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ANNUAL REPORT 2014 -`15

राष्ट्रीय परिवहन योजना एवं अनुसंधान केंद्र

National Transportation Planning and Research Centre

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

Sasthra Bhavan,Pattom-695004,Thiruvananthapuram

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Dr.B G Sreedevi
Director
NATPAC

It is my pleasure to present to you, on behalf of the Staff of National Transportation Planning and Research Centre, our Annual Report for 2014-'15. This has been a remarkable year for NATPAC. During this period the Centre was able to establish its place as an important voice in the Traffic Safety as well as the Traffic and Transportation Development for the State. This year witnessed NATPAC translating its goals and priorities into specific work plans. This report gives an overview of the activities of NATPAC from April 2014 to March 2015. During this year, the Scientists of the Centre handled 18 R & D Projects and 40 Sponsored Studies.

NATPAC has assessed the existing traffic scenario at the Technopark area and were given suitable measures to overcome the congestion caused at the merging of traffic from the campus and the NH 66 bypass. To increase the travel by transit or active transportation (walking, cycling, etc.) NATPAC has done the Strategic Transit Oriented Development Plan for Kochi on the identified Metro Transit Oriented Corridor. The plan complements the existing city character in terms of the basic identity of a station area. Traffic and transportation studies for three towns were completed and has given short-term as well as long-term proposals for improving the transportation scenario of the towns and for the overall development of the towns. Passenger demand analysis for the proposed bus station at Technopark, Thiruvananthapuram was done and based on the analysis suitable layout plans for the bus terminal were proposed which considered reduction in pedestrian vehicle conflict, smooth flow of buses, optimum utilization of land spaces, access to differently abled people and provision for non-motorized traffic. NATPAC has developed a Quick Response Travel Demand Estimation Technique, which will be of much help to improve the trip generation estimation in travel demand fore casting in small and medium towns that may not have sufficient resources to conduct field surveys.

At the instance of Department of Tourism, Government of Kerala, NATPAC has done a feasibility study for developing a ropeway system at Ilaveezhapoonchira to give a fillip to tourism activities in the region. A successful parking management strategy for a city should involve both demand side management by restricting the demand for parking and supply-side management by involving effective supply of parking spaces. NATPAC evaluated the parking deficiencies and recommended potential solutions including additional parking, parking pricing and management strategies in urban areas

The Price Index for Stage Carriage Operations (PISCO) prepared by NATPAC would be helpful for Government in taking decisions on revision of fare for Stage Carriages in our State. With the number of vehicles on the road and the number of vehicle - miles traveled escalating rapidly, the state is on the fast road to uncontrolable air and noise pollution. Emissions from passenger vehicles are increasing despite attempts to make engines more fuel efficient and addition of antipollution devices. Measurement of air quality and noise level were done at the proposed IISER campus and it was observed that the noise level was maximum at some locations because of the man made activities like sewage treatment plant, construction activity, welding process, etc.

Critical appraisal of the highway development projects was significant to the highway research in the State. NATPAC brought out quantified results in facts and figures to substantiate the performance of State Highways. The Centre evaluated the feasibility of fibre reinforced asphalt mixes and its suitability to Kerala condition.

NATPAC attempted to study the trend of urbanization by analysing the pattern of urban growth from 1995 to present to predict the urban growth till 2030. Inland Water Transport is a safe, multifunctional, reliable, economical and environmentally friendly mode of transport with still untapped capacities and potentials for growth. NATPAC estimated the carbon credit for in-land water transport in NW-3 and it was observed that the cargo movement through inland waterways is technically as well as financially feasible. Inland water transportation is better than road transportation on the basis of pollution caused and much environmental cost can be saved while using the inland water transportation. The Centre addressed the issues related to Water Transportation such as transportation of dangerous goods, environmental, inter-modal, logistics and statistical issues.

The Traffic Safety Division of NATPAC is dedicated to reduce the deaths, serious injuries, and economic losses associated with motor vehicle crashes in the State. The Centre is conducting behavioral modification programs to advance the safety and welfare of the travelling public. We are promoting road safety action in key areas including education, technology, research and innovation. This provides a new approach to road safety, encouraging community support and collaboration with road safety agencies. Our work on traffic safety initiatives and programmes are designed to encourage safety behaviours and promote safe driving. Road Safety Education through Schools in Kerala, Safe Community Programme for Panchayaths, Road Safety Training Programme for Ambulance Drivers, Driving School Instructors and General Public, Road Safety Youth Leadership Programme, Safe Road to School etc., were the cornerstone of NATPAC's battle to reduce serious injuries and fatalities on roads. 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 students of various research institutions and universities.

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 Public Works have been a 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. I believe the energy and enthusiasm of our Staff will firmly establish NATPAC among the pioneers of Traffic and Transportation Sector. We are determined that our voice will be heard, our ideas will be received and the impact of our contributions to society will be fully realized. We still have a long way to go and I hope this report demonstrates that this institution is making good progress. '***All growth depends upon activity. There is no development physically or intellectually without effort, and effort means work'.***

Dr.B G Sreedevi

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SUMMARY OF PROJECTS

1. Traffic Solutions for Technopark – NH Access

Thiruvananthapuram Technopark, the largest information technology park in India, contributes considerable amount of traffic on NH 66 Bypass road. The traffic is expected to grow in the upcoming years with the commissioning of all the three phases of Technopark. The generated traffic from Technopark during peak hours and through traffic on NH 66 Bypass will cause severe traf ic congestion on the road stretch from Kazhakkoottam and Thampuran Nada. Electronics Technology Park, Kerala entrusted NATPAC to suggest possible solutions for easing the traffic considering the formation of entries to the NH 66 Bypass.

Once the Technopark becomes fully functional, it is expected to have 10 entries/exits on NH 66 Bypass. It was observed that, during morning and evening peak hours, NH Bypass road near main entry/exit of Technopark is experiencing severe traffic congestion. The traffic from the expected entry/exit points will further deteriorate the traffic scenario in this stretch.

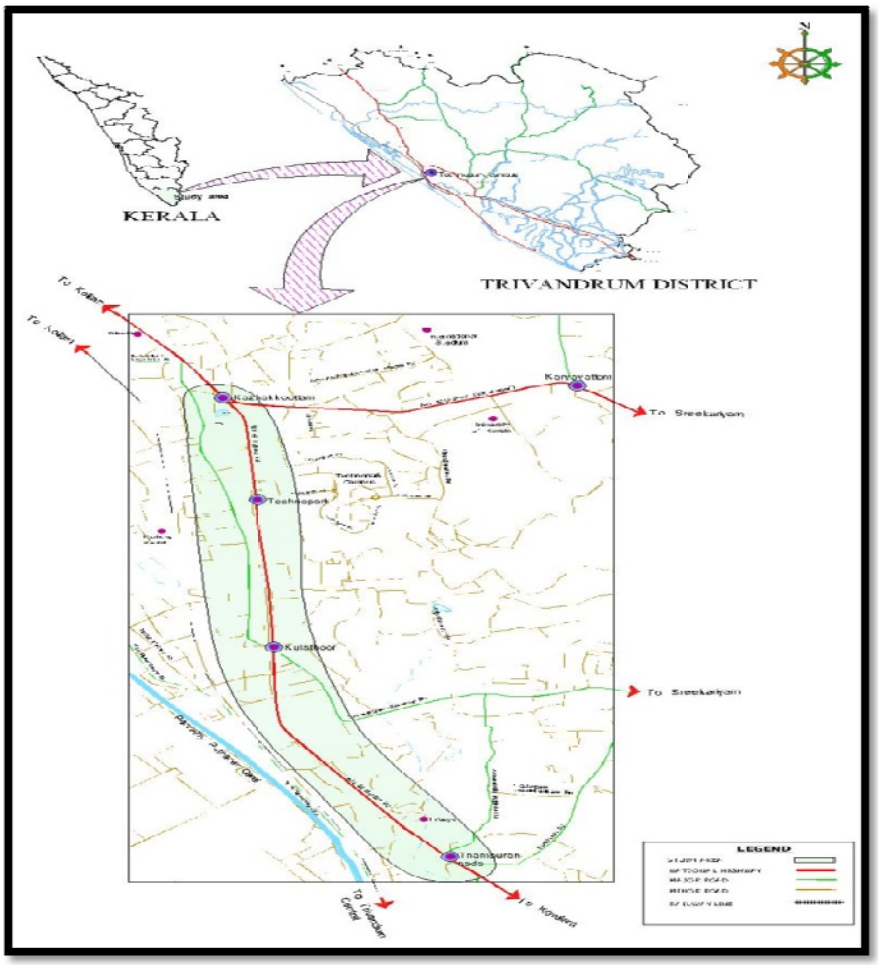


Figure 1: Study Area Map of Technopark

On the NH 66 bypass road section, maximum daily traffic was to the tune of 47,037 Passenger Car Unit (PCU) between Technopark and Thrippadappuram intersection, followed by 46,369 PCU between Thampuran Nada intersection and Akkulam. On NH-66 stretch, a maximum traffic of over 60,000 PCU was observed at Kazhakoottam to Pallippuram stretch and more than 31,000 PCU was observed at Kazhakkoottam - Kariavattom stretch. The maximum traffic during peak hour on the study stretch was observed at Technopark phase I campus intersection followed by Kazhakkoottam and Kulathoor intersections. All the road sections in the study stretch on NH Bypass road are operating with nearly three times more than its capacity during the base year itself.

30% of the trip makers inside the Technopark Campus use two wheelers while 26% use car and bus as their mode of travel. Among the proposed entry/exit points, estimated traffic volume during peak hour observed at Technopark main gate entrance was in the order of about 2,400 PCUs. TCS entry in SEZ zone (near Technopark main entry) caters traffic volume of 4,000 PCUs during peak hour. Proposed entry/exit point to Infosys campus attracts traffic volume around 5,000 PCUs during peak hour. Anticipated peak hour traffic from UST Global campus (Exit 2) and Phase III SEZ (Exit 3) is estimated to be around 3,600 and 3,400 PCUs respectively. The generated traffic from all phases of Technopark will directly flow to NH bypass through the proposed ten entry/exit points.

Future levels of traffic on road stretches in the study area were estimated for different horizon years. It was seen that the existing road network would not be able to handle the traffic in the horizon years without upgradation of the current transport infrastructure facilities. More number of entry points creates more junctions in the highway, which affects the safety and speed of traffic flow in the main stream. Hence limiting the entry points by developing internal roads, which connects all the three phases of Technopark and providing two or three well designed access at proper locations to the highway is the best solution while considering the heavy traffic flow on the NH Bypass.

Among the six intersections surveyed, maximum number of vehicles are using the Kazhakoottam intersection. The road links, intersecting at Kazhakoottam junction (Kazhakoottam-Technopark link, Kazhakoottam-Market road, Kazhakoottam- Kollam road and Kazhakoottam-Ulloor road) are carrying traffic loads more than its capacity and exert maximum conflicts. Therefore, by considering the IRC: SP:84-2009 recommendations, provision of a flyover at Kazhakoottam will be more beneficial as long-term traffic management strategy. Considering the estimated traffic

from Technopark phase I campus, a fly over is required at the existing main gate point also. Accordingly, a six-lane elevated road from Kazhakoottam to Technopark of length 2 km with at-grade service road on either side has been proposed. Two lane service roads are proposed for the entire stretch while a three lane service road is proposed under the first flyover. At-grade median openings are proposed at entry and exit points of proposed bus terminals, entry/ exit of phase I campus and entry/exit of TCS campus. An opening from service road to main carriageway is proposed at two locations.

While considering the future traffic from the Technopark phase III campus to Kulathoor junction on NH bypass, a flyover is required to cater the through traffic. Correspondingly a six-lane flyover at Kulathoor road intersection with a total length of 700m (including approach), with two-lane service road at-grade on either sides has been proposed. The proposed flyover at Kulathoor starts 320m ahead of Kulathoor junction on NH 66 Bypass. Traffic from commercial zone and SEZ of Phase III development should use the service road. Four - lane divided carriageway with two-lane service road on either side is proposed from the end of the second flyover to Thampuran Nada Junction. Traffic from UST Global's campus and Infosys campus should use the service road and should merge with the NH at Thampuran Nada junction. At-grade junction improvements are required at Menamkulam road junction, Kazhakoottam Junction, Technopark Main entry junction, Kulathoor junction and Thampuran Nada junction. It is proposed that service roads on this road stretch may be regulated as one-way.

Appropriate transportation improvement measures are suggested to reduce the congestion and delay experienced between the Kazhakoottam to Thampuran Nada road stretch. The proposals can very well handle the traffic and cause minimum disturbance to the through traffic on the NH. Traffic from the ten exits from the Technopark Campus is very well accommodated to merge with the NH traffic with least disturbance. For long run benefits, i.e. in order to accommodate sufficient traffic, it is proposed to strengthen and widen the roads passing near the boundary of Technopark mainly Arasamoodu - Kuzhivila road and Kariavattom- Thrippadapuram road.

2. Strategic Transit Oriented Development Plan for Kochi

Transit Oriented Development (TOD) is generally defined as a compact, mixed use high density development near transit facilities with high-quality walking environments. TOD is a mixed-use residential and commercial area designed to maximize access to public transport, and often incorporates features to encourage transit ridership. A TOD neighborhood typically has a center with a transit station or stop (train station, metro station, or bus stop), surrounded by relatively high-density development with spreading outward from the center.

TOD encourages transit supportive land use with the intent to provide more balanced transportation choices so that travel by transit or active transportation (eg. walking, cycling, etc.) can be a more viable option than driving. The overall goal of TOD is to encourage development with specific forms and features that facilitates easier access to transit and create attractive pedestrian-focused areas rich in amenities and providing a mixture of use.

The Strategic Transit Oriented Development Plan for Kochi identifies and illustrates the TOD principles, discusses and defines their applicability in Kochi on the identified Metro Transit Oriented Corridor. The plan complements the existing city character in terms of the basic identity of a station area. The plan also develops further on the existing city land use policies and regulations and also provides further guidance on implementing the revised land use policies and zoning.

Principles for Kochi TOD

To support the vision for Kochi TOD, a total of eight parameters are identified.

i) *Diversity* -When there is a mix of complementary uses and activities within a local area (eg., a mix of residences, workplaces and local retail commerce), many daily trips can remain short and walkable. Two key principles for diversity are provision of a balanced mix of land uses and a balanced mix of resident income levels.

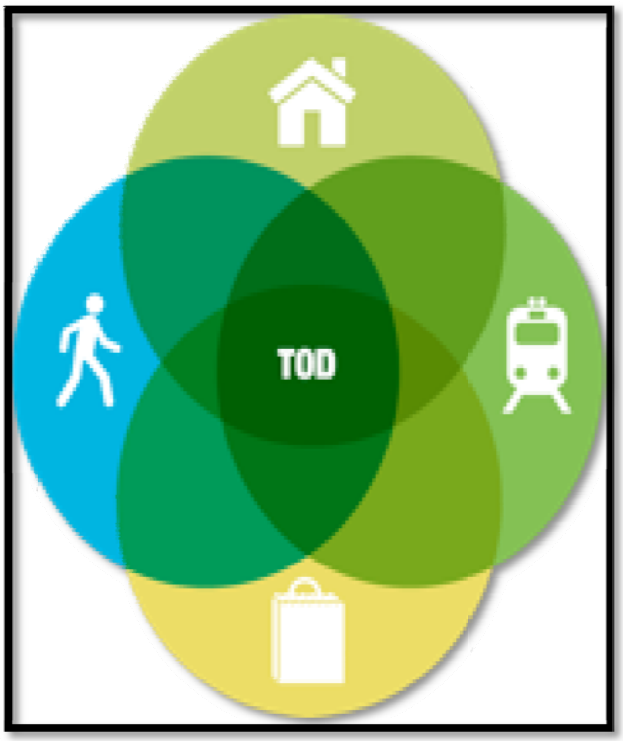


Figure: 2
Integral components of TOD - Walking, Transit, Work and Residence

ii) *Density* -To absorb urban growth in compact and dense forms, urban areas must grow vertically.

iii) *Compactness* -The basic organizational principle of dense urban development is compact development. In a compact city, the various activities and uses are conveniently located close together, minimizing the time and energy required to reach them and maximizing the potential for interaction.

iv) *Walkability* -Walking is the most natural, affordable, healthy, and clean mode of travel for short distances and a necessary component of a majority of transit trips. The key factors to make walking appealing are: safety, activity and comfort.

v) *Cyclability* -Cycling is an emission-free, healthy, and affordable transport option that is highly efficient and consumes little space and few resources.

vi) *Connectivity* -Short and direct pedestrian and cycling routes require highly connected networks of paths and streets around small, permeable blocks. A tight network of paths and streets offering multiple routes to many destinations can also make walking and cycling trips varied and enjoyable. Frequent street corners and narrower right of ways with slow vehicular speed and may encourage many pedestrians in street activity and local commerce.

vii) *Reliable Public Transport Network & Multi-Modal Integration*-Access and proximity to high-capacity public transit service is a prerequisite for TOD. Integration of mass transit with city bus system, and extended to NMT modes such as E-rickshaws, bicycles as well as IPT not only ensure first and last mile connectivity but also seamless transfer of network user.

viii) *Shift in the Urban Scape*-When cities are shaped by the above seven principles, personal motor vehicles become largely unnecessary in day-to-day life. Walking, cycling and the use of high-capacity transit are easy and convenient, and can be supplemented by a variety of intermediary transit modes.

Approach towards TOD Strategies

Based on the principles of planning, several strategies and guidelines are suggested for effective implementation of TOD on ground. The 22 metro stations located in varied environs across the city are identified. As per the Ministry of Urban Development (MoUD) Guidelines, integration of mass transit with feeders and Non-Motorised Transport (NMT) is essential for a successful TOD. NMT includes bicycle and walking share of the modes.

The guidelines include:

- Ensure sidewalks accessible to all and allow ease of movement
- Create safe and inviting places for pedestrians

- Plan for pedestrians when planning transit stations and new developments
- Network of cycle tracks connecting metro stations with all major uses in the station area
- Safe and segregated from fast vehicular movement
- Shelters for all weather conditions
- Integrated bike parking with metro stations
- Design guidelines need to be developed enabling inclusion of the mode even in constrained environment
- In congested areas and areas with narrow access widths it is recommended to create common pedestrian cum cycle paths.

It is important to integrate the metro system with other key modes in order to provide first and last mile connectivity. Bus is an important and integral mode of transport for commuters and it is suggested that a good bus system and Integrated Public Transport (IPT) network be integrated with the metro system. Another key factor to be considered is managing the high parking demand by providing shared public parking facilities and parking for Metro Stations. All parking facilities provided in public provision should be limited in supply and at premium pricing. An organized multi-modal integration is an important factor to be addressed. It is envisaged to develop Vytilla as a multi-modal hub.

Figure 3: Characteristics of multi-modal integration

The Kochi Metro Corridors as identified by DMRC and currently under execution as Phase I of Kochi Metro runs from Aluva to Petta. The 22 stations are Aluva, Pulinchodu, Companypady, Ambattukavu, Muttom, Kalamassery, CUSAT, Pathadipalam, Edapally, Changampuzha Park, Palarivattom, JLN Stadium, Lissie, Kaloor, MG Road, Maharajas College, Ernakulam South, Kadavanthra, Elamkulam, Vytilla, Thykoodam and Petta. Based on the studies conducted and guidelines proposed, additional street network for each of the 22 stations have been identified and classified according to the functional category and carriageway widths. An additional

network of 53.70 km is proposed to be increased to improve the traffic flows and direct connectivity to the stations. The proposed street network envisaged to come into existence by the year 2034, shall redefine the traffic movement in Kochi city including the trips by the metro system. In order to increase the accessibility of inner areas to the main transit corridor, additional street network links have been provided.

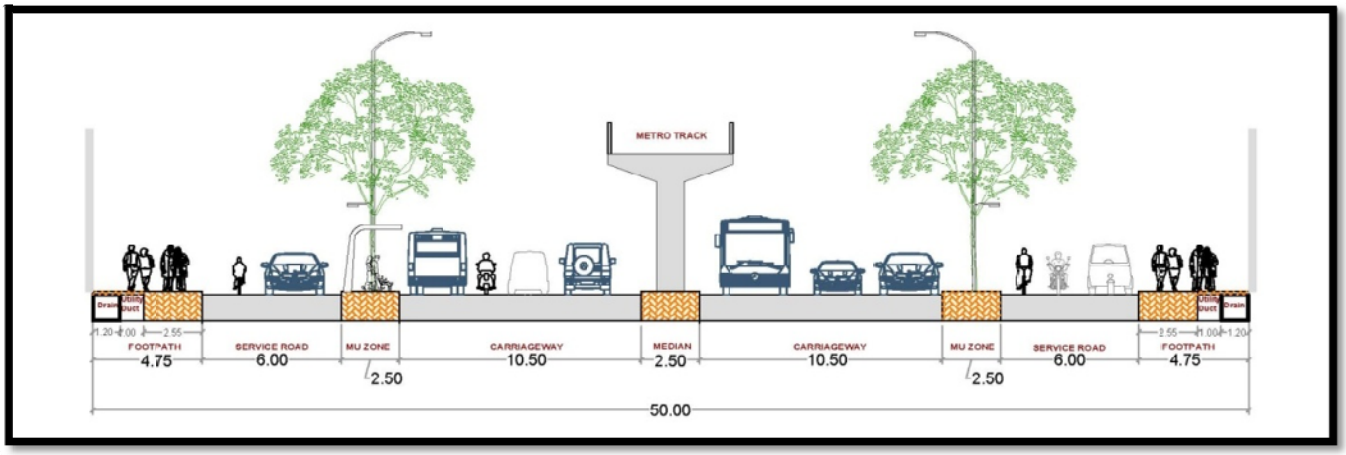


Figure 4: Proposed Cross Section of an Urban Expressway with RoW of 40 m (bituminous)

3. Short Term Improvement Plan for Chinnakkada, Kollam

The construction of vehicular underpass at Chinnakkada junction in Kollam was progressing well and suitable improvement plan was to be formulated so as to have a minimum conflict to the road users once the construction is over and the traffic becomes operational in full. The Rail Over Bridge (ROB) as well as the approach road pertaining to the NH were being constructed with two lane carriageway width only. This in-turn will create congestion considering the substantial traffic along the NH. Also, the approach road ends very near to the Chinnakkada roundabout and will become a seven armed junction with two of them being one-way.

NATPAC officials visited the site and held discussions regarding arious me sures to be taken up with regard to the underpass as well as construction of approach road to the Rail Over Bridge (ROB). Some interim suggestions were put forward by NATPAC.

1. A lateral clearance of 50 cm has to be provided on either sides of the Reinforced Earth (RE) wall and this has to be facilitated by means of a curb.

2. The beach road has to be provided with a minimum of 5.5 m effective carriageway. This will ensure movement of vehicles in two parallel lanes in a controlled way, one towards Alappuzha direction and the other towards Kottarakkara. The traffic to Alappuzha direction can have a free left movement, while the movement of traffic towards Kottarakkara will have to be controlled by signal.

3. Covered drains with a width of 1.8 m to act as footpath has to be provided in the beach road. The pedestrian lateral movement is considerably high along this road and the width proposed is the minimum as per IRC standards.

4. The underpass arm from Chinnakkada round is to be made with an effective carriageway of seven metres. Side drain as well as footpath has to be provided to this arm with a width of 1.8 m.

5. A separator in the form of a 20cm wide median will have to be given to segregate the traffic from beach road and NH.

6. A central median, as an extension of the channeliser has been proposed to the approach road for a length of 16.5 m to segregate the up and down traffic along the NH.

7. The space allocated for utility provision portion will have to be merged with the carriageway of NH once the same is taken underground.

8. The market road has to be regulated as one way.

Pedestrian movement has to be restricted beyond the location of proposed stairs to the beach road and railway station road from approach road. Signal redesigning will have to be done after determining the volume of turning movement in the intersection. Highway traffic to Alappuzha/Kottarakkara direction and the traffic from beach road to Kottarakkara are to be separated, lest traffic accidents may take place.

Detailed Traffic Operation Plan has to be prepared for Kollam City with comprehensive field data collection and analysis. The traffic situation, especially at Chinnakkada is likely to worsen once the fly over becomes operational. Improvements are required at the underpass junction

with the level cross road and other junctions ahead. Based on the base map submitted by Kerala Sustainable Urban Development Project (KSUDP), a design has been formulated for Chinnakkada junction with the foresight of providing a better level of service to the junction traffic.

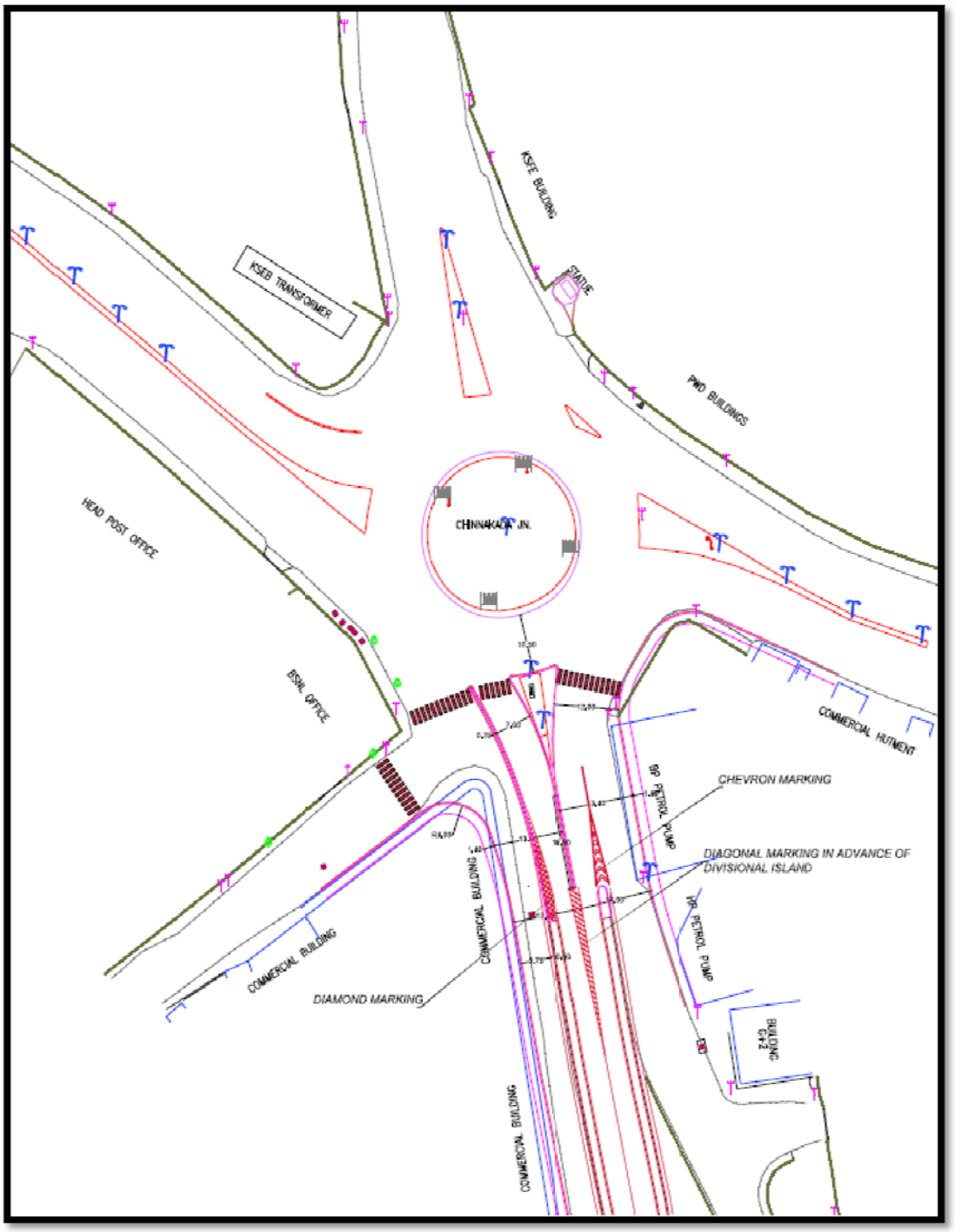


Figure 5: Improvement Plan for Chinnakkada Junction, Kollam

4. Accessibility Analysis for Thiruvananthapuram Urban Area

Accessibility refers to the opportunity that an individual at a given location possesses to take part in a particular activity or set of activities. It helps to evaluate the potential impacts of transportation projects, track changes in accessibility over time, and unite the effects of land use and the transportation system.

