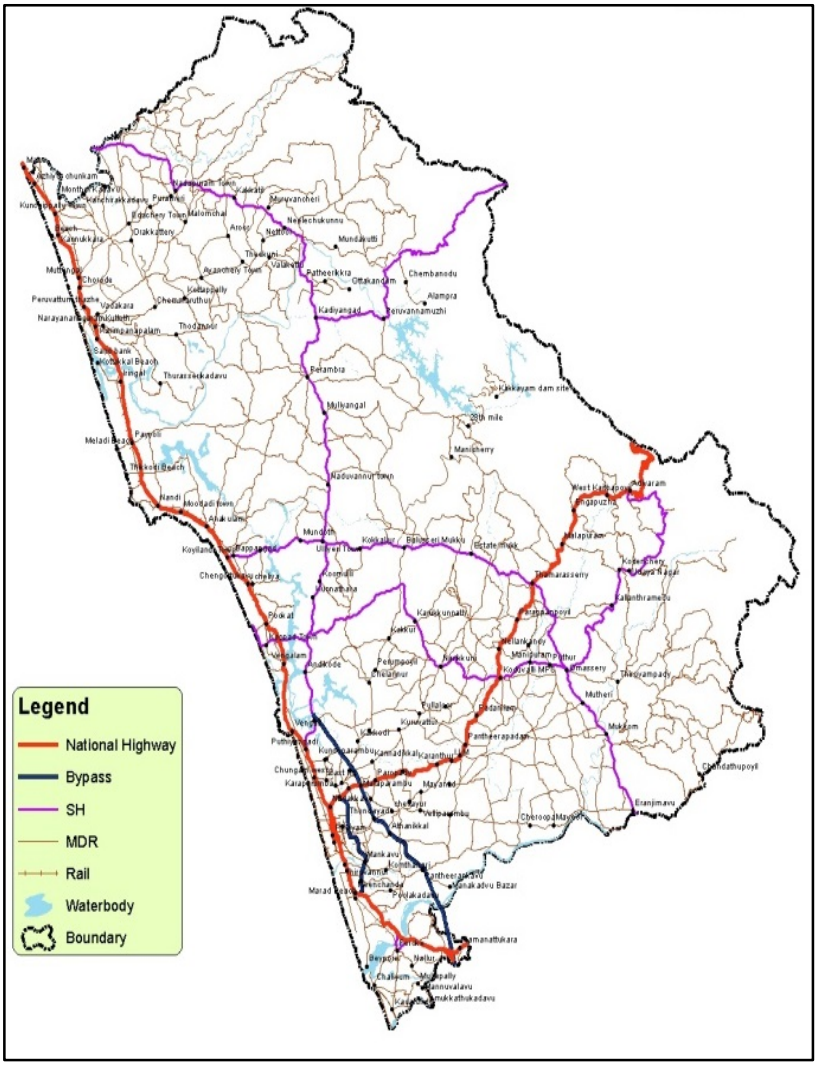


Figure 10: Road Network Map of Kozhikode District

Traffic surveys were conducted at each of the homogeneous sections to assess the daily traffic. The Volume – Capacity (V/C) value of the links on NH 66, even at the base year itself, varied from 1.00 to 2.29. Similarly V/C ratio on NH 766 varies from 0.78 to 2.23. This necessitates improvement of the road for catering to the easy flow of the current traffic.

Turning movement surveys at 18 major intersections in the study area were conducted to ascertain the peak hour demands. It could be seen that Thondayad Junction witnessed the maximum peak hour traffic flow of 6299 PCU. Malaparamba Junction had a peak hour flow of 4818 PCU.

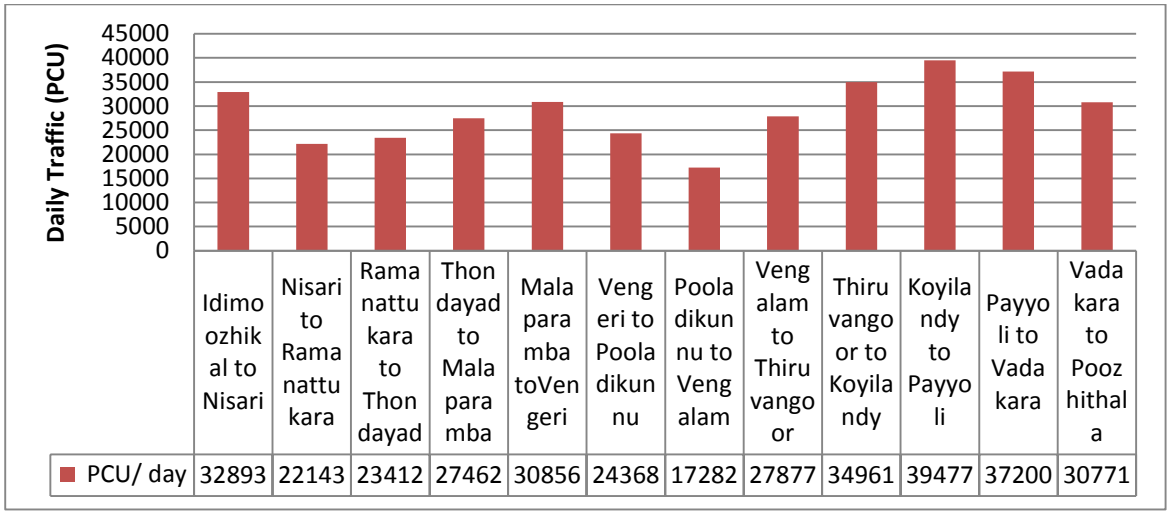


Figure 11: Bar Chart showing the Traffic Volume of the Links on NH 66

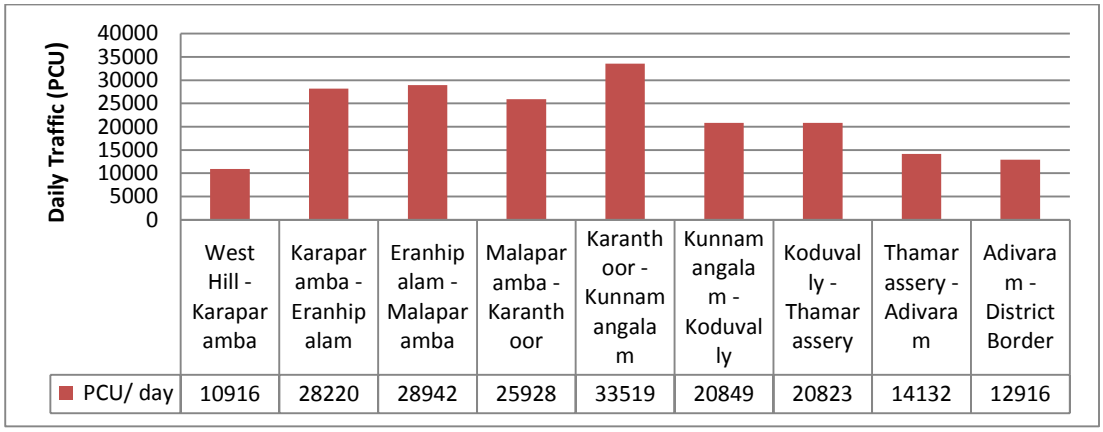


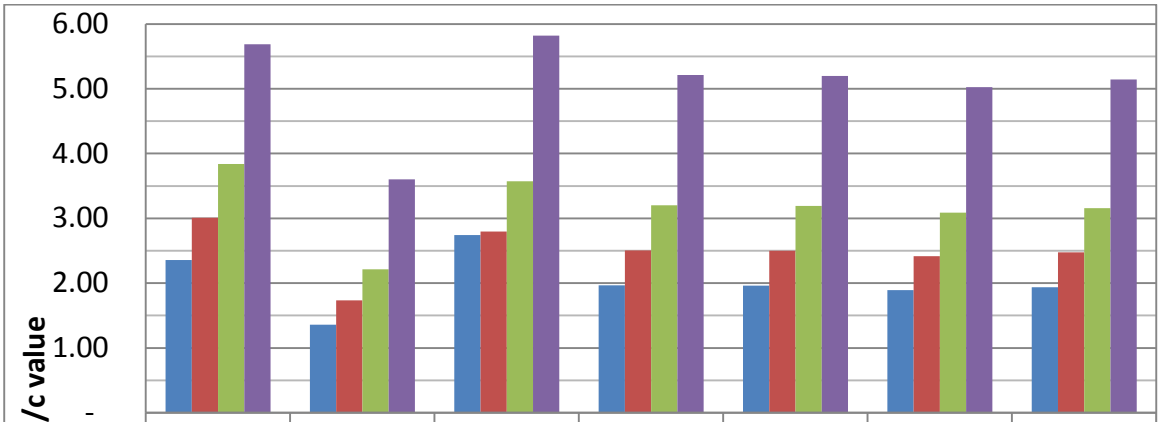
Figure 12: Bar Chart showing the Traffic Volume of the Links on NH 766

The volume of traffic plying through the identified homogeneous sections was forecasted for various horizon years. It was seen that, even for a conservative growth rate, the volume of traffic at all the sections increases to such an extent that the stretches will be severely congested on a do-nothing scenario. This warrants immediate attention and interventions.

NATPAC prepared a development plan for the two NHs in Kozhikode. The plan takes into account of the existing traffic scenario and is based on an evaluation of the future traffic on the base year network.

The identified development options for NH in Kozhikode have been proposed to be implemented in phases. Phase I is in the base year itself viz; 2016 and Phase II is by the year 2021 which is five years from the base year. Phase II proposes four-laning of NH66

and construction of grade separators at major intersections like Thondayad, Ramanattukara, Malaparamba, Koyilandy, Vadakara and Eranhipalam.



	Poozhithala-Vengalam	Vengalam-Nisary	Nisary-Idimoozhikkal	West Hill - Malaparamba	Malaparamba-Kunnamangalam	Kunnamangalam-Thamarassery	Thamarassery-Kozhikode Border
2016	2.36	1.36	2.74	1.96	1.96	1.89	1.94
2021	3.01	1.73	2.80	2.51	2.50	2.42	2.47
2026	3.84	2.21	3.57	3.20	3.19	3.09	3.16
2036	5.69	3.60	5.82	5.21	5.20	5.03	5.14

Figure 13: Forecasted V-C Ratio on the Homogeneous Sections in the NHs in Kozhikode

24. Performance of Highway Development Projects in Kerala

National Transportation Planning and Research Centre (NATPAC) carried out a study for the appraisal of the highways developed under Kerala State Transport Project (KSTP). Traffic studies and pavement evaluation studies were done to evaluate the performance and thereby collect a comprehensive database on the structural and functional performance of the highways of the state. This will help in formulating of deterioration models for the state roads. Large and ever-increasing investment demands for the upkeep and for ensuring the desired level of serviceability of road infrastructure facilities emphasize the need for addressing road maintenance and rehabilitation problems. The accurate prediction of pavement performance is important for efficient management of the transportation infrastructure.

The scope of the study is limited to selected stretches of SH-1 developed under Kerala State Transport Project. The methodology adopted consisted of collection of baseline

data, structural and functional evaluation of the pavements, traffic studies and thereby developing a pavement performance prediction model. The details of the road stretches in the study area are given in **Table 15**.

Table 15: Study Stretches

Sl No	Name of Study Stretch	Sections
1	Vetturoad-Pothencode(Sainik School to Kinfra)	HS I
2	Chanthavila to Kattaikonam	HS II
3	Venjaramoodu to Nilamel (Thandrampoika)	HS III
4	Nilamel to Chadayamangalam	HS IV
5	Vayackal to PolicoduJn	HS V
6	Lower Karickam to Kottarakkara	HS VI

Four-year pavement evaluation data such as condition survey data, Benkelman Beam Deflection data, international roughness value, texture depth variation, skid resistance etc. were collected and analyzed. The pavement condition or performance is evaluated on the basis of four aspects such as riding quality, surface distress, structural capacity and skid resistance. Models were developed for predicting these four aspects by considering the variables affecting these aspects such as pavement age, texture depth, Pavement Condition Index (PCI), California Bearing Ratio (CBR) and Pavement Smoothness Index (PI) etc. Pavement performance prediction model was developed using SPSS statistics software and Artificial Neural Network modeling (ANN) and were compared.

Findings

The traffic plying on the study roads varies from 444 Commercial Vehicles per Day (CVPD) to 1479CVPD conforming to heavy traffic on most of the stretches. From the laboratory investigations, it is clear that soil with good CBR strength was used as subgrade. Mostly the soil is of clayey sand type (SC). Study roads strengthened under KSTP showed good performance as indicated by lower deflection value and desirable skid resistance value. On an average 3 to 5 % reduction in Pavement Condition Index of distress ($PCI_{Distress}$) was observed every year. The study roads exhibit a current functional performance of good to average rating based on the unevenness values indicated by the IRI values of the study stretches. Signs of impending failures have initiated on the pavement surface of the study roads in the form of various distresses like fractures or cracks, distortion, disintegration etc. Ravelling and alligator cracks are the

major distresses seen on the pavement surface. Initiation of potholes is also noticed at some of the locations.Based on theoretical, statistical and field works conducted, a multiple nonlinear regression model was developed to predict the performance of State Highway 1, which helps in forecasting of performance of pavement over a period of time. The developed performance models are deflection model, skid resistance model and IRI model. These models were validated to ensure their better use in field conditions. Models were developed using ANN and validated to ensure better use in field work. Model has been tested with MAE (Mean Absolute Error) and MAPE (Mean Average Percentage Error) to indicate how much closer the predicted and observed values.

25. Overloading of Vehicles and its Impact on Pavement

The overloaded trucks plying on the highways of the state stress the pavement structure beyond its safe bearing capacity and causes drastic reduction in the pavement service life and gets destroyed before its design life. NATPAC studied the overloading of trucks and its impact on pavement structure.

The major objectives of this study are:

- To analyse the behaviour of truck overloading on flexible pavements;
- To study the Vehicle Damage Factor (VDF) in detail for various classes of trucks with respect to varying loading condition;
- To analyse the variations in thickness and cost of a flexible pavement subjected to truck overloading;
- To explore the severity of overloaded vehicles on pavement service life.

The methodology adopted includes selection of study area, data collection, axle load data analysis, VDF analysis, determination of pavement thickness for overloaded and normally loaded condition and finally to quantify the economic impact of overloading. National Highway connecting Kerala with other states was selected as study stretches to get a good sample of overloaded vehicles. The study locations were Kanhangad, Wayanad, Kanjirappally, Aryankavu and Neyyattinkara. Primary data such as vehicle load, number of vehicles and trip pattern was obtained by conducting axle load, traffic

volume count and origin-destination surveys respectively. Secondary data such as pavement maintenance data and California Bearing Ratio (CBR) were adopted from earlier studies conducted by NATPAC. The collected data was analysed to determine the number of overloaded vehicles. VDF analysis was done to determine the variation of load impact on pavement for varying load combinations. Finally, estimation was done to quantify the economic impact of overloaded vehicles.

Some of the significant findings are listed below;

- Preliminary analysis shows that Kanhangad is facing huge truck traffic than all other locations. 2-Axle truck contributes a higher traffic volume in all the survey locations;
- 60% of vehicles moving towards Thenmala is found to be overloaded, in which, 3-Axle and 4-Axle truck contribute a huge ratio. Also, 40% of vehicles moving towards Kannur at Kanhangad location and towards Thamaraserry at Adivaram is overloaded and 30% of truck moving towards Kottayam at NH 183 and 29% vehicle moving towards Thiruvananthapuram at Neyyattinkara (NH66) location is found to be overloaded.

In general all the truck traffic towards Kerala is found to be overloaded. Overloaded vehicles with imbalance load distribution show a significant reduction in pavement life. With every 5% increase in overloading, 2-Axle truck shows a higher VDF value when compared to 3-Axle and 4-Axle truck. This implies that the damage caused to the pavement by an overloaded 2-Axle truck is more. Wayanad is experiencing the highest VDF value of 20.6 followed by Neyyattinkara (18.8) and Aryankavu (15).Pavement thickness analysis at Aryankavu location shows that a 5cm additional thickness is to be maintained for overloaded condition than the normally loaded condition. Financial analysis of pavement construction at Aryankavu location shows that if the overloading of vehicle persists an additional cost of 2.71 crores of rupees per kilometre is to be spend to maintain the design life of pavement.

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

Reclaimed Asphalt Pavement (RAP) is a recycling technique where there is reuse of the aggregates and binder which are milled out from the deteriorated pavements and mix it to the Hot Mix Asphalt (HMA) as aggregates in such a proportion so that, the mix should get the required strength and performance. A study is being undertaken for determining the suitability of RAP in Kerala conditions.

Objectives

- To characterize the RAP, that was collected from field by finding the asphalt content and gradation of aggregates;
- To prepare RAP (0%-20%)-HMA mixes for the surface course;
- To evaluate the performance of the mixes based on wheel rut test, indirect tensile strength test and moisture susceptibility test;
- To suggest optimum RAP content in HMA based on the performance studies.

The scope of the study is limited to the collection of RAP from existing pavements which have to be milled for repair of utilities. The study is limited to the surface course.

Methodology

The methodology adopted for the study consisted of collection of RAP from field, obtaining the properties of RAP, preparation of RAP-HMA surface mix and performance evaluation of the prepared mix.

Bitumen was extracted from RAP (**Plate 4**) using the centrifuge extractor. The percentage of bitumen present in RAP was obtained as 5.35% and the gradation of the aggregates in RAP obtained is tabulated in **Table 16**.

The gradation of RAP was compared with the BC gradation II (MORTH-2013) and missing aggregates were found out. Virgin aggregates were added to different RAP percentages to achieve the desired gradation of BC grade II (MORTH 2013) and mix design was carried out by Marshall Method using VG30 as well as VG10 binders. The bitumen content corresponding to 4% air voids was taken as the optimum binder content and was ensured that this bitumen content also satisfied the requirements specified for

stability, flow, bulk density, VMA and VFA. Optimum Binder Content (OBC) for virgin BC was obtained as 5.7 % and virgin binder required for different percentages of RAP, so that the mix satisfied the requirements for OBC are listed in **Table 16**.

Plate 4: Scarified RAP

Table 16: Virgin Binder Required for Design Mix

RAP (%)	VG30	VG 10
0 (Virgin BC)	5.7	
5	5.4	5.5
10	5.3	5.45
15	5.1	5.2
20	4.65	4.8

Indirect tensile strength tests and wheel rut tests were conducted to evaluate the performance of the HMA-RAP mixes designed at their corresponding optimum binder content. The results are tabulated in **Table 17**.

Table 17: Performance Test Results

RAP % in HMA	ITS (kPa)		TSR (%)		Rut (mm)	
	VG 30	VG 10	VG 30	VG 10	VG 30	VG 10
0	387.70		94.56		3.27	
5	499.00	419.23	93.52	94.21	3.14	3.21
10	561.18	461.76	89.04	93.63	2.64	3.17
15	564.74	533.93	80.76	87.75	2.58	2.84
20	719.78	628.21	76.20	83.56	2.28	2.51

The performance of HMA-RAP mixes was evaluated by conducting laboratory studies. Based on the laboratory tests, the following conclusions were drawn.

- With the addition of RAP the virgin binder required to obtain a desirable mix has reduced considerably in the case of both binders. A decrease of 18% was achieved when RAP content was 20% of the total aggregate with VG 30 as binder and 15% decrease was achieved for VG 10 binder;
- With the addition of RAP, the ITS strength increased (higher for mix with VG30) and rut depth decreased (lower for mix with VG 30) for both binders.

From the laboratory tests it can be understood that the recycled mixes perform similarly or even better than a virgin mix. Hence, it may be suggested to recycle the pavement materials extracted during maintenance or reconstruction of the pavement by using them again for relaying on the pavement after proper mix design. This will help in reducing the cost of construction and making the construction eco-friendly. Therefore, the use of HMA-RAP mix can be considered in Kerala where a huge amount of money and resources are spent for maintenance of the roadways.

27. Strategy for Improving Walkability in Major Cities of Kerala

Walkability is the measure of the overall walking and living conditions in an area. It is the extent to which the built environment is friendly to the presence of people walking, living, shopping, visiting, enjoying or spending time in an area. It can be linked to the quality of built environment, the urban form and connectivity, safety and desirability to walk and accessibility of infrastructure. This study aims at comparing the walkability of major cities in Kerala, identifying the performance of the city and formulating remedial measures that will have bigger impact in improving walkability. The scope of the study is constrained to selected road corridors in Thiruvananthapuram and Ernakulum cities in Kerala.

Objectives

- To assess, review and quantify the existing pedestrian facilities and infrastructure in various road corridors and nodes in the major cities of Kerala;
- To understand and compare the current state of walkability in the cities;
- To identify the standards in the existing walking environment and to work on the areas of improvement for better walkability;

- To determine the pedestrian's preference and aspects to improve walkability;
- To formulate strategies to enhance better accessibility, convenient and safe walking environment.

Around 22 road stretches in Thiruvananthapuram and 19 road stretches in Ernakulam were taken into consideration.

Methodology

- Collection of road inventory details, pedestrian volume & Pedestrian opinion survey;
- Determination of walkability index for the selected road corridors;
- Model development for pedestrian overall satisfaction score for pedestrian level of service.

Walkability Index

Walkability index was used in the studies commissioned by the Ministry of Urban Development (MoUD). The index was a function of the availability of footpaths and a pedestrian facility rating. The perception of pedestrians was gauged based on the availability and quality of footpaths, obstructions, maintenance, lighting, security, safety of crossings, and other qualitative factors.