The study measured the accessibility for Thiruvananthapuram taking into consideration of the socio-economic factors and travel pattern and suggest how it can be made beneficial in the planning process of Thiruvananthapuram urban area.

For assessment of accessibility to employment opportunities a Hansen measure has been adopted. The approach of this type of measure is that the opportunities available in each zone are discounted (or reduced) according to the difficulty of reaching that zone. In the present study, the normalized version of Hansen's Index by giving weights is used:

$$A_i = \frac{\sum_j O_j f(C_{ij})}{\sum_j O_j}$$

- Where, A_i is Hansen's Index
- O_j is employment opportunities available
- $f(C_{ij})$ is the impedance function representing the separation between i and j, $f(C_{ij}) = \frac{1}{X_{ij}}$
- X_{ij} is the impedance offered between i and j

The accessibility to employment opportunities by personalized mode (two wheeler and car) and public transport was calculated for each ward in the study area. The centroidal distances between the wards are calculated using Network Analyst tool in Arc GIS software.

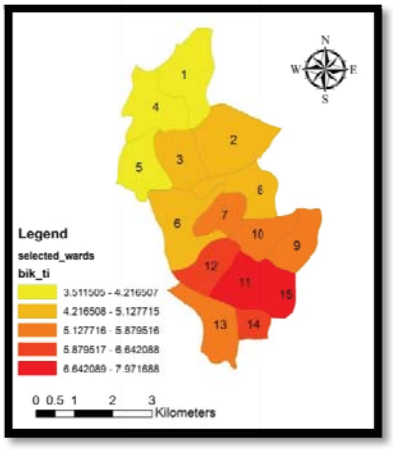


Figure 6
Accessibility to zones by two wheelers

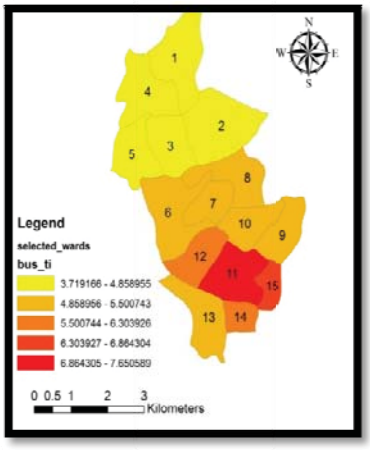


Figure 7
Accessibility by Public Transport

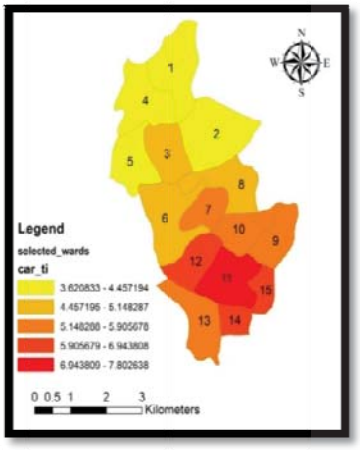


Figure 8
Accessibility by Car

By using Arc GIS Network Analyst, the service areas around any location on a network can be found out. A network service area is a region that encompasses all accessible streets (that is, streets that are within specified impedance). For example, the 5-minute service area for a point on a network includes all the streets that can be reached within five minutes from that point. The service areas created by Network Analyst also helps in evaluating accessibility. After creating the service area, the employment opportunities available within the service area covered by each mode is calculated. The service area covered by two wheeler, car and public transport is different as the impedance offered by these modes is different.

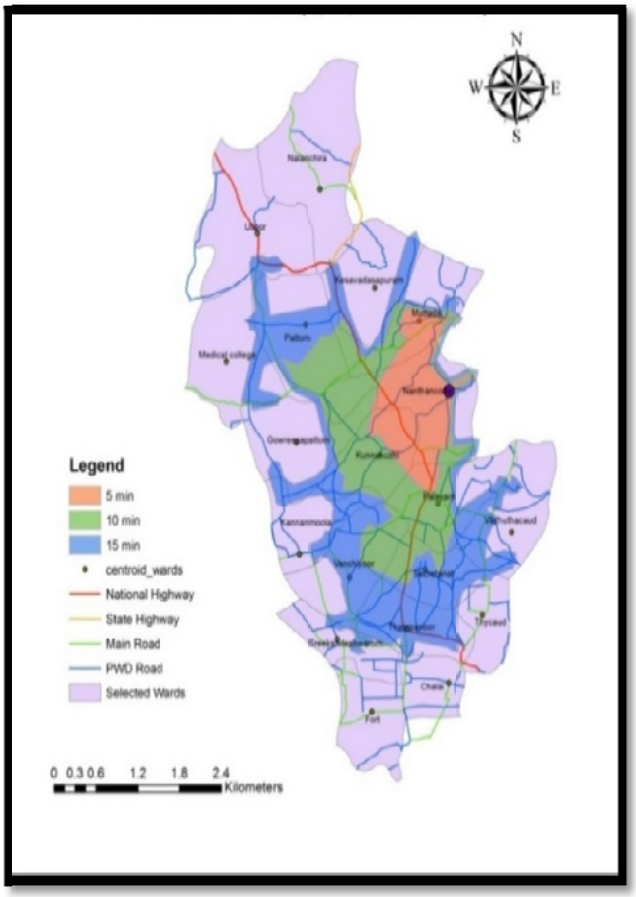


Figure 9
Service Area covered from Nandancod Ward by Car

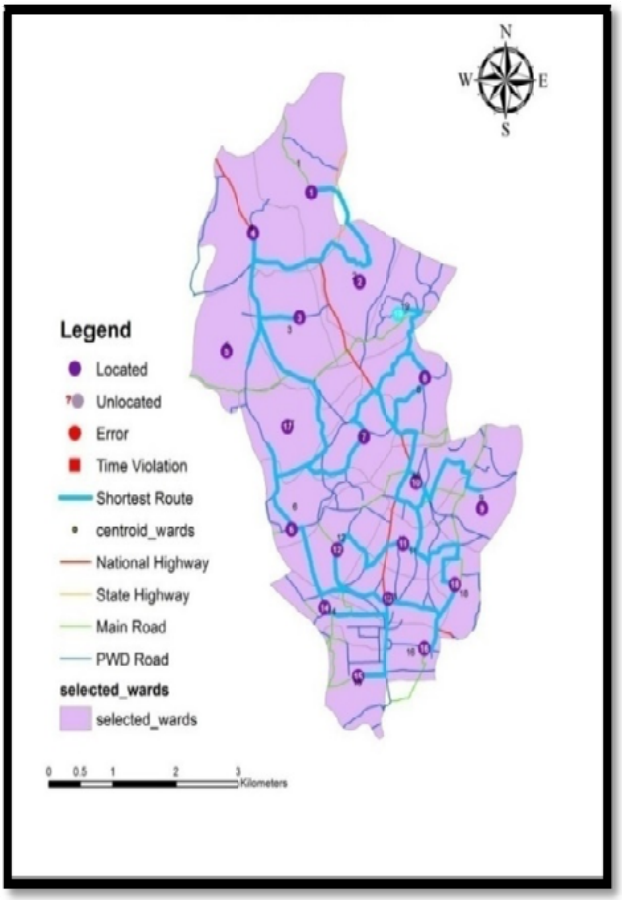


Figure 10
Shortest Route between the Centroids of Each Ward

It has been observed that accessibility to opportunities is governed mainly by land use pattern and the transportation facilities available in the area. The accessibility is high in the city centre and as the distance increases, level of accessibility decreases. Accessibility was found to be highest for two wheelers followed by car and was least for bus. Thampanoor, Palayam and Chalai wards has the highest level of accessibility to employment opportunities.

5. Suitability of Land Development in KINFRA Industrial Park, Adoor

Kerala Industrial Infrastructure Development Corporation, KINFRA has acquired some land to the tune of 85.34 acres near to Enadimangalam in Adoor. The proposed industrial park is located in between mid-land and high-land region. The elevation of the area varies across its terrain, the levels ranging from 96.795 to 208.637 m. This has posed difficulties in providing effective connectivity across the park. The current physical situation of the park implies that new development activities are difficult.

NATPAC identified the developable and undevelopable areas in the park based on gradient and levels criteria. It has been found that the gradient variation is sharp and even rises to the tune of 80m vertical in a distance of 340m, making the gradient as 1 in 4. Fixing a road alignment in such a terrain is a herculean task and will have to be accomplished with the provision of hair pin bends and embankments constructed up to heights of 10 to 15m.

The entire area of KINFRA Park is divided into 18 plots and is classified into developable and undevelopable land based on the level difference and the gradient. The developable lands are those which can be given connectivity with little difficulty, whereas undevelopable lands require huge investment for development. The plots A2, A3 and A15 are undevelopable due to the high variation of levels and the task of providing the road connectivity to the above plots are huge cost consuming. Though there is a level difference of 43 m in Plot A16, the area has been demarcated as developable, since the total extent of the plot amounts to about 10 acres, and the level difference is spread over the total area leading to less developmental costs. There are roads already existing along the boundary of the said plot.

6. Traffic and Transportation Studies for Varkala and Attingal Towns in Thiruvananthapuram District

At the instance of Town and Country Planning Department, GoK, National Transportation Planning and Research Centre (NATPAC) carried out Traffic and Transportation Study for Varkala and Attingal towns in Kerala.

Scope and Objectives of the Study

The purpose of the study is to compile the base line data, and to summarize the findings and recommendations of Transportation Sectoral Plan for incorporation into the Development Plan of the Towns.

(i) Assess the condition of road network and to identify the traffic bottlenecks and physical constraints.

(ii) Identify the existing street architecture and traffic control systems in the town.

(iii) Study the traffic volumes on selected roads and intersections, and to assess the extent of short fall of the road system.

(iv) Assess pedestrian flow along and across road stretch and intersections.

(v) Study origin and destination characteristics of the traffic passing through the town and quantify the extent of bypassable traffic and the scope for developing a bypass route for the town.

(vi) Study the characteristics of public transport users and also Intermediate Public Transport (IPT) users in the study region.

(vii) Estimate the traffic demand for the horizon year and formulate a road development plan keeping the growth potential of the town in mind, making optimum trade-off between "land use driven transportation network" and "transportation network driven land use".

Varkala Town

Varkala town has a geographical area of 4.87 sq.km with a population of 40,048 as per 2001 India census. The density of population works out to 2,693 persons per sq km. Major roads in the town are Varkala-Kallambalam road, Varkala – Edava road via Janardhanapuram, Varkala –

Edava road via Punnamoodu, Varkala – Parippally road (State Highway No. 64) and Varkala – Kadakkavoor road.

Traffic volume at major intersections: Maidanam Puthenchantha Junction witnessed the maximum peak hour traffic volume of 2,817 Passenger Car Unit (PCU) followed by 1,095 PCU at Punnamoodu Junction and 1,040 at Srinivasapuram Junction.

Parking: Most of the parking in Varkala Town was found to be in the railway station area, Puthenchantha – Kallambalam road and Janardhanapuram – Beach road. Majority of the vehicles were found to be parked for short duration of less than 30 minutes.

Inter-city passenger traffic: About 1.5 lakh passenger trips were performed in the study region on a reference day. Major traffic generating zone within the study region was the Central Business District (CBD) area with 44,912 trips.

Inter-city goods transportation: 3,453 goods carriers transported goods to and from the study region on a day with a quantum of 3,364T.

Traffic projection: The projected traffic on the existing road network within the CBD area implies that the existing road network is able to handle the traffic in the horizon years without upgradation of the transport infrastructure facilities.

Road development plan for Varkala town: The road development plan envisages hierarchical pattern of road network conforming to the following categories of road system.

(i) Primary distributor road
(ii) Secondary distributor road
(iii) Tertiary road
(iv) Local road

Apart from the road development plan, improvement plan for bus transport system, parking and pedestrian infrastructure were also proposed by NATPAC.

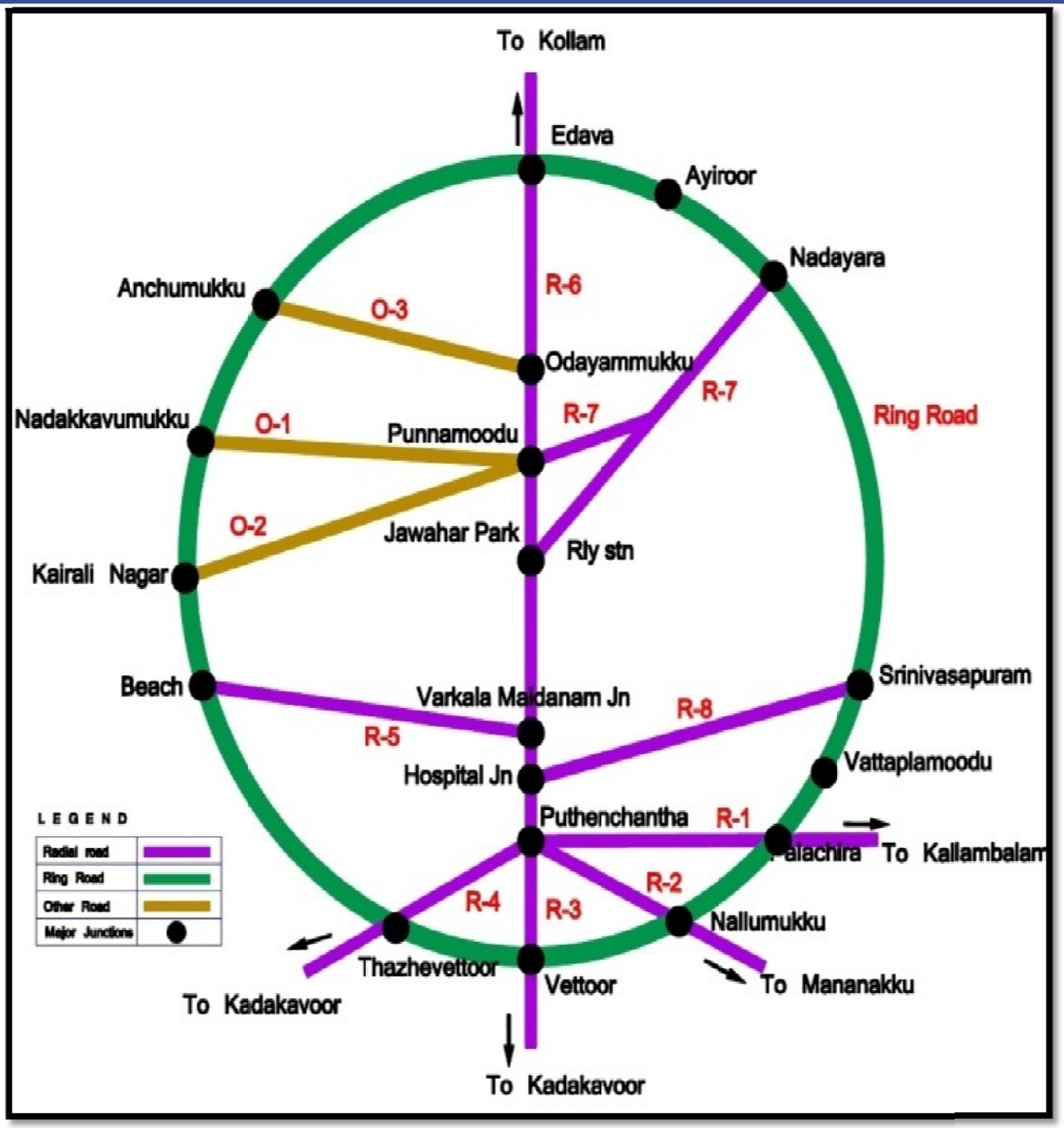


Figure 11: Conceptual Road Development Plan for Varkala Town

Proposal for Tourist highway along the coast

There is a proposal for a tourist highway between Thiruvananthapuram and Kollam is proposed along the coastal area. It starts from Thiruvallam and passes through Beemapally Mosque, Valiyathura Palam, Thiruvananthapuram Domestic Airport, Shangumugam Beach, Vettukkadu Church, Veli Tourist Village, Murukkumpuzha Kayal, Ponnumthuruthu Island, Pulimoottil Kadavu, Anchuthengu, Puthiyapalam, Thazhavettoor, Janardhana Swamy Temple, Papanasam Beach, Varkala Cliff, Priyadarshini Boat Club near Edava, Paravoor Kayal, Kollam Beach and ends at Kollam Boat Jetty.

The proposed tourist highway alignment is shown in **Figure 12.**

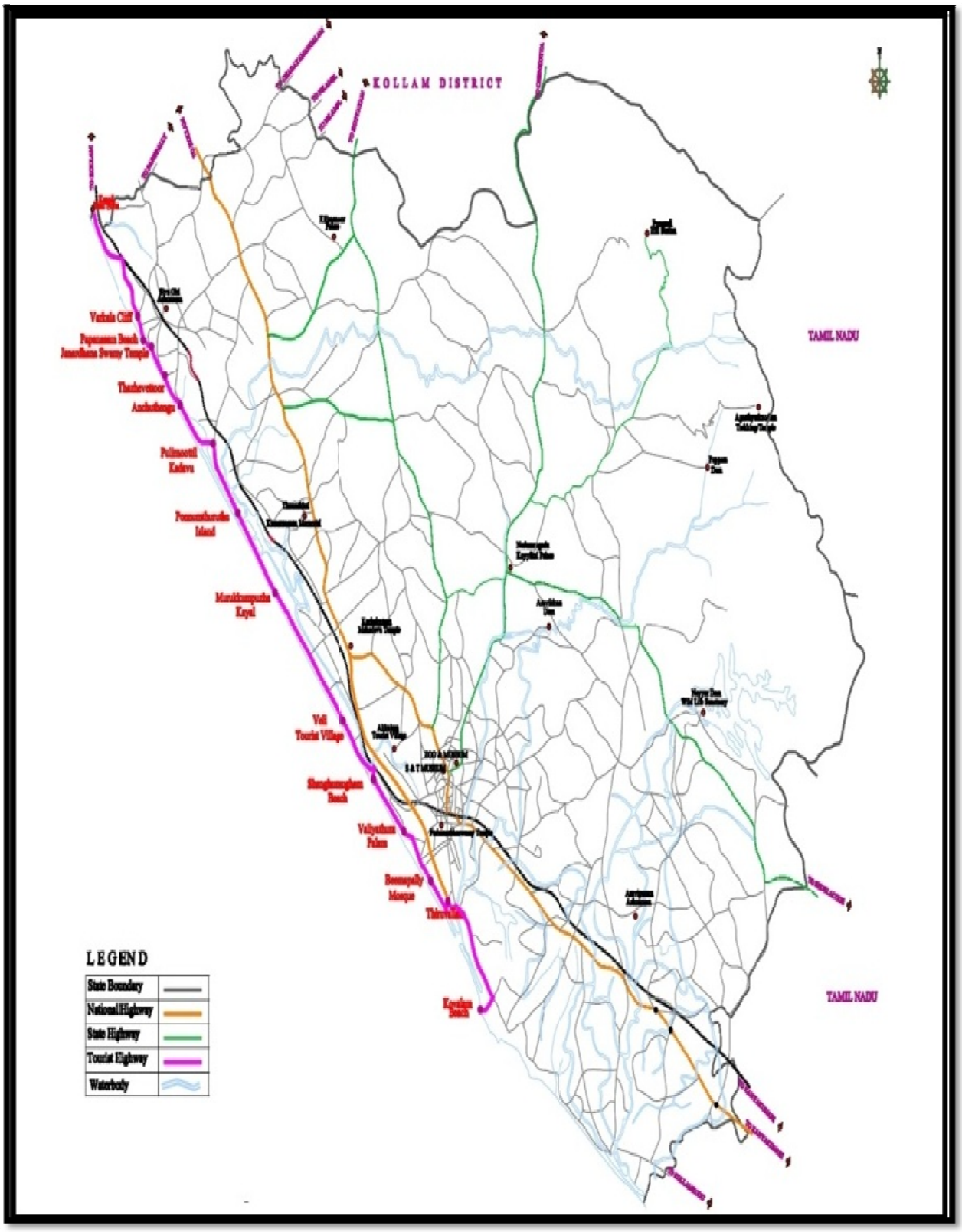


Figure 12: Proposed Tourist Highway Alignment for Varkala Town

Attingal Town

Attingal town is spread over an area of 16.87 sq km with a population of 37,346 as per 2001 census.

Traffic volume at major intersections: Kacheri intersection witnessed the maximum peak hour traffic volume of 4,401 Passenger Car Unit (PCU) followed by 4,311 PCU at Moonumukku Junction. KSRTC Bus Station, Market road and Alamcode intersection witnessed peak hour traffic flow between 3,000 PCU to 4,000 PCU. At other intersections, the traffic volume was less than 2,000 PCU.

Parking: Most of the parking in Attingal was found to be in KSRTC bus stand area with 79 vehicles at a time. This was followed by CSI School Junction-Poovanpara road and Kachery junction – CSI school Junction road with 69 and 65 vehicles respectively. Majority of the vehicles parked were found to be for short duration of less than 30 minutes.

Inter-city passenger traffic: 2.9 Lakhs inter-city passenger trips were performed in the study region on a reference day. Trip pattern of Attingal town from OD study reveals that:Attingal Town area generated 1,11,853 trips (38%),Thiruvananthapuram region generated 1,64,354 trips (56%) and other district region generated 14,917 trips (5%).

Inter-city goods transportation: 6,701 goods carriers transported goods to and from the study region with a quantum of 44,378T, on a referred day.

Traffic projection: The projected traffic on the existing road network within the CBD area implies that the capacity of all road sections in NH-66 exceeded the design capacity in current year considerably.

Road development plan for Attingal town: The road development plan envisages hierarchical pattern of road network conforming to the following categories of road system.

(i) Primary distributor road
(ii) Secondary distributor road
(iii) Tertiary road
(iv) Local road

Apart from the road development plan, improvement plan for bus transport system, parking and pedestrian infrastructure were also proposed by NATPAC.

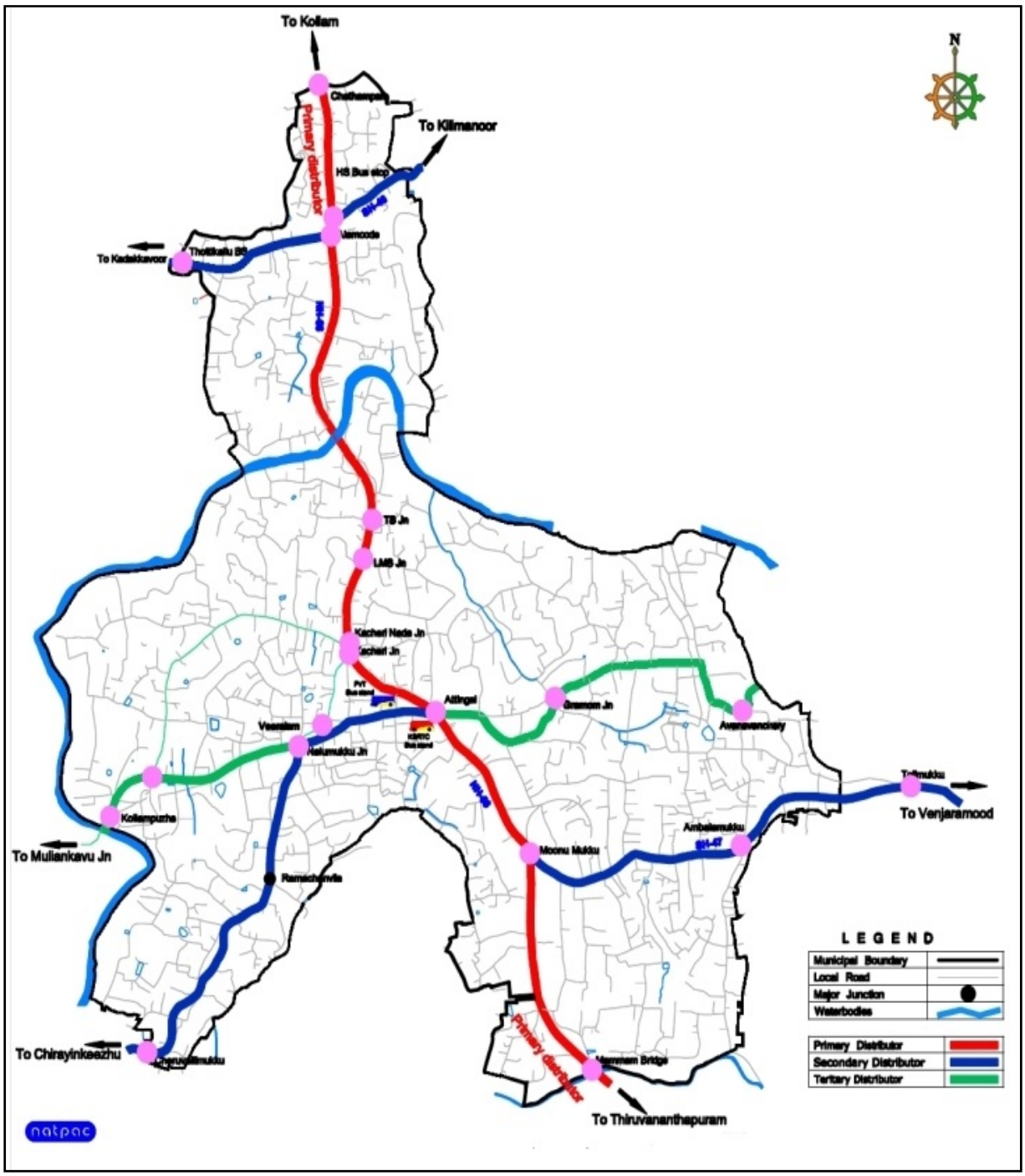


Figure 13: Conceptual Road Development Plan for Attingal Town

7. Traffic and Transportation Studies for Kuthuparamba Town in Kannur District

At the instance of Town and Country Planning Department, GoK, Kannur District, National Transportation Planning and Research Centre (NATPAC) carried out Traffic and Transportation Study for Kuthuparamba town .

Scope and Objectives of the Study

The purpose of the study is to compile the base line data, summary findings and recommendations of Transportation Sectoral Plan for incorporation into the Development Plan of the Town.

(i) Assess the condition of road network and to identify the traffic bottlenecks and physical constraints.

(ii) Identify the existing street architecture and traffic control systems in the town.

(iii) Study the traffic volumes on selected roads and intersections, and to assess the extent of short fall of the road system.

(iv) Assess pedestrian flow along and across road stretch and intersections.

(v) Study origin and destination characteristics of the traffic passing through the town and quantify the extent of bypassable traffic and the scope for developing a bypass route for the town.

(vi) Study the characteristics of public transport users and also Intermediate Public Transport (IPT) users in the study region.

(vii) Estimate the traffic demand for the horizon year and formulate a road development plan keeping the growth potential of the town in mind, making optimum trade-off between "land use driven transportation network" and "transportation network driven land use".

Kuthuparamba Municipal Town has a population of 32,408 with an area of 16.76 sq km.

Traffic volume at major intersections: The highest peak hour volume of 2,483 PCU was observed at Town Square Junction, followed by 2,263 PCU at Pookode Junction and 2,134 PCU at Palathumkara Junction.

Parking: Most of the parking activities in Kuthuparamba town were found to be along Maroli Town Square and Bus stand with 90 vehicles during peak time. Majority of the vehicles parked in parking corridors were found to be for short duration of less than 30 minutes. Pedestrian movements were observed to be high at Kuthuparamba Bus stand between 12 noon and 1 pm.

Modal split of Inter-city passenger traffic: About 1.8 lakhs inter-city passenger trips were performed in the study region on a reference day consisting of 91,845 bus passenger trips (51.07%), 22,733 car trips (12.64%), 19,417 auto trips (10.80%) and 12,377 two-wheeler trips (6.88%). There were 26% internal - external trips (Study region to outside study region), 30% external to internal trips and 45% external-external trips.

***Modal split of goods traffic**:* 3,108 goods vehicles passed through various outer cordon points in Kuthuparamba town, of which 417 were trucks, 1,900 mini-trucks and 791 goods autos. The quantum of goods handled by these goods vehicles was to the tune of 12,817tonnes.

Traffic Projection: Thalasserry-Coorg road is expected to carry double its designated capacity by the year 2030. In addition, Kannur road (between Town square junction and Purakalam) and Thrikkannapuram road will also exceed their capacity by 1.5 times.

Road development plan for Kuthuparamba town: The road development plan envisages hierarchical pattern of road network conforming to the following categories of road system.

(i) Primary distributor road
(ii) Secondary distributor road
(iii) Tertiary road
(iv) Local roads

Apart from the road development plan, improvement plan for intersections, bus transport system, parking and pedestrian infrastructure were also proposed by NATPAC.

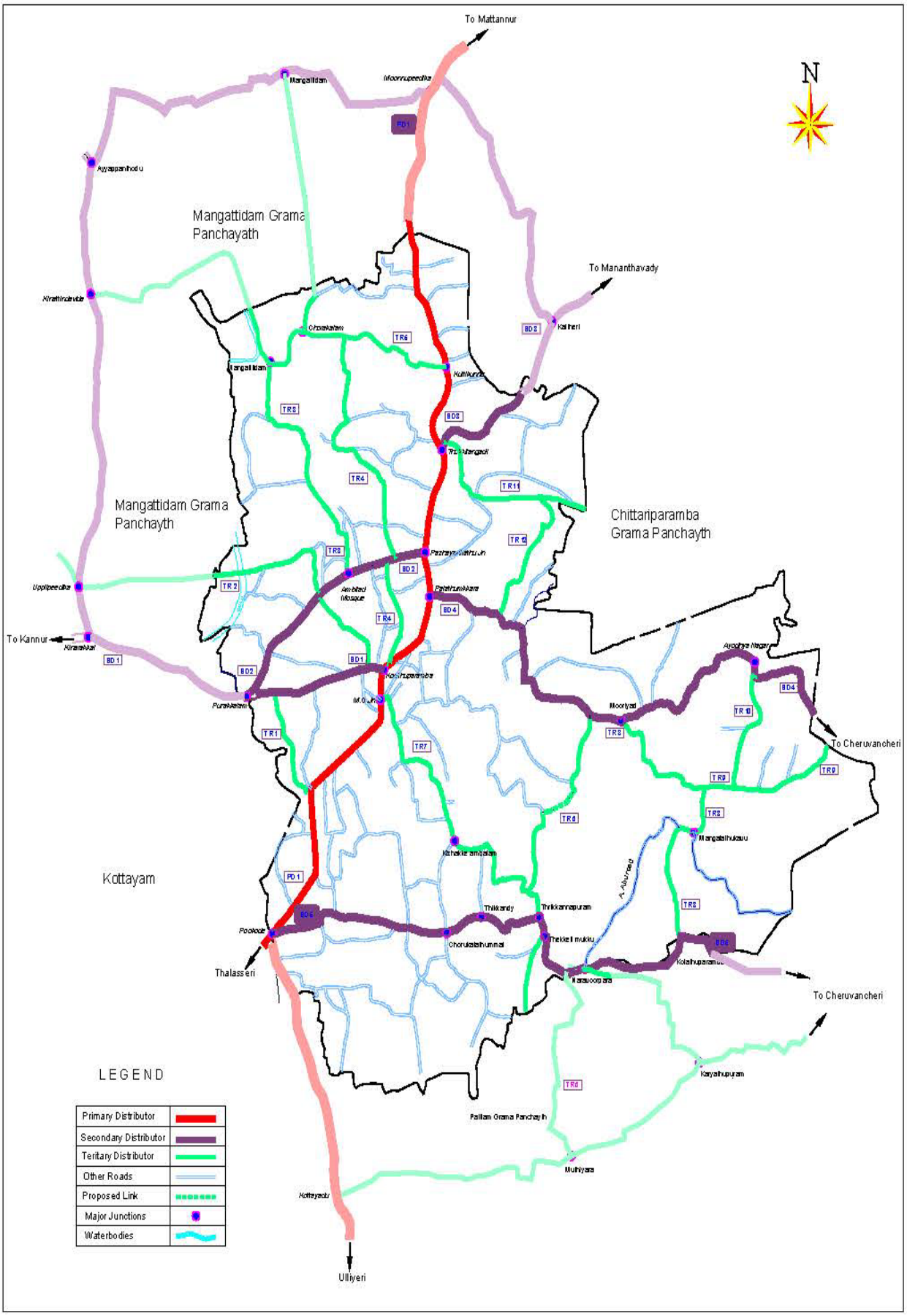


Figure 14: Proposed Road Network for Kuthuparamba Town

8. Measurement of Air Quality and Noise Level at Proposed IISER Campus, Vithura, Thiruvananthapuram District

The proposed permanent campus of Indian Institute of Science Education and Research, Thiruvananthapuram (IISER-TVM) is situated at 08º04'13" N latitude and 77º07'26"E longitude on the slopes of the mountain chains of Bonacaud in the southern part of the Western Ghats; at Kottamala popularly known as Kurusumala. IISER-TVM has obtained the necessary clearance from the Ministry of Environment and Forest (MoEF) for carrying out the construction at Vithura. So, it is necessary to monitor the pollution levels during construction.

Scope and Objectives

The aim of the study was to measure the concentration of air pollutants such as particulate matter, Nitrogen Dioxide (NO_2), Lead (Pb), Carbon Monoxide (CO) and Ammonia (NH_3) at five locations at the proposed IISER Campus as per CPCB guidelines with varying number of anthropogenic sources. The measurement was done in two seasons - Season I (September-November) and Season II (December-February). The Noise level at five locations during two seasons in and around IISER Campus was measured with the guidelines of International Electro Technical Commission (IEC).

To study the extent and effect of air pollutants and noise levels in the study area, five stations were identified by NATPAC in and around proposed IISER campus, Vithura. **(Table 1).**

Table 1 : Details of Sampling Station in IISER Campus

Sl.No	Sampling Station	Latitude	Longitude
1	Physical Science Building(Station I)	08º40'57" N	**77º08'05"E**
2	IISER Entrance (Station II)	08º40'44" N	**77º08'03"E**
3	Labour Colony (Station III)	08º40'42" N	**77º08'11"E**
4	Outside Campus (Station IV)	08º40'31" N	**77º08'11"E**
5	Main Plant (Station V)	08º40'54" N	77º08'05"E

Air Quality in and around IISER Campus

Under Ambient Air Quality (AAQ) monitoring, the criteria pollutants viz., Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM or PM_{10}), Sulphur dioxide (SO_2), Nitrogen dioxide (NO_2), Lead (Pb), Ammonia (NH_3) and Carbon Monoxide (CO) were measured as per Central Pollution Control Board guidelines. The summarized results of two seasons are given in **Table 2.**

Table 2 : Summarised Result of Air Quality in and around IISER campus

Station/ Pollutants	SPM ($\mu g/m^3$)	RSPM ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	Pb ($\mu g/m^3$)	NH_3 ($\mu g/m^3$)	CO ($\mu g/m^3$)
STATION I	53.22	40.99	12.36	21.73	0.0061	49.40	398.68
STATION II	53.71	36.24	11.29	16.43	0.0041	45.40	370.14
STATION III	44.79	29.04	10.56	13.55	0.0033	39.47	275.40
STATION IV	44.57	27.44	9.25	12.72	0.0033	45.30	350.50
STATION V	58.93	39.8	13.70	20.54	0.0060	55.23	458.69

Particulate Matter

The major sources of particulates are formed by mechanical disruption (eg: crushing, grinding etc), operation of mixture plant and the vehicular movement for carrying the concrete mixtures to the construction site. Other sources of fugitive dusts are from construction and demolition, and fly ash from fossil fuel combustion in the study area.

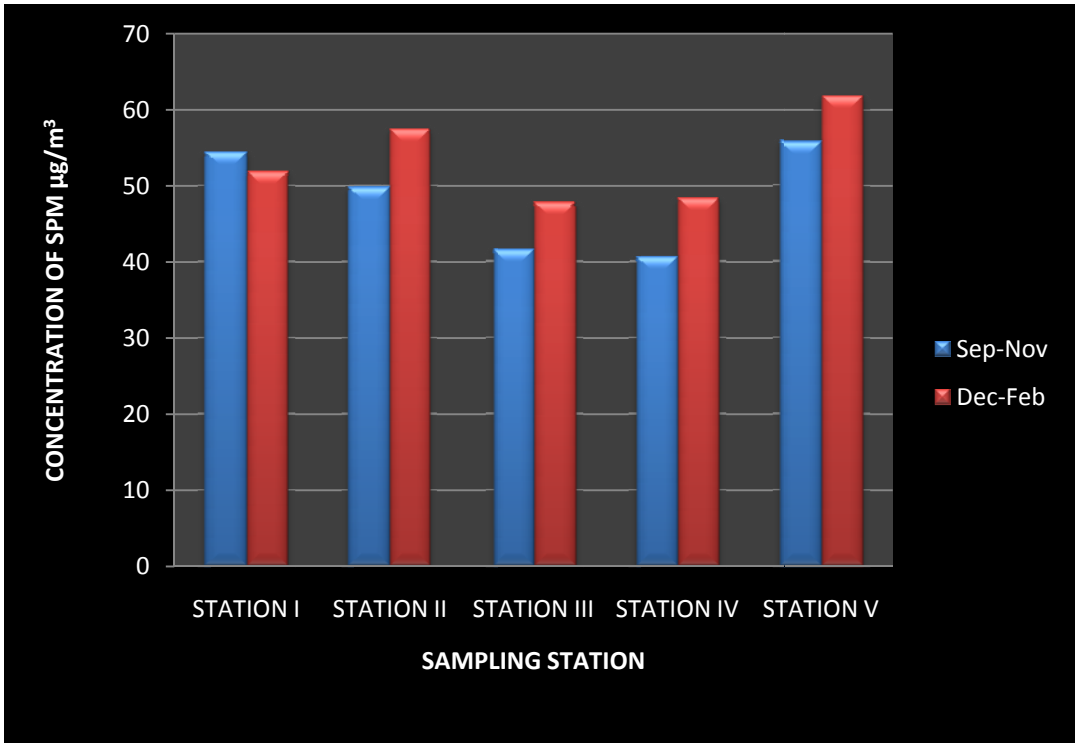


Figure 15: SPM concentration in IISER Campus

For controlling the air pollutants, the bag filter is attached with the mixture units at Station V. The average values at all sampling stations are found well within the permissible limits of Central Pollution Control Board (CPCB).

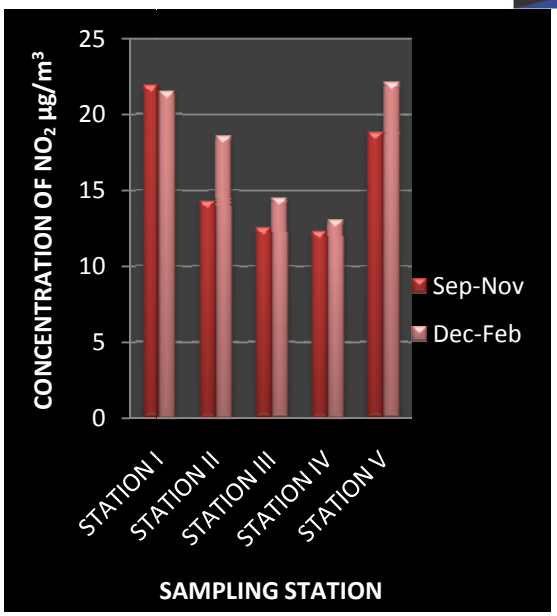


Figure 16: NO_2 Concentration in IISER Campus

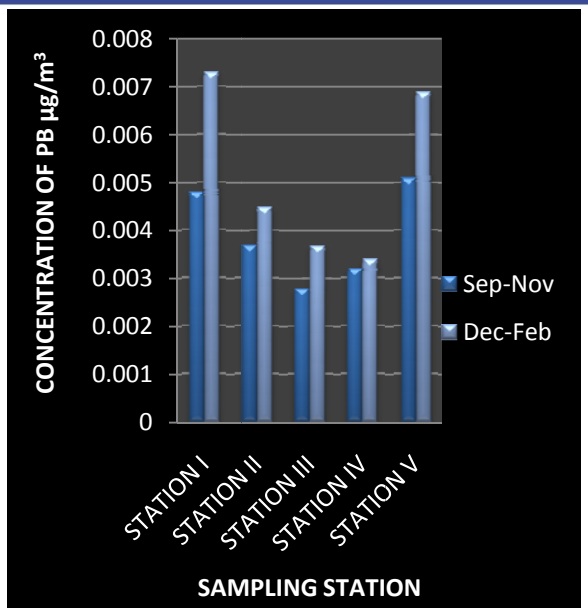


Figure 17: Pb Concentration in IISER Campus

Gaseous Matter

There were no exceedances of gaseous pollutants such as SO_2, NO_2, Pb, NH_3 and CO concentration with ambient air quality standards in all the stations. Stations I &V shows higher values because the vehicular emission, diesel generators and operation of mixture unit are having fewer amounts of gaseous pollutants.

Noise Levels

The major source of noise in the study area in the construction activity which includes operation of concrete mixture plant, vehicular movement, power generators etc. Decibel is the standard for measurement of noise. The ambient air quality with respect to noise level at five locations was measured and the observed values are given in Table 3.

Table 3 : Summarized Result of Noise Level

Station/Season	Sept-Nov	Dec-Feb
STATION I	45.45	48.73
STATION II	52.84	57.33
STATION III	42.22	50.28
STATION IV	47.81	52.51
STATION V	48.93	53.89

The day time average at Station I to V are 47.09 dB (A), 55.09 dB (A), 46.25 dB (A), 50.16 dB (A) and 51.41 dB (A) respectively. The average maximum noise level was observed at Station II i.e Main Entrance. It was caused due to human made activities like Sewage Treatment Plant, construction activity, vehicular movement, welding processes etc arouund the station.

9. Proposed Bus Station at Technopark, Thiruvananthapuram

Realizing the need for a well equipped bus terminal to offer adequate facilities for the commuters, Technopark has come forward with the proposal for transferring about 243 cents of land to Trivandrum Development Authority (TRIDA) adjacent to the NH Bypass in the Technopark phase-I campus for constructing a bus station. NATPAC was entrusted with the task of preparing a technical study report containing passenger demand assessment and suitable design for the bus terminal at the proposed location.

NATPAC assessed the existing traffic scenario of the area to establish the feasibility of bus station within the available land and also proposed adequate layout plan for the approaching roads and the bus station. The future travel demands arising out of the upcoming Phase II and III developments of Technopark and the mode shift from personalised modes has also been considered.

The methodology adopted for the study consisted of traffic volume surveys, passenger boarding alighting surveys, passenger opinion surveys, opinion surveys of Technopark Employees and collection of secondary data.

Findings

1,228 buses pass through the study area, consisting of 837 local services and 391 premium services. More than 18,000 commuters were handled at the major bus stops located in the influence area of the proposed bus station. During peak hours, more than 2,200 passengers either boarded or alighted at these bus stops. It was found that more than 1,100 passengers out of 2,200 passengers boarding or alighting at the bus stops had their first origin/ final destination within the influence area of bus station.

More than 42,300 people visited various campuses of Technopark in a normal working day. Future expansion of Technopark is expected to bring in additional 5,400 employees/visitors to the campus. Modal split of the employees and visitors was in favor of private vehicles with 46 percent, followed by 22 percent public transport users.

Passenger demand analysis for the proposed bus station considered three components namely (i) Existing demand (ii) Induced demand from modal shift of Technopark employees and visitors and (iii) future demand of expanded Technopark. Demand analysis is based on boarding/ alighting survey and opinion survey of bus passengers and Technopark employees and visitors. Induced demand is based on the notion that with the new bus station quite near the Technopark, 15% of Technopark employees/ visitors will shift from personal modes to bus transport. Accordingly, modal share of public transport is expected to increase from 22% to 25.8%. As per the demand analysis, a total

of 2,617 passengers in 85 trips are estimated to be handled by the new bus terminal as shown in **Table 4.**

Table 4 : Passengers estimated to be handled by the new Bus Terminal

No.	Component	No. of passengers	No. of bus trips
1	Existing demand	1,094	51
2	**Induced demand:** Shift from Technopark Phase I	826	18
3	**Future demand:** Additional passengers from Technopark expansion	697	15
	Total	**2,617**	**84**

For handling 84 bus trips in an hour, 14 bus bays are required on the assumption that one bus bay can handle six buses in an hour.

Based on the demand analysis, layout plans for the bus terminal have been proposed which considers reduction in pedestrian vehicle conflicts, smooth flow of buses, optimum utilization of land spaces, access to differently abled people and provision for non-motorized traffic. Five alternative layout plans have been prepared with bus bays, parking facilities for IPT modes and personalized vehicles, passenger waiting areas and amenities, crew resting areas, maintenance garage, pedestrian footpath and cycle track, commercial areas, fuel filling points and separate entry/exit to Technopark Phase I.

A typical design for bus terminal is shown in **Figure 18.**

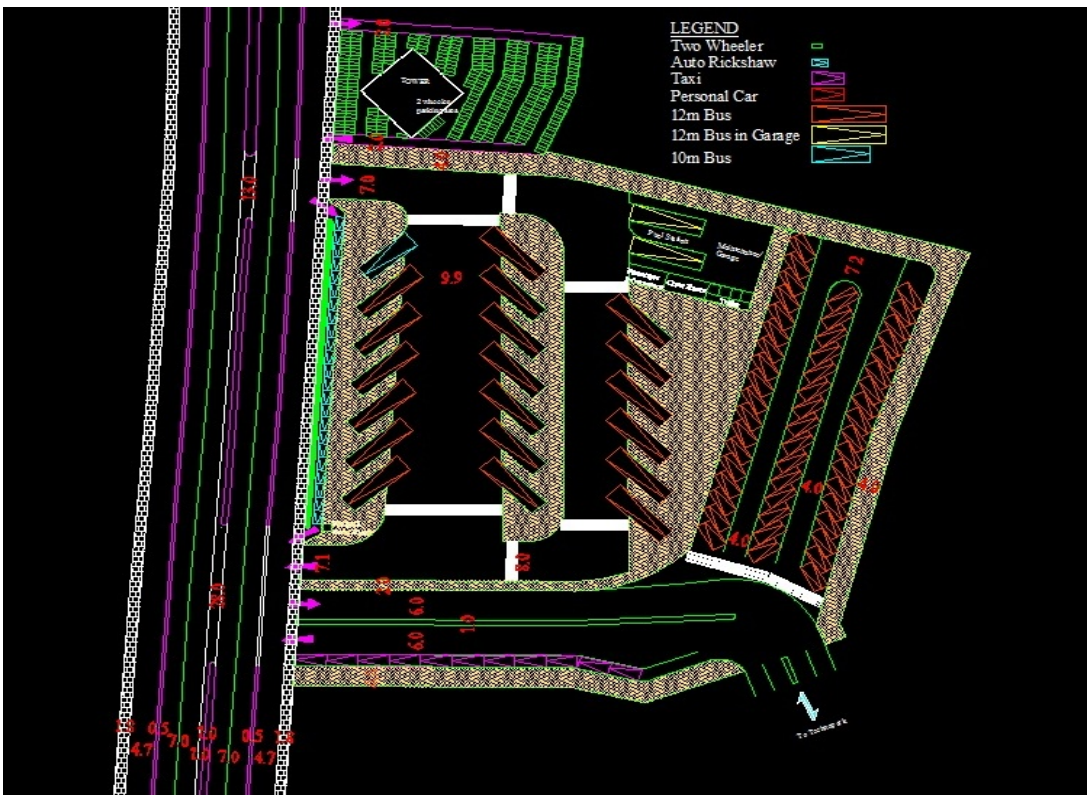


***Figure 18: Proposed Bus Terminal Layout** Plan*

Multi modal integration is ensured in the design of the bus terminal. Universal accessibility was one of the major points of consideration for design. Any public transport initiative would be incomplete without properly designed last mile connectivity. This has been taken care of by proposing an eco-friendly mode of transport from the bus terminal to Technopark (phase 1, 2 and 3) and to the railway station via Kazhakkuttam junction. They included KSRTC feeder buses, Solar/ Electric/ Hybrid vehicle and Personalized Rapid Transit (PRT) modes.

Introduction of Intelligent Transportation System (ITS) applications like Passenger Information System (PIS) is recommended to be integrated into the new bus terminal. The bus terminal can utilize the permissible Floor Space Index (FSI) for revenue generation purposes. Some of the social and economic benefits of the development of proposed infrastructure are promotion of mass transport, decongestion of roads in the vicinity, safer roads, connectivity with proposed LRT facility, tranquil intra-city commuting, better connectivity to Technopark, sustainable and eco-friendly modes of transport, multi modal integration and encouraging better patronage of public bus transport.

10. 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.

Data sets are developed from the results of various traffic and transportation studies conducted by National Transportation Planning and Research Centre (NATPAC) and other government agencies.

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 studies done in NATPAC for the past 10 years. 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.

Objectives

- 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 develop trip generation models using quick-response concept
- To conduct model performance evaluation upon similar towns

The methodology adopted for the study consisted of data compilation, analysis of data, identification and selection of transferable parameters, model development and evaluation of formulated models. Based on the analysis of compiled data, the independent variables selected for model development include census population, population density, motorable road length, per capita vehicle ownership (total, transit and non transit), and volume capacity ratio. The variables were selected for model formulation after checking the correlation statistics as well.

Regression analysis is followed to develop models to estimate intercity person trips in various forms for the two categories of small and medium towns differentiated based on population size. Multiple linear and non linear regressions were utilized to accurately estimate intercity trips as far as possible. 16 towns were identified as small towns with population less than 50,000; out of which 14 towns were used for model development and the remaining two were used for model performance evaluation or model validation.

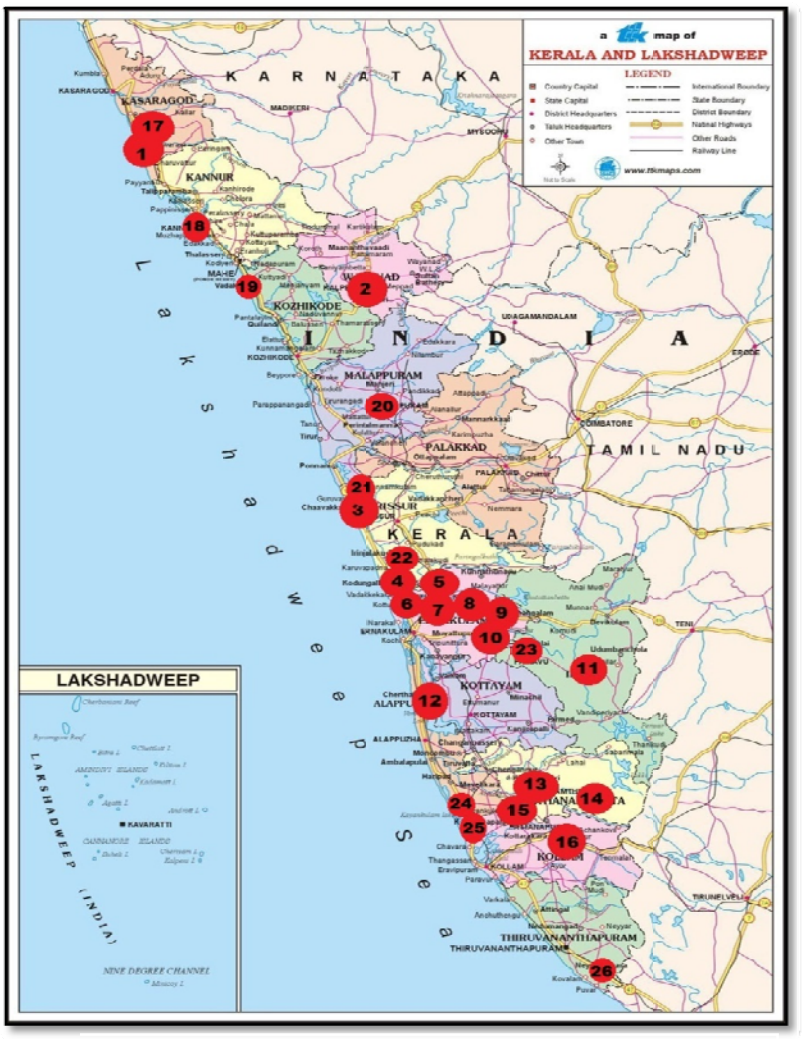


Figure 19: Geographical distribution of selected towns

Towns having census population between 50,000 to 1,00,000 were classified as medium towns in this study. 10 such towns were identified under this category, out of which eight towns were used for model development and the remaining two for validation. With the available sample size, multiple linear regression models were developed using SPSS to estimate intercity person trips, intercity transit person trips and intercity non transit person trips respectively at 95% confidence interval.

Appropriate model was selected using statistical significant testing tools like f-test, P-value, rmse (root mean square error) etc.

Table 5: Models developed for estimation of intercity person trips, internal to external trips and external to internal trips for small and medium towns

Town category	Model	R^2 value
Small towns	IEtrips = -0.233 + 1.488*pcvo +0.409*vol +1.023*pop	0.843
	EItrips = -0.057 +1.332*pcvo +0.124*vol +1.024*pop	0.817
	trips = -0.290 +2.819*pcvo +0.533*vol +2.047*pop	0.859
Medium towns	log(IEtrips)= 4.563–0.047*RD+ 0.671*vol -0.088*pop	0.798
	log(EItrips)= 4.476+0.011*den +0.172*RD+0.282*vol	0.890
	log(trips)=4.848-0.003*(e^den)-0.018*(RD^0.5)+0.194*e^vol +0.113*pcvo	0.537

Where,

Small towns	: towns with population less than 50,000
Medium towns	: towns with population between 50,000 and 1 lakh
IE trips	: internal to external person trips in trips per day in lakh
EI	: external to internal person trips in trips per day in lakh
trips	: total intercity person trips in trips per day in lakh
den	: population density in thousand (person/km^2)
pcvo	: per capita vehicle ownership
vol	: traffic volume in PCU/day of intercity road links in lakh
RD	: road density of town in kilometer/square kilometer
e	: Euler's constant

- In case of small towns, a positive influence of all independent variables is seen on dependent variable
- For the case of medium towns, road density has positive influence on external to internal trips while negative influencewas there between road density and internal to external trips
- Road density is a measure of urban development of a town and as the road density increases the needs of the population are met within the town and they need not pursue an internal to external trip
- The models developed have fairly moderate R^2 value satisfying statistical tests performed

The models developed here will 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. The quick response travel demand estimation

technique can be effectively utilized in estimating travel demand of urban areas with higher degree of predictive accuracy and in estimating not only regional but zonal travel demand which are very much useful for planning and evaluation of transportation schemes in small and medium sized towns.

11. Feasibility of Ropeway at Ilaveezha Poonchira in Kottayam District

Ilaveezha Poonchira is a tourist destination located in Melukavu village in Kottayam district near Kanjar and is surrounded by three enchanting hillocks - Mankunnu, Kudayathoormala and Thonippara. At the instance of Department of Tourism, Government of Kerala, NATPAC carried out a feasibility study for developing a ropeway system at Ilaveezha Poonchira to give a fillip to tourism activities in the region.

The study was conducted with several tasks like reconnaissance survey; preparation of base plan of the area, and tentative sketch of alignment; assessment of geological, climatological and meteorological data relevant to the area; fixing of location of base station and intermediary points along with details of the span arrangement; assessment of tourist demand for the ropeway; selection of appropriate ropeway system, power requirements, electrical and telecommunication requirements with particulars about manufacturers/ vendors/ suppliers and major installations; indication of staffing requirements for operation and maintenance and efficient functioning of the project; assessment of the space required for support services like parking facilities; assessment of the total capital investment including Civil, Mechanical and Electrical components; estimation of cost of operation and maintenance; environmental impact assessment of the project and mitigative measures and financial analysis of the project.