Walkability Index *is calculated as;*

$$Wi = [(W1 \times \text{Availability of footpath}) + (W2 \times \text{Pedestrian Facility rating})]$$

where, W1 and W2 are Assumed weightage (50% for both, in this case)

Availability of footpath:

$$\frac{\text{Footpath length } X \text{ Average available width of footpath}}{\text{Length of major roads in the city Standard width as per IRC}}$$

Pedestrian Facility Rating: It is the score estimated based on opinion on available pedestrian facility. As far as walkability is concerned, rating below 50% is considered as bad, between 50% and 70% is satisfactory, above 70% and below 90% is fair and above 90% is good. In Thiruvananthapuram region the average walkability of footpath is 48% which is considered very bad. Almost 92% of footpath has walkability rating below

70%. In Ernakulam region the average walkability of footpath is 49% which is also considered as bad. Only one road stretch scored above 70% walkability rating in this region.

The pedestrian opinion from all the selected corridors in Thiruvananthapuram and Ernakulam was recorded with respect to pedestrian facilities such as footpath surface, footpath width, obstructions, encroachment, and potential for vehicle conflict, continuity and pedestrian user factors such as pedestrian volume, safety, comfort, walk environment.

In order to improve the pedestrian level of service, pedestrian overall satisfaction was extracted from the pedestrian opinion survey against each parameter that is responsible to enhance the level of service. The determination of pedestrian overall satisfaction was based on the rating provided by the pedestrian upon the ten parameters that was explained previously which have more influence over the pedestrian level of service. From analyses the significant parameters have been chosen from the ten parameters and with those significant parameters linear regression model have been developed.

Linear Regression:

The prediction equations for overall satisfaction of the pedestrian for the two scenarios in the Thiruvananthapuram city are:

Scenario 1: Road Corridors with Partially Available Footpath

POS = 3.473 + 0.099 FPS + 3.059 FPW + 1.863 OBS + 1.473 ENC + 2.667 PVC

Scenario 2: Road Corridors with Fully Available Footpath

POS = 7.504 + 2.874 FPS + 1.229 FPW + 1.399 OBS + 1.968 ENC

The prediction equation for the two scenarios in Ernakulam city is:

Scenario 1: Road Corridors with Partially Available Footpath

POS = 6.433 + 1.301 FPS + 1.582 FPW + 1.164 OBS + 1.147 ENC + 1.665 PVC

Scenario 2: Road Corridors with Fully Available Footpath

POS = 8.906 + 2.239 FPS + 0.159 FPW + 1.860 OBS + 1.387 ENC

The statistical analysis and development of model conclude that the walkability index in the 8 stretches in Thiruvanthapuram city and 7 stretches in Ernakulam city can be enhanced by increasing the footpath width, improving the surface, removing the obstructions & encroachments in the following road corridors in the two cities.

And also the walkability index in the 7 stretches in Thiruvanthapuram city and 3 stretches in Ernakulam city can be improved by increasing the footpath width, improving the surface, removing the obstructions and encroachments, reducing the potential for vehicle conflicts, walkability index in the following stretches can be improved in both the cities.

28. Prefeasibility study for Providing Pedestrian Crossing Facilities at Medical College area, Thiruvananthapuram

Medical College junction is a busy junction situated in Thiruvananthapuram District. It is one of the busiest areas in Thiruvananthapuram due to frequent movement of ambulances and emergency vehicles. It is a multi-armed uncontrolled intersection. Most of the pedestrians are bystanders, patients or employees of the hospitals. Roads that meet in this junction are the Ulloor-Medical College road, Chalakuzhi lane, Pattom - Medical College Road, Kumarapuram Road and Medical College campus road. **Figure 14** shows the location map of the study area.

NATPAC conducted a prefeasibility study for providing a pedestrian foot over bridge across the various roads in Medical College junction with access ramp as per Indian Road Congress (IRC) Guidelines. The methodology adopted for the study consisted of Reconnaissance Survey, Secondary data collection from the concerned authorities, Assessment of Land availability at the project location, Development of different foot-over bridge/ramp options and Rough Cost Estimate for the suitable option.

The existing pedestrian flow pattern and vehicular conflict movement in the Medical College Junction was assessed. It has been observed that the pedestrian flow from Medical College campus to the area opposite to Medical College campus is considerably high as most of the medical shops and commercial shops are located in this area. It is observed that more than 4000 pedestrians including patients and bystanders are crossing

the junction in this direction during peak hour (7:45AM to 8:45AM). The total width of road measured in the junction varied from 12 - 18 meter which is unsafe for pedestrians to travel in the crisscross traffic movement. Also the footpath opposite to Medical College which is occupied by street vendors is also being used by pedestrians. A preliminary survey has been conducted to explore the existing scenario such as characteristics of road, footpath, presence of signals and bus stops in the roads that lead to Medical College Junction (**Table 18**).

Figure 14: Study Area Map

The provision of butterfly shape foot over bridge is the best suited option to be constructed in the medical college junction to ease the pedestrian movements. This model will decrease the walking distance and attract the pedestrian to make use of it. It is also determined that the provision of dog-legged landing staircase ramp is feasible as it will reduce the land area to be acquired.

Table 18: Existing Road Characteristics

Sl. No	Name of Road		Ulloor Road	Chalakuzhi Road	Murinjapalam Road	Kumarapuram Road
1.	Type of road		PWD	PWD	PWD	PWD
2.	Width (m)	CW	17.4	8.5	12	8
3.	Footpath (m)	L	0.8-1.2	1.25	2.15	1.2-2
		R	2.1	1.15	2.35	1.2-2
4.	Condition of foot path		Poor, no handrails	Narrow, unauthorized encroachments	Very poor, with obstructions	Very poor, with obstructions
5.	Bus stops	L	2	0	1	1
		R	1	0	0	0

The plan showing the pedestrian foot over bridge with the proposed ramp location area is shown in **Figure 15**. The typical sectional elevation and the typical cross section of walkway is shown in **Figures 16 and 17** respectively.

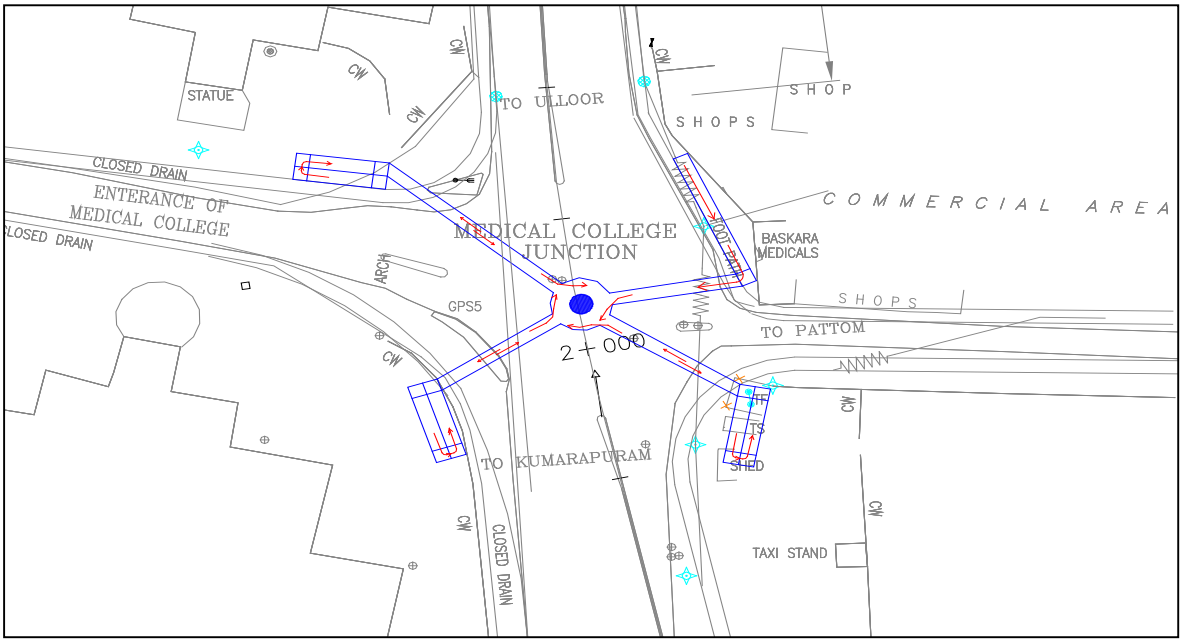


Figure 15: Proposed plan of Pedestrian Foot Over Bridge at Medical College Junction

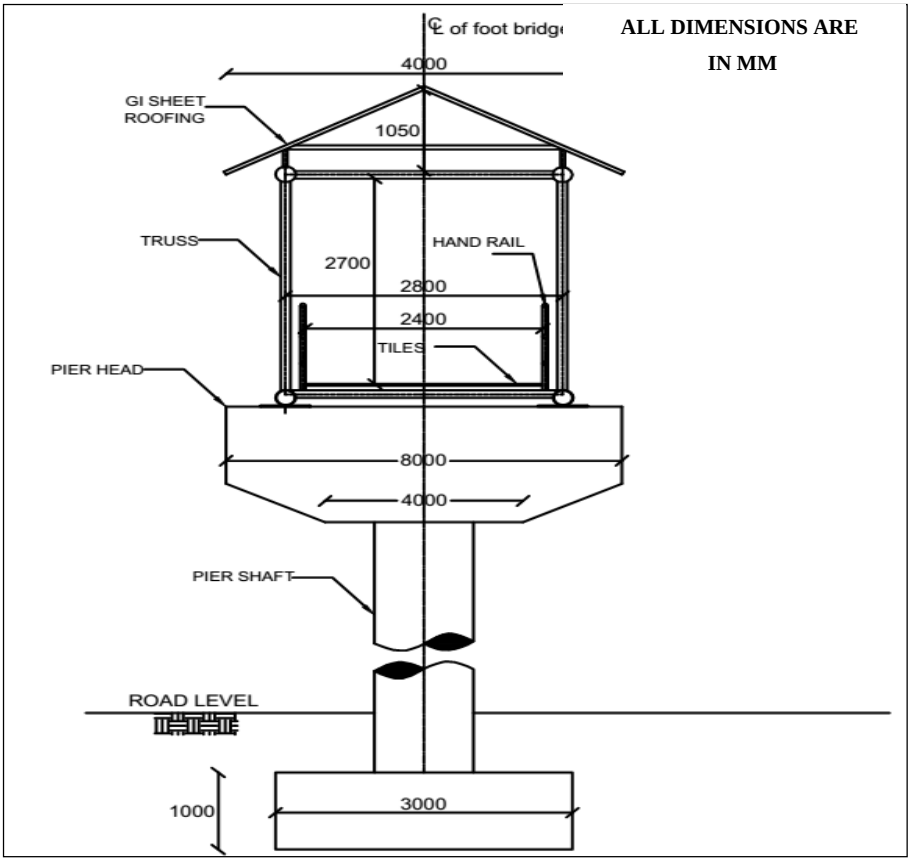


Figure 16: Typical Cross Section of Walkway - Proposed Pedestrian Foot Over Bridge

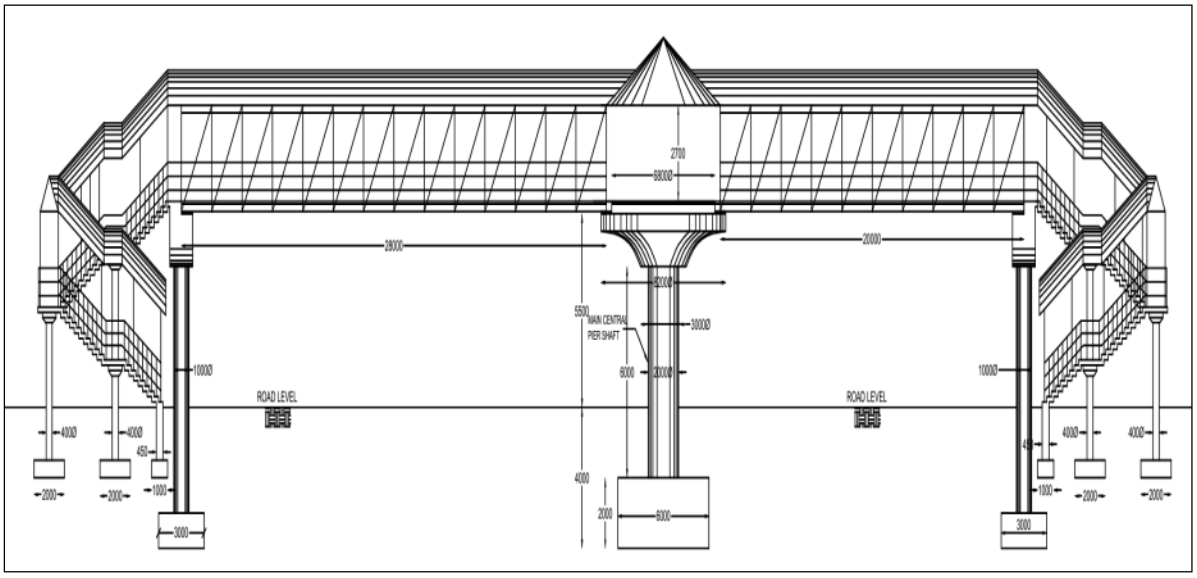


Figure 17: Sectional Elevation - Proposed Pedestrian Foot Over Bridge

29. Pedestrian Crossing and Vehicle Conflicts - A Case Study of Malabar Region

At the instance of Kerala Road Safety Authority (KRSA), NATPAC carried out a study on pedestrian crossing and vehicle conflicts at selected road stretches in Malabar region. The scope of the study was limited to selected major urban road stretches in Kozhikode and Malappuram. The objectives of the study were:

- To assess the existing pedestrian flow pattern on selected road corridors;
- To explore the safety aspects of pedestrians at crossings;
- To determine the motorist yielding characteristics at pedestrian crossings.

Methodology

The methodology adopted for the study consisted of review of literature, collection of secondary data, primary surveys such as vehicle- pedestrian traffic surveys, spot speed studies, yielding compliance surveys and road inventory surveys, data analysis, determination of yielding compliance at designated pedestrian crossings and suggesting probable measures to improve yielding compliance level by motorists.

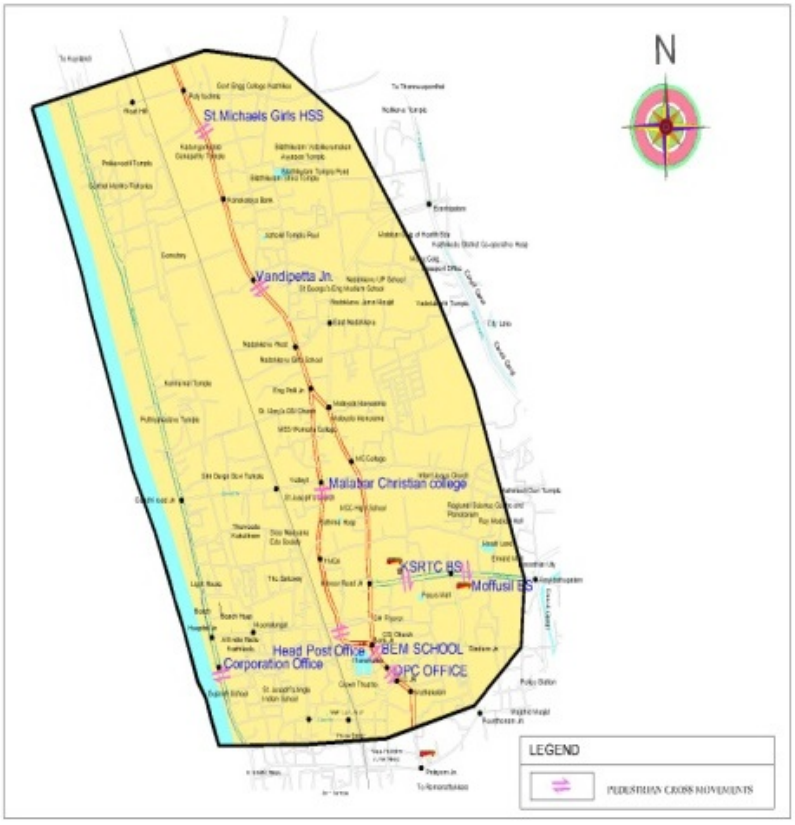


Figure 18: Crosswalk locations in Kozhikode

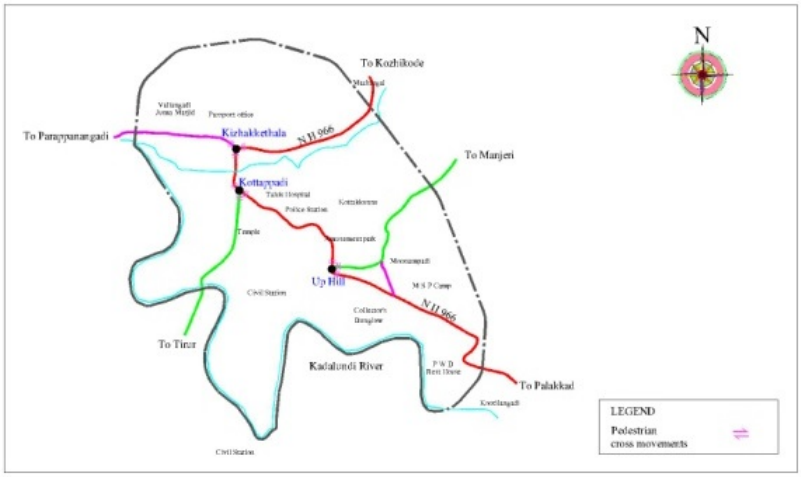


Figure 19: Crosswalk locations in Malappuram

Salient findings

In Kozhikode, maximum peak hour pedestrian cross movement was observed at Mofussil Bus Stand having 2419 pedestrian cross movements. Road-user behavior at pedestrian crossings indicates that road users are less disciplined. Only 31 percent of the pedestrians are aware of the rule that pedestrians have the right of way at uncontrolled pedestrian crossings. Pedestrians felt very safe under the police controlled pedestrian crossing, where as they felt safe at signalised crossing facilities consisting of pedestrian phase signal and pelican signals.

In Kozhikode, crosswalks near Mofussil bus stand witness the maximum peak hour traffic flow of 3228 vehicles followed by 2824 vehicles at KSRTC, along the stretch of Mavoor road. In Malappuram, the peak hour traffic flow is along the Perinthalmanna road at the Kottappady junction, which recorded 2729 vehicles, followed by Kozhikode road with 2478 vehicles. From the Spot speed study, 85th percentile speed at crossings varied from 18kmph to 37kmph in Kozhikode, whereas in Malappuram, the spot speed varied from 42kmph to 57kmph. The socio-economic characteristics study revealed that driving experience, frequency of driving and yielding behaviour of the drivers at pedestrian crossings is highly influenced.

Survey results shows that only 46 percent of the drivers are aware of the rule that pedestrians have the right of way at uncontrolled pedestrian crossings which highlights major road safety problem. Questionnaire survey revealed that only 44% of the

respondent drivers had a proper understanding of pedestrian crossing facilities. Only 37% of the respondent drivers had a clear understanding on flashing amber signal on roads and only 16% had proper knowledge on the use of Zig Zag road markings on the roads.

The indicator of pedestrian-vehicle conflicts namely PV2 value has exceeded the critical value of 2 x 108 in almost all major locations in the Kozhikode city with high PV2 values.

Yielding compliance rate is the willingness of the drivers to stop for pedestrians in crosswalks. Average Yielding Compliance Rate at designated pedestrian crossings on the study road sections was evaluated and locations with high yielding compliance rates were characterized with heavy congestion, which forced the drivers to yield at those crossings. Average Yielding compliance rate varied from 5% to 63% in Kozhikode, where as in Malappuram, the rate varied from 14% to 56%.

In order to ensure pedestrian friendly environment, an improvement plan has been formulated complying IRC: 103-2012 'Guidelines for pedestrian facilities' and Central Public Works Department (CPWD) 'Handbook on Barrier free and accessibility'-2014.

30. Mitigative Measures for Reducing Pedestrian Related Accidents in Selected Urban Roads in Kerala

NATPAC identified the most hazardous stretch for pedestrians based on accident data in Thiruvananthapuram city and developed accident predictive models for pedestrians that would describe the expected number of accidents at selected road stretches in Thiruvananthapuram city and also proposed countermeasures for the safety of the pedestrians.

The scope of the study was to develop a pedestrian accident prediction model for urban road stretches in Kerala. The study area was limited to a particular road corridor in Thiruvananthapuram city, where pedestrian accidents occur frequently.

Primary data for reducing pedestrian accidents from the reports and documents comprising earlier studies, online literatures and other relevant documents containing pedestrian safety or related information were collected and catalogued. The secondary data were collected from various sources such as accident raw data from Kerala State Crime Records Bureau. This data was compiled and analysed to identify the road stretch on which highest number of pedestrian accidents are recorded in the Thiruvananthapuram city.

From the analysis of road accident data compiled from SCRB for last five years, it was seen that 22 pedestrian accidents/km occur along the section from Ulloor to Karamana. It has been found that nearly 209 accidents occurred along this stretch from the period 2010-'15. Hence the study stretch was selected as starting from Ulloor to Karamana along NH-66 and having a total length of 9.5 km. The study stretch was further divided into 19 sections of nearly 500m for study purpose.

The primary data collected included the road inventory, inventory of pedestrian walking and crossing facilities, inventory of roadside features, traffic and pedestrian volume, speed of vehicles and adjoining predominant land use. The inventory data was collected for every 100m along the study stretch from Ulloor to Karamana.The study will formulate strategies to enhance pedestrian safety based on the research findings. The factors influencing the safety of pedestrians and the effects of various road geometric characteristics on pedestrian accident rates will be assessed.