Ridership Forecast

The base year tourist visits at Ilaveezha Poonchira during the peak seasons was arrived at from local enquiries with jeep drivers and local residents. Daily tourist arrival to Ilaveezhapoonchira during peak season is estimated to be 250 persons. With the development of Ilaveezha Poonchira as a premium tourist centre, it is expected that there will be a quantum jump in the number of tourists visiting the spot. Tourist interview survey was conducted in nearby tourist destinations to know the expected tourist arrival to Ilaveezha Poonchira and their willingness to take a ride in ropeway. It is known from the tourist interview survey that, nearly 30 % of the tourists visiting Kottayam and Idukki districts are assumed to visit Ilaveezha Poonchira. To be on the conservative side, 25% of tourists visiting Kottayam and Idukki districts were taken as potential tourists to Ilaveezha Poonchira for the year 2013 and thus the tourist demand was estimated at

253,176. The ropeway riders were obtained from the opinion survey of the tourist against different ticket charges.

Projection of ridership at ropeway system for various horizon years was carried out to assess the requirement of rope cars and to estimate the revenue accruals from operating the ropeway system. For projecting the ridership, growth rate method was applied. The projected ridership for various horizon years is shown in **Table 6.**

Table 6: Ridership forecast of ropeway for horizon years

Average & Peak seasonal Ridership	2013	2015	2020	2025
Average per month	15,247	17,784	26,131	36,650
Average per Day	610	711	1,045	1,466
Peak Day	1,108	1,293	1,899	2,664
Average Day Peak Hour	102	119	174	244
Peak Day Peak Hour	185	215	317	444

Alignment Selection

Several alignment options were considered after preliminary reconnaissance survey. Feasibility of alignment options were discussed and evaluated in detail by conducting aerial survey with the help of geo mapping software and geographical information such as Google earth, expert GPS, Surfer etc.

Three alternative ropeway alignments were established connecting the hill top and base camp developments at Ilaveezha Poonchira. The alternate alignments for the proposed ropeway project at Ilaveezha Poonchira are shown in **Table 7.**

Table 7 : Alternate alignments considered for ropeway system

Alignment options	Cable Car terminal Station	Geographical Coordinates		
		Latitude	Longitude	Elevation (m) above MSL
Alternative 1	Base camp	9.8031°	76.78249°	840.53
	Hill top	9.8053°	76.78342°	909.30
Alternative 2	Base camp	9.80316°	76.78161°	843.65
	Hill top	9.80655°	76.78128°	939.70
Alternative 3	Base camp	9.80316°	76.78161°	843.65
	Hill top	9.80596°	76.78179°	922.13

The proposed alignment was finalized considering the availability of land for terminal stations, altitude above Mean Sea Level (MSL), ground clearance required, height of trestles, inclination angle of the ropeway and aerial view from the cable car. Based on the technical evaluation, third alternative alignment was considered as the most feasible alignment.

Figure 20: Poposed alignment for ropeway system

The horizontal distance between base camp terminal station and hill top terminal station will be 310.72m and vertical level difference will be 78.49m. Ropeway connecting the terminal stations will have a length of 320.48m. Height of rope at intermediate supporting tower, at a horizontal distance of 155.5mm from base camp terminal station, will have a height of 23m from ground level.

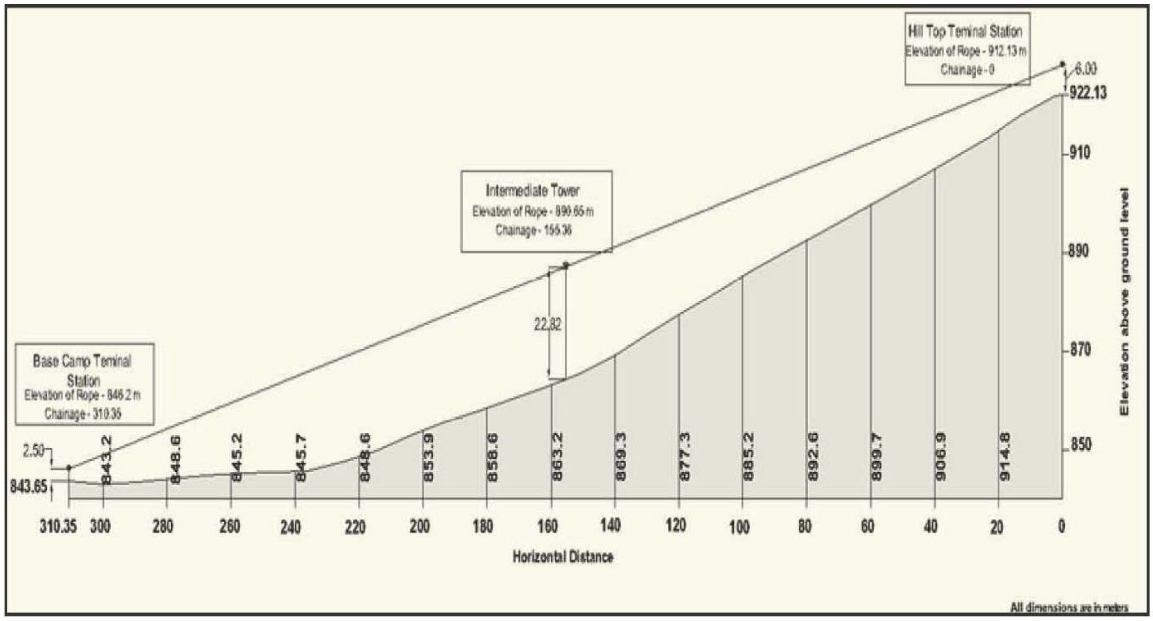


Figure 21: Profile of proposed ropeway alignment at Ilaveezha Poonchira

Environmental Baseline Data

A study of the existing environmental conditions was carried out. Attributes of the physical environment like air and noise quality in and around the study area were assessed primarily

through field studies and by undertaking air quality monitoring and analysis of samples collected from field and mitigation measures were found out.

Table 8: Recommended Technical Specifications of Ropeway System

Sl. No.	Parameters	Specifications
1	Type of ropeway system	Fixed Grip type Monocable Zigback Gondola
2	Location of ropeway	Ilaveezha Poonchira
3	Length of track (inclined)	321.35m
4	Vertical rise	81.98 m
5	Alignment	Straight
6	Ropeway carrying capacity	185 Passenger Per Hour (Peak)
7	Ropeway design capacity	450 Passenger Per Hour (Peak)
8	Maximum ropeway speed	2 meter / sec.
9	Average ropeway speed	1.5 meter / sec.
10	No. of ropeway stations	2
11	No. of intermediate towers	1
12	Cabin capacity	4 (four) passengers
13	Number of cabins	6 (Six) Cabins
14	Braking System	(i) Service Brake (ii) Emergency Brake on main drive sheave (iii) Electric stop
15	Drive Station	Base camp terminal station
16	Tensioning	Hydraulic tensioning equipment driven by electricity.
17	Type of grip	Fixed
18	Type of cabins	Enclosed, fully ventilated, glazed and with automatic door opening/closing mechanism. Ventilation scheme to be approved by Engineer-in-Charge.
19	Type of towers	Galvanized, Latticed/Tubular Steel Construction
20	Tower sheaves	Aluminum casted with rubber liners
21	Ropeway stations	Galvanized and welded steel section stations housing the ropeway equipment. All the passenger amenities like waiting rooms, toilets and ticket counters to be provided separately
22	Motor rating required	90 KW
23	Power supply	415V $\pm$ 10%, 3 Phase, 50 Hz.$\pm$ 3%

Estimated Cost

The total estimated cost for installing the system worked out to Rs.540 lakhs which include design of electrical and mechanical components and civil works.

Table 9: Broad break-up of cost estimate for installing ropeway system

Sl. No.	ITEM	ESTIMATED COST (Rs.)
1	Design and Engineering	61,00,000
2	Supply of Mechanicals	1,78,00,000
3	Supply of Structurals	1,22,00,000
4	Supply of Electricals	81,00,000
5	Civil Work	43,00,000
6	Erection and Commissioning	55,00,000
	TOTAL	**5,40,00,000**

12. Traffic Impacts of Converting Curbside Lane of a Multi-Lane Road to exclusive Bus Lane – Case Study in Thiruvananthapuram City

The road traffic on Indian cities is highly heterogeneous comprising of wide ranging vehicle characteristics. All these vehicles share the same road space without any segregation and occupy any lateral position on the road depending on the availability of road space at a given instant of time without any lane discipline. Buses, being relatively larger vehicles, find it difficult to maneuver through this mixed traffic. Bus transport system forms an indispensable part of urban transport because of its major role in the social and economic growth of an area. Buses as a main transportation mode have several advantages. One of the common bus preferential treatments is provision of reserved bus lanes on major urban roads to facilitate faster movement of buses, which will make the mode more attractive.

Thiruvananthapuram, the capital city of Kerala suffers from traffic congestion problems in the peak hours and might get worse in the future. As part of exploring new traffic management techniques, NATPAC studied the traffic impacts of allocating a curb side mixed flow lane exclusively for buses in the morning peak hours of traffic. M G road, in Thiruvananthapuram has six lanes and is chosen for conducting the study. The impacts of shifting the bus bay are also considered for the study.

Traffic simulation was done using VISSIM software 7.00 – 05 giving preference to through traffic along the main corridor and for buses. For accuracy, simulation is done for 1.2 kms of road stretch between Pazhavangadi and Pulimoodu intersections of M G Road, Thiruvananthpuram.

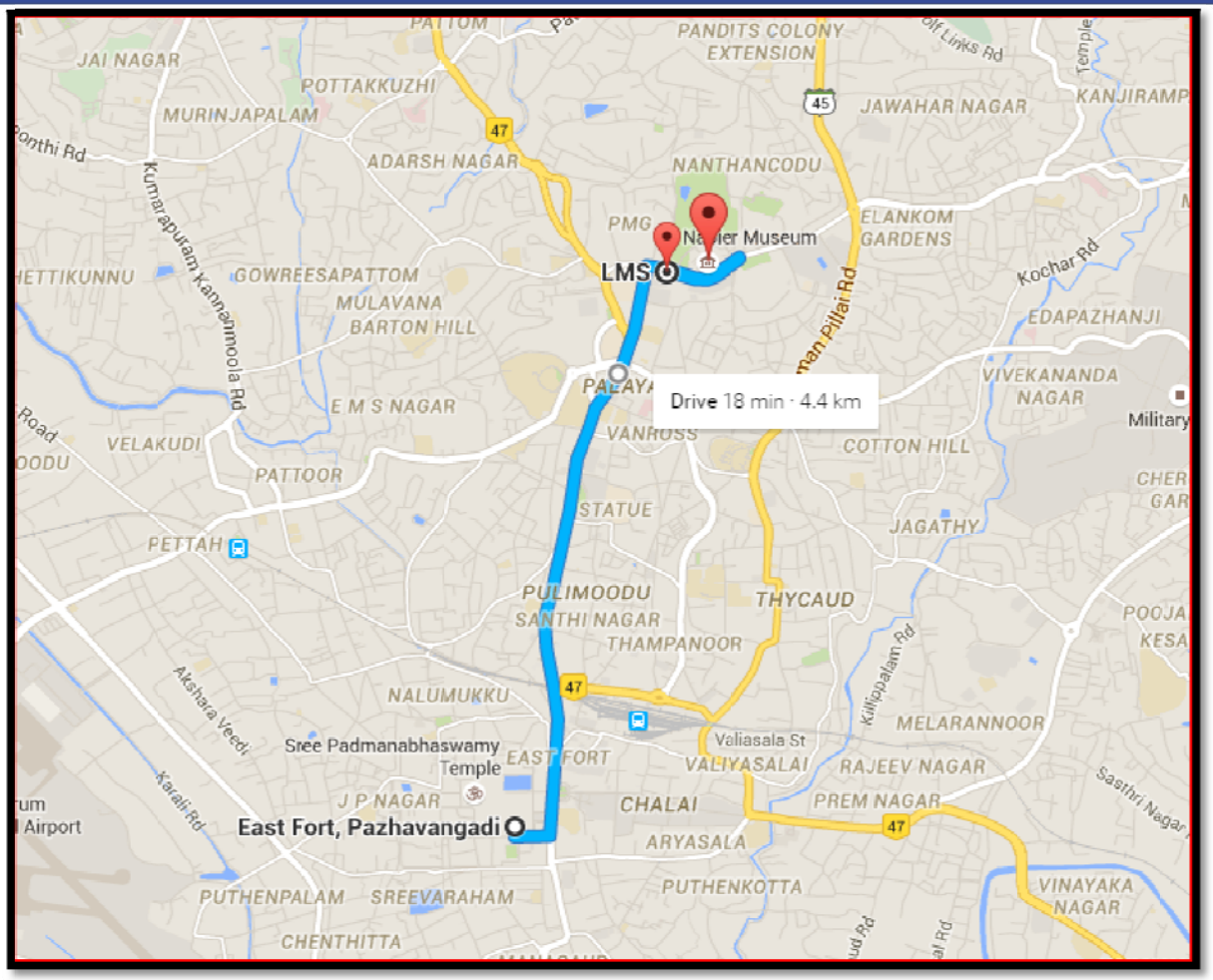


Figure 22 : Study Stretch in Thiruvananthapuram

The key arterial road in the Trivandrum metro area is the north-south NH 66 (formerly the NH 47). Its old alignment, through the centre of the city forms the arterial Mahatma Gandhi road (MG road) and is the most important north-south road in Thiruvananthapuram city. The road starts from the busy place of East Fort and ends in the Museum Road, Thiruvanathapuram and its length is about 6 kms. Like the rest of urban roads of Thiruvananthapuram, MG road too suffers congestion during peak hours. This condition could be tackled only if public transportation facilities i.e. buses is promoted so that congestion by private vehicles could be reduced. In the case of M G road, BRTS is an unworthy suggestion as land acquisition is not possible due to various nearby establishments. As there exists six lanes, one of the most acceptable solutions is exclusive curb side bus lane during peak hours.

Objectives

- Determining the existing traffic characteristics of the identified stretch between Pazhavangadi and Pulimoodu intersections

- To calibrate and validate the model in VISSIM 7.00

- Assessing the impact of the lane conversion on traffic parameters like travel time and delay for buses and for rest of the traffic

- Assessing the impacts of exclusive bus lane when the bus bay position is shifted to about 90m.

The methodology adopted for the study consisted of:

(i) Road inventory survey for the identified study stretch between Pazhavangadi intersection and Pulimoodu intersection along with details of various arms of the intersections were collected. The data collected includes number of lanes, width of each lane, width of shoulder and width of foot path.

(ii) Turning Movement survey were performed to know the classified volume at the four intersections at Pazhavangadi, Overbridge, Ayurveda College Junction. and Pulimoodu respectively for four hours from morning 8.00am to 12.00am on a normal working day

(iii) Travel time and delay study to determine travel time and delay on the identified roads by travelling in both bus and car.

(iv) Calibration and validation of the Model created in the VISSI M 7.00.

(v) Traffic simulation using VISSIM 7.00 software to study the effects of lane conversation on traffic parameters like travel time and delay.

The Peak hour turning volume count is shown in **Figure 23.**

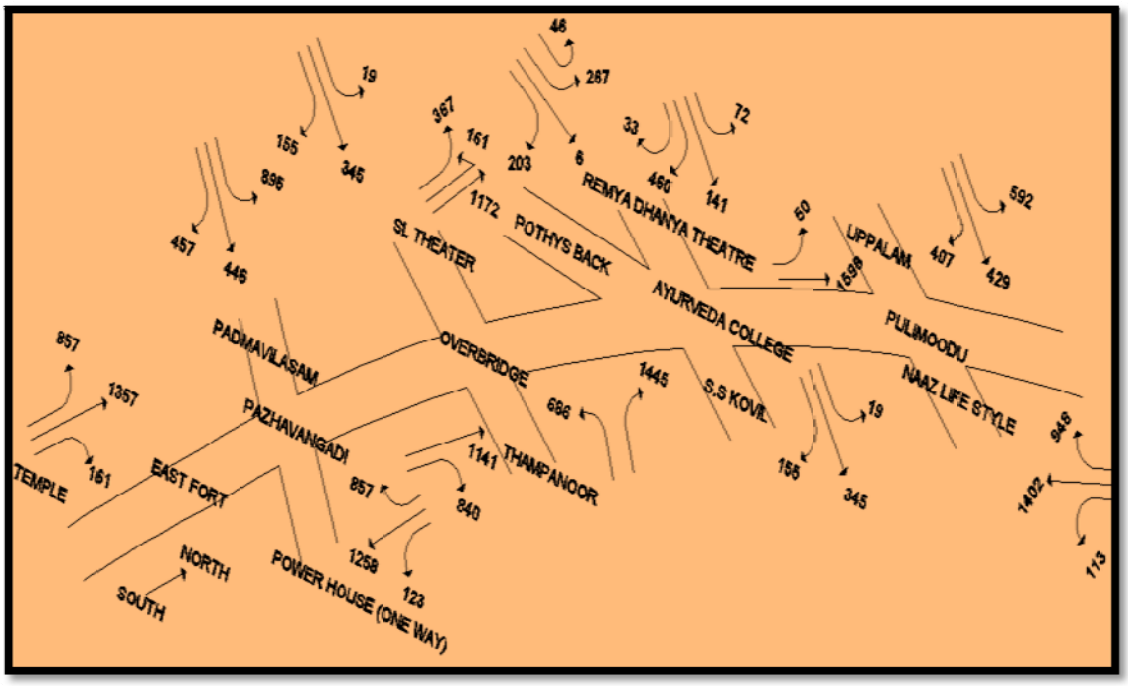


Figure 23: Peak Hour traffic movement at four intersections

The results are obtained as VISSIM micro simulation model output for about 10 simulation runs for a range of 900s to 4500s with 12 intervals and the average is being considered. The traffic parameters used for the study are average vehicle travel time and average vehicle delay. The three cases considered for comparison are Present scenario, Exclusive bus lane case and Bus stop shifted for exclusive bus lane case.

Case 1: The first case includes the simulation of the current scenario at the study stretch.

Case 2: The second case includes the assessment of traffic impacts on providing the exclusive bus lane along the curbside during morning peak hour at the study stretch.

Case 3: The third case includes the assessment of traffic impacts on shifting bus stop for about 90m from the original position in the exclusive bus lane case. The comparisons of these cases are graphically represented in **Figure 24**.

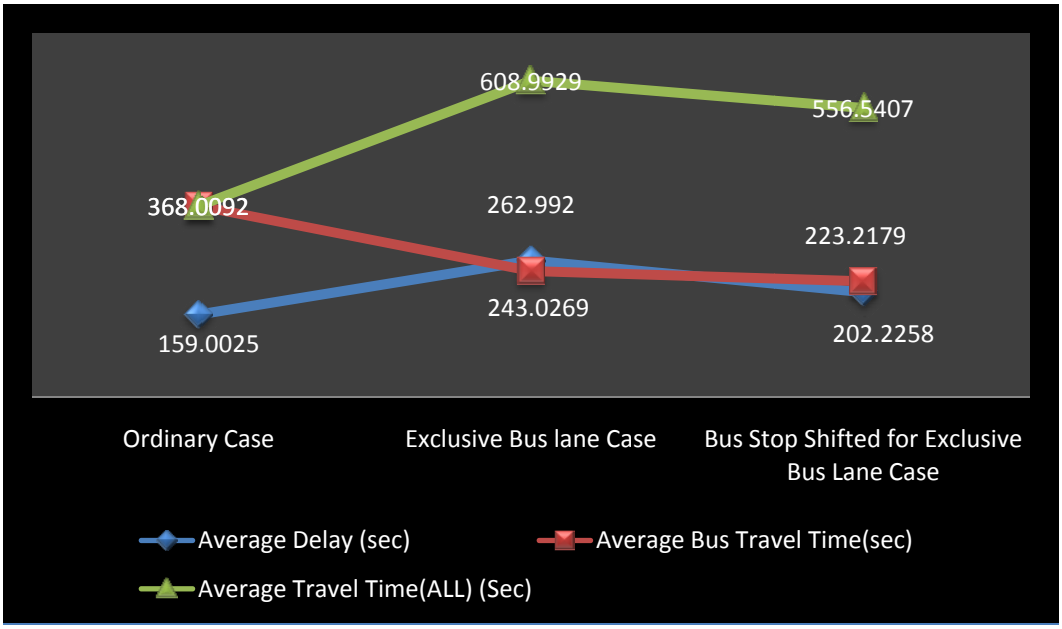


Figure 24: Graphical representation of Results

From the graph it can be seen that as expected the provision of the exclusive bus lane reduces the travel time for the buses considerably. At first travel time for the buses over the complete stretch was 159.0025s. When exclusive bus lane was provided along the curb side the travel time reduced to 243.0269s. It further reduced to 223.2179s when the bus stop was shifted to about 90m from the original position.

Provision of exclusive bus lane reduces the travel time for the buses completely as there is no interference from the rest of the traffic on buses.

13. Impact of Weather on Traffic Flow and Capacity of Roads in Different Areas and Terrains

Weather causes considerable impacts on the transportation system. Extreme weather events, such as rain, snow and fog can bring traffic to a standstill. It is well known that inclement weather can significantly affect travel demand, driving behavior and traffic flow characteristics. Rainfall causes series of damage to the traffic and also the influence the behavior of the commuters. Without a comprehensive understanding of the weather influence on traffic flow, implementation of related operation policies will not be possible to improve traffic efficiency and safety. Study on impact of weather becomes more necessary for effective transportation planning.

Objectives

1. To assess the variations in traffic flow parameters in different weather conditions
2. To assess the travel behavior of commuters during inclement weather

A case study of different road corridors in Thiruvananthapuram District is considered. The road sections selected for the study include i) Urban section of Main Central Road (SH-1) between Trivandrum –Kilimanoor, ii) Semi-urban section of SH-46 between Attingal – Kilimanoor, and iii) Rural section of MDR between Attingal - Chierayinkeezhu.

The methodology adopted for the study consisted of data collection from primary and secondary sources, inventory of selected road corridors, classified traffic volume counts during different weather conditions, measurement of spot speeds of all category of vehicles using speed radar gun, commuter opinion survey and passenger vehicle occupancy survey.

The traffic characteristics observed in the study area during inclement weather conditions are:

1. *Urban Section*

   Analysis of data has shown that traffic volume during adverse weather got reduced by 15% (from 5,032 PCU to 4,286 PCU) when clear sky condition changed to moderate intensity of rain. While the composition of two wheelers in traffic mix dropped by 7% during bad weather; their speed reduced by 15% (from 45 to 38 kmph) and car speeds dropped by 11% (from 45 to 40 kmph). A maximum of 24% speed reduction was noticed among trucks and nominal speed variations of 5% among buses were observed during change of weather from clear sky to moderate rainfall.

2. *Semi - Urban Section*

Variation in traffic volume was not significant in semi-urban sections, when the weather condition changed from clear-sky to rainy. The share of two wheelers decreased by 8% while share of Light Motor Vehicles (LMV) increased by 10% during rainfall. The spot speed of two wheelers dropped by 20%; cars by 18%; and the speed reductions for bus and truck varied from 6 to 8% during clear sky and adverse weather conditions.

3. *Rural Section*

In rural section,the decrease in traffic volume was more pronounced (from 2,877 to 2,003 PCU) compared to other sections. Nearly one-third reduction in traffic volume was observed when weather changed from clear-sky to heavy down pour. The variation in traffic composition was insignificant in rural section. While 12% drop in speed was observed for buses and two wheelers, a small variation of 5-8% speed reduction was recorded among cars, autos and trucks during changed weather condition from clear sky to moderate rainfall.

Vehicle Occupancy

In order to know the vehicle occupancy during inclement weather conditions survey was conducted on the same stretches where the traffic characteristics were observed. Change in the occupancy of vehicles was observed in the semi urban and rural section whereas the urban section was not affected by change in weather conditions.

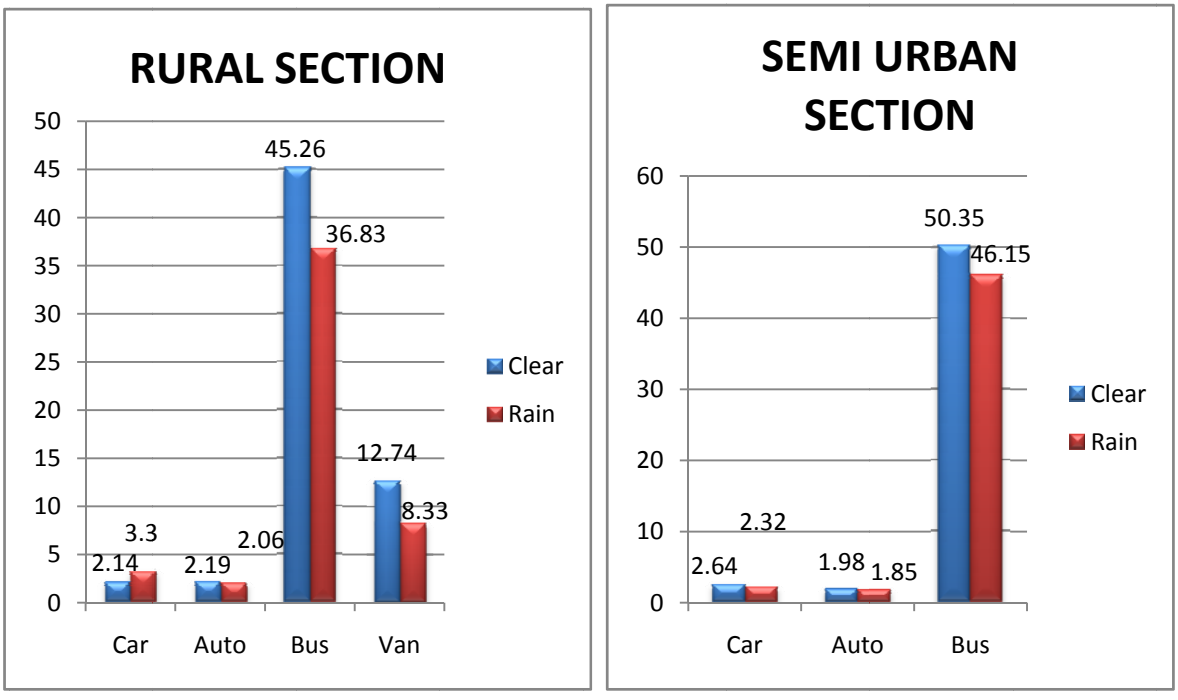


Figure 25: Graph showing the occupancy of vehicles

Mode Choice

Mode Choice analysis was performed and the results indicated that travel behaviors were affected by weather conditions which in turn correlate the types of trips. For analysis, the four types of trips such as essential, optional, business and health were considered and the commuter's mode-choice for this different types of trips at various weather conditions were questioned. The mode-shift of travelers during various climatic conditions was also analyzed for the different types of trips.

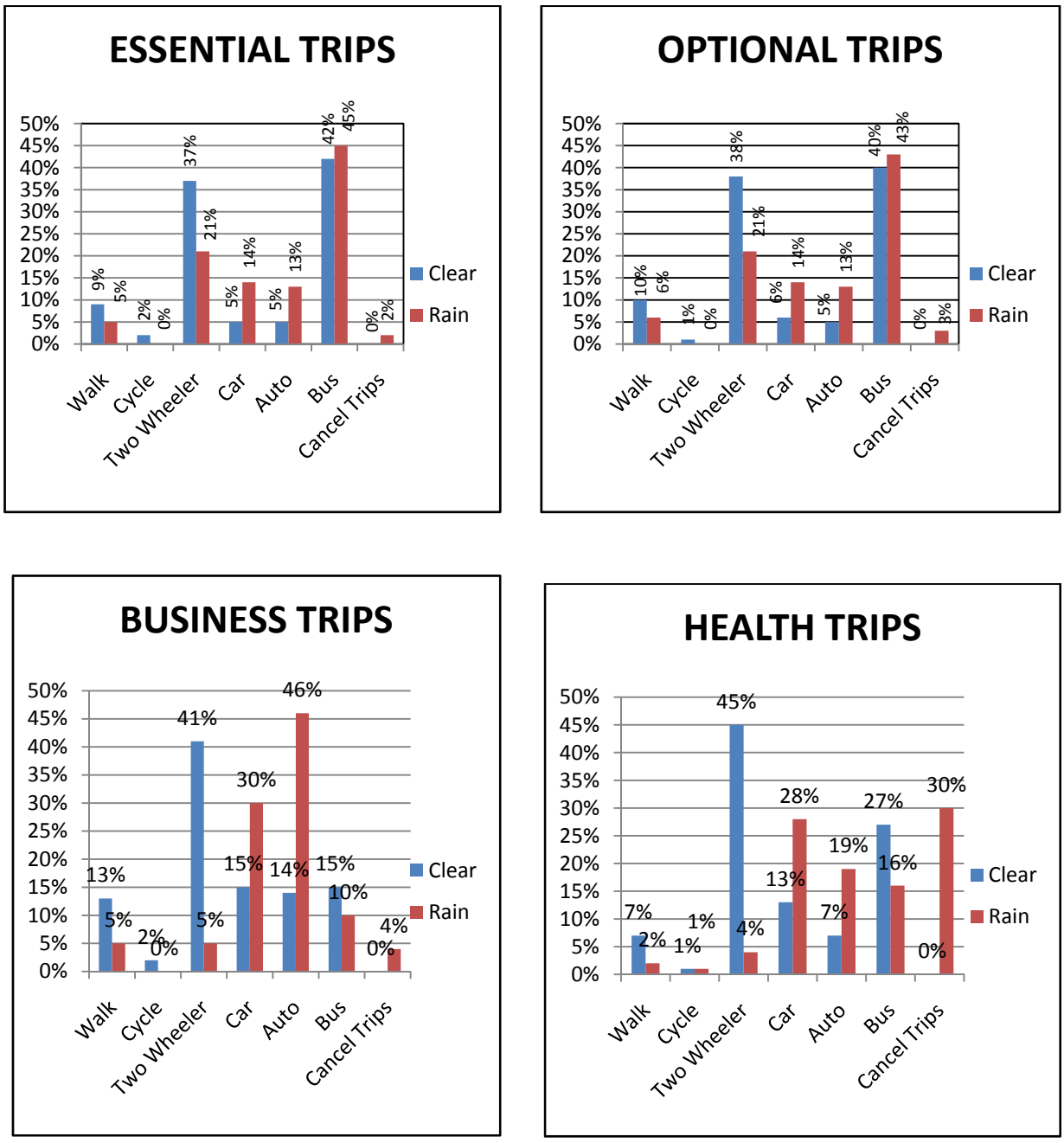


Figure 26: Mode-shift of travelers during various climatic conditions

Findings

1. Traffic volume on Major District Road (MDR), SH-1 and SH-46 was 1276, 2207 and 638 PCU/Hour in clear weather and 978, 2146 and 567 PCU/Hour in rainy weather in both directions of the roads.

2. On the MDR, the traffic volume was affected more by rainfall than the State Highways. A 23% reduction was observed on MDR, 11% on SH-46 and only 3% on SH-1.

3. Composition of traffic in MDR consists of 47% two wheelers, 17% cars, 21% three wheelers, 8% buses and 2% trucks in clear weather and 39% two wheelers, 30% cars, 20% three wheelers, 5% buses and 2% trucks in rainy weather.
   On SH-1, the traffic volume comprised 48% two wheelers, 30% cars, 12% three wheelers, 5% buses and 4% trucks in clear weather and 43% two wheelers, 38% cars, 13% three wheelers, 3% buses and 3% trucks in rainy weather.
   On SH-46, the traffic consisted of 41% two wheelers, 27% cars, 16% three wheelers, 5% buses and 2% trucks in clear weather and 31% two wheelers, 36% cars, 16% three wheelers, 7% buses and 1% trucks in rainy weather.

4. Comparing the vehicular composition during clear and rainy weather on the three roads, the effect of weather was more prominent in case of Major District Road than the State Highways. In both category of roads, the percent of two wheelers reduced in rainy condition and that of cars increased. On the MDR, an 8% reduction took place in case of two wheelers and 13% increase was observed in case of cars. On the State Highways (SH-1 & SH-46) the reduction in two wheelers and increase in cars composition was about 5%-10% when the weather changed from clear to rainy.

5. All speed elements like 98^{th} percentile speed, 85^{th} percentile speed, 15^{th} percentile speed and average speed in respect of all vehicles on all the three roads considered in the study get reduced due to rain.

14. Congestion Charging in Central Areas of Cities in Kerala State – Case Study of Thiruvananthapuram City

Increase in travel demand results in the growth of vehicular traffic on road networks which eventually leads to congestion. Congestion can be tackled in two ways:

- By increasing the capacity of road network/ infrastructure which would encourage additional traffic to ply on this network
- By managing travel demand by introducing traffic management schemes, non-motorised options, introduction of congestion charging etc.

The second approach is considered to be better than the first one owing to its benefits in encouraging sustainable transport by optimum usage of the existing infrastructure.

Congestion charging is one of the methods adopted world-wide for travel demand management. Congestion charging is introduced in different forms like for an area/ road stretch for particular time duration (usually peak hours), implementation of parking charges, crowd pricing etc. In the present work, the study area has been limited to the central area of Thiruvananthapuram city.

The objectives of the study are:

1. To establish a methodology for determining congestion
2. To determine the congested corridors in the central areas of Thiruvananthapuram City
3. To establish a methodology for congestion charging
4. To formulate 'parking charge' and 'crowd charge' based on congestion charging
5. To work out a system architecture for implementation of congestion charging

The Congestion Level is defined as a combined index which is a function of Travel Speed Rate and Very Low Speed Rate. Congestion causes external costs to all road users. By levying congestion charge, the externality is being internalised. The external costs include (1) Journey Time Cost (2) Vehicle Operating Cost (3) Pollution Cost (4) Scheduled Delay Cost and (5) Accident Cost. Among these the first three are significant and is being considered in this study. There are two methods to determine Congestion Charge as given by *Singh and Sarkar (2009)*. First method determines the optimal fee to be charged to fully internalise the external costs. This is the intersection point of demand elasticity curve and the marginal external cost curve. Second method finds the volume to be maintained for LOS C and then from the demand elasticity curve determines the congestion charge to maintain that particular traffic flow.

Primary surveys were conducted to obtain the average speed of vehicles. Speed delay survey and household surveys (joint Revealed Preference – Stated Preference surveys) were conducted.

The survey locations are shown in Figure 27. The user preference survey conducted covered a sample size of 3.4% households. The joint Revealed Preference (RP) – Stated Preference (SP) survey was carried out in 20 wards of the municipal corporation area.

The willingness to pay survey was conducted and 882 samples were collected out of which 80% stated that they experience congestion on roads while 20% stated that they do not experience congestion. A weighted average of Rs 10/- was obtained as the amount they are willing to pay towards alleviating congestion. The private vehicle users were also asked about how they would react to the situation if the congestion charge imposed were too high for them. It was observed that most of the private vehicle users would resort to ride sharing,avoid route or shift to public transport to avoid congestion charging .

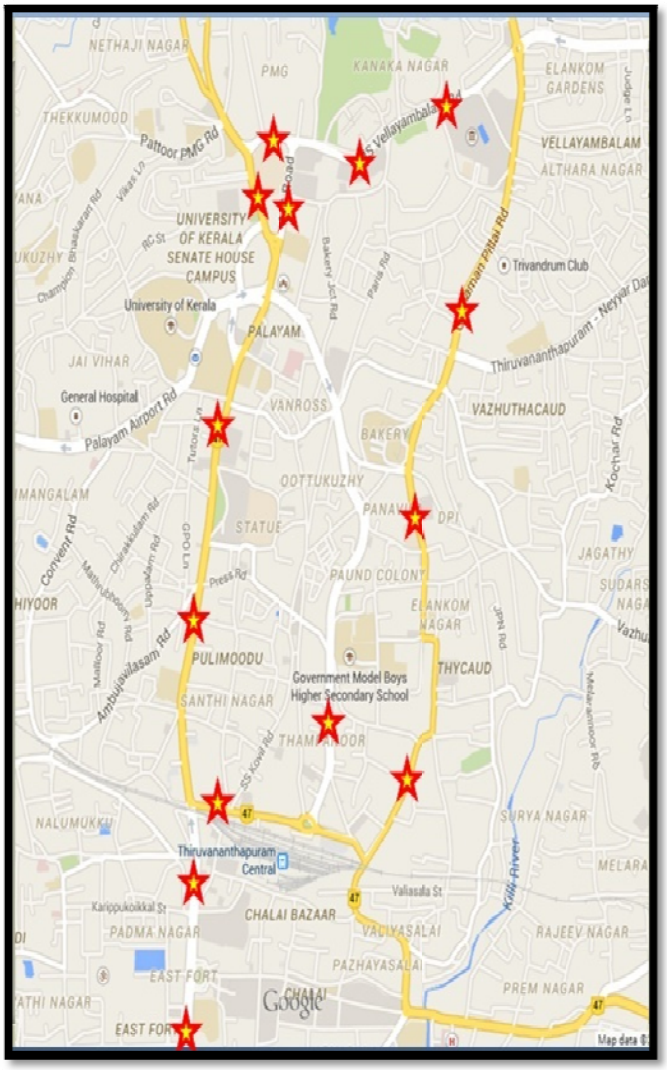


Figure 27: Survey locations within the study area

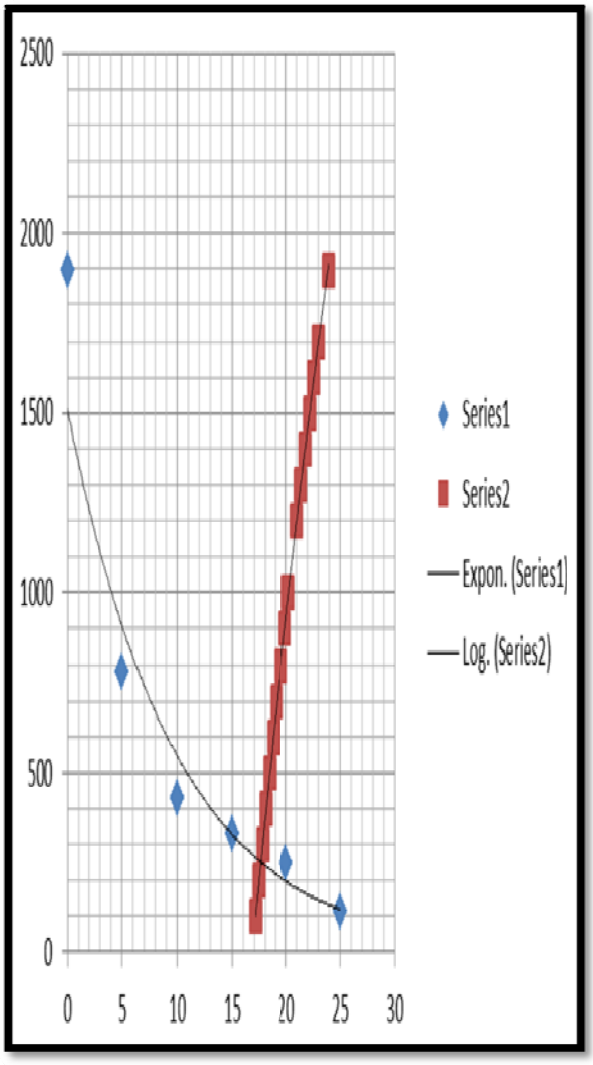


Figure 28: Congestion charge to internalize the external costs

The congestion charge that could be imposed to internalise the external costs associated with congestion is obtained from **Figure 28**, which comes to around Rs 18/-.

As car owners are willing to pay Rs 10/- and the congestion charge to be levied to internalise the external costs of congestion amounts to approximately Rs 18/-, it is recommended to levy a congestion charge of Rs 20/- for every car users in the peak hours on all working days. Strict implementation of this system with good enforcement and penalisation of violators would bring down congestion to a large extent. The complementary schemes of parking charge and crowd charge should also be implemented so that a further discouragement to private transport use and thus a reduction in congestion and pollution caused due to vehicular transport could be achieved.

Pricing policies including 'congestion charging', 'parking charging' and 'crowd charging' are the important immediate steps to be taken in order to reduce congestion. All of these measures when implemented concurrently in an integrated multi-level approach can deliver significant improvements in urban traffic conditions in central areas of cities in Kerala.

15. *Parking Management System for Major Roads in Thiruvananthapuram City – Case Study of M.G.Road*

Mahatma Gandhi road (MG road), connecting LMS and Attakulangara, is the lifeline of Thiruvananthapuram city, passing through its central area **(Figure 29)**. Major traffic generators like Government Secretariat, Office of Accountant General, City Bus Station, Ayurveda College, Corporation Office, Educational Institutions and a number of banks, commercial centres, shopping complexes etc. are located along MG road. In the absence of adequate off-street parking facilities, vehicles are parked haphazardly along the curb causing traffic congestion and hazards. At the instance of Kerala Road Safety Authority, NATPAC conducted a parking management study on LMS and Attakulangara stretch of MG road.

The study was confined to MG road, the major road passing through the centre of the city, of road length 3.4km connecting LMS and Attakulangara. The major objectives for the study were preparation of a parking management plan along with suitable parking policy framework that could be easily implemented in Thiruvananthapuram city and could be replicated in other towns and cities in Kerala.

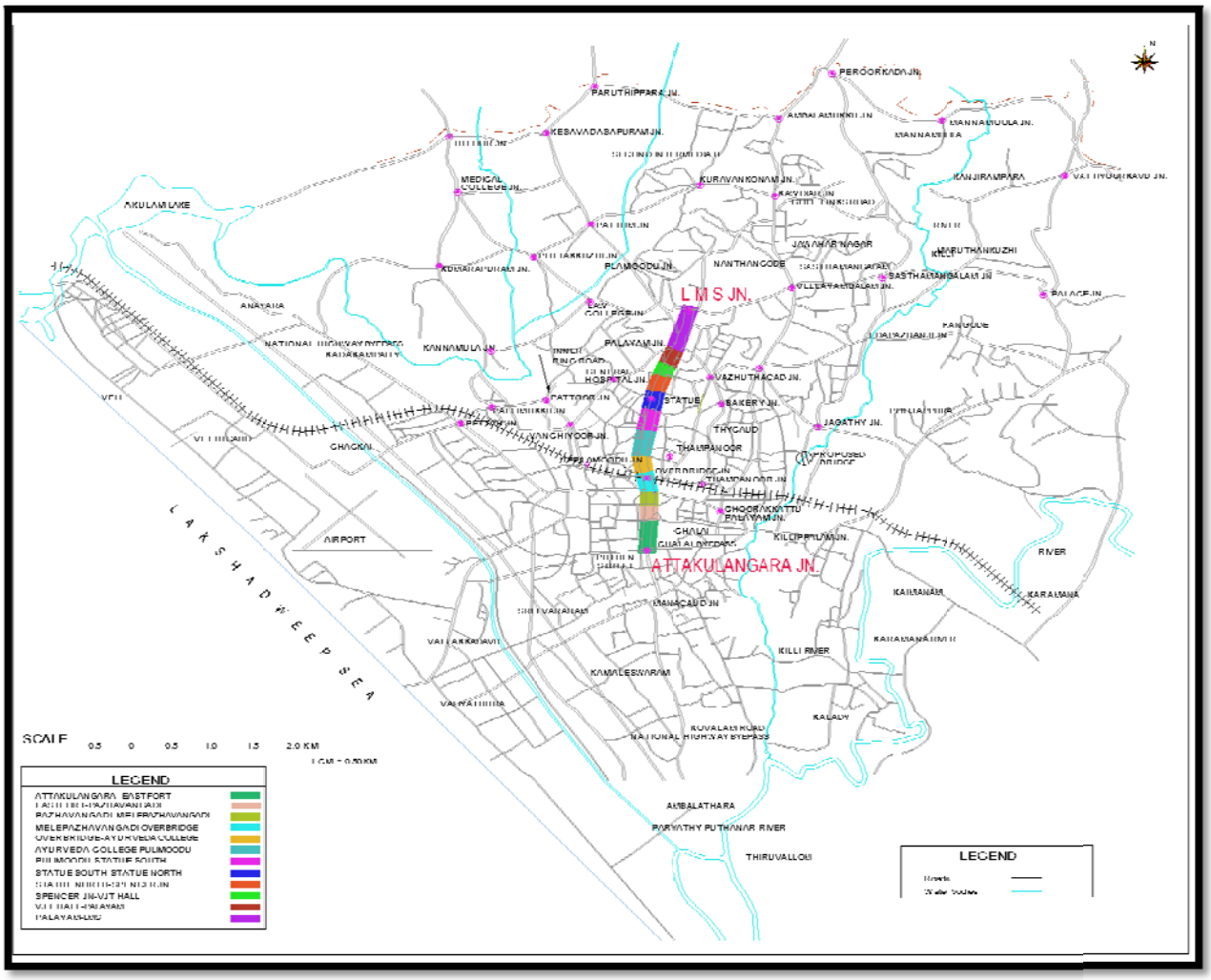


Figure 29: Map of Thiruvananthapuram City showing project road

The following sub-tasks were also carried out:

i) Assessment of parking demand and supply characteristics along MG road in Thiruvananthapuram city

ii) Evaluation of adequacy of parking facilities provided to meet the short term and long term parking demand

iii) Identification of appropriate locations for on-street and off-street parking lots depending on the space availability and parking demand

iv) Preparation of preliminary design for on-street and off-street parking lots

v) Working out implementation mechanism for the proposed parking schemes.

Opinion survey was conducted among the private vehicles entering the city through major travel corridors. More than 74% of the respondents either strongly favoured or favoured the concept of "park-and-ride" and 72% of the respondents favoured "car-pooling" concept. Nearly 95% of

respondents are supporting the concept of off-street parking complexes. The catchments area for parking complexes has to be confined to a radius of 100 metres from major traffic generators.

Parking adequacy study was done by analysing the adequacy of effective parking supply against parking demand at both on-street and off-street locations to estimate the requirements of additional parking space. The analysis of aggregate peak parking demand and supply in the study area revealed that there was a parking deficiency of 2,536 Equivalent Car Space (ECS) in the base year.

Parking Management Schemes for M.G.Road

Parking improvement schemes for the MG road is proposed in accordance with latest norms and policies stipulated by Municipal Building rules, IRC and MoUD. Public transport system and non motorized transport system has to be promoted and developed to reduce the parking demand on M.G. Road. As far as possible on-street parking of vehicles must be discouraged as it consumes valuable urban space especially in the land-scarce Kerala State. Parallel parking with pricing may be permitted in certain stretches during specified durations from 7.00pm – 8.00am. Parking on the link roads leading to MG road were also considered based on availability of road width and traffic considerations. On-street parking supply of more than 1000 ECS could be made available by legalizing restricted duration on-street parking at selected locations on MG-road and on approach roads leading to M.G Road.

Suitable spaces for development of off-street lots were identified through land use survey. These sites can be later considered for development of integrated parking facilities for mass transit stations along M.G road. In addition to the four locations already identified by Thiruvananthapuram Corporation/TRIDA, additional 65 sites were identified for proposing off-street parking facilities measuring a gross plot area of about 98,000 sq m. Parking supply equivalent to around 2000 ECS could be provided by developing off-street surface parking lots at the public and private sites identified along the MG road. The feasible off-street surface parking facilities identified can be gradually converted to multi-storied car parking systems considering the parking demand and availability of land. Off-street multi-level car parking is proposed at three locations measuring total plot area of around 9,500m^2 along M.G Road. By providing multi-level parking facilities, the parking supply could be increased by 1815 ECS.

A total supply of about 400 ECS of parking space in an approximate area of 2,700m^2 could be provided by the development of automated parking lots at the identified sites.

Parking supply could be increased through the sharing of parking facilities available at the off-street locations of both public and private buildings. This would help in the productive use of available off-street parking areas, which are under-utilized. A supply of about 2100 ECS of parking space in an approximate area of 43,700 sq.m could be utilized through shared parking facilities at the identified sites. The locations for development of peripheral parking schemes on the out skirts of the city along major travel corridors leading to the city centre were identified and the likely demand was estimated.

By developing off-street surface parking, multi-level parking and automated parking systems accompanied with parking controls, the on-street parking on M.G Road can be completely eliminated. Even the enhanced parking supply through the provision of off-street parking system will not be sufficient to meet the growing parking demand. Hence additional measures need to be implemented to control car growth and usage, thereby reducing the parking demand. The improvement in the public transport system, non-motorized transport system and development of peripheral parking schemes were expected to further reduce the parking demand along the MG road. The dispersement of activity centres away from the central area of the Thiruvananthapuram city, will result in reduction in traffic and parking demand along MG road. Adequate parking facilities shall be provided for bicycles and for the persons with disabilities. ITS parking systems ensure better utility of parking space and collection of revenue. Strict enforcement and regulation accompanied with parking facilities, parking information systems, road markings and signs will be effective in addressing on street parking problems in the city.

Paid parking in the city may be implemented and in order to cater to the demand, differential parking rates for the CBD have been adopted.

A parking management strategy, which would help in optimally utilizing the existing parking spaces, was formulated by NATPAC. The strategy included techniques of parking demand management, parking supply management measures and pricing mechanism.

16. Goods Transportation in Kerala

Road freight transport is the backbone of the real economy, but its future depends on providing safe, efficient and sustainable transport. In comparison with railways, road transport is highly unorganized and mostly in the hands of private sector, no data bank has been created, so as to use the same as input to initiate advance action plans. NATPAC addressed all aspects of goods transport operation by truck including the quantity and type of commodity transported, cost of operation, service level offered, freight charged, safety condition of vehicles etc.

The objectives of the study are:

- Assess the quantum of goods transportation in the state and their macro modal split
- Assess operational characteristics, fixed and variable cost of goods transport operation by trucks
- Determine the official freight rate for different transportation of various goods.

The tonnage and intensity of freight traffic within Kerala is increasing steadily as demand for consumer goods and other products grows and as manufacturers and retailers move from inventory based to just-in-time supply chain and distribution systems. From the primary surveys, it was estimated that around 3.18 lakhs tonnes of interstate goods are being transported every day in the state. The existing modal share of interstate freight transportation in Kerala is shown in **Figure 30.** Freight transport through roads dominates over other modes of freight traffic in the state.

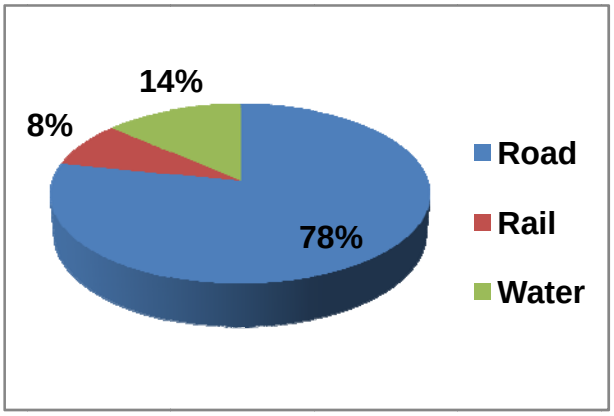


Figure 30: Existing modal share of interstate freight transportation in Kerala

Data regarding the goods transport in roads which include commodity type, quantity of goods, origin & destination and vehicle type were collected from 36 locations near to major check posts in Kerala. An average of 20,000 commercial vehicles per day (cvpd) carrying various commodities crosses different check posts in both directions. Lorry and Truck contributes 54% of goods vehicles followed by parcel vehicles (24%). The value of commodities transported by road through various check posts is around 600 crores/day.

It is estimated that a total of around 2.4 lakh tonnes of freight are transported daily through check posts in Kerala. Nearly 80% of the commodities are transported to Kerala from other states. Of the 2.4 lakh tonnes, 2.6% are perishable, 93.9% are non perishable and 3.4% are hazardous goods. Walayar checkpost handles the highest commodity movement (34%), followed by Bengramanjeshwar checkpost (17%) and Muthanga checkpost (12%). Ariyankavu checkpost handles the highest perishable commodity movement (34%), whereas Walayar checkpost handles highest non perishable (35%) and hazardous commodity (42%) movements compared to other checkposts. Fruits & Vegetables (56%) and live stock (29%) form a major share of commodities among perishable commodities. Textile Products (31%) and Construction Materials (24%) dominate over other commodities in case of non-perishable commodities. Hazardous commodities include chemical products (69%), LPG (16%) and POL (15%) products. Tamil Nadu, Karnataka and Maharashtra together contribute 68% of goods movement to Kerala and 70% of goods from Kerala. 64,000T (33%) of interstate goods are destined to Ernakulam followed by Kozhikode (22,500T, 12%) and Thrissur (19,000T, 10%).

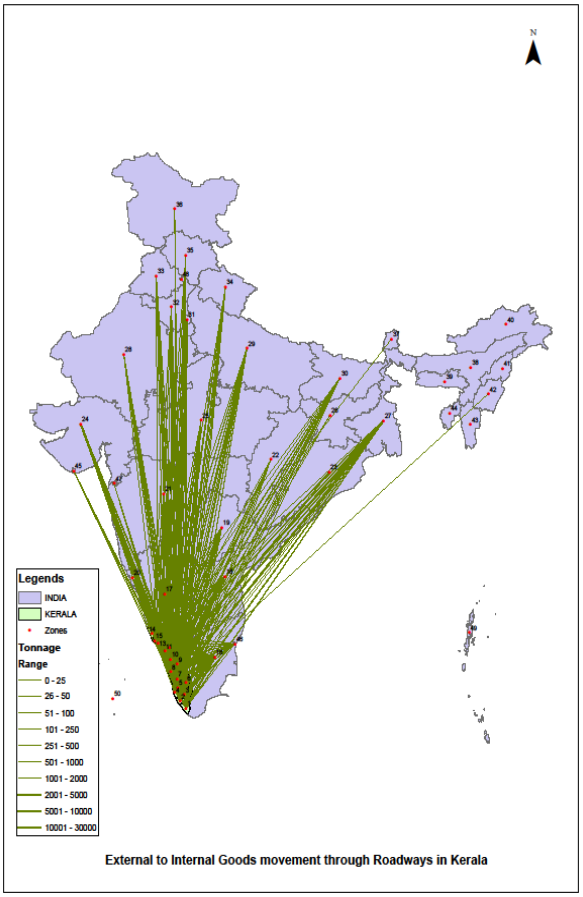


Figure 31: External to Internal Goods movement by **Roadways** *in Kerala*

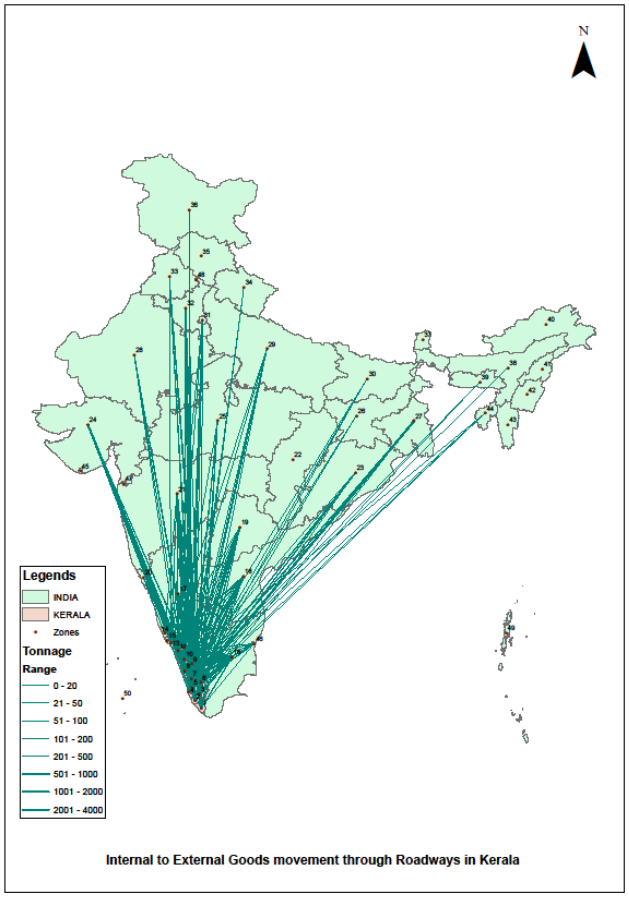


Figure 32: Internal to External Goods movement by **Roadways** *in Kerala*

Kerala transports nearly 32,000T of commodities to other states in India. Around 11,300T (35%) of interstate goods originate from Ernakulam followed by Kottayam (5,800T, 18%) and Kozhikode (4,200T, 13%). Kerala's export dominates over import from other states for commodities such as Ice, Natural Spices, Coconut products, Timber products, Rubber products, Leather goods, Tyres & Tubes and Waste Materials.