31. Improvements to Accident Prone Curve at Vattappara Curve in NH17

Vattappara, a major accident spot along the highway is located 26 km from Valanchery. The location is highlighted by the presence of sharp curves and the accidents that occur here are often severe, resulting in fatalities and grievous injuries. Most of the crashes occurred due to over speeding and resulted in overturning of vehicles into the valley side of the curve. Although suitable measures were enacted by the Public Works Department (PWD), the accidents remain a continuing story. NATPAC carried out studies and prepared improvement measures for the Vattappara curve.

Plate 5: Study Area

Plate 6: Accident location at Vattappara

From local enquiry, it was observed that, most of the accidents at this location results in overturning of vehicles while crossing the curve at higher speed and hence there may be a deficiency in the super elevation provided at the curve. **Plate 5** shows the study location.

Improvement proposal

All curves are proposed for improvement to meet the design standards. The design speed adopted along the project road varies from 40kmph at the straight portion to 20kmph at the critical curve location. Vertical geometry was improved to a design speed of 40kmph throughout the road stretch. In order avoid the reconstruction of pavement, vertical geometry is kept in line with the existing profile to the maximum extent possible. All vertical curves shall comply with the criteria of stopping sight distance. The cross section adopted at straight portion and at curve portion is shown in **Figure 20 and 21** respectively.

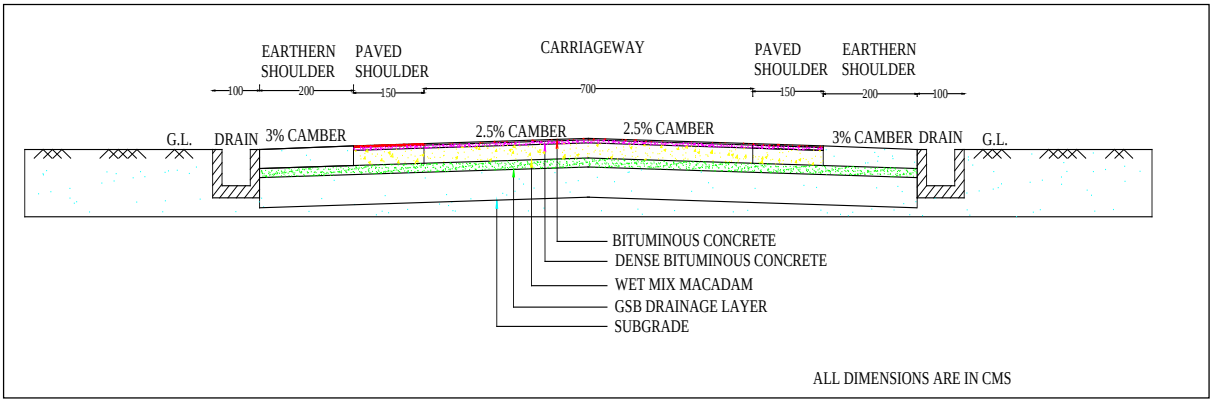


Figure 20: Pavement Cross Section at Straight Portion

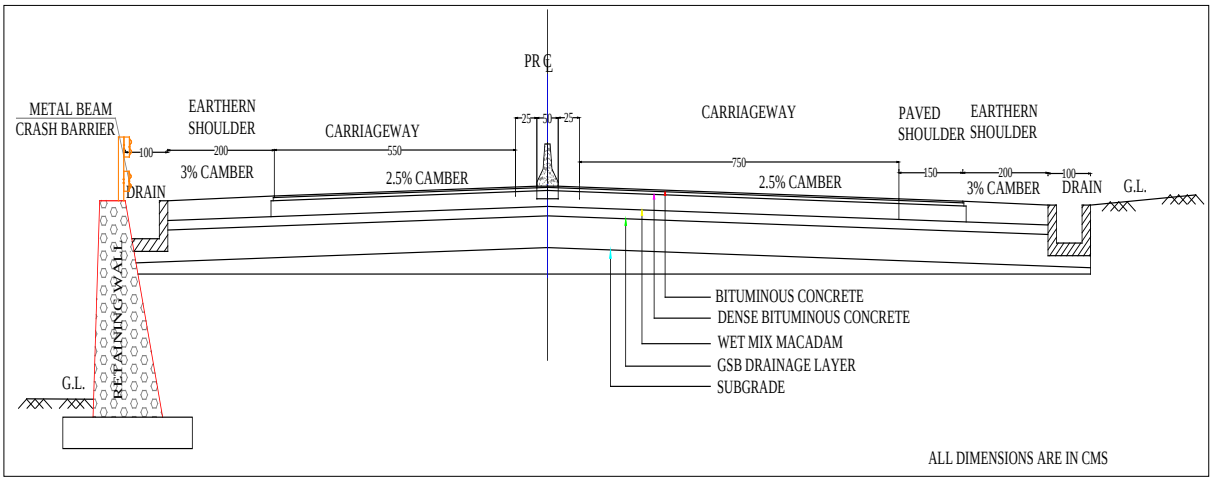


Figure 21: Pavement Cross Section at Curved Portion

The curve radius at the accident spot location is increased to provide a smooth manoeuvring flow of traffic along the curve. Also, the existing two lane road at the curve is improved to intermediate/2 lane movement separated by a New Jersey type barrier. This will guide the vehicle drivers to follow the lane discipline which in turn avoid the possibility of head-on collision. Transition curves as well as the super elevation at the curve location are duly considered as part of the improvement proposal.

32. Development of GIS Based Road Safety Database Management System

At the instance of Kerala Road Safety Authority (KRSA), NATPAC developed an accident database management system using Geospatial tools for Thiruvananthapuram District.

Objectives of the study:

- Develop software to sort and correct the raw accident data obtained from State Crime Records Bureau (SCRB);
- Develop GIS based information system to highlight the road accident scenarios;
- Update accident scenario in NATPAC website periodically;
- Visualize the accident data in Mobile platform.

Figure 22: Location Map

Accident Information System (AIS) is a web portal solution to manage accident information. The software developed assist in the management of the road safety work. It is an integrated data management system, consisting of road accident database and a mapping tool. The system combines and integrates geospatial technologies and the accident database. The information system is a spatial referenced database with all data modelled as spatial objects (point and line) and encoded in geospatial format, which stores all accident related data for the study area in a centralized location, providing functionalities to perform spatial query and spatial analysis and integration with other spatial database.

Road accident data pertaining to three year time periods 2013, 2014 and 2015 for Thiruvananthapuram district were used for the application development. QGIS is taken as a GIS platform to portray the results. GIS view page of the software shows the accident Geo-Spatial data on Web GIS platform. The Web GIS platform is also made available in mobile.

The system developed try to correct the accident data pertaining to different time periods, analyze the data and suggest the black spots and finally visualize the data on a GIS platform.

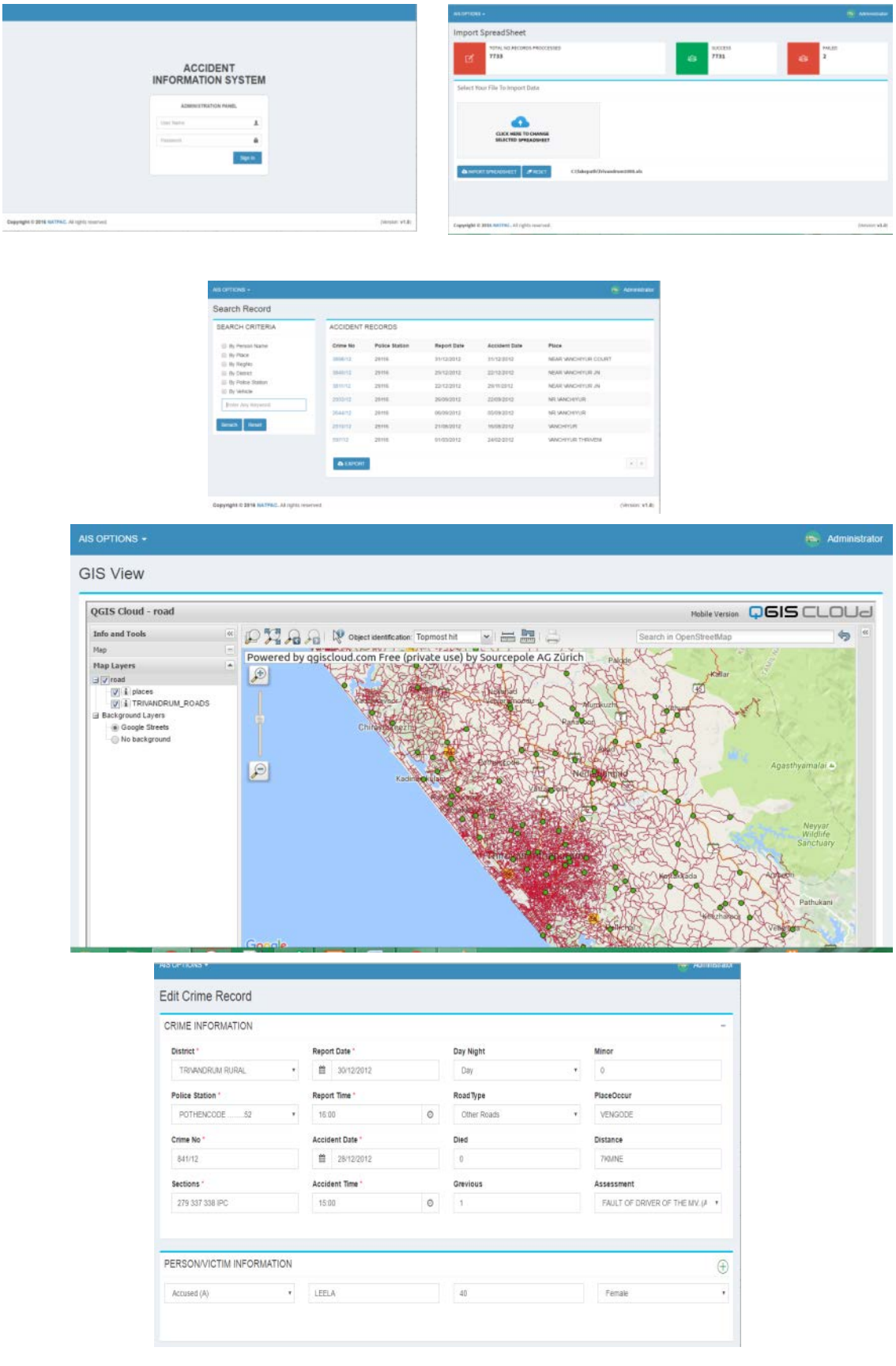


Figure 23: Snapshots of Software Developed

33. Implementation of District Level Road Safety Activities in Kerala

Public Works Department, Kerala (PWD) entrusted NATPAC the responsibility of identifying the roads where road safety activities could be implemented. The main objective of this study was to prioritise the given road stretches where road safety activities need to be implemented so that PWD could effectively utilize their finances available for this purpose. Scope of the study is confined to the 138 road stretches that were previously identified by NATPAC. These road stretches were further pruned on the basis of recent road safety works or inclusion in any improvement scheme etc. After pruning, the road stretches were reduced to 87 numbers covering all the PWD Divisions of Kerala with a total length of 855.46 km. For the selected road stretches, various road safety activities could be implemented to reduce risk potential of the roads and in turn reduce the number of accidents, their severity and fatalities in the long run.

The approach adopted for prioritization of road stretches was based on traffic volume on the road stretch measured in terms of Average Daily Traffic (ADT), road hierarchy and accident data.

The final Priority Index for each road stretch was determined by using the formula:
Priority Index = [Weightage for Traffic Volume * Weightage for Road Hierarchy * Weightage for Accident]

The Road Stretches were arranged in the descending order of their Priority Index along with the cost estimates for the proposed road safety activities on those road stretches. By the timely implementation of the proposed road safety activities, probability of accidents and their severity could be drastically brought down, thereby adding towards the ultimate aim of zero or negative accident growth rate.

Plate 7
Thodupuzha – Puliyanmala road in Idukki Section

Plate 8
Adoor – Sasthamcotta road in Sasthamcotta Section

Plate 9
Beenachi - Panamaram road in Pulpally Section

34. Application of Intelligent Transportation Systems in Road Safety

The ITS applications are mainly aimed at increasing comfort while driving and at improving accessibility and safety. The Intelligent Transportation Systems (ITS) application of automated Red Light Camera (RLC) enforcement systems have been recently introduced on the roads in Kerala. The red light running cameras at intersections are gaining extensive acceptance as they enact as enforcement cameras to improve intersection safety through capturing red light runners who may cause severe crashes and pose serious danger to the other road users. Also there is a possibility of variation in the operational effect of RLCs in reduction of red running violations when they are used in combination with two different signal systems of fixed time mode and vehicle actuated mode. These scenarios need to be investigated and studied to discover the operational effect of Red Light Cameras at different signalised intersections.

Objectives

A comparative analysis on the number of red light running cases in two scenarios of traffic signal system that is fixed time mode of signaling and vehicle actuated mode of signaling is aimed at. The scope of the study is limited to one intersection in Thiruvananthapuram urban area where it is possible to operate both the signal systems mentioned here.

- Comparison of red light running violations for Vehicle actuated and Fixed time modes at a signalized intersection;
- Determination of the hourly variation of the red light running cases on week days and weekends;
- Determination of lane wise distribution of red light violation cases;
- Ascertain the causes and reasons for the increased number of red light violation in one scenario over the other.

Study area

The study area is a three legged intersection in front of the entrance gate of CDAC, connecting Vellayambalam, Museum and Manaveeyam road where red light cameras are installed **(Figure 24).** The red light cameras are installed only on one of the approaches having two lanes.

Figure 24: Study Area Map of three legged intersection in front of the entrance gate of CDAC

Intelligent Red light identification System (iRIDS) is an indigenously developed Red Light Violation Detection System by C-DAC and is operational at the study intersection as shown in **Figure 25** and **Plate 10**.

Plate 10: Red light camera at the study area

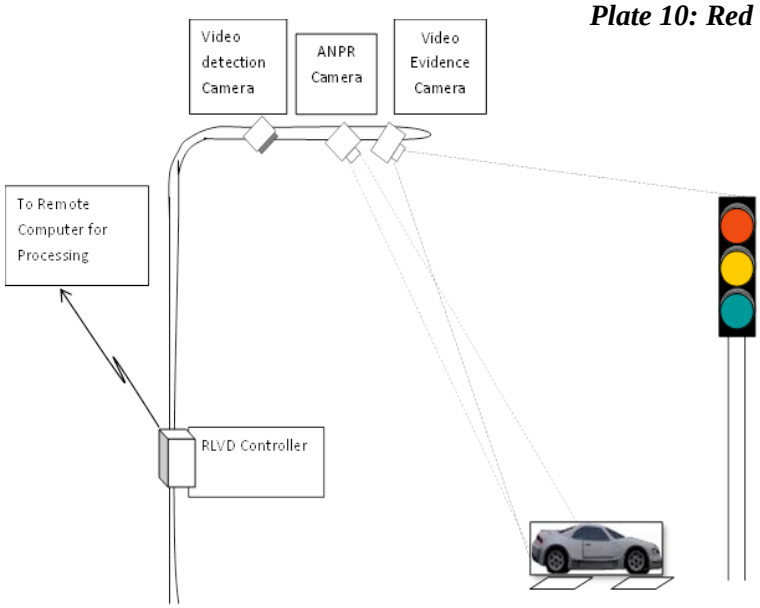


Figure 25: Red Light Violation Detection System

The drivers who cross the stop line and proceed through the intersection after the onset of the red indication are identified and counted as the red light violation cases. The data extracted and collected from the data acquisition system at CDAC were analysed to make a comparative study on the operational effect of red light camera on the two modes of signalling system i.e. Vehicle Actuated (VA mode) and pre timed or fixed time mode for both weekdays and weekends on an hourly basis. This was done to comprehend and appreciate the variation in different situations i.e. how the results vary with respect to the lanes and the hours of the day. The results obtained from the comparative analysis were logically interpreted to discover the means to improve upon the collective operational efficiency of the signal system and RLCs. An assessment of the traffic plying through the intersection was done by taking categorised traffic volume count from the turning movements at the intersection obtained from video data.

The average number of red running violations across the lanes of the approach under consideration is found out on an hourly basis for the week days and weekends as well to appreciate the variation in different situations.

Table 19: Number of Lane wise Red Light Violations in Weekdays and Weekends

Mode	Lane 1 Kerb Lane		Lane 2 Median lane	
	Weekdays	Weekend	Weekdays	Weekend
VA Mode	455	186	534	282
Average	91	93	106.8	141
FT Mode	307	132	376	140
Average	61.4	66	75.2	70

It is inferred that the adaptive traffic control system with the real time signals co-ordination has to be implemented at all the junctions along a road corridor rather than implementing them at individual locations. The signal co-ordination with the proven traffic management strategy of adaptive traffic control system can be effective in increasing the operational efficiency of red light cameras at signalised intersections. This system is meant to reduce delays at traffic signals considerably which in turn will reduce the cases of red light jumping and thereby preventing the chances of accidents arising out of it.

35. Cautionary Signage Scheme for Cross Roads on Kollam-Alappuzha Stretch of National Highway 66 in Kerala

Kerala Road Safety Authority (KRSA) engaged National Transportation Planning and Research Centre (NATPAC) to identify the locations for cautionary signs boards in the small lanes entering the National Highway in Kollam-Alappuzha stretch with a cautionary signage scheme. The study was confined to the National Highway section from Kollam to Alappuzha.

The objectives of the study were:

i) To identify the locations of necessary cautionary sign boards alerting the road users entering the NH from the access roads;
ii) Designing of traffic sign boards in accordance with IRC 67:2012-Code for Practice for road signs;
iii) To estimate a block cost of the sign boards suggested for the side roads intersecting the highway section.

The stretch of NH 66 from Kollam to Alappuzha, starting from Vellayittambalam Jn in Kollam to Hospital Jn in Alappuzha town, with a length of 80.3km was taken as the study corridor.

A site investigation was carried out throughout the highway in order to identify the minor and major roads connecting the highway and the needs of cautionary signage scheme was evaluated. As the study emphasizes on side roads intersecting the highway, the profile of the side roads were compiled which includes- (i) Name of intersection from where the access road originates, (ii) Type of intersection whether three arm, four arm or staggered, signalized, (iii) Width of access roads and (iv) Name of place where the access roads lead to.

Three types of sign boards namely 'Stop', 'Major road ahead', 'T intersection Major road ahead' were designed as per guidelines of Indian Roads Congress 'IRC 67:2012-Code for Practice for road signs'.

(i) 'STOP' sign with message of STOP, LOOK, PROCEED in Malayalam	
Alternative 1	**Alternative 2**
	

Figure 26: Sign Boards Designed (a)

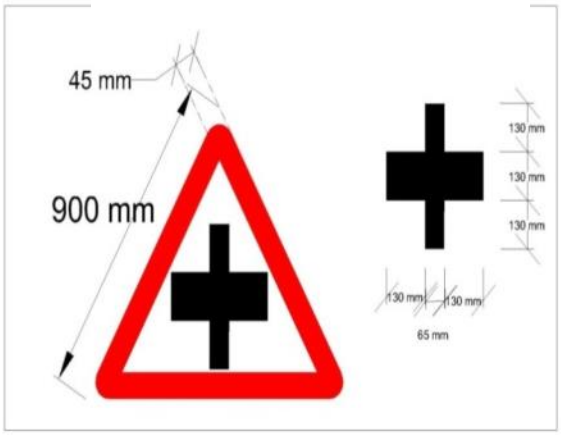
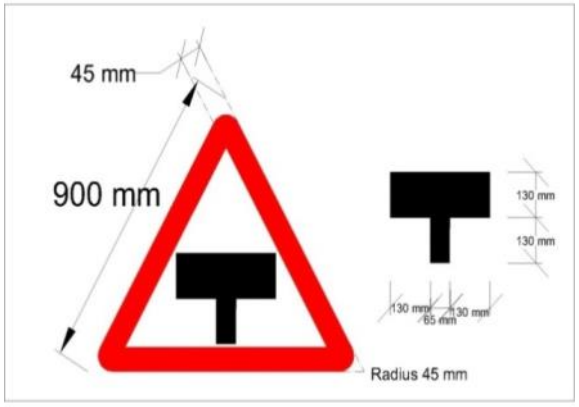
(ii) Major Road Ahead Sign	(iii) Cautionary sign – 'T Intersection Major road' ahead:
	

Figure 27: Sign Boards Designed (b)

36. Road Safety Improvement Study on Oachira - Kollam-Parippally Stretch of National Highway - 66

At the instance of Commissioner of Police, Kollam, NATPAC has conducted road safety inspection on the highly accident prone Oachira - Kollam-Parippally stretch of National Highway-66.

The major objectives of the study are to determine the accident-prone locations, identify potential road safety hazards, and suggest short-term improvement measures. Short term recommendations to the potential safety hazards have been suggested in the present study. Indicative cost for the proposed schemes for implementation has been estimated.

Road fatality statistics for the last two years in the study stretch was collected from District Crime Records Bureau, Kollam. Road Safety Inspection (RSI) was conducted by a group of road safety experts. Over speeding and rash driving of the vehicles were identified as the major cause of fatal accidents on the study stretch, which needs to be curbed. Nearly 55% of road users involved in accidents are vulnerable road users comprising of cyclists, pedestrians and two wheelers. Around 30% of road users involved in accidents are cars, KSRTC buses and trucks.