In case of freight transport through railways in Kerala, Trivandrum and Palghat divisions together transports an average of 42,400T of freight. 6.6 lakh tonnes of goods are transported monthly under Trivandrum railway division, of which 68% are non-perishable and 32% are hazardous goods. Major commodities transported are POL products, Construction Materials and Food grains together contributing to 76% of freight traffic through railways in Kerala.

Significant share of hazardous and non-perishable commodities being transported through road can be transported through railways and waterways. Roll on - Roll off services has to be promoted through railways and waterways so that heavy vehicle traffic composition, accident rate and vehicular pollution on roads could be reduced.

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

At the instance of the Department of Transport, Government of Kerala, NATPAC has been undertaking studies related to public transport, such as Stage Carriages, Taxi, Auto, State Passenger Boat Service etc. and is computing the cost of operation. This helps the Government to take appropriate decision whenever fare revision matter is taken up by the operation.

Cost Table Approach is being adopted to compute cost of operations of vehicles under optimum utilization of capacity, which is derived from detailed analysis of life cycle behavior of almost all important vehicle components. A price index is also being computed at entry-level conditions from two time periods to assess and compare movement of prices at different time periods. The index gives a scientific basis for taking decision such as fare revisions on different public transport operations in the state.

The objectives of the study are:

- To update the existing 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

- To determine the fare structure of various category of services of concerned transport operations.

Computation of Price Index for Stage Carriages Operation (PISCO) as on February 2015 Prices

The last fare revision was announced in May 2014. It can be seen that the price of diesel and certain other items have been changed since then. The diesel price alone decreased from ₹ 61.49 per litre in June 2014 to ₹ 50.91 per litre with effect from February 2015. The tyre price has decreased by one percent, lubricants by 1.3 percent and maintenance labour charges increased by 4.5 percent between June 2014 and February 2015. The cost of spare parts has also decreased marginally during the period. The salary and wages of crew have increased around six percent and the third party insurance premium showed some marginal changes during the period.

The Whole Sale Price Index (WPI) of respective transport components have also shown similar decrease in input prices. Costs of Living Price Index of industrial workers have been used for computing the changes in the salary and wages of crew and labour. The PISCO is updated to February 2015 prices based on the current prices collected through market enquiry and WPI. As per the PISCO, the variable cost showed a decrease of 13.2 percent and that of fixed cost showed an increase of four percent between June 2014 and February 2015. The overall price index showed a variation of 6.48 percent in cost of operation of stage carriages between the period of June 2014 and February 2015.

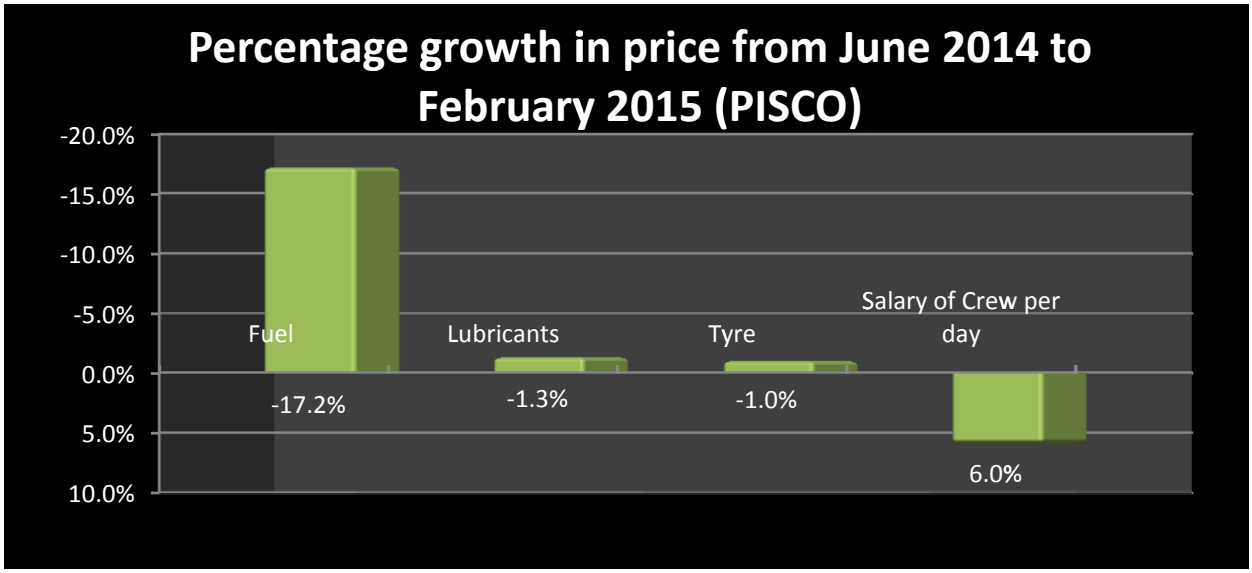


Figure 33: Computation of Price Index for Stage Carriages Operation (PISCO) as on February 2015 Prices

The input costs and assumptions were followed for the computation of various operating cost of auotrickshaws and taxis. The total cost of operation for autos and taxis is taken by adding all the variable and fixed cost components. Same quantities and variables have been retained to compute the price index. The overall Price Index for Autorickshaw Operations (PIARO) index showed a decrease of 8.7 percent between September 2014 and February 2015. The overall Price Index for Taxi Operation (PITO) index showed a decrease of 9.3 percent between September 2014 and February 2015. The computation and periodic updation of Price Indices for Autorickshaw and taxi operation in Kerala has been very effective in reflecting the relative variations in cost of operations between two time periods.

18. *Impact of Higher Floor Area Ratio in the Transportation Network of Major Commercial Corridors in Kerala*

As per Kerala Municipal Building Rules 2013, Government of Kerala has decided to increase the Floor Area Ratio (FAR) values from 2 to 4. Higher FAR values means the extent of built up area will increase without any change in the plot area i.e. more number of floors can be constructed on the same area of land. In an already congested city like Kochi, this move will cause tremendous increase in traffic volumes and pedestrians. The existing infrastructure facilities will become insufficient to meet the transportation requirements of the people. NATPAC studied the effect of higher FAR values in the transportation network of major commercial corridors in Kochi and suggested suitable development control measures.

The study area is confined to 200m on either side of major corridors of Central Business District (CBD) area of Kochi city. The commercial study corridor is selected along the MG Road from Jos Junction to Shenoy's (1 km stretch). The predominantly residential study corridor starts just after Valanjambalam junction where the road over bridge takes off in the S A Road and extends till the GCDA junction. (1km stretch).

As per the Kerala Municipal Building Rules 2013, the maximum permissible FAR in Residential A1 (plotted residential) is 3.0 whereas with an additional fee, the same may be increased to 4.0. For Special Residential A2 category, the maximum permissible FAR is 2.5 whereas with additional fee, it may also be increased up to a figure of 4.0. Similarly, for commercial and institutional uses such as educational, medical and offices, the maximum permissible FAR varies

from 2.0 to 2.5 which may be increased to 3.0 or 4.0 (in case of mercantile businesses). It is imperative to note that FAR of 3.0 and 4.0 is very high, extensive and exhaustive. Even in metropolitan cities such as Delhi and Mumbai, such FARs being utilised is rare, whereas in Kochi with distinctly sub-divided smaller plots achieving these FARs is very difficult.

Another reason for absence of such high FAR utilisation is found to be absence of a regulation for mixed uses. The KMBR Rules 2013 as well as the Development Plan for Kochi City Region 2031 do not encourage mixed land uses, as a result of which such high FAR on a single land use is seen as a rule which may bring in an exodus supply of a single use as against the demand in the market. Keeping in view the above, the maximum permissible FAR is retained to be 4.0 only while strategies are being proposed to utilise these FARs.

19. Long Term Strategies for Parking Management in Urban Areas

There is a need to formulate a long term parking strategy taking into account the extent of present parking demand including the suppressed demand, existing parking supply and limitations, optimal use of available spaces by use of Intelligent Transportation Systems (ITS), exponential growth in vehicle population and their impact on parking demand, parking supply provided in different land uses and their drawbacks etc.

NATPAC evaluated the parking deficiencies and recommended potential solutions including additional parking, parking pricing and management strategies. The study area was confined to the NH stretch between Pattom – Kesavadasapuram region in Thiruvananthapuram city.

The objectives of the study are:

- Assess the realistic values of parking capacity and parking demand (both on street and off street)
- Assess the demand-supply gap in the light of the above
- Identify the shortcomings in the respective clauses of building rules for the provision of parking space in the context of relatively high vehicle ownership
- Suggest suitable amendment in building rules for parking supply
- Formulate long term strategies for parking management

Following parking surveys were conducted in the study stretch.

- Land Use Survey
- On-street and Off-street Parking Surveys
- Road Inventory Survey
- Opinion Survey

The results obtained from the survey were analysed to determine the demand- supply gap in the study stretch.

From the road inventory survey, the available on-street parking space was estimated as per the minimum parking space requirements given in IRC SP:12 and Kerala Municipality Building Rules (KMBR, 1999). Access roads were also considered for the estimation of both on-street parking demand and supply. **Table 10** shows the comparison between on-street parking demand and supply in the selected stretch.

Table 10: Demand-Supply Gap (On-Street Parking)

Sl No.	Stretch	Parking demand (ECS)	Parking supply (ECS)	Demand-supply gap (ECS)
1	Pattom to Kesavadasapuram	174.8	113.75	-61.05
2	Kesavadasapuram to Pattom	165	131.3	-33.7
	Total	339.8	245.05	-94.75

Table 10 reveals a shortage of nearly 95 parking spaces in the study stretch, thus pointing out the fact that majority of the buildings in the study area is incapable of serving the parking demands of the motorists, due to which they are forced to park on-street.

Off-street parking survey was conducted in the selected 11 buildings to know about their existing parking demand and supply, which is as given in **Table 11**. Comparison between the parking demand and supply is to be found out to know whether the existing supply is satisfying the demand. The parking supply required for each building as per KMBR was also calculated to know if the buildings have provided their respective parking spaces as per the KMBR.

Table 11
Demand-Supply Analysis (Off-Street Parking)

Establishment code	Total parking demand (ECS)	Total parking supply (ECS)	Existing demand-supply gap	Parking requirement needed as per KMBR
C1	37.61	13.75	-23.86	26.01
C2	22.64	37.50	14.86	12.63
C3	28.11	13.50	-14.61	8.92
C4	136.19	52.50	-83.69	69.82
O1	23.73	19.50	-4.23	4.46
O2	7.67	2.50	-5.17	2.23
O3	14.97	14.25	-0.72	15.61
E1	78.28	73.75	-4.53	103.81
E2	38.70	21.25	-17.45	55.00
A1	75.00	136.25	61.25	28.00
A2	28.84	35.00	6.16	NA
Total	**491.75**	**419.75**	**-72.00**	**326.50**
# NA - Data not available to calculate the parking requirement				

It is clearly observed from Table 11 that only three out of the total 11 buildings were capable of satisfying the parking demands. About 50% of the buildings are not providing the required parking space as per KMBR,1999. Those buildings which have provided the parking space requirements even higher than the specifications mentioned in KMBR are not able to meet the parking demands, which clearly indicate that the parking space requirements given in KMBR have become inadequate due to high vehicular growth and urbanization.

There should be a revision to the existing building rules taking into account the specific purpose for which the building is used (for example, in case of commercial - textiles, restaurants, automobiles, etc.), the estimated number of trips attracted to the building, and the estimated parking generation rate. The following amendments can also be made to the existing KMBR to improve the parking conditions in a city:

- Sanction for building multi-storied residential apartments and commercial complexes within the influential area of access roads should be provided only to those buildings, where the access road is having a minimum width of 8 - 10 m.

- Approval for building new shopping malls should be given only after conducting a traffic impact study for the estimation of approximate parking demand in the building.

A successful parking management strategy for the city should involve both demand side management involving restricting the demand for parking and supply side management

involving effective supply of parking spaces. Rather than identifying a single solution to parking problems, developing combinations of solutions and using contingency planning can solve the issue of parking management to a great extent. Some of the long-term parking management strategies that could be adopted for the present study stretch are shared parking, parking regulations, introduction of progressive parking fee, carpooling, improving walking and cycling environments, improving the public transport facilities, increasing the capacity of existing parking facilities, intelligent parking systems and providing parking facilities during special events.

20. Forecasting Urban Growth based on GIS, Remote Sensing and Urban Growth Model for Major Cities in Kerala

NATPAC made a study on the trend of urbanization by analysing the pattern of urban growth from 1995 to present and to predict the urban growth for the study areas till 2030. The main focus of the study is to provide effective suggestive measures to plan the cities to accommodate its future growth. The study area were confined to Cherthala in Alapuzha district, Chalakudy in Thrissur district and Kanhangad in Kasargode district i.e., three main towns falling in three zones of Kerala viz., South, Central and North. The study provides effective suggestive measures to plan the cities to accommodate its future growth.

Scope and Objectives

- Generate detailed dataset for the study area using GIS and remote sensing technique
- Analyze the land use change in the study area for a time period of 18 years using IRS satellite data
- Analyze the urban growth pattern of cities from 1995 to 2013 and develop a model to predict its expansion till 2030
- Analyze the transport demand for the projected urban areas
- Suggest measures to effectively plan the cities for its future growth.

The capabilities of remote sensing and GIS were utilized to obtain the urban boundaries for four different time periods and predicts the growth of the cities during 2030 using urban growth margin model. Traffic forecasting is done based on the available traffic data.

Satellite imageries are the base for the data creation and analysis. Imageries pertaining to the study area viz., Cherthala, Chalakudy and Kanhangad towns were obtained from National Remote Sensing Centre (NRSC). Satellite data pertaining to 1995, 2000, 2005 and 2013 were procured.

Image Processing techniques were applied to enhance the quality of raw images.The supervised classification algorithms - maximum likelihood and minimum-distance classification were used. The land classes over the study area have been grouped into six different classes' viz., water bodies, built up area (CBD), mixed crop, coastal area, barren land and mixed crop with settlement.

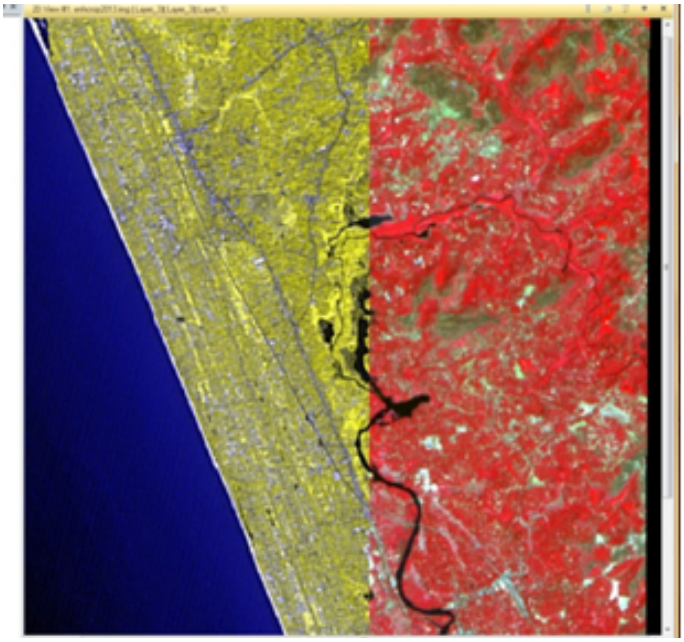


Figure 34
Satellite Image Georeferencing Using Erdas Image

All data created like feature of temporal margins (boundaries) and a baseline with the required attributes as t he input and transect lines across the margins for calculating the rate of change statistics was managed within a personal Geo database. The detail of the model is given in the Figure below.

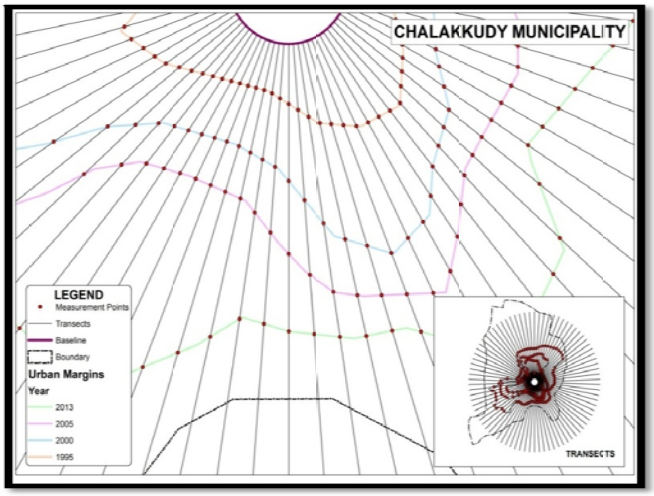


Figure 35
Representation of Urban Margins, Baselines and Transects

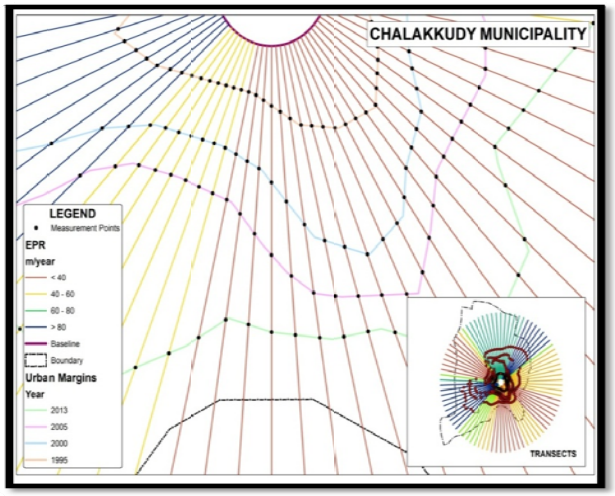


Figure 36
End Point Rate Statistics

In order to analyze the predicted Urban Margin (UM), a mean coefficient of determination (R^2) of all transect measurement points are calculated. The results are a global R^2 of 0.95 (with a range of 0.76 to 0.99) for Cherthala, 0.92 (with a range of 0.75 to 0.99) for Chalakudy and 0.91 (with a range of 0.60 to 0.99) for Kanhangad town. The study predicted the growth of the CBD till 2030 along with the growth of vehicular population.

21. Detailed Road Network Map for Kerala using GIS, Remote Sensing and GPS

Geographical Information System (GIS), Remote Sensing (RS) and Global Positioning System (GPS) are the three pillars in Geoinformatics technology. NATPAC attempted to update the road network map for Thiruvananthapuram district in Kerala. Thiruvananthapuram is the densest district in Kerala with 1,509 people per square kilometre. It is divided into six taluks: Thiruvananthapuram, Chirayinkeezhu, Neyyattinkara, Nedumangadu, Varkala and Kattakada. The urban bodies in the district are the Thiruvananthapuram Corporation, Varkala, Neyyattinkara, Attingal and Nedumangad municipalities. The district is 33.75% urbanised.

Scope and Objectives

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

Road network data set available with Government and other agencies were obtained and integrated in ArcGIS software. Detailed road network map for the district were prepared from satellite imageries available in the ESRI website. Road network for the district were generated and attribute information pertaining to the road was updated in GIS environment.

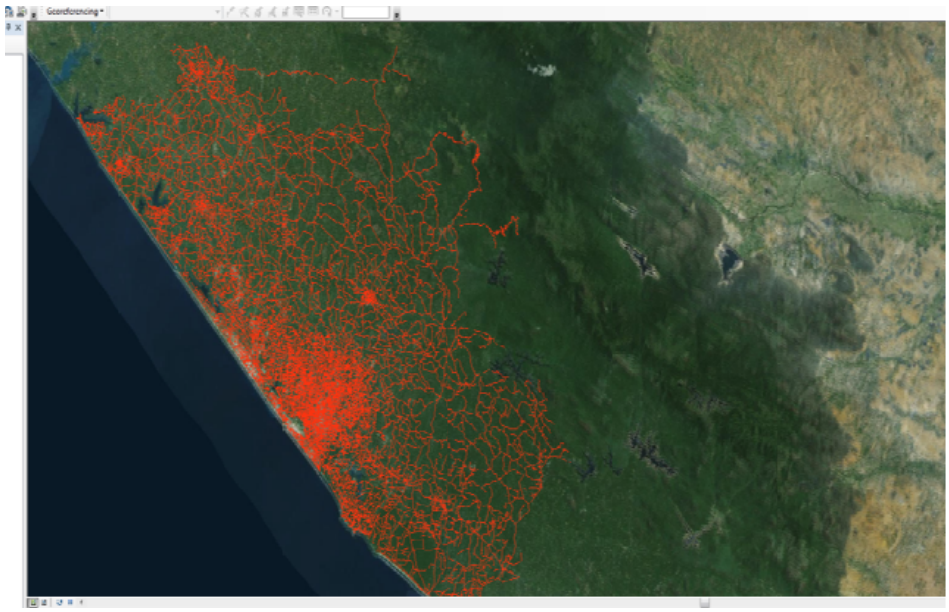


Figure 37: Map of Digitalized Thiruvananthapuram District

22. Strengthening and Modernization of Tourist Information Offices in Kerala

At the instance of Department of Tourism, Government of Kerala, NATPAC carried out the study of strengthening and modernization of twenty three tourist information offices within and outside Kerala. Department of Tourism, Government of Kerala runs Tourist Information Offices (TIO) in different districts of the State as well as other States for providing information related to tourist attraction thereby promoting tourism industry.

Scope and Objectives

- Assess the existing facilities available and location aspects in 23 Tourist Information Offices within and outside Kerala State.
- Identify measures to improve the functioning of the TIOs by;
    i. Relocation of TIOs, if needed and
    ii. Suggest measures for improving the current functioning of TIO's.

For understanding the current status of Tourist Information Offices, and to gain baseline data on visitors from TIO, all the twenty-three tourist information offices (TIO) were visited. Data collection was done through questionnaire survey with Tourist Information Office staff and tourists who visited the office. Opinion survey was conducted in major tourist spots in Kerala to ascertain the knowledge of tourists regarding the presence of TIO. Access to the Tourist Information Offices, building and ground facilities, site characteristics and the services offered were also measured.

Conceptual innovations that a modern Tourist Information Office should possess and cost estimate for the construction of new Tourist Information Office were prepared and submitted **(Figures 38 & 39).**

Figure 38: Sample Sign Board

Figure 39: Front View of a Modern Tourist Information Office

23. Improvement Proposals for Oachira-Kalpakavadi Section along NH 66

The NH section in the District of Alappuzha, Kerala has been prone to a series of accidents owing to the considerable speed of vehicles plying through, along two-lane wide road. A number of pocket roads also exist along the length of the section and they directly merge with the main traffic owing to the lack of service roads. NATPAC analysed the major factors aggravating the accident severity in the stretch and suggest appropriate measures to reduce the number and severity of accidents. Short term improvement measures are suggested to reduce the accidents along the Kalpakavadi – Oachira road stretch

Table 12: Accident Prone Locations and Suggested Improvement Measures

Sl. No.	Name of the Intersection	Improvement Measures
1	Oachira (Vedakkapalli)	• Improvement of junction as per the standards • Provide adequate lighting • Install adequate sign boards • Clear the vegetation on the shoulder
2	Ajantha Junction	• Provide adequate lighting • Mark continuous road marking along the curve • Relocate the bus stop with bus bay • Clear the vegetation from the shoulder
3	Mukkada Junction	• Improve the junctions as per the design standards • Install sign boards & signals • Provide adequate shoulder to the pavement • Ensure safe movement of pedestrians by providing foot paths & zebra crossing • Relocate the bus stops with bus bay • Ensure the proper working of Medium Mast Light • Remove advertisement boards from the channelizers
4	Krishnapuram Palace Junction	• Relocate the bus stop with bus bay • Adopt proper junction improvement measures.
5	KPAC Junction	• Provide earthen shoulder on either side of the pavement for a minimum width of 1.2 m • Ensure safe movement of pedestrians especially school children • Provide proper road markings and sign boards • Provide pedestrian actuated signals
6	TEXMO Junction	• Improve the junctions as per the design standards • Install adequate sign boards • Provide enough sight distance at the junction • Provide earthen shoulder and safety fencing on either sides of the pavement • Clear the vegetation along the embankment and road shoulder • Adopt suitable embankment protection measures
7	Kayamkulam bridge Junction	• Install lights & reflectors • Install proper sign boards
8	ONK junction	• Improvement of junction by providing bell mouth to the side roads • Provide enough earthen shoulder on either side of the pavement • Relocate the existing bus stops with bus bays • Ensure safe movement of pedestrians providing foot paths & zebra crossing
9	Puthenroad	• Provide enough lighting • Provide bus bay at the bus stop • Clear the vegetation along the embankment and road shoulder
10	Kareelakulangara	• Construction/strengthening of earthen shoulder • Install medium mast light • Provide bus bay at the bus stop

11	Maliyekkal	• Install medium mast light • Relocate the electric post at the junction • Provide bus bay at the bus stop • Construction/strengthening of earthen shoulder
12	Ramapuram HS	• Install medium mast light • Provide bus bay at the bus stop • Ensure safe movement of pedestrians by providing foot paths & zebra crossing • Construction/strengthening of earthen shoulder
13	Cheppad	• Install high mast light with visibility on all arms • Relocation of bus stop with bus bay • Ensure safe movement of pedestrians by providing foot paths & zebra crossing • Ensure proper setback to the shops
14	Nangyaarkulangara	• Clear the vegetation along the shoulder and median
15	RK Junction	• Redesign the junction as per the standards and raising of minor roads to the level of highway • Install high mast light • Adopt suitable embankment protection measures • Widening/strengthening of earthen shoulder
16	Thamallakkal	• Install lights, road markings & reflectors • Ensure safe movement of pedestrians by providing foot paths & zebra crossing • Provide bus bay at the bus stop • Ensure proper setback to the shops
17	Karuvatta HS	• Provide sufficient road markings • Ensure safe movement of pedestrians
18	Karuvatta Vazhiyambalam	• Provide bus bay at the bus stop • Correction of geometry by converting compound curve to simple curve and incorporating proper transition length and super elevation

Below are few situations observed along the Kalpakavadi – Oachira road stretch.

Plate 1
Edge Drop at Kareelakulangara Junction

Plate 2
Dangerous Turning Movement at TEXMO Junction

Plate 3
Conflicting Traffic Movements at RK Junction

Plate 4
Bus Stopping at the Carriageway Due to Lack of Bus Bay

24. Provision of Additional Access to the Kozhikode Bypass – Phase II

At the instance of Public Works Department (NH), GoK, NATPAC inspected the Kozhikode bypass towards deciding the feasibility of additional accesses at chainage 1/350 and between chainage 2/400 & 2/600. The demand of the same has been raised by the local people. The bypass alignment in the said stretch is being built on embankment portion having an average height of about 5.5m and 6.0m respectively. In order to substitute the existing cross roads, openings in the form of underpasses are already provided at km 1/345, 2/340 and 2/610 for the cross movement of local traffic from the adjacent portion of the bypass.