Absence of poor retro-reflective signs, less visible markings, lack of retro-reflective studs, absence of street lighting, unscientific design of segregated bus stops etc. add to the woes. Road markings and signages provided do not comply with relevant Indian Roads Congress (IRC) standards, which should be reinstated. Edge line marking and centre line marking which are not visible should be repainted. Traffic signage, which was installed years before, has lost its retro reflective property, which needs to be replaced. Retro reflective/Solar road studs or rumble strips or profiled line marking applied longitudinally as an edge line and centreline can be effective in reducing run-off-the-road and head-on accidents to certain extent. These can also be provided transversely across the road at accident prone sections, intersections, pedestrian crossing locations etc. Any obstruction or encroachment in the form of vegetation, advertisement boards, waste materials, construction materials etc should be removed to increase visibility.

Major accident prone locations on the road stretch are in the vicinity of minor intersections, where slow traffic from the side roads often conflicts with high speed traffic on the National Highway. Short term measures for reducing road accidents at

minor intersections include provision of road signs, markings, studs, speed breakers, channelizing physical islands and ghost islands. Acceleration and deceleration lanes along with protected turn lanes will reduce the risk significantly at such locations, which are considered as a medium-term improvement measure. The suggested remedial measures/treatments should be further studied, and implemented conforming to relevant Indian Road Congress (IRC) and Ministry of Road Transport & Highways (MoRTH) standards/specifications.

A good education programme and well-trained professionals such as instructors and examiners are imperative for achieving the goals on safe driving skills and knowledge. The existing system of driver training system and driver licensing system needs to be overhauled and enhanced with state of art facilities.

37. Investigation of Major Accident Spots and Accident Causative Analysis

NATPAC investigated 21 road traffic crashes that occurred in 2015-16. The causative factors to selected road traffic crashes in Kerala were investigated in an ergonomic perspective. Majority of the crashes have been attributed to the human factor. Information from Police Stations was collected and panel discussions with concerned officials were held in order to draw possible causes for each incident.

The first case that was analyzed occurred at the opening of the year when a few youngsters under the age of 20 succumbed to the injuries from a head-on collision with a truck, after having a New Year bash. The involvement of youth was visible in most of the cases investigated. State owned and privately owned stage carriers, multi axle vehicles, cars, two wheelers and auto rickshaws have marked their presence in the case studies.

The road traffic crash investigations conducted by NATPAC in 2015-16 are listed below.

1. Car x LPG Bullet Trailer Truck Accident near Chathannoor
2. Two Wheeler x Multi Axle Truck Accident at Kareelakkulangara
3. SUV x Truck Accident near Kilimanoor
4. Truck x Tourist Bus Accident at Ramanattukara

5. Multi Axle Truck x Car x LCV Truck Accident at Kuthiran
6. Truck x Two Wheeler, HGV Tipper Truck x Auto-rickshaw Accident at Vattappara
7. Mini Bus x Two Wheeler & Pedestrian Accident at Thenhipalam
8. LPG Bullet Trailer Truck Capsize at Edaricode
9. KSRTC Superfast Bus x Car Accident near Karunagappally
10. Car x KSRTC Bus x Car Accident at Mararikkulam
11. KSRTC Fast Passenger x Mini Tipper Truck Accident near Venjarammoodu
12. Car Capsize into Deep Marsh near Pudukkad
13. Car x KSRTC Bus Accident at Kozhinjampara
14. Private Bus x Two wheeler and Capsize at Mamom
15. Tourist BusxMulti Axle Truck Accident at Kaithakunda
16. Car x Roadside Objects at Biyyam
17. Auto rickshaw x LCV Tipper Truck at Vaniyamkulam
18. Two-wheeler x Multi Axle Truck at Choondal
19. KSRTC Volvo x Multi Axle Truck at Choondal
20. KSRTC Bus x Car x Tanker Truck at Ochira
21. LCV Truck x KSRTC Super Deluxe Bus at Pandikkad

On conducting detailed research on these cases, major causative factors for vehicular accidents have been observed as users ignorance of basic vehicular characteristics, rules and regulations road geometry and surface condition, excessive speeding, tailgating, poor lane keeping, dangerous overtaking, negligent lane changing, failure to give way, fatigue, inattentive driving nature, lack of periodic maintenance, shortcomings in enforcement, lack of safe road infrastructure, incorrect road maintenance practices, inadequate training and licensing etc.

The road infrastructure system should evolve into a tolerant one, capable of protecting the humans involved even when they commit error. In this context, correction in geometry and surface finish have been suggested in some cases where critical constraints exist, while installation of safety measures and devices have been found necessary in most cases. Provision of adequate street lighting, reduction of roadside severity, periodic removal of vegetation, provision of protective fencing, lane markings and retro reflective studs can help in preventing crash occurrence to an appreciable extent. In some cases, infrastructure necessary to support traffic capacity has been suggested. But all

interventions will be fruitful only if the road users become safety conscious, content and disciplined. Modern scientific and technological advancements have to be adopted into the traffic safety system in the best interest of personal and social wellbeing. Coordination between departments has to be ensured to maintain functionality of roads in all conditions. Enforcement agencies have to be equipped with technological innovations to advance with limited manpower. In due course, a positive paradigm shift in the road traffic safety scenario can be anticipated in the state.

Plate 11
Accident Investigation at Mamom, Attingal

Plate 12
Accident Investigation at Biyyam, Malappuram

Plate 13
Accident Investigation at Ochira, Kollam

38. Assessment of Risk Potential of State Highways using iRAP Methodology

Critical assessment of existing road networks has been conducted to determine the level of safety assured for their users.This road safety assessment was conducted using iRAP methodology for four categories of road users viz. Vehicle occupants, motorcyclists, pedestrians and bicyclists in the 24.7km long Adoor- Chengannur stretch of Main Central Road (State Highway 1) in Kerala and recommendations for improvement were made. The specific objectives of the study were to generate the existing star rating indices in terms of safety aspects of the selected road stretch, and to propose road improvement plans for reducing traffic accidents.

The whole road stretch was rated as 1 and 2 star for all road users which shows that the stretch is of high risk. The raw star ratings showed that about 64% of road length is rated as 1 and 2 stars for vehicle occupants whereas for motorcyclists, the share was about 90%. The entire road stretch had 1 and 2 star ratings for pedestrians and bicyclists. The share of 3 star roads for the vehicle occupants and motorcyclist were 36% and 10% respectively. There were no 5-star or 4-star sections for any road user on the surveyed route.

Based on the current road condition, countermeasures for improving the safety performance were suggested. By implementing these measures, it is estimated that considerable increase of 84% in 5-star road sections for vehicle occupants and an increase of 87% in the 4-star rated sections for motorcyclists can be achieved. 97 % of the road length can be rated as 3-star and above for vehicle occupants as well as for motorcyclists. 38% of road length can be rated as 3-star and above for pedestrians whereas it will be 13% for the bicyclists. A considerable decrease of 77% in the 1-star sections can be observed in the case of pedestrians whereas the percentage decrease will be 40% in the case of bicyclists. Forgiving nature and built-to-standard condition must be the two essential mandates for roads to suit the traffic flow in the study stretch.

Plate14
Observer car

Plate 15
Assessment of road surface condition

Plate 16
Assessment of roadside severity

39. Impact of Speed Governors on Safety of Heavy Vehicles and Fuel Efficiency

The number of traffic accidents involving heavy vehicles especially the Kerala State Road Transport Corporation (KSRTC) and privately owned buses were on the rise. As a measure to regulate the speeds of these heavy vehicles and to reduce their involvement in accidents and related impacts, the Motor Vehicles Department (MVD) of the Kerala Government had come up with strict orders to implement speed governors in all heavy vehicles in the year 2007-08. NATPAC was mandated to bring out the impacts of the installation of such speed governors on the safety of heavy vehicles and their fuel efficiency.

Plate 17: Speed Limitation Devices in Bus

Scope of the study was confined to Kerala State Road Transport Corporation (KSRTC) buses operating in Kerala State.

The main objectives of the study were to:

- Assess the safety impacts of the speed governors on heavy vehicles especially in terms of reduction in accidents and their severity;
- Assess the impacts on fuel efficiency of heavy vehicles.

Primary Surveys and Secondary Data Collection:

Data collection from various sources includes:

- Data regarding fuel efficiency of speed governors installed in KSRTC buses were collected from Transport Bhawan, Thiruvananthapuram;
- Data regarding fleet size, kilometers operated and bus service types were also collected from KSRTC. It has also been shared that the limiting speed for KSRTC buses, except Multi Axle, is 65 kmph and for Multi Axle it is restricted to 80 kmph;
- Data regarding number of accidents in which KSRTC buses were involved in were collected from State Crime Records Bureau (SCRB).

As primary surveys could not be carried out and secondary data has been relied upon, there are some assumptions on which the analysis has been carried out. The main assumptions are:

- In 2008 all KSRTC buses were fitted with speed limiters;
- Even though there have been upgradations in emission standards, they have not been considered in analysis;
- Service type percentage in fleet has been assumed for the proportion of service type kilometers travelled;
- One speed limiter device is assumed to work with repairs only for a period of 6 months.

Cost Benefit Analysis:

The data was analysed to get the bus service wise average fuel efficiency and also the accidents per 1000 buses every year from 2008 to 2015. Cost Benefit Analysis was carried out with equipment cost, maintenance cost and manpower cost as cost

components and savings in accidents, shown in **Table 20**, and fuel saved, shown in **Table 21**, as benefit components.

Table 20: Savings in Accidents due to Speed Governors

Year	Accidentsper1000buses		Accident reductionper1000buses	5% of accidentreduction	Accidents saved	Savingsinaccidents			Cost of accidents saved (lakhRs)
	Actual	Normal trend				Fatal	Severe	Minor	
2008	253	265	12	0.59	592	138	339	378	3,847
2009	242	248	6	0.29	292	61	171	180	1,745
2010	230	233	3	0.16	158	38	92	103	1,047
2011	232	219	-13	0.16	160	34	103	103	991
2012	235	208	-27	0.16	160	33	100	96	959
2013	206	198	-8	0.16	160	32	109	137	980
2014	181	191	10	0.49	494	109	330	349	3,187
2015	186	185	-1	0.16	160	36	112	104	1,056

Note:
1. Wherever accidents have increased from the normal trend, the least of the accidents saved in other years has been adopted
2. From literature review, the cost of accidents adopted is: Rs 21,56,755/- (Fatal), Rs 1,97,195/- (Severe) and Rs 52,032/-(Minor)

Table 21: Savings in Fuel due to Speed Governors

Year	Kilometers Operated (lakh km)	Diesel price (Rs/ ltr)	Savings in fuel for bus type (lakh Rs)					
			VND	ORD	FP	SFP	S.EXP	Total
2008	4,615	33.22	80	683	141	11	21	936
2009	5,146	32.22	87	739	152	12	23	1,013
2010	5,359	38.53	108	920	189	15	28	1,261
2011	5,546	44.85	130	1,108	228	19	34	1,519
2012	5,733	47.71	143	1,219	251	20	37	1,671
2013	5,920	58.28	168	1,432	295	24	44	1,963
2014	6,107	60.11	192	1,636	337	27	50	2,242
2015	6,294	52.89	174	1,483	305	25	46	2,033

Fuel saved was determined with the following equation:

$$FuelSaved = \sum_{t=2008}^{2015} \sum_{bustype} KMO * DP * (\frac{1}{MB} - \frac{1}{MA})$$

Where, KMO = kilometers (km) operated by each bus type
DP = year wise diesel price (in Rs/ litre), average of diesel prices each year
MB = mileage before installation (taken as 4.4 kmpl)
MA = mileage after installation (in kmpl)

The cost benefit analysis (CBA) is expressed in Benefit Cost Ratio (BCR) as well as Net Present Value (NPV). For the year wise monetary terms to be compared, they are required to be converted to a constant year. In this study the prices are converted using a discount rate of 12% to reflect 2015 constant prices. **Table 22** depicts the Net Present

Value saved due to installation of speed governors from 2008 to 2015 on all KSRTC buses while **Table 23** shows the Benefit Cost Ratio for the same.

Table 22: Net Present Value

Year	Cost (in lakh Rs)			Benefit (in lakh Rs)		Benefit- Cost (in lakh Rs)	Discounted net benefits (in lakh Rs)
	Equipment cost	Maintenance cost	Manpower cost	Savings in accidents	Savings in fuel		
2008	971.25	310.80	67.160	3847	936	3,434	7,591
2009	110.75	346.24	67.160	1745	1,013	2,234	4,409
2010	49.5	362.08	67.160	1047	1,261	1,829	3,224
2011	41	375.20	73.876	991	1,519	2,020	3,178
2012	41	388.32	73.876	959	1,671	2,127	2,988
2013	41	401.44	73.876	980	1,963	2,427	3,044
2014	41	414.56	80.592	3187	2,242	4,893	5,480
2015	41	427.68	80.592	1056	2,033	2,540	2,540
Net Present Value (NPV) in 2015 Constant Prices (lakh Rs)							32,454

Table 23: Benefit Cost Ratio

Year	Total Cost (in lakh Rs)	Discounted Total Cost (in lakh Rs)	Total Benefit (in lakh Rs)	Discounted Total Benefit (in lakh Rs)
2008	1349.21	2982.67	4,783	10,574
2009	524.15	1034.58	2,758	5,444
2010	478.74	843.70	2,308	4,067
2011	490.08	771.14	2,510	3,950
2012	503.20	706.95	2,630	3,695
2013	516.32	647.67	2,943	3,692
2014	536.15	600.49	5,429	6,080
2015	549.27	549.27	3,089	3,089
Grand Total		8,136		40,591
Benefit Cost Ratio				4.99

As a result of the Cost Benefit analysis, a Net Present Value of savings worked out to Rs32,454 lakhs in 2015 constant prices and a Benefit Cost Ratio of approximately 5. While there are limitations to the study, it can be asserted beyond doubt that the installation of speed governors on KSRTC buses in particular and heavy vehicles in general would yield positive results as far as accident reduction and fuel efficiency is concerned.

While attention is being given to the burning issue of Road Safety and Environment pollution, it needs to be properly complemented by the implementation of in-built and tamper proof speed governors. It is only with such strict measures that the ultimate aim of significantly reducing accidents by 2020 could be achieved in Kerala State.

40. Setting up a Metal Shredding Plant in Thiruvananthapuram For Confiscated Vehicles

The number of dumped/confiscated vehicles in various departments (police stations, Motor Vehicle Office) and those being dumped on the road side is increasing every day. This result in reduction of available space that could be productively made use of. The Metal Scrap Trading Corporation (MSTC Govt. of India) has expressed its willingness to setup a shredding plant in Thiruvananthapuram, Kerala which could effectively process the scrap metal thus providing an effective and efficient solution to the problem of dumped vehicles and a study was done in this regard by NATPAC.

Objectives of the study

i. To assess the amount of metal scrap available from various sources like police station and other enforcement agencies, confiscated by Govt. departments, KSRTC, dumped by public, any other sources not mentioned etc.

ii. Pre- feasibility study regarding the setting of shredding plant.

The various data collected was analysed to arrive at an estimate of the scrap metal that will be available to the shredding plant. The pre- feasibility of setting up such a plant is thus determined.

The number of vehicles available for the shredding plant arises from the following sources.

- Vehicles that are confiscated by various agencies ;
- Vehicles that have met with severe accidents;
- Vehicles that have reached its end of life.

Table 24: The summary of ELV data collected from various agencies in Thiruvananthapuram

Source	Number	Time Period	Remarks
RTO	92	2008 to 2014	Vehicles shifted to Eenchakkal KSRTC yard
Traffic	417	2008 to 2014	Vehicles shifted to dump yard in Thumba from city traffic police station
KSRTC	736	2008 to 2014	Vehicles sold in Auction as Scrap
Total	1245		

Around1.97% of the vehicles gets scrapped due to accidents per year. The total number of scrap vehicles thus available from accidents is given in **Table 25**.

Table 25: Details of Assumed Scrap Vehicles due to Accidents in 2015 (Thiruvananthapuram)

TYPE OF VEHICLES INVOLVED IN THE ACCIDENT	FROM 1ST JANUARY 2015 TO 31st DECEMBER 2015	TOTAL	ASSUMED SCRAP VEHICLES	TOTAL
KSRTC	260	6514	5	128
Pvt. Bus	148		3	
Lorry	155		3	
Mini Bus	121		2	
Car	1149		23	
Jeep	61		1	
Auto	663		13	
Two Wheeler	3762		74	
Others	195		4	

The study related to a typical metal shredding plant was also carried out. The components of a typical metal shredding plant include Pre-shredder, Main Shredder, Air Separating System and Separate and Transfer System.

Plate 18: The main shredder (Capacity is 10 vehicles ie. car body size an hour)

Table 26: Assumed Vehicles for the Scrapping Plant

Source	Number
Confiscated/ dumped vehicles	1245
Accidents	1024
Total	2269

It is estimated that a total of 2269 vehicles can be used by the scrapping plant. Considering the constraint of land availability in Thiruvananthapuram, a small sized shredding plant is recommended. Area of the potential metal shredding plant and dumping yard is 2-5 acres; cost of setting up the plant is Rs15-25 crores.

41. Feasibility of Connecting Thrissur Town to National Waterway-3 through Waterways

About half-a-century ago, the main mode of transportation from Thrissur to Kochi was the 18 meter wide Puthenthode. This waterway connecting Kochi and Thrissur was used for commercial as well as public transportation till the construction of NH-47. The glory of waterways started diminishing with the development of road transport. As the National Waterway No 3 is developed and operational, it is essential to connect it to all major towns and market places through feeder canals. By connecting the Thrissur town to NW-3, the potential of the waterway will increase tremendously.

Objectives

The major objective of the study is to assess the feasibility of connecting NW-3 with Thrissur town through waterways. The specific tasks of the study are:

1. To identify the major canals and waterways in Thrissur region and develop a network of waterways which connects to the NW-3;
2. To study the present condition of the waterways and suggest improvement measures;
3. To prepare a development plan for the canals connecting the major destinations including industrial and recreational areas and other transportation modes;
4. To study the feasibility of connecting Thrissur town to NW-3;
5. To study the traffic demand and divertible traffic;
6. To conduct economic analysis for the feasibility of the project;
7. To access the benefits due to the proposed development of the waterway.

The methodology adopted for the study consisted of literature review, reconnaissance survey, hydrographic survey and detailed inventory, analysis of soil, water and sediment sample, traffic survey to identify divertible cargo and passengers and industries survey to identify the potential cargo and location.

Two routes were identified to connect Thrissur Town to NW-3. One is the PuthenThodu from Karuvannur River near Karanchira ending at Vanchikkulam near Thrissur Railway Station (17.0 km), which was used for cargo transportation in the last century. It passes through Kole paddy fields and it is a man-made canal from Karanchira to Thrissur (14.5 km) and the rest is Karuvannur River. 18m width is available throughout the waterway

and there is no need of land acquisition. Dredging is required to make the waterway navigable. Vegetative bank protection will be suitable for the waterway. Six out of the total seven bridges are to be reconstructed and the lock chamber at Karanchira is to be renovated.

Another route under consideration was the Puzhakkal river from Kothamukku to Puzhakkal near Poonkunnam(14.0 km). This waterway is more than 50m wide in all stretches and need no land acquisition. This can be developed for tourism purpose by connecting existing Puzhakkal tourism project and other attractions near Thrissur to nearby places like Thriprayar, Chavakkad, Chettuva and Kodungallur. In future, this can also be developed for cargo movement as this can connect the proposed extension route of NW-3 to Kozhikkode with Thrissur region, as this waterway is wide enough and can connect to the hinder lands without affecting the Thrissur city.

There is also a connection canal (link canal- Chettupuzhathodu) existing between Puthenthodu and Puzhakkal river with length 2.5 km. which can also be utilized for better management of cargo traffic on a later stage.

42. Environmental Improvement of selected Canals in Alappuzha Region

Waterways being the gift of nature can be used for navigation with minimum investment. The benefit of water transport lies in its capacity to move bulk cargo at a cheaper cost. The presence of a lot of backwaters and canals in Alappuzha and Kottayam districts make water transport popular means of transport.

The navigational waterways selected for environmental improvement are shown in **Table 27. Figure 28** shows the base map of study stretches.

Table 27: Study Stretches

Sl. No	WATERWAYS	NAME OF FEEDER CANAL	LENGTH (km)
1	Alappuzha-Kanjiram-Kottayam	A.K canal	23
2	Kottayam (Kanjiram)-Vaikom (actual distance from Kottayam to Vaikom is 42 km i.e 3.5+24.5+14 km)	KV canal	42
3	Alappuzha – Changanserry	AC canal	28
4	Athirampuzha Canal	Athirampuzha	15

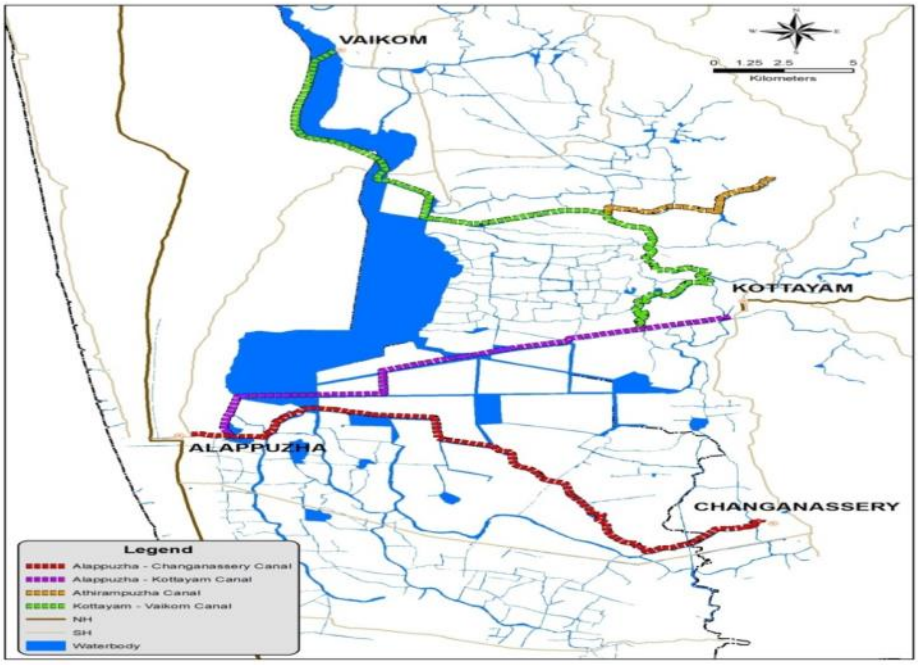


Figure 28: Study Area Map

Scope and Objectives

- To conduct detailed inventory;
- To assess the existing population profile;
- To estimate the water demand, wastewater and solid waste generation and disposal methods;
- To identify the tourism potential spots, recreational activities along the canal by providing walkways, butterfly parks etc.
- To list out the improvement proposal;
- To work out implementation mechanism and organisational set up for carrying out the developmental activities.