Existing Scenario

Three underpasses of dimensions 5m x 4.5 m, 4m × 3m and 8m × 5m has been built at km 1/345, km 2/340 and km 2/610 respectively. The second one helps for the movement of the lighter vehicles while the other two will cater movements of all types of vehicles. Two bridges namely Korapuzha Bridge and Purakkattiri Bridge are also being built at chainages 2/050 and 4/370 respectively with two-lane standards and consequently the service roads of the highway do not have continuity. In order to provide a direct access for the local traffic to the bypass, an at-grade intersection has been planned at km 3/480. Correspondingly, the local traffic from the northern side of Korappuzha bridge may need to travel a maximum additional distance of 8 km, if they want to perform a to and fro trip towards Kozhikode direction and similarly those from southern side of Korappuzha bridge may need to travel a maximum additional trip of 6 km if they want to perform a to and fro trip towards Koyilandy direction.

Scope for an Additional Access

Option 1: Access as per IRC Standards

Based on the reconnaissance survey and considering the site conditions, it is found that provision of an access ramp to the bypass from km 1/350 and between km 2/350 and km 2/600 may help to connect the traffic from the adjacent area to the NH bypass. The possibility of providing ramps on either sides of the bypass was thought of, but this idea was ignored considering the limited service road width available on the left side of the alignment. Correspondingly a standard junction layout as per IRC standard has been prepared for the service road merging and diverging location.

Option 2: Access compromising IRC standards

Provision of accesses with a compromising of the IRC standards was also tried out. Here also, the ramps have been proposed at one side of the bypass considering the limited width of service road on left side.

Likely Issues with the Proposed Access

The highway is already designed for vehicles to move at high speed in the range of 80-100 kmph. The vehicles approaching the highway from the proposed ramps may find it difficult to enter into the highway. This demands a signal controlled intersection for a safe and smooth functioning of the traffic on the highway.

However, some of the issues that may arise as a consequence to the additional access are listed below.

1. The proposed ramps will act as a barrier for the adjacent area for the length of 220 m and 260m at these two additional access locations, and this area will get totally segregated from the highway. The traffic from the corresponding houses and lands will be denied of access to the bypass through the proposed ramps. Residents of the area will have to opt for some other local roads, to reach the at grade junction/underpass in order get access to the highway as well as the service road.

2. An at-grade intersection for the bypass is already planned at km 3/480. The provision of the ramps for getting access to the highway results in the formation of an intersection at km 1/210 and at km 2/460. The distance between these intersections (all are being signal

controlled) is around one kilometre only which is not desirable for a National Highway. As per IRC standards, the minimum distance between intersections at a National Highway is 2 km.

3. Moreover, five intersections controlled with signals are formed within the 5 km bypass road, which is not suitable considering the straight traffic through the bypass.

4. In the case of option 2, since the turning radius is not adequate and smooth, more time is required for the turning operations and hence the risk of accidents is higher.

The additional cost incurred for four-laning the bypass section in the intersection area, construction of ramps, medians, extension of underpasses (from two-lane width to four-lane width), etc are to be duly considered, in addition to the required land acquisition and the corresponding cost.

25. Improvement of Kallettumkara Junction in Thrissur District

Kallettumkara is a small town located near Irinjalakuda in Thrissur district located at 10°20′0″N and 76°16′0″E. The church gate road deviating from the SH-61 at this location creates a 'T' junction. Also two minor roads are bifurcating from the SH-61 immediately after the church road junction thus creating a '+' junction. The state highway 61 links the two major towns in Thrissur district namely Irinjalakuda and Chalakudy. These towns cross Shornur – Ernakulam broad gauge double line railway track through a Rail Over Bridge near the Kallettumkara town. The railway station road deviates from the SH-61 exactly at the end portion of ROB approach. This results in the formation of a new 'Y' junction which is about 50m before the Church road junction. Since the ROB approach was constructed at a gradient of 4%, the ROB arm of the new junction was also constructed at the same gradient. Absence of proper delineation and warning sign boards creates dilemma. The vehicle drivers are not warned about the presence of a junction ahead.

Traffic Flow and Projection

From the classified volume count survey it is found that maximum traffic flow occurred between 8 AM and 9 AM. About 1,336 Passenger Car Unit (PCU) (1,277 vehicles) was observed at these junctions during peak hours. Of which, about 50 % of vehicles are two wheelers and 19% are cars.

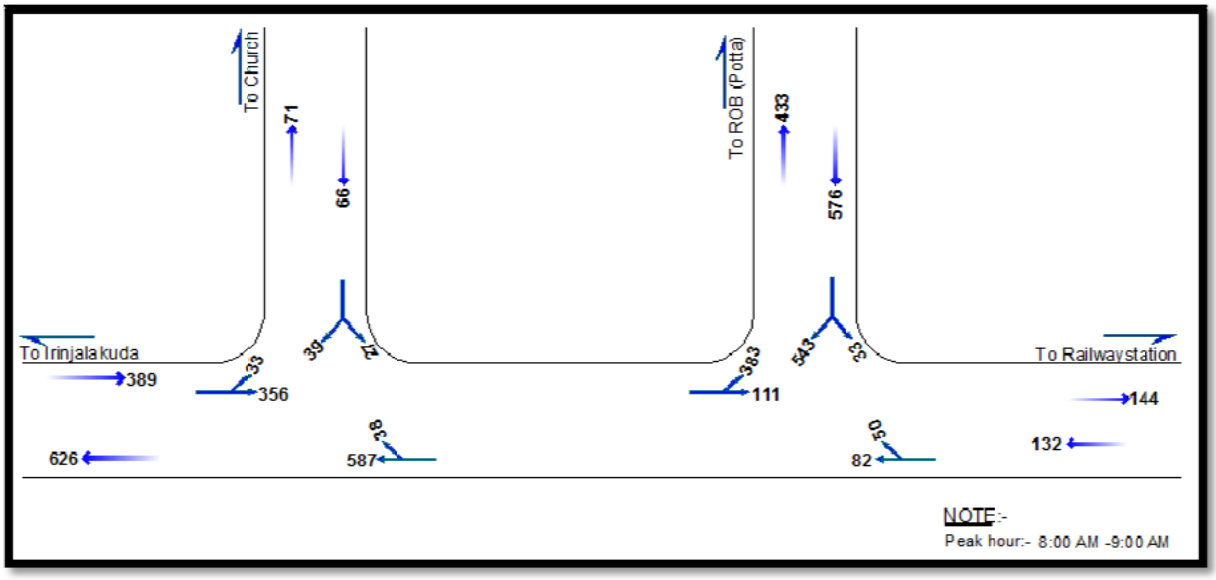


Figure 40: Traffic Flow Diagram at Kallettumkara

After considering the existig trafic situation and the projected traffic, two options were worked up for improving the junction.

Improvement proposal upto horizon year

It is suggested to widen the junction by utilizing the existing right of way and to provide drop islands on all the three arms to ease the turning movement. Adequate sign boards and proper delineation are also proposed to guide the drivers to avoid accidents at the junction. Land acquisition and dismantling of structures are not required as part of this improvement proposal.

Improvement proposal after the horizon year

After considering the future traffic and possibilities of accident, a long term proposal is worked out. A new link is proposed towards Irinjalakkuda direction from the ROB approach junction as a continuation of ROB arm. This link is proposed as a one-way road towards Irinjalakkuda and the existing road is also treated as one way for the traffic towards Potta direction.

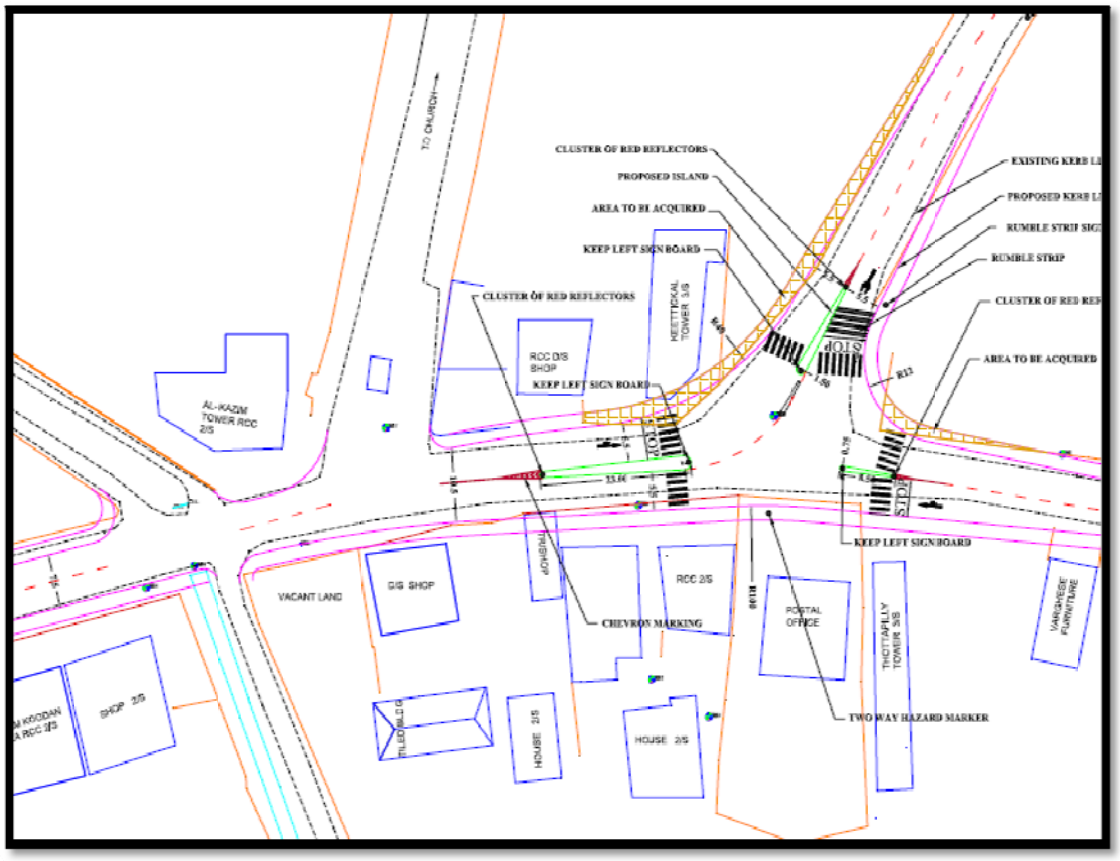


Figure 41: Improvemment proposal up to horizon year

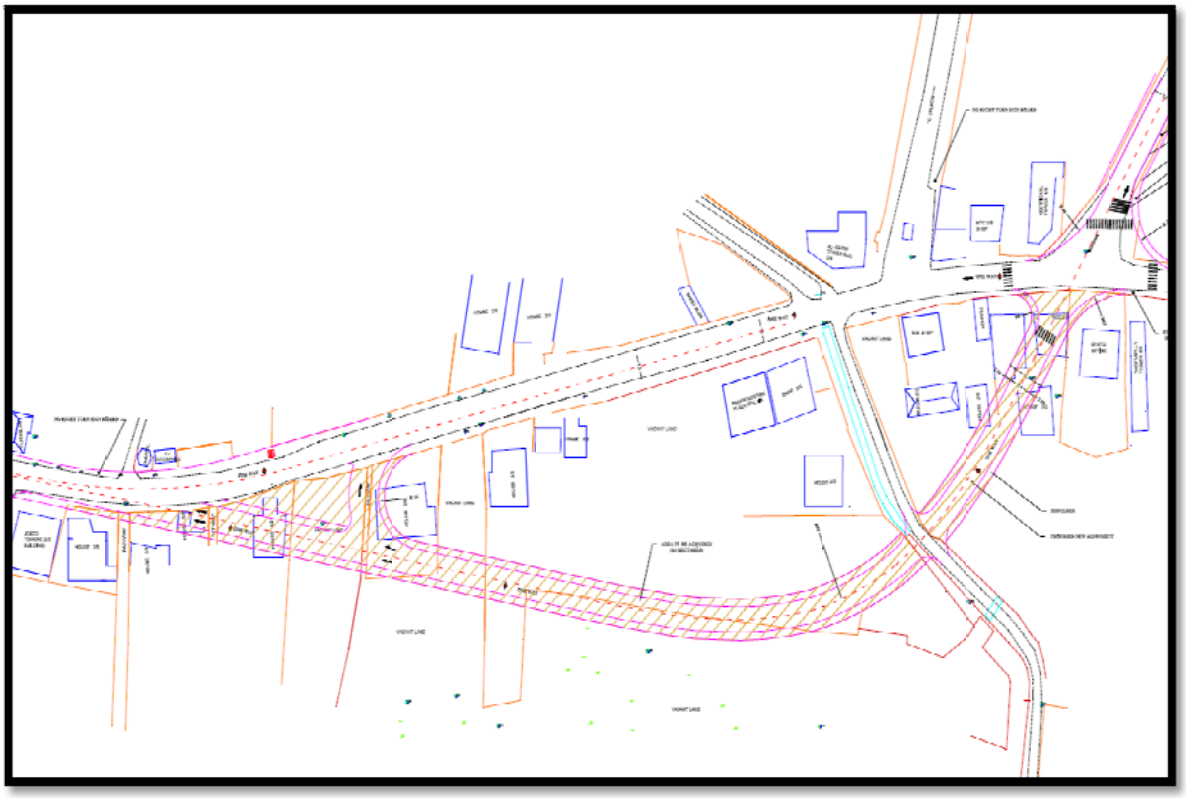


Figure 42: Improvement proposal after the horizon year

26. Evaluation of Fibre Reinforced Asphalt Mixes and its Suitability to Kerala Condition

The amount of distresses such as rutting, raveling, undulations, cracking, bleeding, potholes etc. occurring in conventional asphaltic pavements (dense graded asphalt concrete mixes) and surface layers have increased dramatically over the time. So we have to focus more on the use of more resistant and durable asphalt mixtures in the surface layer, such as mixtures with discontinuous graduation, like Stone Matrix Asphalt (SMA). SMA is found to have high resistance to rutting, increased service life, improved low-temperature performance, improved macrotexture, and reduced tyre noise. But due to the gap graded gradation of SMA, it is considered appropriate to add fibres in the mix to reduce the drain down of bitumen through the air voids of the mixture. The addition of fibres improve the performance of SMA mixtures against permanent deformation and fatigue cracking by providing additional tensile strength.

In developing nations like India it is required to construct maximum road length at minimum cost. This is possible only by utilizing locally available and cheapest material. There is an urgent need to find the suitability of locally available fibres in asphaltic mixes.

Objectives

- To evaluate the feasibility of using coir fibre in SMA and to compare it with glass fibre reinforced SMA mixes
- To quantify change in mix properties due to inclusion of fibre by conducting Marshall Stability test
- To compare the performance of fibre reinforced SMA mixes with Virgin SMA mix and develop an appropriate mix ratio

Plate 5
Coir Fibres

Plate 6
Glass Fibres

The scope of the study is limited to experimental investigation on SMA reinforced with coir fibres and glass fibres

Methodology

- Conduct Marshall Stability test on unreinforced and fiber reinforced SMA to obtain bitumen content and arrive at suitable mix design
- Conduct tests on different percentages (0.0%, 0.3% ,0.4% and 0.5%) of coir fibres and glass fibres to arrive at optimum amount of fibre to be added in SMA
- Study the effect of length of fibre by performing tests on 1cm, 2cm and 3cm length coir fibres in reinforcing SMA
- Conduct wheel rut test, draindown test and indirect tensile strength (ITS) test to evaluate the performance of fibre reinforced SMA over virgin SMA

Marshall Stability test was conducted to obtain the optimum binder content of SMA mixes. The optimum binder content was obtained by taking the average of binder content corresponding to:

- Peak stability value
- Peak unit weight value and
- At 4% air voids value

Accordingly, the optimum binder content for virgin SMA was obtained as 5.95 %

Drain down tests, wheel rut tests and indirect tensile strength tests were conducted to evaluate the performance of the SMA mixes designed at their corresponding optimum binder content.

Table 13 Performance test on SMA with and without fibres

SMA mix	Length (cm)	Percent Fibre	Drain down	ITS (kPa)	TSR (%)	Rut (mm)
Virgin SMA	-	-	0.58	144.96	74	4.98
SMA mix with Coir fibre	1	0.3	0.32	151.97	94	3.89
		0.3	0.41	153.42	99	3.73
		0.4	0.21	222.89	98	3.53
		0.5	0.23	141.24	60	4.19
SMA mix with glass fibre	2	0.3	0.03	316.31	88	3.04
		0.4	0.06	236.72	97	2.43
		0.5	0.11	238.49	91	2.50

Conclusion

The optimum length of coir fibre is 2 cm and the optimum fibre content is 0.4 % based on performance tests. The optimum fibre content for 2cm glass fibre used as stabilizer is 0.4 %. There is a significant influence of the type of fibre used on the performance of SMA mix. When the ITS values increases, draindown decrease and the rutting also decreased on stabilizing the SMA with optimum fibre content. Even though both the fibres showed good performance, the glass fibre stabilizer resulted in slightly better values. However, the natural fibre i.e. the coir fibre being of low cost and readily available in Kerala it will be more suitable to pavements in Kerala.

27. Effect of Geometric Parameters on Road Safety – Case Study of Newly Upgraded Highways in Kerala

Safety of a road is always a matter of major concern. The safety of a road is measured by the frequency and severity of crashes expected to occur on it. It seems that the human factor is more dominant than the road or vehicle factors in the happening of accidents. The control of the road factor is much easier than the human factor. Moreover, by making a geometrically good design, it is possible to compensate for the other factors and thus decrease the number of traffic accidents. This makes it apparent that in order to establish highway safety, it is important to make a good geometric design.

The highway design standards are limit standards. Limit standards do not tell the designer what the safest design is. Rather, they specify the limit of what is permissible. Geometric road design standards have a direct bearing on the level of risk for drivers and other road users. The effective management of road safety risk involving different road design elements requires an understanding of:

- The factors that contribute to risk and how to reduce them
- The extent and distribution of these factors in the road network

This knowledge allows comparison of the effects of geometric parameters on safety. It also provides a framework for road designers to measure the road safety impact by applying minimum standards where funds are limited.

NATPAC identified the road geometric design elements and characteristics and find out how and to what extent they affect highway safety. The Centre also studied how a variation in design elements affects the safety of roads in different environments.

The study area selected was a part of SH 1 also referred as MC road, stretching from Kazhakkoottam to Adoor having a length of 77 km. This highway was divided into 14 sub sections for the study purpose.

Three-year location wise accident data were collected from the police stations in the sub sections of the study road. Accident rates were calculated in different groups, namely total accidents, fatal accidents, injury accidents and damaging accidents (property damage only) etc. The geometric parameters of these subsections were also collected. Finally, a regression analysis was performed for establishing the relationship between geometric parameters and the accident rates.

The database used in the prediction model is of a two-lane State Highway covering 77 kilometers where 1,369 crashes occurred (out of which 201 were fatal) from 2010 to 2012. The variables used in this prediction model are the Annual Average Daily Traffic (AADT), gradient, horizontal curve radius, section length, shoulder and lighting details. All the parameters used in the model are significant to a 95 Pearson chi-square and scaled deviance values can be used to rank the models according to best data fit. Even though the dispersion parameter is best for binomial regression analysis than Poisson regression analysis, both Poisson Regression and Negative Binomial Regression analysis were done for model development.

Impact of length

There are 14 homogeneous road segments of arterial roads analyzed in this study having road length varying from 3.2 m to 6.6 km. Length appeared as a significant variable in all models. The positive sign of its intercept confirms the increase in risk with every kilometer of travel, which also conforms to the findings of Hadayeghi et al. (2003).

Impact of curve radius

The horizontal curve radius was found to be significant in the models. The positive sign of intercept of dummy variables of curve radius indicates increased risk of total crashes on mid blocks.

Impact of shoulder

The stretch has paved shoulder whose width ranges from 0 m to 3.5 m. Here, the presence of shoulder proved insignificant parameter.

***Impact of AADT*:**

AADT has no significance in causing accidents as per the model.

Statistical analysis indicated that, several highway geometric parameters are very significant to cause accidents in the highway. It is found that number of total crashes and fatal crashes increases with increase in section length, horizontal curve radius and gradient. AADT and lighting did not show any significant effect in the study stretch. Shoulder width is having least significance in predicting fatal crashes.

28. Improvement of Muthuvara and Mundur Junction in Thrissur District

Muthuvara and Mundur are two major T – intersections in State Highway 69, between Thrissur and Kunnamkulam. These junctions carry a lot of turning movements and accidents occurred frequently as the layouts are not scientific. At the instance of Public Works Department (PWD), NATPAC studied the existing situation and junction layout and proposed a suitable improvement plan for these locations.

Traffic Flow at Muthuvara Junction: From the Classified volume count survey, it was observed that maximum traffic flow occurred between 8.15 AM and 9.15 AM. 3,868 Passenger Car Unit (PCU) (4,228 vehicles) were plying at this junction during the peak hours. 50 % of vehicles are two wheelers and 27 % are cars. Majority of vehicles are plying through the State Highway 69. About 25% of traffic at this junction is turning traffic.

Traffic Flow at Mundur Junction: Maximum traffic flow occurred at Mundur junction is between 4.45 PM and 5.45 PM. 2,594 PCU (2,480 vehicles) were plying at this junction during the peak hours. 39 % of vehicles are two wheelers and 35 % are cars. About 77% of traffic is through in nature and the balance 23 % is turning traffic at this junction.

Proposed Improvement

Muthuvara Junction: - After considering the existing traffic situation and the projected traffic, improvements in terms of modification in the junction layout is proposed according to MoRTH standards. The junction should be treated as a signalised intersection to ensure the smooth flow of traffic (***Figure 43)***.

Mundur Junction: - Two alternative proposals are made for this junction. Option one is as per the standards, but this option affects many structures including a multi storied building. Hence a second option is also proposed compromising the standards. However, the first option is recommended for implementation (***Figure 44)***.

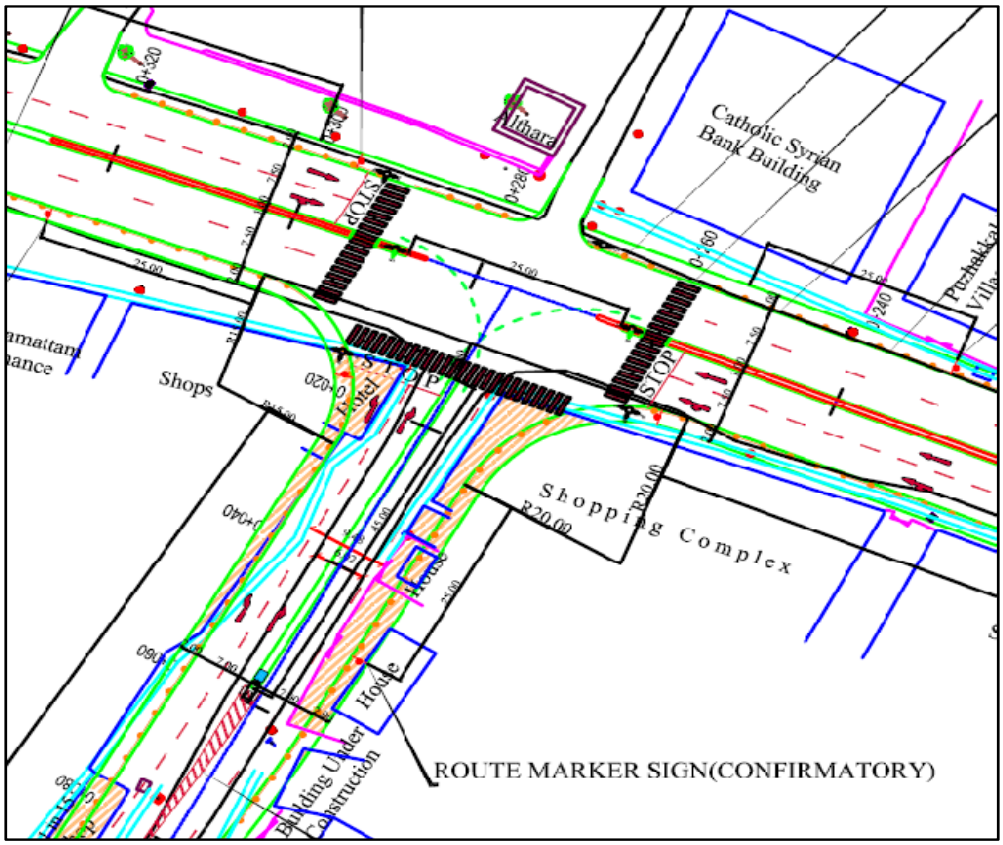
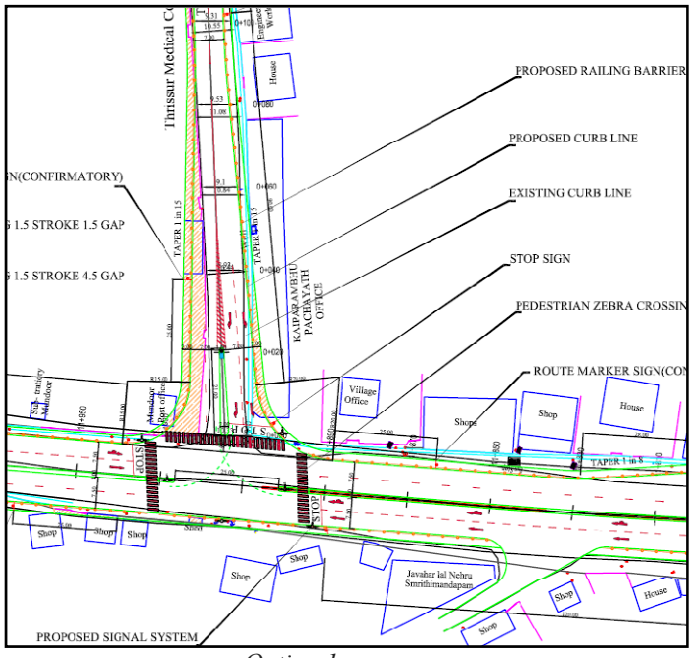
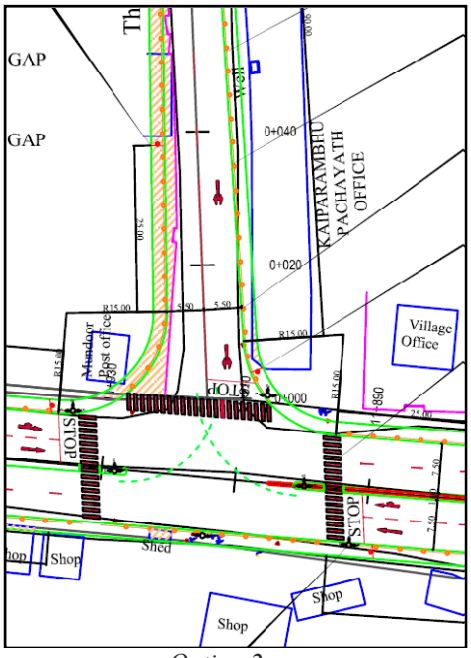


Figure 43: Improvement proposal at Muthuvara Junction



Option 1



Option 2

Figure 44: Improvement proposals at Mundur Junction

29. Combined Bypass for Thalassery and Mahe

Bypass roads are constructed in order to let through traffic flow without interference from local traffic, to reduce congestion in the built-up area, and to improve road safety. The alignment for Thalassery bypass was finalised way back in 2008 with a total length of 18.15km. Bypass alignment has got segments which stretches in Kerala and Mahe. The alignment starts at km 170+150 near Muzhappilanagadi and ends at km188+300 after Mahe railway station and just ahead of the Mahe excise checkpost. Public Works Department, National Highways has entrusted NATPAC to prepare project reports for the initial 10.8km length for which land acquision is complete.