The methodology adopted for the study consisted of reconnaissance, inventory and condition survey, socio-economic survey, calculating water demand, generation of waste water and solid waste calculation for the projected population and design of sewer line.

Water samples were collected from locations where there is change in the characteristics and tested in the laboratory for parameters like temperature, pH, conductivity, dissolved oxygen, BOD, total suspended solids, total dissolved solids, chloride, turbidity, total hardness, calcium, magnesium, iron, sulphate, nitrite, nitrate, inorganic phosphate, total nitrogen and total phosphorous. Sediment samples were collected using grab sampler

and tested in the laboratory for parameters like oxygen demand, settling velocity, organic carbon, phosphorus, iron and sulphide.

Development proposals were identified to make the canal navigational which includes desilting, widening, protection of banks, improvement of the canal, provision of navigational aids, improvement of approach roads, reconstruction of cross-structures with inadequate clearance, sewage and sewerage treatment facilities, canal protection and safety measures etc. In order to sustain the utility of the canal, locations were identified to develop spots for tourism activities. Canal beautification schemes are also outlined.

Major Findings

Inventory of Bridges

The total cross structures along the study stretches are given in **Table 28**. Out of 40 cross structures only 9 cross structures are having the vertical and horizontal clearances of State Irrigation standards.

Table 28: Summarised Result of Cross Structures

Sl.No.	Canal	Type	Remarks
1	AC Canal	Road bridge – 1 FOB – 3 Total - 4	Out of 4bridges only 2 FOB's are obeying the standards
2	AK Canal	Road bridge – 3 FOB – 6 Total – 9	3 Road bridges and 1 FOB are obeying the standards
3	KV Canal	Road bridge – 16 FOB – 5 Total – 21	2 Road bridges and 1 FOB's are obeying the standards
4	Athirampuzha	Road bridge – 3 FOB – 3 Total - 6	All the C/S are to be modified

Existing and Projected Population

The total population along the study stretches is 11,560 for the base year. Based on the decadal growth rate from 1901, the population is projected for 2025 and it is estimated as 11,821.For the projected population the water demand, wastewater and solid waste generation are determined and are given in **Table 29.**

Sanitary Sewer line

Two Sewage Treatment Plants (STP's) are proposed at Kainady (STP 1) in Alappuzha district and Maniyamparambu (STP 2) in Kottayam district. The sewage generated along

AC and AK canal will be treated at STP 1 and at STP 2 the sewage from KV and Athirampuzha canals will be treated. The design area of sewer pipeline is estimated as 108 Ha.

Table 29: Population, Water Demand, Wastewater and Solid Waste in 2025

CANAL NAME	POPULATION	WATER DEMAND (Ltr/day)	WASTE WATER GENERATED (Ltr/day)	SOLID WASTE GENERATED (kg/day)
AC canal	3743	935707	701781	2807.12
AK canal	2272	567922	425942	1703.77
KV canal	4987	673245	504934	2493.5
Athirampuzha	819	204816	153612	614.45
Total	11821	2381690	1786269	7618.84

Water Sample Analysis

Water samples were collected at 12 locations and the physical, chemical and biological parameters were analysed.

Environmental Constraints

The weeds and water hyacinths are the major constraints of all the canals and water bodies. The removal and disposal of water hyacinths is a major bottleneck of inland water navigation. Various methods like salinity approach, cattle feed, biogas generation, packing materials, floral arrangements, pulp and paper manufacturing, manure composting and other appropriate physical, chemical and biological methods for removal as well as disposal of water hyacinths are suggested.

Water/Sediment Quality

Due to the absence of sewage treatment and disposal of solid waste the canal became the dumping yard of the settlers on banks. Even most of the places the availability of portable drinking water are scarce. So it is recommended that a detailed study on these issues should be carried out.

Other sources of water pollution are due to the pumping of excess water from adjacent sites of agricultural field which includes fertilizers, chemicals etc. The micro and macro nutrients from these agricultural fields get deposited on the bed of the canal. The enrich sediments are becoming the best nutrition for the growth of weeds, water hyacinths and other plants which is the major concern of inland water navigation and other environmental concerns.

EXTENSION SERVICES

1. Workshop on 'The Role of Corporation in Road Safety'

National Transportation Planning and Research Centre (NATPAC) organized a one day workshop on '*The Role of Corporation in Road Safety*' on 5th February 2016 at Thiruvananthapuram. The aim of the workshop was to discuss about the role of councillors in road safety. The workshop was inaugurated by Shri. V K Prasanth, Hon'ble Mayor of Thiruvananthapuram Corporation. Dr. B G Sreedevi, Director, NATPAC delivered the introductory speech.

The workshop was attended by Smt. Rakhi Raveendran, Deputy Mayor; Shri. James Varghese IAS, Principal Secretary to Local Self Govt. Dept, Shri. Shaji, Asst. Transport Commissioner and 61 Councillors of Thiruvananthapuram Corporation.

A Panel Discussion on 'The Role of Corporation in Road Safety' was also held. The strategy evolved from various discussions was that, in the decentralised planning process, the representatives of the people can contribute substantially to bring down the incidence of road accidents.

Plate 19
Shri V K Prasanth, Hon'ble Mayor of Thiruvananthapuram Corporation inaugurating the workshop

Plate 20
Dr B G Sreedevi, Director, NATPAC giving introductory remarks on 'The Role of Corporation in Road Safety'

2. Road Safety Education through Schools in Kerala – Phase II

NATPAC in association with Kerala Road Safety Authority (KRSA) launched Phase II of the two day teachers' training programme on 28th September 2015 at Loyola College Campus, Sreekariyam, Thiruvananthapuram.

The State level inauguration of the programme 'Road Safety Education through Schools in Kerala – Phase II' was done by Shri. Rishi Raj Singh IPS, Addl. Director General of Police at Loyola College, Thiruvananthapuram on 28th September 2015. Dr. B G Sreedevi, Director, NATPAC presided over the function. Keynote address was delivered by Smt. M S Jaya IAS, Director, Public Instructions. Shri. P M Shaji, Asst. Transport Commissioner, Dr. George Varghese, Member Secretary (i/c) & Director, KSCSTE, Dr G Ravikumar, Scientist – F, NATPAC and Shri. George Koshy, Registrar, NATPAC spoke on the occasion.

Plate 21
State level inauguration of 'Road Safety Education through Schools in Kerala' by Shri. Rishi Raj Singh IPS

Plate 22
Dr.B G Sreedevi, Director, NATPAC giving an overview of the programme

Plate 23
A view of the participants

Shri. Rishi Raj Singh IPS, released the documentary film –'The Last Mile' directed by Shri. Venu Nair highlighting major research activities of NATPAC.

Plate 24
Releasing of the documentary film on NATPAC –'The Last Mile' by Shri. Rishi Raj Singh IPS and received by Dr. George Varghese, Member Secretary, KSCSTE

The following districts were covered under this project during 2015-16.

District	Date	Participation
Kollam District	8th - 9th October 2015	98 teachers participated
Alappuzha District	12th -13th November 2015	106 teachers Participated
Kasargod District	17th – 18th November 2015	87 teachers participated
Kannur District	19th – 20th November 2015	237 teachers participated
Wayanad District	23rd – 24th November 2015	100 teachers participated
Palakkad District	29th – 30th December 2015	79 teachers participated
Malappuram District	31st December 2015 – 1st January 2016	90 Teachers participated
Ernakulam District	18th – 19th January 2016	102 teachers participated
Idukki District	16th -17th February 2016	83 teachers participated

3. 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. The inaugural session was attended by Smt. R Sreelekha IPS, Transport Commissioner, Dr. Suresh Das, Executive Vice President, KSCSTE, Dr. B G Sreedevi, Director, NATPAC and Dr.G Ravikumar, Scientist-F, NATPAC.

Plate 25: Dr. B G Sreedevi, Director, NATPAC welcoming the participants

Plate 26: Inauguration by Shri. Thiruvanchoor Radhakrishnan, Hon'ble Minister for Transport and Forest, Govt. of Kerala

Plate 27: Presidential Address by Dr. Suresh Das, Executive Vice President, KSCSTE

Plate 28: Key Note Address by Smt. R Sreelekha IPS, Transport Commissioner

In the technical sessions presentations in the areas of Accident Scenario, Defensive Driving Techniques, Advanced Driving Skills, Fire Fighting, Class Label, Hazchem Code, Product Information, Emergency Procedure, Driver Fitness and Vehicle Fitness and Driving Emergencies were made. Fire demonstration and Tanker Truck demonstration were also arranged for the participants. On the whole 60 drivers participated in the training programme.

Plate 29
Fire Fighting demonstration

Plate 30
Tanker Truck demonstration

Plate 31
Participants of Ist batch with faculties

Eleven programmes were completed this year at the NATPAC office, *K Karunakaran Transpark*, Aakkulam.

21st – 23rd May 2015	48 drivers participated
16th – 18th June 2015	32 drivers participated
14th – 16th July 2015	29 drivers participated
4th – 6th August 2015	18 drivers participated
19th – 21st October 2015	44 drivers participated
16th –18th December 2015	32 drivers participated
20th – 22nd January 2016	34 drivers participated
20th –22nd February 2016	32 drivers participated
28th February 2016	15 drivers from IOC bottling plant participated
29thFebruary - 2ndMarch2016	33 drivers participated

Plate 32
Participants with Dr. B G Sreedevi, Director, NATPAC

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

NATPAC in association with Kerala Police organised 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 Sasthrabhavan, Pattom. Dr. B G Sreedevi, Director, NATPAC presided over the function. Keynote address on 'Road Safety' was delivered by Dr. G Ravikumar, Scientist – F, NATPAC. In addition to the inaugural session, 16 programmes were completed during this period as listed below.

1.	Kochi Range, at Central Police Station Conference Hall, Ernakulam	04.07.2015
2.	Kannur Range, at Police Club Conference Hall, Kozhikode	07.07.2015
3.	Thrissur Range, at Police Commissioner Office Conference Hall, Thrissur	10.07.2015
4.	Kasargode Range, at AR Camp Conference Hall, Kasargode	22.07.2015
5.	Thiruvananthapuram Range, at Conference Hall, CPO, Thiruvananthapuram	17.08.2015
6.	Kannur Range, at Police Co-operative Society Auditorium, Kannur	20.08.2015
7.	Wayanadu Range, at Mananthavady Police Station Conference Hall	22.08.2015
8.	Wayanadu Range, at PWD Rest House, Vadakara	24.08.2015
9.	Kozhikode Range, at Police Club Conference Hall, Kozhikode	25.08.2015
10.	Kollam District, at AR Camp Conference Hall, Kollam	03.12.2015
11.	Malappuram District, at DPO Conference Hall, Malappuram	10.12.2015
12.	Kochi City, at Kochi City Traffic Police Conference Hall, Kochi	02.02.2016
13.	Ernakulam Rural, at Kochi City Traffic Police Conference Hall, Kochi	03.02.2016
14.	Idukki District, at AR Conference Hall, Painavu, Idukki	18.02.2016
15.	Thrissur City, at CPO Conference Hall, Ramavarmapuram	08.03.2016
16.	Thrissur Rural, at Collectorate Conference Hall, Ayyanthole	09.03.2016

Plate 33
Inauguration of the Training Programme on 'Identification of dangerous and hazardous goods and dealing with emergencies' to Junior Sub Inspectors by Shri. Manoj Abraham IPS, IG of Police

Plate 34
Training programme on 'Identificationof dangerous and hazardous goods and dealing with emergencies' to Junior Sub Inspectors at Thrissur Range

Plate 35
Dr. Sreenivas A IPS, District Police Chief inaugurating the Training programme on 'Identification of dangerous and hazardous goods and dealing with emergencies' toJunior Sub Inspectors at Kasargode Range

5. Safe Community Programme for Panchayaths

The 'Safe Community Programme for Panchayaths' has been designed by NATPAC with the intention of adopting the zero-accident policy. Panchayaths which have high exposure to accident risk were selected and organised road safety initiatives. During this year the following Panchayaths were covered:

Sl. No.	Details of Place, Venue and Participation	Date
1.	Chathannoor Panchayath (Kollam District). The programme was inaugurated by Shri.N.K.Premachandran, Hon'ble MP	18th – 20th August 2015
2.	Valanchery Panchayath (Malappuram District), at Panchayath Community Hall, Valanchery	15th September 2015
3.	Mathilakom Panchayath,(Thrissur District), at Block Panchayath Hall, Mathilakom	28th September 2015
4.	Kattakkada Panchayath (Thiruvananthapuram District), at Panchayath Community Hall, Kattakkada	3rdOctober 2015
5.	Harippad Panchayath (Alappuzha District),at Panchayath Community Hall, Harippad	7thOctober 2015
6.	Kalluvathukkal Grama Panchayath (Kollam District), at Panchayath Community Hall, Parippally. 200 Act Force volunteers participated	11thDecember 2015
7.	Thamarassery Grama Panchayath (Kozhikode District), at Panchayath Community Hall, Thamarassery. 150 Act Force volunteers participated	15thDecember 2015
8.	Kuzhalmannam Panchayath (Palakkad District), at Panchayath Community Hall, Kuzhalmannam. 150 Act Force volunteers, Panchayath members,Kudumbhasree workers, Members of youth club and Community Police representatives participated	14thJanuary 2016
9.	Muttom Grama Panchayath (Idukki District), at Martha Mariyam Parish Hall, Muttom. 167 Act Force volunteers participated	18thFebruary 2016
10.	Kalady Grama Panchayath (Ernakulam District), at PanchayathCommunity Hall. 120 Act Force volunteers participated	21stMarch 2016

Plate 36
Inauguration of 'Safe Community Programme for Panchayaths' at Chathannoor Panchayath by Shri N K.Premachandran, Hon'ble MP

Plate 37
Class on 'Road Engineering and Road Safety' at Mathilakom Panchayath

Plate 38
Class on 'First Aid and Trauma Care by Dr Binod, Medical Officer, P H C Valanchery at Valanchery Panchayath

6. Road Safety Training Programme for Driving School Instructors

NATPAC organised training programme for driving school instructors by considering the fact that driving instructors play a pivotal role in tutoring students. Five programmes were completed this year.

Sl. No.	Details of Venue and Participation	Date
i.	Panchayath Community Hall, Valanchery, Malappuram (in association with Motor Vehicle Department, Malappuram) - 125 driving school instructors attended the training	16.09.2015
ii.	Wyndvalley Garden Resorts, Kalpetta, Wayanadu District	16.12.2015
iii.	Panchayath Hall, Palakkad District - 225 driving school instructors attended the training	13.01.2016
iv.	Hi-Range Residency Auditorium, Idukki District - 143 driving school instructors attended the training	17.02.2016
v.	Renewal Centre, Kaloor, Ernakulam District - 111 driving school instructors attended the training	23.03.2016

Plate 39
Participants with NATPAC Officials at driving school instructors training programme, Valanchery

7. Road Safety Youth Leadership Programme

NATPAC launched a State-wide programme to train Young Volunteers in Road Safety and related aspects. Nine programmes on Road Safety Youth Leadership were completed this year.

Sl. No.	Details of Venue and Participation	Date
i.	Azhoor Grama Panchayath Hall (Kollam District) (in association with Kerala State Youth Welfare Board)	29.04.2015
ii.	Kerala Law Academy, Thiruvananthapuram (for the members of National Service Scheme) - 150 students attended the training	15.07.2015
iii.	MES Arts College, Valanchery, Malappuram (for NSS Volunteers and Members of Traffic club)	19.09.2015
iv.	Hotel Regency, Sulthan Bathery, Wayanad (for Wayanad Bullet Club Members and NSS Volunteers)	17.12.2015
v.	UKF College of Engineering, Parippally	22.12.2015
vi.	Dr.Reddie's Foundation College, Palakkad - 50 students attended the training	16.01.2016
vii.	Awareness class on 'Energy Management and Road Safety' at Devaswom Board College, Sasthamcotta (jointly organised by NATPAC and Energy Conservation Society) - 200 students attended the programme	10.02.2016
viii.	Awareness class on 'Energy Management and Road Safety' at Thalayolaparambu, Kottayam (jointly organised by NATPAC and Energy Conservation Society) - 150 students attended the programme	15.03.2016
ix.	Adi Sankara Institute of Engineering and Technology, Kalady- 150 students attended the programme	22.03.2016

Plate 40
Class on 'Road Safety' at MES Arts College, Valanchery

8. Safe Road to School

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

Plate 41
SRS Programme at Meladoor Govt. Samithy HSS

Plate 42
Road Crossing Wardens at Govt. UP School, Poovachal

Sl. No.	Details of Place, Venue and Participation	Date
1.	Govt. U. P. School, Poovachal	23.06.2015
2.	Meladoor Govt. Samithy Higher Secondary School for selected 15 students and 2 Teachers each from 20 schools within Mala Police Circle, Thrissur in connection with the inauguration of School Protection Group – a Kerala Police initiative	25.06.2015
3.	'Training on Road Safety and Basic First Aid' for 600 Junior Red Cross Student Volunteers and Red Cross Councillors from 35 schools in two batches at Town Hall, Thrissur. The programme was conducted in association with Junior Red Cross, Thrissur	22.07.2015
4.	Govt.Vocational Higher Secondary School, Ezhuthachan Hall, Chathannoor for 2 teachers and 10 selected students each from 9 selected schools a) K.K.P.M.U.P.S, Vaniyam b) N.S.S.H.S.S, Chathannoor c) Vimala Central School, Karamcode d) St.George U.P.S, Chathannoor e) Sreenikethan School, Chathannoor f) K.M.L.P.S, Chathannoor g) C.M.U.P.S, Chathannoor h) S.M.U.P.S, Chathannoor i) Govt. V.H.S.S, Chathannoor	19.08.2015
5.	MES College Auditorium, Valanchery, Malappuram for 2teachers and selected students from 2 schools a) Girls High school, GUPS Painkannur b) A.U.P.S. Vaikathur	17.09.2015

6.	Block Panchayath Auditorium, Mathilakom, Thrissur for 2teachers and selected students from 3 schools a) GMHS, Chamakkala b) Student Police Cadets from St.Josephs HSS, Mathilakom c) GLPS Pappinivattom	29.09.2015
7.	Govt. Girls Vocational Higher Secondary School, Haripad	08.10.2015
8.	Vocational Higher Secondary School, Naduvattom, Haripad	08.10.2015
9.	L.M.S.H.S.S, Amaravila	30.11.2015
10.	Amrita H.S.S, Parippally	22.12.2015
11.	Awareness class on 'Energy Management and Road Safety' at Govt. Higher Secondary School, Varkala jointly organised by NATPAC and Energy Conservation Society. (115 students from higher secondary classes participated)	14.01.2016
12.	C.A H.S.S, Kuzhalmannam (SPC Cadets from C.A.HSS and Scout & Guides from G.B.U.P.S, Kuzhalmannam participated	15.01.2016
13.	Ezhippuram H.S.S, Parippally, Kollam (80 Student Police Cadets Participated)	27.02.2016
14.	SNDPUPS, Pattathanam, Kollam (203 students participated)	29.02.2016
15.	Govt. UPS, Veliyam, Kollam (200 participants including students, teachers and parents)	04.03.2016
16.	St. Mary's HSS, Pattom, Thiruvananthapuram in association with Community Police, Medical College, Thiruvananthapuram (68 Student Police Cadets participated)	18.03.2016

Plate 43
Kerb drill demonstration at SNDPUPS, Pattathanam, Kollam

9. Road Safety Awareness to Higher Secondary Students in Kerala

NATPAC in association with Kerala Road Safety Authority organised one day programme on Road Safety Awareness to Higher Secondary Students at selected schools, as listed.

Sl. No.	Details of Venue and Participation	Date
i.	Aazchavattom Higher Secondary School, Kozhikode District (200 students participated)	12.10.2015
ii.	Govt.Ganpath Higher Secondary School, Chalappuram, Kozhikode District. (70 students participated)	12.10.2015
iii.	Kuttichira Higher Secondary School, near Valiyangadi, Kozhikode District. (60 students participated)	13.10.2015

iv.	Manachira Higher Secondary School, Kozhikode District. (90 students participated)	13.10.2015
v.	Providence Higher Secondary School, Nadakkavu, Kozhikode District. (140 students participated)	14.10.2015
vi.	Mohammadan Higher Secondary School, Parappil, Kozhikode District. (400 students participated)	16.10.2015
vii.	Government Higher Secondary School, Perambra, Kozhikode District. (105 students participated)	17.10.2015
viii.	NSS Higher Secondary School, Kollam District (Members of the School Road Safety Cell, Students, Teachers and PTA members participated)	04.12.2015
ix.	KPMV Higher Secondary School, Cheekkakada, East Kallada, Kollam District. (Volunteers of NSS participated)	21.12.2015
x.	Govt. H.S.S, Muttom, Thodupuzha (70 students participated)	18.02.2016

10. Training

a) In-house Training

Sl. No.	Details of Training	Date
i.	Training on PTV VISUM, VISSIM and VISTRO for scientists	6th – 9th May 2015
ii.	'Training of Trainers Programme' to scientists organised by the Institute of Urban Transport (India), sponsored by Ministry of Urban Development, Govt. of India under Global Environment Facility (GEF) and UNDP assisted Sustainable Urban Transport Project	14th – 16th September 2015
iii.	'Presentation on ROMDAS equipments especially on iRAP accredited systems' to scientists and Technical Officers by Mr. Ben Clotworthy, Sales and Marketing Manager, ROMDAS	5th November 2015
iv.	'Training/demo on SPSS Software and their online training portal' to scientists and Technical Officers	4th December 2015

Plate 44
NATPAC Scientists with Officials of Institute of Urban Transport (India)

Plate 45
Training/demo on SPSS Software and their online training portal

b) External Training/Presentations

Sl. No.	Details of Training/Presentations	Date
i.	Shri. P Kalaiarasan, Scientist-C conducted a '*Demonstration on DGPS Applications'* to the scientists of National Centre for Earth Science Studies, at NCESS, Thiruvananthapuram	28th April 2015
ii.	Shri. P Kalaiarasan, Scientist-C made a presentation on *'Sustainable Urban Transport'* in the Sustainable Development Program organised by IMG, Thiruvananthapuram	28th -30th May 2015
iii.	Shri. K C Wilson, Scientist-C gave *'One day Training on Mx Roads to M.Tech Students'* of RIT Kottayam	12th-13th October 2015
iv.	Shri B Anish Kini, Scientist-B gave *'Half day Training on VISSIM Software to M.Tech Students'* of RIT Kottayam	12th-13th October 2015

c) Road Safety Training for Various Target Groups

Sl. No.	Details of Training	Date
i.	'Road Safety Education Programme for students' as part of Summer Vacation Camp organised by Sree Narayana Gurukulam, Varkala	6th April 2015
ii.	'Namukke Yengane Surakshitharakam' for school children as part of Summer School - 2015 organised jointly by Kerala State Council for Science Technology and Environment (KSCSTE) and State Central Library, Thiruvananthapuram	27th April 2015
iii.	'Road Safety Education Programme for students' at Mar Thoma Higher Secondary School, Chungathara, Malappuram on 15	15th May 20
iv.	'Safe Driving Skills and Traffic Rules' for drivers at State Excise and Research Centre Academy, Thrissur	22nd – 23rd May 2015
v.	'Training on Safe Driving Practices and Circulars and Guidelines issued by the Government on Safe Transportation of Educational Institution Buses and Eye Camp' for school bus drivers, conductors and attenders at Ideal International English School, Kuttippuram	26th May 2015
vi.	Training on Road Safety in connection with the Passing out Ceremony of 108 Road Safety Wardens of Marthoma Higher Secondary School, Chungathara in association with NATPAC. The programme was inaugurated by Shri.P.V.Abdul Vahab, Hon'ble MP.	19th June 2015

vii.	'Road Safety Education Programme for students' at Govt.UPS, Poovachal, Kattakkada	23rd June 2015
viii.	Training on Road Safety for general public in association with Police Station, Mala at Mala, Thrissur	26th June 2015
ix.	'Road Safety Education Programme for different categories of drivers' at Lions Club Auditorium, Mala, Thrissur	23rd July 2015
x.	Training on Road Safety for 300 driver trainees of Kerala Police Academy, Ramavarmapuram, Thrissur	29th – 30th July 2015
xi.	Training on Road Safety for different categories of drivers and Driving School Instructors at Ezhuthachan Hall, Govt.VHSS Chathannoor	20th August 2015
xii.	Road Safety Education Programme for NCC Cadets at Ranni, Pathanamthitta	27th August 2015
xiii.	Training on Road Safety for police cadets at Police Training College, Thiruvananthapuram	16th September 2015
xiv.	'Road Safety Awareness Programme for the employees of Thai Group of Companies at Kozhikode	15th October 2015
xv.	Road Safety Education Programme for different categories of road users at Kottayam	8th December 2015
xvi.	Training on Road Safety for NSS unit students at East Kallada, Kollam	21st December 2015
xvii.	Road Safety Education Programme for students at Paripally, Kollam	22nd December 2015
xviii.	Road Safety Education Programme for students at Mylapore, Kollam	29th December 2015
xix.	Road Safety Education Programme for students at S N School, Sreekariyam, Thiruvananthapuram and Government Higher Secondary School for Girls, Peroorkada, Thiruvananthapuram	-
xx.	Road Safety Training Programme for different categories of drivers at Kuzhalmannam, Palakkad District	16thJanuary 2016
xxi.	Road Safety Education Programme for students at Government UP School, Arimpur, Thrissur in association with Department of Community Health	27th January 2016
xxii.	Road Safety Education Programme for college students at DB College, Sasthamcotta	10th February 2016
xxiii.	Road Safety Awareness Programme to teachers of Vyppin in Ernakulam District at Block Resources Centre (BRC), Edavanakkad, Vyppin	26th February 2016
xxiv.	Training on 'Driving and Road Safety' for new recruits of State Excise Dept. at State Excise Academy & Research Centre, Poothole, Thrissur	8th - 9th March 2016
xxv.	Road Safety Training to Police Officials of Kollam City	15th March 2016

11. International Car Free Day

The Centre observed International Car Free Day on 4th September 2015 with ESAF partnership. The Ramanilayam road in Thrissur was made traffic free. The programme was inaugurated by Shri Therambil Ramakrishnan, Hon'ble MLA.

The programme was aimed at encouraging and promoting the use of public transport system, to encourage active transportation like walking and cycling and also to encourage motorists to consider more environmentally friendly alternatives to cars. Car Free Day aims to take the heat off the planet for just one day by encouraging people to be less dependent on their cars and try alternatives.

Plate 46
Inauguration of International Car Free Day by Shri.Therambil Ramakrishnan, Hon'ble MLA

12. Meetings

i. Meeting on 'Improvement of Public Transport Services in Thiruvananthapuram City' on 2nd May 2015 at Sasthra Bhavan, Pattom.

Plate 47
Dr. B G Sreedevi, Director, NATPAC welcoming the participants

ii. NATPAC organised Stakeholders meeting as part of preparing a Comprehensive Mobility Plan (CMP) for Thiruvananthapuram City on 6th July 2015 at Mascot Hotel, Thiruvananthapuram. The meeting was inaugurated by Shri V S Sivakumar, Hon'ble Minister for Health and Dewaswom, Government of Kerala.

Plate 48
Shri V S Sivakumar, Hon'ble Minister for Health and Dewaswom, GoK; Dr B G Sreedevi, Director, NATPAC; Shri Sheikh Pareeth IAS and Shri.P K Venugopal, Chairman, TRIDA at the Stakeholders meeting for CMP

iii. As part of preparing a Comprehensive Mobility Plan (CMP) for Kozhikkode City NATPAC organised Stakeholders meeting on 10th August 2015 at Alakapuri Hotel, Kozhikkode. The meeting was chaired by Dr B G Sreedevi, Director, NATPAC. Shri. S Shaheem, Scientist – E1, NATPAC presented the final draft report of CMP. Shri.N Seshadri, Vice President, Urban Mass Transport Company Ltd., Bengaluru presented the short and medium term proposals.

iv. NATPAC organised Stakeholders meeting as part of preparing a Comprehensive Mobility Plan (CMP) for Thiruvananthapuram City on 9th September 2015 at Sasthra Bhavan, Pattom. Dr B G Sreedevi, Director, NATPAC briefed the major features of the Draft Final Report prepared by NATPAC. Officials representing various Departments/Agencies including Kerala Rapid Transit Corporation Ltd, Thiruvananthapuram Development Authority, Thiruvananthapuram Corporation, Regional Town Planning Office, PWD (NH), TRDCL, Kerala State Urban Development Project, Vizhinjam Port, KINFRA, Southern Railways, KSRTC etc., participated.

13. Exhibitions

i.	Road Safety Exhibition and audio-visual programmes at Sree Gurukulam Nursing College, Neyyattinkara, 10th – 12th April 2015
ii.	Road Safety Exhibition and audio-visual programmes at Govt. Polytechnic College, Neyyattinkara, 12th June 2015
iii.	NATPAC secured 2nd position in the State Government category of Science and Technology Expo conducted in connection with Swasraya Bharat – 2015, organised by Swadeshi Science Movement - Kerala (a unit of Vijnana Bharati) and ICAR – Indian Institute of Spices Research at Swapna Nagari, Kozhikode, 15th - 21st October 2015
iv.	Road Safety Exhibition and audio-visual programmes in 'C.V.Raman Venad Sahodaya Science Exhibition' at Sree Narayana Central School, Kollam, 20th – 21st November 2015
v.	Road Safety Exhibition and audio-visual programmes at Higher Secondary School, Pathanapuram, Kollam, 2nd – 6th January 2016
vi.	Road Safety Exhibition and audio-visual programmes at Jawahar Balabhavan, organized by Kerala Institute of Labour and Employment (KILE), 20 – 21st January 2016
vii.	Road Safety Exhibition and audio-visual programmes in the Technical Exhibition organized by Rajiv Gandhi Institute of Technology, Kottayam, 10th – 13th February 2016
viii.	Road Safety Exhibition and audio-visual programmes in the Techno-Cultural Exhibition, Rajadhani Institute of Engineering and Technology, Attingal, 25th – 26th February 2016

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

Name of Programme	Organised by	Date	Venue	Participants
Seminars/Conferences				
Annual Convention 2015: Leapfrogging Road Safety: Way Forward	Society for Automotive Fitness and Environment (SAFE)	21.04.2015 – 22.04.2015	Taj Vivanta, Thiruvananthapuram	Dr B G Sreedevi
Preparation of Status of Environment 2015 report	KSCSTE	23.06.2015	Sasthra Bhavan	P Kalaiarasan
Role of Taxation		21.07.2015	Mascot Hotel, Thiruvananthapuram	Dr B G Sreedevi
CEO's conclave	DC Books	07.08.2015	Ramada, Ernakulam	Dr B G Sreedevi George Koshy V S Sanjay Kumar
Coastal Vulnerability Assessment & Climate Change Financial Framework Interim Review	Dept.of Environment and Climate Change	11.08.2015	Taj Vivanta, Thiruvananthapuram	P Kalaiarasan
State Action Plan on Climate Change Kerala	Dept.of Environment and Climate Change	08.09.2015	Taj Vivanta, Thiruvananthapuram	P Kalaiarasan
'ROADTECH – National Conference on Sustainable Roads and Highways – Role of New Technologies and Value Engineering in Construction, Maintenance and Safety'	The Associated Chambers of Commerce and Industry of India	09.10.2015	Hotel Le-Meridian, New Delhi	Shaheem S V S Sanjay Kumar Anish Kini
Urban Mobility Conference	Ministry of Urban Development, Government of India	24.11.2015 – 27.11.2015	New Delhi	Shaheem S T Ramakrishnan

Colloquium on 'Information Security in E-Governance	Computer Society of India, Thiruvananthapuram	25.11.2015	Thiruvananthapuram	Sanjai R J Deepa Radhakrishnan
'TRIMA 2015', 'Make in India – a Kerala Perspective', The Annual Management Convention of Trivandrum Management Association	Trivandrum Management Association	09.12.2015 – 10.12.2015	Taj Vivanta, Thiruvananthapuram	Veena.K.S A Jegan Bharath Kumar D Shaju
Bridging the Gap: Theory and practice in Pavement Engineering	Transport Research Centre (TRC)	23.01.2016	College of Engineering, Thiruvananthapuram	Salini U
'Health Infoscape'- Health Information for Librarians	Kerala Library Association	12.03.2016	Kerala University Library	Veena K S
Workshops				
Financing of State Action Plan on Climate Change in Kerala	UK Dept. of International Development (DFID)	10.06.2015	Taj Vivanta, Thiruvananthapuram	P Kalaiarasan
Two Day Workshop on 'ITS for Road Safety – ITS – Applications, Challenges and Way Forward'	RIT, Kottayam	16.07.2015 – 17.07.2015	RIT, Kottayam	Ebin Sam Anish Kini
Development and Pavement Management System for High Speed Corridors	CSIR-Central Road Research Institute	07.10.2015	New Delhi	V S Sanjay Kumar
Emotional Intelligence at Work	Trivandrum Management Association	09.10.2015	Trivandrum	Subin B K Mohanakumar
Climate Finance in Kerala – GCF & NAFCC	Dept.of Environment and Climate Change	16.10.2015	NABARD Regional Office, Thiruvananthapuram	P Kalaiarasan
River Based Management in Kerala	Pamba River Basin Authority and CWRDM	18.11.2015	Govt. Guest House, Thycaud, Thiruvananthapuram	P Kalaiarasan
Computational Geotechnics and Soil Dynamics	Indian Geotechnical Society - Thiruvananthapuram Chapter	23.11.2015 – 25.11.2015	Thiruvananthapuram	Salini U
Green Climate Fund	Dept. of Environment & Climate Change and NABARD, Kerala Circle	04.01.2016 – 06.01.2016	Taj Vivanta, Thiruvananthapuram	P Kalaiarasan
National Workshop on "Coastal Environment Day"	National Centre for Earth Science Studies (NCESS)	19.02.2016	NCESS, Thiruvananthapuram	P Kalaiarasan
Training Programmes				
Workshop "*How to become a Goody Goody Boss*"	Trivandrum Management Association	17.07.2015	Mascot Hotel, Thiruvananthapuram	D Robinson V S Sanjay Kumar
Fuel Efficiency in Transport Sector	MORTH	07.10.2015	Kochi	Geroge Koshy Subin B Arun Chandran Ebin Sam
Laboratory training on Material Characterisation, Mix Design, and Pavement Evaluation	TRC	18.01.2016-22.01.2016	College of Engineering, Thiruvananthapuram	Salini U
Road Safety and Road Safety Audit for Highways	Indian Academy of Highway Engineers (IAHE)	29.02.2016-04.03.2016	New Delhi	Subin B M S Saran

15. 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 Scientific Divisions is given below:

Name of the Institution	Course	Guide	No.of Students	Topic
National Institute of Technology, Karnataka, Surathkal	M Tech (Transportn. Engineering)	Dr B G Sreedevi	1	Study on the effect of Geometric Parameters on Road Safety – A Case Study on newly upgraded Highways in Kerala
National Institute of Technology, Kurukshethra	M Tech (Transportn. Engineering)	Dr B. G Sreedevi	1	Utilization of Jarofix and other waste material for road construction
Cochin University of Science and Technology	M Tech (Transportn. Engineering)	Dr B G Sreedevi	1	Study on the influence of subgrade soil on the strength of inservice flexible pavements
National Institute of Technology, Karnataka, Surathkal	M Tech (Trpt.System Engineering)	Shaheem S	1	Parking demand management for Transit Corridors in Trivandrum
National Institute of Technology, Karnataka, Surathkal	M Tech (Transportn. Engineering)	Shaheem S	1	Parking demand assessment for LRT Stations in Thiruvananthapuram
National Institute of Technology, Karnataka, Surathkal and Warangal	M Tech (Transportn. Engineering)	Shaheem S	14	Study of rationalization of bus routes in Thiruvananthapuram City
Dayanand Sagar College of Engineering, Bangalore	B Tech (Civil)	Shaheem S	2	Study on the upgradation of bus routes in Thiruvananthapuram
Dayanand Sagar College of Engineering, Bangalore	B Tech (Civil)	Shaheem S	2	Traffic analysis report for NH-47 in Tamil Nadu
Gurudev Institute of Technology, Kottayam	B Tech (Civil)	Shaheem S	4	Traffic Impact of Lulu Mall on NH bypass
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	V S Sanjay Kumar	1	Modeling the Effect of Road Geometrics and Roughness on Road Safety
NIT Calicut, Kozhikode	M Tech (Transportn. Engineering)	V S Sanjay Kumar	2	Pavement Design for Nadukani-Parappanangadi Road in Malappuram District
Pankaja Kasthuri College of Engineering and Technology, Thiruvananthapuram	B Tech (Civil)	V S Sanjay Kumar	5	Planning of routes for emergency vehicle
St Joseph's College of Engineering & Technology, Pala	B Tech (Civil)	Kalaiarasan P	4	Estimation of Carbon Credit for Inland Water Transportation of NW3
Muslim Association College of Engineering, Venjaramoodu	B Tech (Civil)	Kalaiarasan P	6	Life Cycle Assessment of Dairy Products, Milma Dairy Plant – A case study
Sree Buddha College of Engineering for Women, Pathanamthitta	B Tech (Civil)	P Kalaiarasan	4	Environmental Study on Selected Canals in Alappuzha Region
Sree Buddha College of Engineering for Women, Pathanamthitta	B Tech (Civil)	P Kalaiarasan	4	Estimation of Vehicular Emission in Thiruvananthapuram Centre
Muslim Association College of Engineering, Venjaramoodu	B Tech (Civil)	P Kalaiarasan	7	Study on improvement of selected Canals in Alappuzha Region

Sarabhai Institute of Science and Technology, Vellanad	B Tech (Civil)	P Kalaiarasan	5	Study on improvement of Kovalam-Akkulam Canal for inland navigation
Sree Narayanguru College of Engineering and Technology, Tamilnadu	B Tech (Civil)	P Kalaiarasan	4	Study on Environmental improvement of Kovalam-Akkulam Canal for inland navigation
Government College of Engineering,Bartonhill, Thiruvananthapuram	B Tech (Civil)	P Kalaiarasan	4	Environmental improvement of Amayizhanjan Canal for inland navigation in Thiruvananthapuram
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	B Subin	1	In-vehicle Distracted Driving in Kerala: A Study on Safety Perception
Sree Buddha College of Engineering	B Tech (Civil)	B Subin	3	Assessment of Risk Potential of State Highways in Kerala: A Case Study of Adoor-Paranthal Stretch
National Institute of Technology, Karnataka, Surathkal	M Tech (Transportn. Engineering)	P N Salini	2	Pre-feasibility of Volvo bus operating centre at Chala in Thiruvananthapuram City
Mar Baselios College of Engineering	B Tech (Civil)	P N Salini	6	Sustainable Transit System for Last Mile Connectivity in an activity centre – Technopark a Case Study
Mar Athenesius College of Engineering, Kothamangalam	B Tech (Civil)	P N Salini	6	Mode choice for Last Mile Connectivity in Infopark
College of Engineering, Kidangoor, Kottayam	B Tech (Civil)	M S Saran	6	Accident Analysis in Kottayam District using GIS
Indian Institute of Information Technology and Management-Kerala (IIITM-K)	MSc Geoinformatics	M S Saran	1	Mapping and Temporal Change Analysis of Land Use/ Land Cover and Vegetation Using Remote Sensing and GIS
CEPT, Ahmedabad	P G In Urban and Regional Planning	Sabitha N M	1	Inland Waterways and its sustainable development
Pankaj Kasthuri College of Engineering & Technology, Thiruvananthapuram	B Tech (Civil)	Wilson K C	5	Capacity Analysis of SH – 1
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	Wilson K C	1	Pavement Performance Modeling
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	Wilson K C	1	Performance Modeling of Flexible Pavements
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	Arun Chandran	1	Effect of queuing of buses at signalized intersection
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	Arun Chandran	1	Planning of lanes exclusive bus on existing carriage way
National Institute of Technology, Karnataka, Surathkal	M Tech (Trpt.System Engineering)	B Anish Kini	1	Assessment of safety of roads in Kerala using iRAP Model
Vidya Academy of Science and Technology, Thrissur	B Tech (Civil)	B.Anish Kini	5	Redesign of Sakthan Thampuran Bus Terminal
Mar Baselios College of Engineering	B Tech (Civil)	B.Anish Kini	5	Advanced Traveller Information System for optimization of road network and reduction of congestion

Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	B.Anish Kini	1	Impact of Implementation of Congestion Charging in Trivandrum City
Valiya Koonambayi Kulathamma College of Eng. & Technology, Paripally	B Tech (Civil)	B Anish Kini	5	Junction Improvement for Kachery Junction, Attingal
Mangalam College of Engineering, Tirupur	B Tech (Civil)	B.Anish Kini	4	Traffic Impact Study of Lulu Complex, Trivandrum
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	B.Anish Kini	1	Impact of flyover at Kanjikuzhi Junction, Kottayam
St.Joseph's College of Engineering & Technology, Pala	B Tech (Civil)	Ebin Sam	4	Parking management system for MG road in Thiruvananthapuram city
St.Joseph's College of Engineering & Technology, Pala	B Tech (Civil)	Ebin Sam	4	Intermodal split of goods transportation in Kerala
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	Ebin Sam	1	Pedestrian accident prediction modeling of selected road stretch in Kerala
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	Ebin Sam	1	Driver behaviour at pedestrian crossings
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M Tech (Transportn. Engineering)	Ebin Sam	1	Development of GIS based traffic-road database
KVM College of Engineering, Cherthala	B Tech (Civil)	Ebin Sam	6	Road Safety Audit and Inspection of Cherthala-Alappuzha road stretch on National Highway 66
Marian Engineering College, Thiruvananthapuram	B Tech (Civil)	Salini U	6	Performance of glass fibre reinforced SMA
SCMS School of Engineering and Technology, Kochi	B Tech (Civil)	Salini U	4	Mix design for coir fibre reinforced bituminous concrete
Amritha Engineering College, Coimbatore	M Tech (Transportn. Engineering)	Salini U	1	Study on Recycled Asphalt Pavements
Sarabhai Institute of Science and Technology	M Tech (GE)	Salini U	1	Geotechnical behaviour of red soil on addition of sawdust with lime
Sarabhai Institute of Science and Technology	M Tech (GE)	Salini U	1	Feasibility study of utilizing waste sand and POFA in stabilizing kuttanaad soil
Sarabhai Institute of Science and Technology	M Tech (GE)	Salini U	1	Utilisation of red mud using lime as an embankment material
SCMS college of engineering, Ernakulam	B Tech (Civil)	Salini U	4	Performance evaluation of SMA reinforced with cellulose
Loyola College of Engineering Nagercoil	B Tech (Civil)	Salini U	4	Performance of jarofix as a filler in bituminous concrete
National Institute of Technology, Kurukshethra	M Tech (Transportn. Engineering)	Salini U	1	Numerical modeling of highway embankment constructed with soil-jarofix mixture
Mangalam College of Engineering, Kottayam	B Tech (Civil)	Jegan Bharath Kumar A	4	Assessment of Pedestrian facilities in major corridors in Thiruvananthapuram
National Institute of Technology, Kurukshethra	M Tech (Transport Engineering)	Jegan Bharath Kumar A	1	Impact of weather on traffic flow and travel behaviour of commuters in selected corridors in Kerala

16. Presentation of Papers in Seminars/Workshops

Sl. No.	Author(s)	Paper details	Date
i.	Dr B G Sreedevi	**"***Infrastructure Development for Capital Region"*, Seminar organised by Builders Association of India	23rd April 2015
ii.	Dr B G Sreedevi	"*Compilation and Formulation of Implementable concepts for developing Trivandrum as green and heritage city"*. Hilton Garden Inn, Trivandrum	30th July 2015
iii.	Shaheem S, Dr B G Sreedevi	"*Mass Rapid Transit Options for Thiruvananthapuram and Kozhikode Cities in Kerala*". 28th Kerala Science Congress organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016
iv.	V S Sanjay Kumar	"*Accessibility Analysis of Thiruvananthapuram Urban Region*". 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016
v.	V S Sanjay Kumar	"*Modeling the Effect of Road Geometrics and Roughness on Road Safety*", 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016
vi.	P Kalaiarasan	"*Study on the impacts of vehicular emission on human health – a case study*", 25th Swadeshi Science Congress organized by Sanskrit University, Kalady	16th -18th December 2015
vii.	P Kalaiarasan, Dr B G Sreedevi	"*Estimation of Carbon Credit for National Waterway – 3"*. 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016
viii.	Subin B, Dr B G Sreedevi	"*Need for Bicycle Infrastructure Facilities, a Case Study of Kollam – Alappuzha Stretch of National Highway – 66"*. 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016

ix.	P N Salini, B Anish Kini, T Elangovan	*"Introduction of Green Transport System for Major Activity Centres – A Case Study"*. Proceedings of Kerala Environment Congress -2015 at Kottayam.	6th – 8th May 2015
x.	Arun Chandran	"*Feasibility Study for Ropeway at Ilaveezhapoonchira*". 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016
xi.	Jegan Bharath Kumar A	**"***Impact of Weather on Traffic Characteristics and Travel Behavior of Commuters – A Case Study of Thiruvananthapuram Region, Kerala"*, 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016
xii.	R Chandra prathap	**"***Design Improvement of Multi Arm Intersection –A Case Study of Thiruvananthapuram City*", 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram, Won the award for the best poster	28th -30th January 2016
xiii.	B Anish Kini	"*Risk Potential of Roads in Kerala using iRAP"*. Workshop on IndiaRAP, New Delhi	7th October 2015
xiv.	B Anish Kini	"*Road User Cost for reducing congestion in Cities – A Case Study of Thiruvananthapuram City*", 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016
xv.	Salini U	"*Study on the Performance of Natural Fibres in Stone Matrix Asphalt*", 28th Kerala Science Congress, organized by Kerala State Council for Science Technology & Environment (KSCSTE) in association with CWRDM, University of Calicut, Malappuram	28th -30th January 2016

Papers Published in Referred Journals

Nija Bind T A, Dr. B G Sreedevi, Benny Mathews Abraham, *"Prediction of Structural Performance of State Highway – 1"*. International Journal of Engineering Research and Technology, Vol.4 (5), May 2015.

17. Invited Talks/Media Interactions

Dr. B G Sreedevi

Media Interactions

Sl. No.	Topic	Media	Date
1.	*'Road safety'*	All India Radio	30th April 2015
2.	*'Nalla Samariyakkar ini pedikkenda'*	All India Radio	June 2015
3.	*'Road Safety Initiatives'*	Kozhikode All India Radio	26th July 2015
4.	*'Road Safety'*	F.M.Radio	6th August 2015
5.	*'Comprehensive Mobility Plan'*	All India Radio	11th August 2015
6.	*'Comprehensive Mobility Plan'*	Asianet, Kozhikode	11th August 2015
7.	*'Vehicle Pollution'*	Discussion in Manorama Channel	5th December 2015
8.	*'Trivandrum – the way forward'*	Panel Discussion in Mathrubhoomi Channel	9th December 2015
9.	*'Traffic Policies at Delhi'*	'Counter Point', Manorama Channel	11th December 2015.
10.	*'Energy Conservation'*	'Samvadam', Doordarshan	12th December 2015
11.	*'Increasing Accidents in the State'*	Discussion in All India Radio, Kozhikkode	20th December 2015
12.	*'Two Wheeler Accidents'*	Discussion in All India Radio, Kozhikkode	29th December 2015
13.	*'Vehicle Pollution'*	Discussion in Manorama Channel	Ist January 2016
14.	*'Vehicle Pollution'*	Panel Discussionin 'Akam Puram' Programme, Mathrubhoomi Channel	2nd January 2016
15.	*'Road Safety'*	Panel Discussion in All India Radio as part of 'Road Safety Week – 2016	8th January 2016
16.	*'Road Safety'*	Discussion in All India Radio, Thiruvananthapuram	12th January 2016
17.	*'Vartha Keralam'*	Live Programme on 'Road Safety in Kerala' , Doordarsan	14th January 2016.
18.	*'Railway Budget 2016'*	Amrita Channel	25th February 2016
19.	*'Vehicle alteration and its effects'*	Discussion in Doordarsan, Varthamanakalam	3rd March 2016
20.	*'Opinion on making helmet compulsory'*	All India Radio	30th March 2016

Invited Talks

Sl. No.	Topic/Particulars	Venue/Event	Date
1.	Talk delivered	'Laurie Baker Memorial Lecture', organised by Swadeshi Science Movement, Kerala at Institution of Engineers Hall, Vellayambalam, Trivandrum	1st April 2015

2.	Talk delivered	Inauguration of 'Sasthra Prathiba' Competition , organised by Swadeshi Science Movement at Carmel Girls Higher Secondary School, Thiruvananthapuram	2nd July 2015
3.	*'Panel Discussion'*	Third International Conference on Modeling and Simulation in Civil Engineering – ICMSC 2015, organised by Dept. of Civil Engineering, TKM College of Engineering, Kollam	10th December 2015
4.	Panelist for 'Samvadam'	In connection with 27th Road Safety Week, organised by Motor Vehicles Department, Kalamassery	9th January 2016
5.	*'Felicitation Speech'*	State Level inauguration of the 27th Road Safety Week, Kalamassery	9th January 2016
6.	Inaugural address	'Sasthra Pratibha Matsaram' – District Level Training Programme, NCESS, Thiruvananthapuram	16th January 2016
7.	Inaugural address	'Seminar on Road Safety', organised by Transport Research Centre, College of Engineering, Thiruvananthapuram	30th January 2016
8.	*'Felicitation Speech'*	Foundation Stone laying for Technopark Bus Stand	8th February 2016
9.	Science Day Lecture	Sree Saraswathi Vidyalayam, Ooruttambalam	25th February 2016
10.	Talk on *'Trivandrum Development'*	Meeting organized by Kazhakkuttam Vikasana Samithi	6th March 2016
11.	Talk on *'Non-Conventional Energy'*	KSEB Officers Association Annual Meeting, Thiruvananthapuram	14th March 2016
12.	Talk on 'Recent Trends in Highway Engineering'	At Rajiv Gandhi Institute of Technology, Kottayam	29th March 2016.
13.	Talk on 'Transportation Engineering – Opportunities and Challenges'	Rajadhani Engineering College, Nagaroor, Thiruvananthapuram	31st March 2016

V S Sanjay Kumar

Invited Talks

Sl. No.	Topic	Venue/Event	Date
1.	*Collaborative Research Opportunities*	Government Engineering College, Barton Hill	10th September 2015
2.	*Inaugural talk*	Civil Engineering Association activities for the year 2015-16 at Holy Kings College of Engineering and Technology, Pampakuda, Ernakulam	7th November 2015
3.	*Introduction to Urban Transportation Planning*	Holy Kings College of Engineering and Technology, Pampakuda, Ernakulam	7th November 2015

P Kalaiarasan

Invited Talks

Sl. No.	Topic	Venue/Event	Date
1.	*Green Climate Fund (GCF) - Views and Thoughts*	To the officials of NATPAC, Sasthra Bhavan, Pattom, Thiruvananthapuram	8th January 2016
2.	*Applications of Differential Global Positioning System (DGPS) in Civil Engineering*	To the Faculties of College of Engineering, Kidangoor as part of Faculty Development Program (FDP) funded by AICTE, College of Engineering Kidangoor	11th January 2016

B Subin

Invited Talks

Sl. No.	Topic	Venue/Event	Date
1.	*Road Safety Education – An Integrated Approach to Inject Quality to Road Transport System*	One day symposium on "Road Safety: Mission towards Safe Roads", organized by Transportation Engineering Research Centre at College of Engineering, Thiruvananthapuram	30th January 2016

M S Saran

Invited Talks

Sl. No.	Topic	Venue/Event	Date
1.	*Basics of GIS and Remote Sensing*	To the faculties of College of Engineering, Kidangoor as part of Faculty Development Program (FDP) funded by AICTE, College of Engineering Kidangoor	11th January 2016

18. 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 (KURTC), Government of Kerala
- Member, Kerala Road Safety Authority (KRSA), Government of Kerala
- Executive Committee Member, Kerala Road Safety Authority, Govt. of Kerala
- Member, H-5 Committee -2015-'17, Indian Roads Congress. (National Level)
- Convener of the working group on 'Roads, Bridges and Road Transport' of Kerala StatePlanning Board, Government of Kerala

- Member, Board of Studies in 'Environmental Studies' Cochin University of Science and Technology 2011-2015
- Member, Technical Committee 'Kozhikode City Road Improvement Project', Kerala Road Fund Board, Government of Kerala
- Member, 'Building Committee of Srinivasa Ramanujan Institute for Basic Sciences (SRIBS), Government of Kerala, 2014
- Member, Electric Mobility Mission Program , Power Dept., Govt. of Kerala
- Chairperson, Building Committee, Jawaharlal Nehru Tropical Botanical Garden & Research Institute, Government of Kerala constituted by KSCSTE
- Expert Committee member for Promotion of Technical Officers for CWRDM & JNTBGRI, constituted by KSCSTE (2015)
- Executive Committee (EC) member of KSCSTE, Government of Kerala
- Chairman, Technical Expert Committee – Urban 2020 Scheme (Urban Transport and Roads & Bridges) of Kerala State Urban Development Project
- Expert member for the selection committee of project manager, Kerala Road Fund Board
- Management Committee member of Srinivasa Ramanujam Institute for Basic Sciences (SRIBS), Kottayam, constituted by KSCSTE
- Member of the committee for preparation of plan document for Roads and Bridges for 12th five year plan , Kerala State Planning Board
- Member, Committee for Coastal Highway (G.O.(R.t) No.1343/2016/PWD dated 30.09.2016), Government of Kerala
- Member, Committee for Hill Highway (G.O.(R.t) No.1343/2016/PWD dated 30.09.2016), Government of Kerala
- Member, TS Committee for PWD Projects related to KIIFB, Government of Kerala

P Kalaiarasan

- 'Nodal Officer' for preparation of Climate Change Report in Kerala to Dept. of Environment and Climate Change (DoECC), Government of Kerala.
- **'**Technical Expert' of DGPS and ETS for Dept. of Survey and Land Records, Government of Kerala

19. Road Safety Education Materials

Films

1. Savari, A Documentary Film on Road Safety – For Autorickshaw Drivers
2. Gathy, A Short Film on Two Wheeler Safety
3. IRC Film (English and Malayalam) – For School Children
4. Right Step (English and Malayalam) – For School Children
5. VIC Roads, Australia – For School Children
6. A Picnic on Pedals – For School Children
7. Vazhikkannumai – On Pedestrian Safety
8. Sradhha – Transportation of Goods Vehicles
9. Take care

10. A Film on Seatbelt
11. A film on Rash Driving
12. A Film on Pedestrian Crossing

Booklets

1. Safe Road to School (English & Malayalam)
2. Preventing Accidents
3. Two Wheeler Driving Manual
4. Road Safety Manual for Goods Vehicle
5. All about Lane Driving and Road Safety
6. Safe Cycling
7. Autorickshaw Driving Manual (English & Malayalam)
8. Defensive Driving
9. Teacher's Manual (English & Malayalam)
10. Safe Community Programme for Panchayats (English & Malayalam)
11. Helping Road Accident Victims (English & Malayalam)
12. Rules of Road Regulations,1989
13. On Car and Safe Driving
14. Defensive Bus Driving and Road Safety Guide
15. Road Safety Slogan
16. Vehicle Upkeep and Safety
17. Alphabets of Road Language
18. Road Safety Quiz
19. Safe and Responsible Parking
20. Road Safety and Youth Leadership Programmes
21. Safety Rules for Railway Level Crossing and Around Tracks
22. Safe and Secure Travel by Train
23. Driver's Guide (Malayalam)
24. Formation and Activities of Road Safety Cell in Schools (Malayalam)
25. കാൽനട യാത്രക്കാർക്കുള്ള സുരക്ഷാ മാർഗരേഖ
26. സ്കൂൾ കുട്ടികൾക്കുള്ള റോഡ് സുരക്ഷാധിഷ്ഠിത ബോധവത്കരണം
27. പഷു 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!
5. While Driving Put off Mobile! Put on Seat Belt!
6. Better to Arrive Late Than Never
7. Courtesy and Common Sense Promote Road Safety

8. Road Safety is a Mission, Not an Intermission
9. Before Crossing Stop! Think! Then Act
10. Kindness is Giving the Right of Way
11. Look Carefully and Drive Safely
12. Be smart, think, then Start
13. Leave sooner, drive slower, live longer
14. Drive as if every child on the street were your own
15. Be careful and be safe
16. At work at play let safety lead the way
17. Safety is a simple ABC- Always Be Careful
18. Safety on road, Safe tea at home
19. The safe way is the best way
20. നിൽക്കൂ!ശ്രദ്ധിക്കൂ!റോഡ് മുറിച്ച് കടക്കൂ!
21. സൂക്ഷിച്ച് വാഹനമോടിക്കൂ, റോഡിലെ തിരക്കിൽ നിങ്ങളുടെ കുട്ടികളും ഉണ്ടായിരിക്കാം
22. വേഗതയിലല്ല സ്മാർട്ടാകേണ്ടത്, സുരക്ഷയിലാണ്
23. ശ്രദ്ധിച്ച് നോക്കൂ, സുരക്ഷിതമായി ഡ്രൈവ് ചെയ്യൂ
24. സുരക്ഷിതത്വം മഹത്വമാണ്
25. വീഥിയിലൂടെ വേഗത വേണ്ട
26. ശ്രദ്ധിക്കൂ സുരക്ഷിതരായിരിക്കൂ
27. അശ്രദ്ധ അപകടമാണ്
28. നേരത്തെ ഇറങ്ങൂ, നേരെ ഓടിക്കൂ, നേരായവിധം ജീവിക്കൂ
29. ശ്രദ്ധയുള്ളിടത്ത് സുരക്ഷ ഉണ്ട്
30. പാഞ്ഞു പോകരുത്, പ്രാണൻ എടുക്കരുത്
31. സുഗമമായ പാത നിങ്ങളുടെ മാത്രം സ്വന്തമല്ല

Calenders

1. Steps to Use Bus safely
2. Safe Road to school – Crossing the Road Safely
3. Safe Road to School – Kerb Drill
4. Safe Road to school – Lessons from Animals
5. Road Signs
6. Important Road Safety Tips for Children
7. 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
II.	**Aggregate Testing Equipments**
18.	Aggregate sieves
19.	Aggregate Impact Value test equipment
20.	Los angles abrasion testing machine
21.	Stripping value test equipment
22.	Specific gravity test - Density basket

23.	Shape test - Thickness gauge & Length gauge, Angularity number test mould
III.	**Bitumen & Emulsion**
24.	Penetration test equipment
25.	Flash & fire point Test apparatus
26.	Softening point test - Ring & ball apparatus
27.	Ductility testing machine
28.	Standard Tar Viscometer
29.	Specific gravity - Pycnometer
30.	Dean and Stark apparatus - water content
31.	Distillation test apparatus
32.	Wax content test apparatus
33.	Solubility test equipment
34.	Particle charge test apparatus - emulsion
35.	Residue on 600 micron sieve test apparatus - emulsion
36.	Coagulation test apparatus - emulsion
37.	Settlement test apparatus – emulsion
IV.	**Tests on Mixes**
38.	Marshall stability test equipment.
39.	Motorized centrifuge extractor
40.	Core cutting machine - (100mm dia. core bit)-undisturbed sampling of bituminous pavement.
V.	**Test on Pavement and Evaluation**
41.	Fifth Wheel type Bump Integrator
42.	MERLIN - Machine for evaluating roughness using low cost instrumentation
43.	Benkelman beam test equipment
44.	Portable wheel weigh bridge/pad
45.	Portable Skid Resistance Tester
46.	Sand Patch method test set
	Wheel Rut Tester
b) Traffic Engineering Laboratory	
47.	Noise level meter
48.	Speed Radar
49.	Distometer
c) Topographic Survey	
50.	DGPS
51.	Single Frequency GPS-5 Nos.
52.	Total stations-3 Nos.
53.	Automatic levels-2 Nos.
54.	Theodolite
55.	High end plotters -2 Nos.
56.	Electronic Total Station

d) Environment Laboratory	
57.	CO Analyzer
58.	CO_2 Analyzer
59.	NO_2 Analyzer
60.	CH_4 Analyzer
61.	Cup Anemometer
62.	Wind vane
63.	Wind logger
64.	RH meter
65.	Thermo couple sensor
66.	Spectro photo meter
67.	Respirable Dust Sampler (APM 460)-2 Nos.
e) Water Transport Laboratory	
68.	Echo sounder
68.	Portable canti lever scale
70.	Distometer
f) General Accessories for Laboratory	
71.	Thermostatically controlled drying oven 0-150^{0}C
72.	Thermostatically controlled water bath
73.	Electronic balances – 200 g, 2 kg, 50 kg
74.	Soaking tank
75.	Heater
76.	Semiautomatic balance 10 kg – 2 nos.
77.	Traffic safety appurtenances
78.	Power generator- 2 nos.
79.	External car battery-3 nos.
80.	Digital Thermometer
g) Application Softwares	
81.	MX ROAD
82.	AUTO CAD
83.	ARC GIS
84.	3D MAX
85.	TALLY
86.	STAD PRO
87.	HDM IV
88.	SPSS
89.	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 Forests, Govt. of Kerala	-	Vice President
8.	Minister for Water Resources, Govt. of Kerala	-	Vice President
9.	Vice Chairman, State Planning Board, Kerala	-	Vice President
10.	The Chief Secretary to Government of Kerala	-	Vice President
11.	The Executive Vice President, KSCSTE	-	Member
12.	The Secretary, Department of Science and Technology, Government of India	-	Member
13.	The Secretary to Government, Finance Department, Govt. of Kerala	-	Member
14.	The Secretary to Government, Planning and Economic Affairs Department, Govt. of Kerala	-	Member
15.	The Vice Chancellor, Cochin University of Science and Technology	-	Member
16.	The Vice Chancellor, Kerala Agricultural University	-	Member
17.	The Director, Vikram Sarabai Space Centre, Thiruvananthapuram	-	Member
18.	The Director, NIIST, Thiruvananthapuram	-	Member
19.	The Director, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram	-	Member
20.	The Member Secretary , KSCSTE (nominated by Government)	-	Member
21.	Director, JNTBGRI, Trivandrum	-	Member
22.	Director, KFRI, Peechi, Thrissur	-	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.	Additional Chief Secretary, Finance, Government of Kerala (Ex-officio)	-	Member
5.	Director, JNTBGRI, Trivandrum	-	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 Convener

iv. Management Committee of NATPAC

1.	Director, NATPAC	-	Chairperson
2.	Director, KSCSTE	-	Member
3.	Director, JNTBGRI	-	Member
4.	Shri. D Robinson, Scientist –F, NATPAC	-	Member
5.	Smt. L Geetha, Additional Secretary to Govt., GoK	-	Member
6.	Registrar, NATPAC	-	Member

v. Information Officers as per the Right to Information Act

Public Information Officers	-	Shri D.Robinson Scientist - F *(Technical Matters)* Shri K Mohanakumar Deputy Registrar (Finance) *(Administrative Matters)*
Asst. Public Information Officer	-	Smt T S Sangeetha Assistant Grade - 1
Appellate Authority, RTI Act	-	Dr B G Sreedevi, Director

vi. Internal Committees

a. Library Committee

Shri D Robinson, Scientist – F	-	Chairman
Shri Shaheem S, Scientist – E1	-	Member
Shri V S Sanjay Kumar, Scientist – E1	-	Member
Shri Arun Chandran, Scientist-C	-	Member
Smt K S Veena, Scientist – B	-	Member Convenor

b. Purchase Committee

Shri D Robinson, Scientist - F	-	Chairman
Shri K Mohanakumar,Deputy Registrar	-	Member
Shri S Shaheem, Scientist – E1	-	Member
Shri P Kalaiarasan, Scientist – C	-	Member

c. Grievance Redressal Committee

Shri K George Koshy, Registrar	-	Chairman
Shri D Robinson, Scientist – F	-	Member
Shri K Mohanakumar, Deputy Registrar	-	Member
Shri T Ramakrishnan, Technical Officer V	-	Member
Shri K C Wilson, Scientist-C	-	Member

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

Smt P N.Salini, Scientist – C	-	Chairperson
Shri M S Saran, Scientist-C	-	Member
Smt N M Sabitha, Scientist-C	-	Member
Smt Mayadevi, Assistant Grade -1	-	Member Convenor

General Administration

Research Council Meeting

The 17th meeting of the Research Council was held on 5thand 6th June 2015 at NATPAC under the chairmanship of Prof. (Dr.) Veeraraghavan.

Management Committee Meeting

The Management Committee met on 5th May 2015 and 30th September 2015 at NATPAC under the chairmanship of Director, NATPAC.

NATPAC STAFF –AS ON 01.04.2016

Sl. No.	Name		Designation
	Dr B G Sreedevi	-	Scientist G & Director
Scientific Staff			
1.	Tomy Cyriac	-	Scientist-F(On Deputation)
2.	D Robinson	-	Scientist-F
3.	D Sunder	-	Scientist-E2
4.	S Shaheem	-	Scientist-E1
5.	V S Sanjay Kumar	-	Scientist-E1
6.	P Kalaiarasan	-	Scientist-C
7.	B Subin	-	Scientist-C
8.	P N Salini	-	Scientist-C
9.	M S Saran	-	Scientist-C
10.	N M.Sabitha	-	Scientist-C
11.	K C Wilson	-	Scientist-C
12.	Arun Chandran	-	Scientist-C
13.	Veena K S	-	Scientist-B
14.	S Ebin Sam	-	Scientist-B
15.	A Jegan Bharath Kumar	-	Scientist-B
16.	R Chandra Prathap	-	Scientist-B
17.	U Salini	-	Scientist-B
18.	B Anish Kini	-	Scientist-B
Technical Staff			
19.	K M Syed Mohammed	-	Principal Technical Officer
20.	T Ramakrishnan	-	Technical Officer Grade -5
21.	C Muraleedharan Pillai	-	Technical Officer Grade -5
22.	V G Sasi	-	Technical Officer Grade -3
23.	M S Radhakrishnan	-	Technical Officer Grade -3
24.	K Devadethan Nair	-	Technical Officer Grade -3
25.	E P Surendran Pillai	-	Technical Officer Grade -2
26.	R J Sanjai	-	Technical Officer Grade -1

27.	Deepa Radhakrishnan	-	Technical Officer Grade -1
28.	T Mohan	-	Technical Assistant Grade-3
29.	S Geetha	-	Technical Assistant Grade-3
30.	R Radhakrishnan Thampi	-	Technical Assistant Grade-2
31.	Shyama C	-	Jr.Library Assistant Grade-1

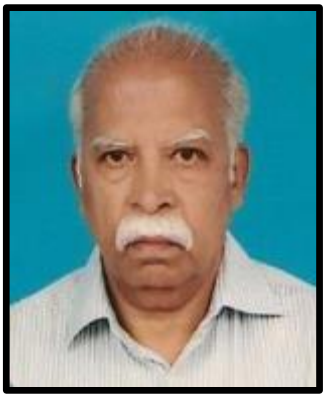
Administrative Staff

32.	K George Koshy	-	Registrar Grade - 2
33.	K Mohanakumar	-	Dy. Registrar Grade - 1
34.	T Vijayan	-	P.A. to Registrar Grade-4
35.	Abey George	-	P.A. to Registrar Grade-4
36.	D Shaju	-	Section Officer Grade-1
37.	R Lekha	-	Typist cum Stenographer Grade-5
38.	Arya S K	-	Assistant Grade – 1
39.	Maya Devi M	-	Assistant Grade – 1
40.	Veena S	-	Assistant Grade – 1
41.	Muhammed Naserudeen C	-	Assistant Grade – 1
42.	Sangeetha T S	-	Assistant Grade – 1
43.	Ramdas M	-	Stenographer Grade – 1
44.	Lajila K B	-	Stenographer Grade – 1
45.	A Praveen Kumar	-	Clerical Assistant Grade -1
46.	G Ragesh	-	Driver Grade - 2
47.	A Somaraj	-	Driver Grade - 2
48.	Surendran Kulangara	-	Driver Grade – 1
49.	Shijil P R	-	Driver Grade – 1
50.	Sukhdev Kolay	-	Jr. Assistant
51.	P X Mathew	-	Jr. Assistant
52.	S Jayakumar	-	Helper Grade -4
53.	G Suresh Kumaran Nair	-	Helper Grade -3
54.	A Anil Kumar	-	Helper Grade -2
55.	Athira S Kumar	-	Helper Grade -1

Retirements

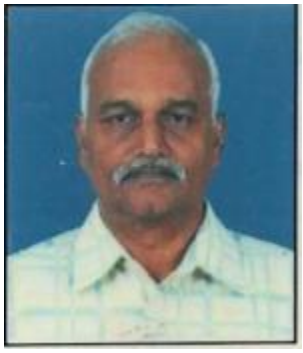
Shri Satheish B Nair
Scientist-F
Superannuated on 30th April 2015

Shri V Jayawardhanan
Technical Officer Grade-4
Superannuated on 31st May 2015



Shri S Ramachandran
Technical Officer Grade-5
Superannuated on 31st August 2015

Retirement



Dr G Ravikumar
Scientist-F
Superannuated on 30th September 2015

Resignation

Shri Santhosh Kadavy
Scientist-B
Resigned on 31st July 2015

Obituary

Shri K Satheesan
Technical Officer Grade-4
Expired on 27th June 2015

Other NEWS

- *Self-help, behaviour, environment, disaster management, spirituality and scientific perspectives on various related topics* – Talk delivered by Shri B K Vedavyas, Member of Prajapita Brahma Kumaris Ishwariya Vishwa Vidyalaya at Sasthra Bhavan, Pattom on 11th August 2015.

- NATPAC Staff Arts and Sports Club (NASAS) organised Onam celebration on 25th August 2015 at K Karunakaran Transpark. Dr Suresh Das, Executive Vice President, KSCSTE inaugurated the celebration.

- NATPAC took part in Onam pageantry organised by Tourism Department, Government of Kerala on 31st August 2015. The theme of the float was '*Green and Safe Transport*'. Street Drama on Road Safety, 'Yathraykkappuram' was also demonstrated for general public.

- Recommendation of NATPAC for inclusion of Alappuzha canals in the 101 waterway declaration proposal sent through the State Government has been accepted by the Inland Waterways Authority of India (IWAI).

- Human Rights Oath taking ceremony was conducted in NATPAC at 11 am on 10th December 2015, the Human Rights Day. Dr B G Sreedevi, Director delivered the oath to the staff of NATPAC.

- Dr B G Sreedevi, Director, NATPAC received the 'Kerala State Energy Conservation Commendation Certificate – 2015' in the category of individuals. The Commendation Certificate was presented by Shri. Aryadan Muhammed, Hon'ble Minister for Power, GoK on 14th December 2015 at Hotel Residency Tower, Thiruvananthapuram.

- NATPAC was nominated in the Public Category of the 'India Road Safety Mission 2015 Awards' instituted by Maruti & Times Now.

- NATPAC Staff Arts and Sports Club (NASAS) organized New Year Celebration on Ist January 2016 at Sasthrabhavan, Pattom.

- Voter's Pledge taking ceremony was conducted in NATPAC on 25th January 2016.

- Programme on 'Road Safety Initiatives of NATPAC' broadcasted in 'Times Now' News Channel on 6th and 7th February 2016.

RESEARCH STUDIES UNDERTAKEN DURING 2015-'16

Sl. No.	Code	Project
1	202/2015-16	Study on the performance of Highway Development Projects in Kerala
2	203/2015-16	Investigation of major accident spots and accident causative analysis and mitigate measures
3	204/2015-16	Periodic updation of Price Indices for different public transport Operations
4	205/2015-16	District level Road Network Planning using GIS, Remote Sensing and GPS
5	206/2015-16	Developing Quick Response Transferable Transport Demand Estimation Technique for Urban Areas
6	207/2015-16	Effect of Queuing of buses at signalized intersection
7	208/2015-16	Impact of proposed Vizhinjam International Deep water Multipurpose Port on Traffic and Transportation System
8	209/2015-16	Study on Feasibility of Connecting Thrissur Town to National Waterway – 3 through waterways
9	210/2015-16	Environmental Improvement of selected canals in Alappuzha Region
10	211/2015-16	An innovative and eco-friendly Public Transit System for Providing Last Mile Connectivity to major work centres – a case study of Technopark Campuses in Trivandrum
11	212/2015-16	Cost of Road Accidents in the state of Kerala
12	213/2015-16	Strategy for improving Walkability in major cities of Kerala
13	214/2015-16	Mitigation measures for reducing pedestrian related accidents in selected roads
14	215/2015-16	Evaluation and Optimization of Trauma Care Centre in Malabar Region
15	216/2015-16	Road Assessment and Road Safety Audit for Adoor-Chenganoor Stretch of MC Road
16	217/2015-16	Study on conservation of natural resources by recycling of Asphalt Pavements
17	218/2015-16	Study on overloading of vehicles and its impact on pavement service life
18	219/2015-16	Strategic Plan for the development of National Highway Network in Kerala
19	220/2015-16	Development of traffic growth rate model for NHs in Kerala
20	221/2015-16 (1)	Study on rescheduling of bus routes in Thiruvananthapuram City
21	221/2015-16 (2)	Study on Goods Transportation and Freight Policy
22	221/2015-16 (5)	Road Safety Improvement Study on Kollam – Oachira Stretch
23	221/2015-16 (6)	Traffic improvement scheme – Chamravattam

CONSULTANCY/SPONSORED PROJECTS IN 2015-'16

Sl. No.	Code	Project	Sponsored by
1	RP 00110	Study of ambient air quality and its impacts on climate change in Kerala	Directorate of Environment & Climate change, Kerala
2	C 02913	Preparation of DPR for Hill Highway - Package 1 - Kasargode and Kannur	Kerala Road Fund Board
3	C 03113	Feasibility study for an elevated corridor in forest section of NH-766	Kerala Road Fund Board
4	C 03313	Total Station Survey and Base Map preparation for DTP Schemes - Attingal Bus Stand Area	Department of Town Planning, GoK
5	C 03413	Total Station Survey and Base Map preparation for DTP Schemes - Central Area Nedumangad	Department of Town Planning, GoK
6	C 03513	Total Station Survey and Base Map preparation for DTP Schemes - Neyyattinkara Bus Stand Area	Department of Town & Country Planning, GoK
7	C 03613	Fixing of GPS Bench Mark along Kuppam - Valapattanam river	CWRDM
8	C 00414	Comprehensive Mobility Plan - Trivandrum and Kozhikode	Kerala Rapid Transit Corporation Ltd.
9	C 00714	Feasibility study and preparation of DPR for elevated structure at Technocity	Electronics Technology Parks – Kerala
10	C 00814	Feasibility study for ropeway at Vazhikadavu near Vagamon	Tourism Department, GoK
11	C 01014	Mapping of Kowdiar Palace Compound	Town Planning Department, GoK
12	C 01114	Estimation of vehicular emission in Thiruvananthapuram Urban Centre	
13	C 01214	Traffic survey at Aakkulam on NH-47 in Thiruvananthapuram	NHAI, Thiruvananthapuram
14	C 01414	Traffic calming measures for improving road safety at KINFRA Industrial Park at Kanjikkode in Palakkad District	KINFRA
15	C 00315	Assessment of Annual Potential Collection of toll on Vallarpadam - Kalamasserry NH 966A in Kochi	NHAI, Kochi
16		Pre-feasibility study of Volvo bus operating centre at Chala in Thiruvananthapuram City	Need based study for TRIDA
17	C 01314	Improvements to Accident Prone Areas at Vattapara Curve	PWD (NH)
18	C 00215	Mapping of work lane from Pallipuram to Kesavadasapuram in the proposed Light Metro Rail Alignment	DMRC
19	C 00715	Economic proposal for Temple road at Cyber park, Kozhikode	Cyber Park Kozhikode
20		Improvement of Kovalam-Akkulam canal stretch in Thiruvananthapuram for Inland Navigation, Tourism and Recreational Purposes	CSIND

22	C 00415	Roughness Index Survey and BBD Survey on city roads	Kerala Road Fund Board (KRFB)
23	C 00914	Implementation of District level Road Safety activities	Road Safety Cell (PWD)
24	C 00515	Traffic survey at three locations on NH-47 & 47 B between Kaliyikkavila and Kavalkinaru in Tamilnadu	NHAI, Nagercoil
25	C 00615	Traffic survey at Balaramapuram on NH-47 in Thiruvananthapuram	NHAI, Thiruvananthapuram
26	C 00715	Preparation of Road Safety Improvement study for Gurgaon	Need based study
28		Preparation of Improvement plan for NH-Bypass near Hilite Mall, Kozhikode	Maruti Suzuki
29	C 00815	Traffic impact study of proposed Lulu Complex at Aakkulam on NH Bypass in Trivandrum	Need based study for TRIDA
30		Feasibility study of Traffic studies –Valiyazhackal bridge and feasibility analysis across Kayamkulam Canal	Lulu International Shopping Mall Pvt. Ltd
31		Traffic Improvement schemes for Vengara in Malappuram District	Need based study
32		Improvement proposal for Chamravattom junction in Malappuram District	Need based study
33	C 01015	Consultancy services for survey and allied works for Trivandrum Light Metro	Need based study
34	C 01215	Traffic and Transportation studies for 11 towns	Department of Town & Country Planning, GoK
35	C 00116	Signage scheme for Karamana River area in Trivandrum City	KSCSTE
36	C 00115	Training on Safe Transportation of Hazardous Goods	

Projects Sponsored by Kerala Road Safety Authority (KRSA) RP **00113**

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.
	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 on 31st March 2016

Liabilities	Sch No	As at 31.03.2016	As at 31.03.2015	Assets	Sch No	As at 31.03.2016	As at 31.03.2015
Reserves & Surplus	4	1,77,14,973	1,45,91,710	Fixed Assets	1	1,77,14,973	1,45,91,710
Current Liablities	5	52,23,839	1,47,07,448	Current Assets	2	12,12,43,593	7,81,34,700
Unspent balance	6	11,02,95,245	5,15,38,045	Loans & Advances	3	9,45,15,090	8,21,00,793
Building Fund Account	4	10,02,39,600	9,39,90,000				
Total		23,34,73,655	17,48,27,203	Total		23,34,73,655	17,48,27,203

For Mohan & Mohan Associates
Chartered Accountants

R. Suresh Mohan
Partner
Membership No. : 013398
Firm Reg. No.: 0020925

Place : Thiruvananthapuram
Dated : 31/03/2017

For National Transportation Planning and Research Centre
Trivandrum

(Dy Registrar) (Registrar) (Director)

Place :Thiruvananthapuram
Dated: 31.03.2017

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 31/03/2016

Expenditure	Sch No	Year ended 31.03.2016	Year ended 31.03.2015	Income	Sch No	Year ended 31.03.2016	Year ended 31.03.2015
		₹	₹			₹	₹
To Infrastructure Strengthening (Plan)	10	1,74,06,755	2,37,57,150	By Grant from Government of Kerala	7	5,76,63,978	4,88,01,008
To Infrastructure Strengthening (Non P	11	45,11,375	94,35,826	By Other Receipts	8	74,22,146	2,58,98,864
To Salaries and Allowances (Plan)	12	-	-	By Depreciation written back	1	39,80,123	43,65,296
To Salaries and Allowances (Non Plan)	13	4,31,67,993	4,15,06,896	By Income from Consultancy Project	9	1,81,50,454	5,82,75,752
To Depreciation	1	39,80,123	43,65,296				
To Consultancy Project Expenses		1,81,50,454	5,82,75,752				
Total		8,72,16,700	13,73,40,920	Total		8,72,16,700	13,73,40,920

For Mohan & Mohan Associates
Chartered Accountants

R. Suresh Mohan
Partner
Membership No. : 013398
Firm Reg. No.: 0020925

Place : Thiruvananthapuram
Dated : 31/03/2017

For National Transportation Planning and Research Centre
Trivandrum

(Dy Regstrar) (Regstrar) (Director)

Place :Thiruvananthapuram
Dated:
31.03.2017

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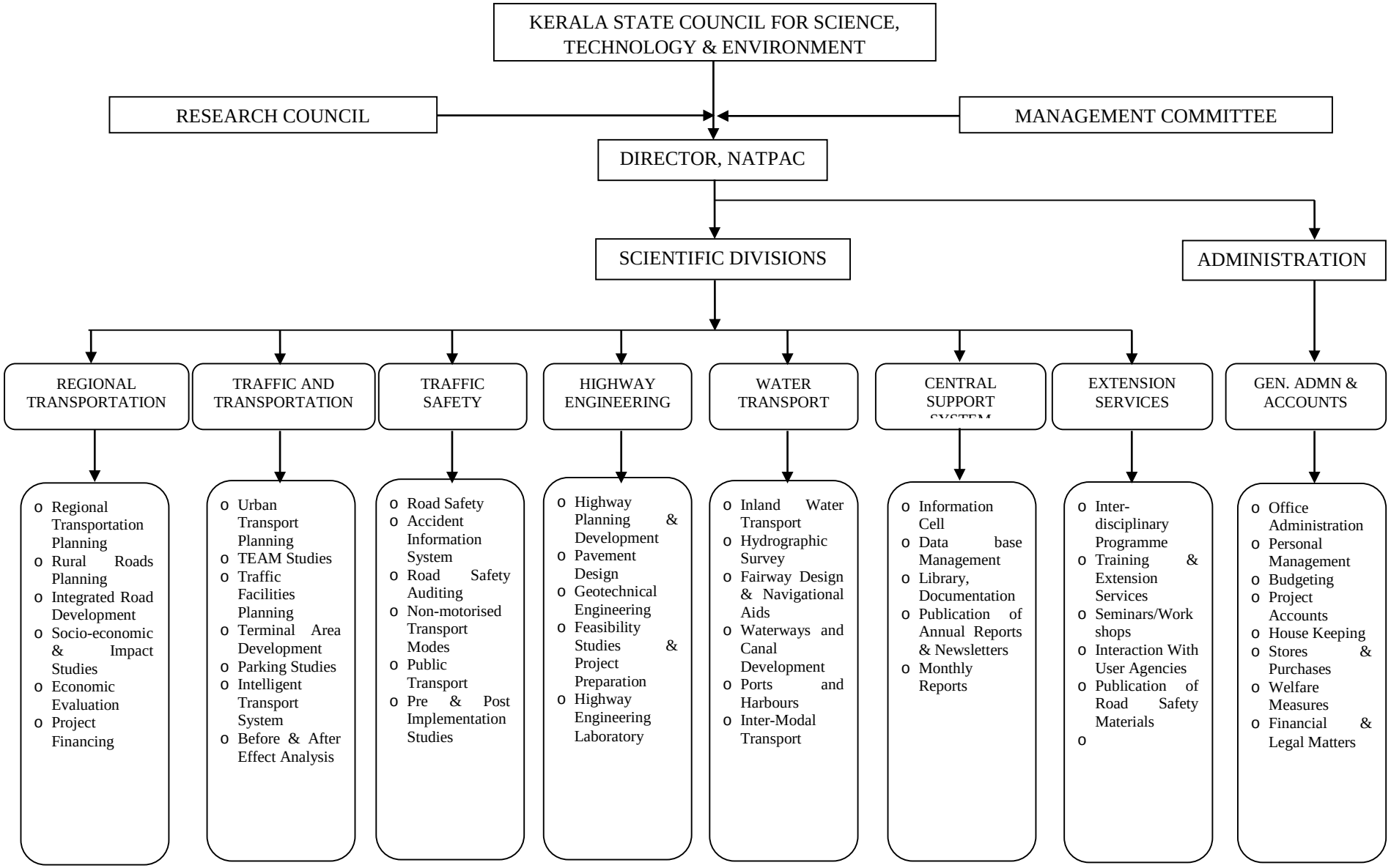
KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY & ENVIRONMENT
RESEARCH COUNCIL
MANAGEMENT COMMITTEE
DIRECTOR, NATPAC
SCIENTIFIC DIVISIONS
ADMINISTRATION
REGIONAL TRANSPORTATION
TRAFFIC AND TRANSPORTATION
TRAFFIC SAFETY
HIGHWAY ENGINEERING
WATER TRANSPORT
CENTRAL SUPPORT
EXTENSION SERVICES
GEN. ADMN & ACCOUNTS
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/Work shops
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