Abstract of the bypass alignment for initial 10.8km is given in **Table 14.**

Table 14 : Abstract of the bypass alignment for initial 10.8km

Sl No.	Description	Details
1	Start Chainage	170+150 (NH-66 near Muzhuppilangad)
2	End Chainage	180+950 (NH-66 near Edathattuthazhe)
3	Length under consideration (km)	10.8
4	Major bridges (No)	4 (Total span 175+385+88=648m) *i. Bridge on Anjarakandi river @Ch. km 171+150of Span 175m (5X35)* *ii. Bridge on Dharmadam river @Ch.km 173+600 of Span 385m (11X35)* *iii. Bridge on Eranholy river @Ch. km 177+715 of Span 88m (4X22)*
5	Vehicular Underpass	5 nos (span 12m each)
6	Culverts (No)	34

For most of the portion along the bypass alignment, earthwork in the form of filling is required. Keeping in view of the general soil characteristics of the region, a minimum value of subgrade California Bearing Ratio (CBR) of 7% is considered for pavement design for the project road. 50 mm Bituminous Concrete (BC), 120 mm Dense Bituminous Macadam (DBM), 250 mm Wet Mix Macadam (WMM) and 200 mm Granular Sub Base (GSB) is proposed over 500 mm prepared subgrade as new pavement layers.

Revised cost estimates have been prepared for the initial 10.8 km of combined bypass for Thalassery & Mahe. The quantities of various items were worked out. Total cost of construction for initial 10.8 km length of Thalassery- Mahe combined bypass is estimated to be ₹ 300.63 crores.

30. Thrippunithura Bypass

At the instance of Public Works Department, National Highways, NATPAC took up the task of preparing report for Thripunithura bypass. The alignment for Thripunithura bypass was finalised way back in 2011. Total length of the Thripunithura bypass for NH 49 (Bodimettu to Kundannoor) is 8.230km and is to be completed in three phases of which phase I and II is of length 3.75km and remaining 4.480km under phase III.

Thripunithura bypass alignment bypasses the busy junctions of Thripunithura town and Thiruvankulam. The bypass starts at 274+000km on NH 85 at Mattakuzhi and passes through plain and rolling terrains and ends at 284+550km on NH 85 at Maradu – Punithura region. The endpoint is near the three arm junction near Gandhisquare. The study region mainly encompasses the territories of Thripunithura and Thiruvankulam. Major state highways such as Thrippunithura – Ettumanur (SH-15) and Thrippunithura – Muvattupuzha are passing through the Central Business District (CBD) of the town.

The starting point is located at the place named Mattakuzhi and thereafter alignment runs mostly through the vacant land affecting only a minimum number of structures. An elevated structure is proposed for about 1.5km with the pillars of the elevated structure to be built along the side Andhakaranazhi thodu which is a man-made canal under the control of Irrigation Department. The main advantage of this is an environment friendly alignment with least impact on settlement. After the elevated portion, the alignment re-joins the existing mini bypass at the approach road of the newly constructed two lane bridge at a chainage of km 7+700.

Plate 7
Andhakaranazhi Thodu

Three lane configuration having a total width of 12m is proposed for the elevated structure. The number of culverts to be constructed is 22. The most desired and significant aspect is that this alignment causes minimal harm to the wetlands. The design speed proposed is 80 kmph except on elevated structure where a design speed of 65 kmph is feasible.

Table 15 :Abstract of the bypass alignment

Sl No.	Description	Details
1	Start Chainage	274+000 (near Mattakkuzhi on NH-85)
2	End Chainage	284+550 (at Gandhi square on NH-49)
3	Approximate Length (km)	8.230
4	Major bridges (No)	1 (span 160m)
5	Minor Bridges (No)	2 (span 8m, 20m)
6	ROB (No)	1(span 540 m)
7	Elevated structure	1.5 km long(12 m width)
8	Culverts (No)	22
9	Alignment through marshy land and wet land	minimal
10	Fill through marshy land	Less
11	Design speed (kmph)	80 with speed restriction at elevated structure
12	Structures affected	65

Keeping in view of the general soil characteristics of the region, a minimum value of subgrade California Bearing Ratio (CBR) of 8% is considered for pavement design for the project road.

Table 16
Flexible Pavement Design for New Construction

Layer	Thickness (mm)
Bituminous Concrete (BC)	40
Dense Bituminous Macadam (DBM)	60
Wet Mix Macadam (WMM)	250
Granular Sub Base (GSB)	200
Prepared Subgrade	500
Subgrade CBR	8%

Revised cost estimates have been prepared for the Thrippunithura bypass. The quantities of various items are worked out and the total cost for construction is ₹ 315.71 crores.

31. Design Improvement of Multi Arm Intersection – Case Study of Station Kadavu in Thiruvananthapuram City

The Station Kadavu junction is located about 400 m away from Kazhakuttom – Chakkai NH Bypass Road and 600 m away from Sreekariyam - Kulathoor road. The junction is a five-arm uncontrolled busy intersection and it holds considerable amount of traffic. The major rail connectivity to Northern part of Kerala from the state's capital is passing about 30 m away from the Station Kadavu junction. There is a level cross at this location and due to the frequent movement of trains, the frequency of closing the gate is more at this manually operated railway cross. Traffic movement in this road network is severely affected which ends up in queuing of vehicles behind the junction.

A total of 1292 PCU (1668 vehicles) was plying through this intersection during the peak hour (08:15 AM to 9:15 AM). Two wheelers constituted 63% of the total traffic followed by cars (19%).

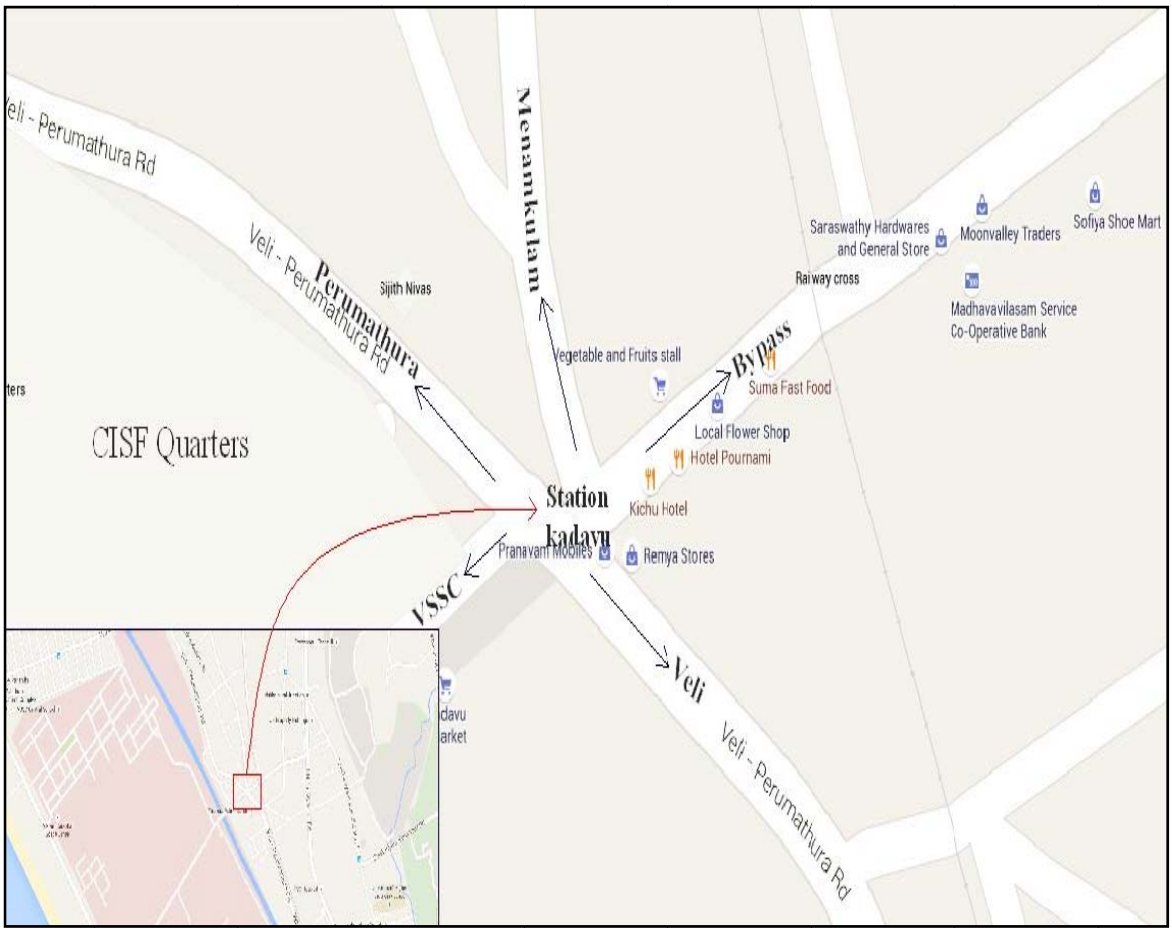


Figure 45: Station Kadavu Junction

Based on the topographic survey, the base plan of Station Kadavu junction is prepared. As per IRC 65-1976, the lowest traffic volume for which rotary treatment should be considered is 500 veh/hr and the maximum traffic volume that a rotary can handle efficiently is 3000 veh/hr. So, considering the traffic, a mini roundabout at the intersection is proposed. The land availability in the intersectional approach road is very less to cater the existing traffic movement and if any improvement scheme is to be implemented, land acquisition will be mandatory.

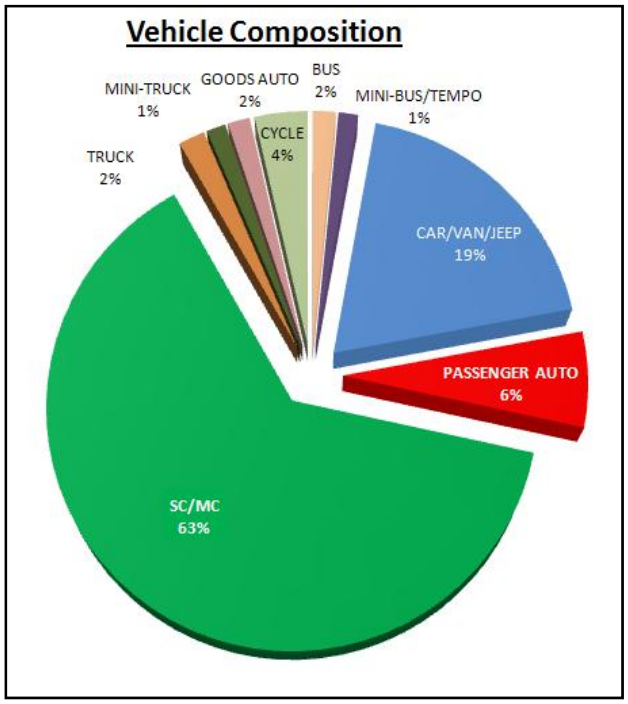


Figure 46: Percentage Distribution of Vehicles

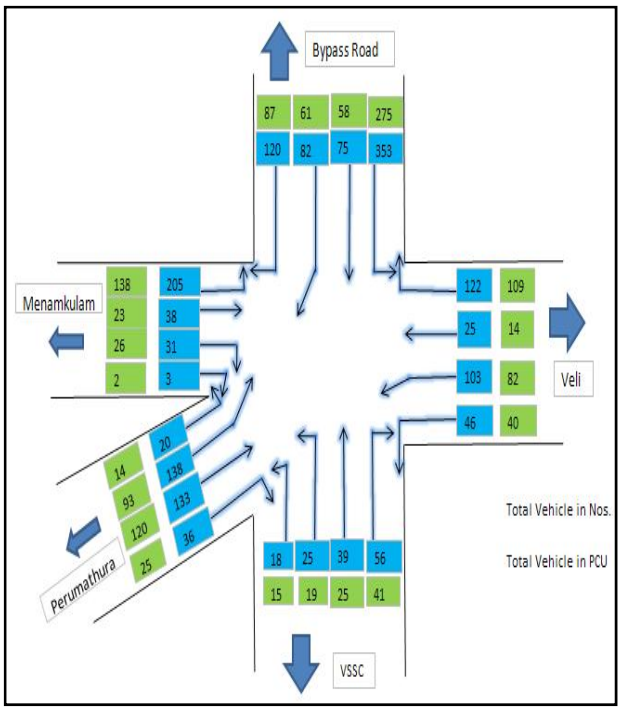


Figure 47: Peak Hour Traffic Flow Diagram

Two alternate improvement proposals for the junction improvement are considered.

Alternative 1- Provision of a Mini Roundabout

A mini roundabout of diameter 12 m has been proposed so that the vehicle movement will be smooth.

- The road connecting Station Kadavu with Bypass is proposed to be of four-lane width for a length of 200 meter from the junction and is to be provided with a median
- Channelizing islands has been proposed to guide the vehicle through the allocated lane so that vehicle conflict is reduced to the maximum possible extent
- All the approach roads intersecting the junction are provided with 14 m width
- 8 m road width is suggested along the circular central island to ensure the free movement of vehicle

- Foot path of 2 m width is provided on the entire approach roads, guarded with hand rails, except at the zebra crossing points to ensure safe movement of pedestrians

- The approximate additional land to be acquired is 0.5059 hectare. Permanent structures that will be affected are 57 in number.

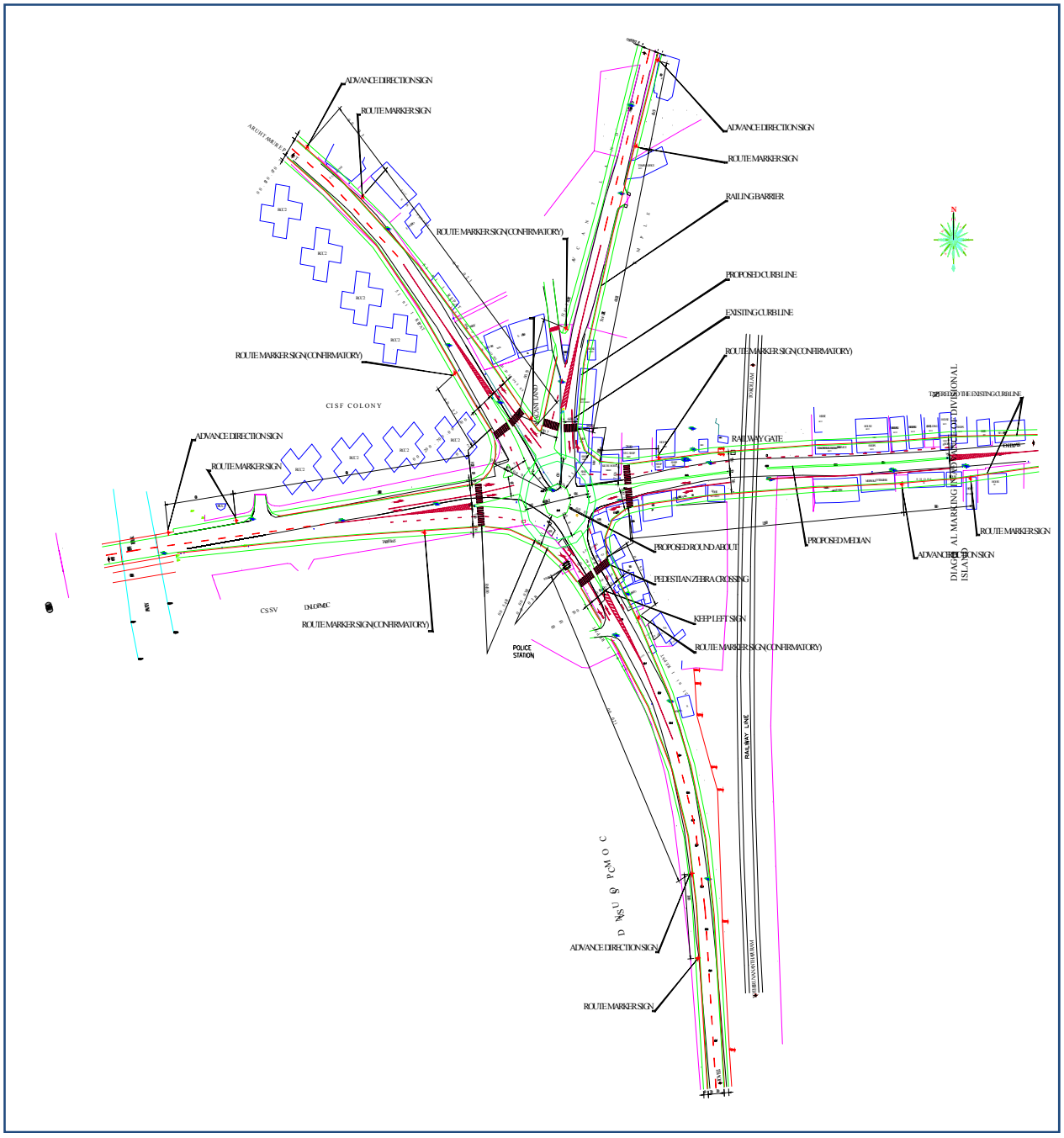


Figure 48 Alternative 1 – Mini Roundabout

Alternative 2- Provision of Channelized islands

A channelizing island is proposed to ensure a free guided flow of traffic through the intersection. Channelization is the separation or regulation of conflicting traffic movements into definite paths of travel by traffic islands or pavement marking to facilitate the safe and orderly movements of both vehicles and pedestrians.

- The road connecting Station Kadavu with Bypass is proposed to have a carriageway width of 12 m with median till the railway crossing, beyond which it get converged to two-lane carriageway width

- All the approach roads intersecting the junction are provided with 12 m carriageway with median, except for the Menamkulam road which has a carriageway of 7.5 m

- A footpath of 2 m is proposed on all the approach roads for the safe movement of pedestrians

- The additional land to be acquired is 0.3763 hectare. Permanent structures that will be affected are 50 in number.

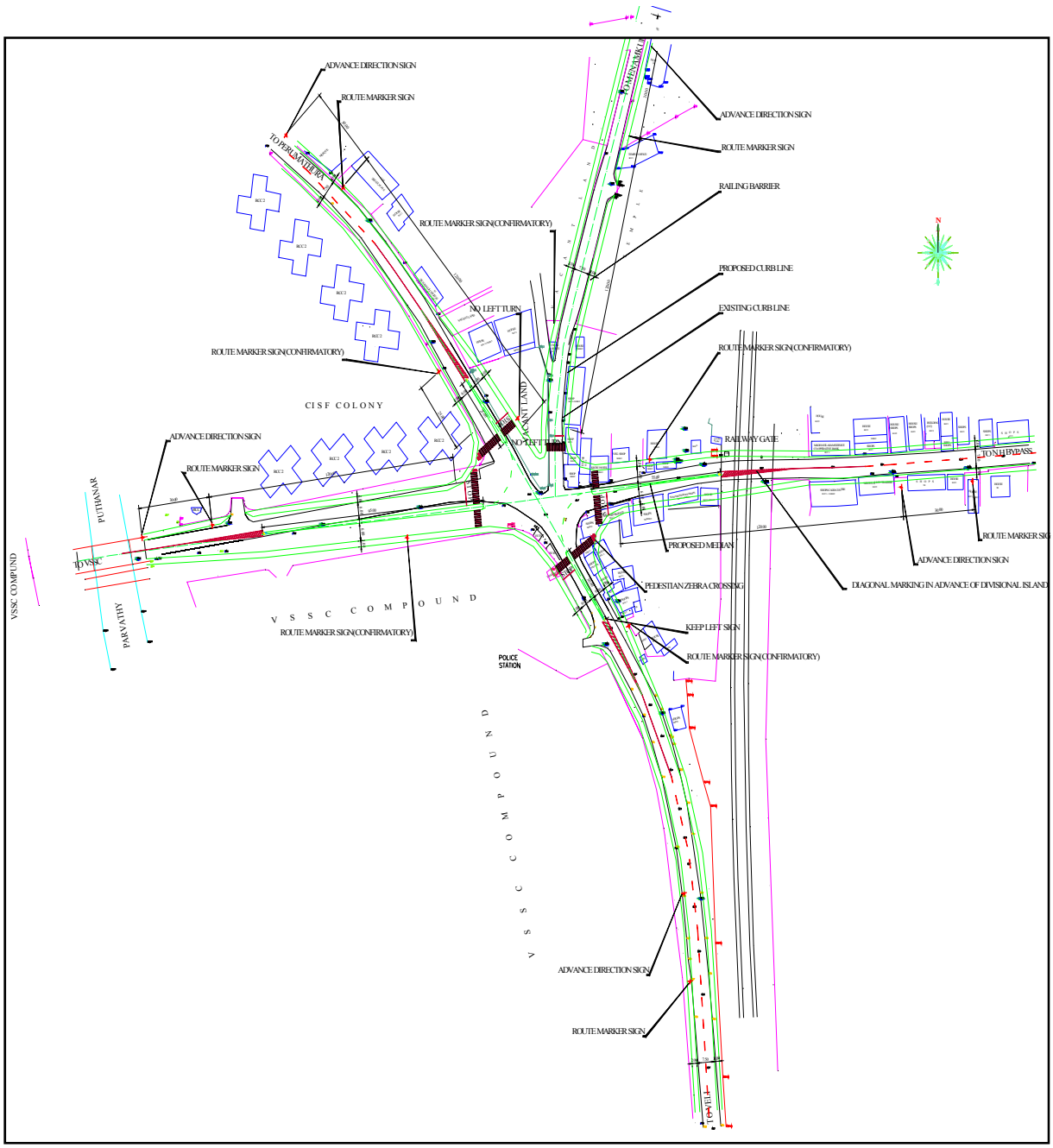


Figure 49: Channelization

32. Performance of Highway Development Projects in Kerala

The accurate prediction of pavement performance is important for the efficient management of the transportation infrastructure. NATPAC carried out a study for the appraisal of highway developed under Kerala State Transport Project (KSTP). The Centre developed a comprehensive database on the structural and functional performance of the upcoming highways of the state thereby helping in formulation of deterioration models for the state roads.

The scope of the study is limited to selected stretches of SH-1 developed under Kerala State Transport Project. The methodology adopted for the study consisted of collection of baseline data, evaluation of structural and functional performance of the pavement of study roads, identify the accident prone locations and design issues by conducting Road Safety Audit, traffic studies and development of pavement performance prediction model.

Table 17
Details of stretches on Study Roads

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

Findings

The traffic plying on the study roads vary from 444 commercial vehicles per day (cvpd) to 1479 cvpd conforming to heavy traffic on most of the stretches. From the laboratory studies it is clear that soil with good California Bearing Ratio (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. The study roads exhibit a functional performance of good to average rating based on

the unevenness values indicated by the International Roughness Index (IRI). 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. Pothole initiation is also noticed at some of the locations. Road safety audit was conducted and the deficiency of the road was identified. The major deficiencies observed are crash barrier inadequacy, high side road gradient, inadequate side road visibility, worn out pavement marking, Sharp curves with no sight distance, on street parking, unsafe junction layout, inappropriate location and visibility of road signs, inadequacy of vulnerable road user facilities, bus stop location, land-use, drainage, big advertisement boards, inadequate delineation, absence street lighting, inadequate delineation at night etc.

The study brought out quantified results in figures and facts to substantiate the performance of State Highway strengthened through the Kerala State Transport Project. The post evaluation of projects is an inevitable part of the highway development process.

33. Estimation of Carbon Credit for Inland Water Transport in National Waterway – 3

Improving Water Transport System facilitates movement of large cargo with minimum cost. This also helps in reducing the congestion and emission in roads and in turn carbon credit. NATPAC identified the main goods and perishable goods transported through roadways in Kerala and calculated the total amount of divertible goods.

The total Carbon dioxide emission from inland waterway and roadway can be calculated using following equation:

$TE = FC_{LF} \times D \times EF_{CO_2}$ [1]

Where:

TE - Total carbon dioxide emission (kg)
FC_{LF} - Fuel consumption (tonnes per kilometer)
D - Distance (km)
EF_{CO_2} - Emission factor for fuel (kilogram Carbon dioxide per tonne fuel)

The value of fuel consumption and emission factor for calculating total emissions (CO_2 emission from freight transport in the U.K, Commission for Integrated Transport, London) is given in **Table 18.**

Table 18
Emission Factors and Fuel Coefficients for waterways and Roadways

Mode	Emission Factors *(g/km)*	Fuel Consumption *(t km/l)*
Waterways	31	105
Roadways	62	24

The West Coast Canal or National Waterway No. 3 (205km) which runs from Kollam to Kottapuram was selected as the study stretch. Traffic volume survey, origin and destination survey and opinion surveys were conducted. The locations selected for traffic surveys were Sakthikulangara in Kollam district, Mararikulam in Alappuzha district, Palarivattam and Cheranallur in Ernakulam district and Ramanattukara in Kozhikode district. The study area map is shown in **Figure 50.**

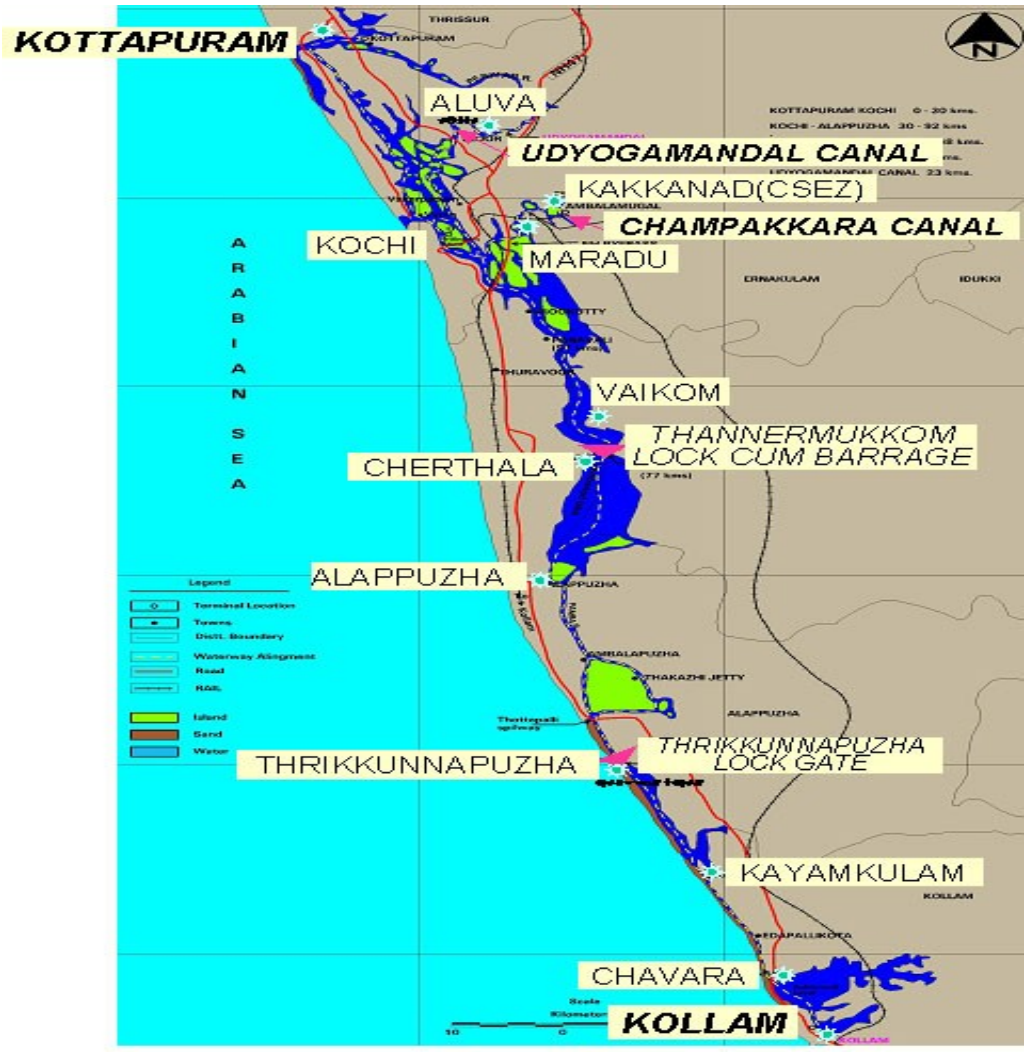


Figure 50: Study Area

Analysis of Data

Traffic volume study helped to identify the intensity of traffic on the road and the number of vehicles carrying goods passing through the road. The rate of flow of traffic through the road can be identified and the need for diverting the traffic to waterways can be understood, which helps in decreasing the amount of pollution caused by the traffic. All goods cannot be transported through waterways, but this can be implemented for the goods carried from long distance.

From the origin and destination survey, total 44 commodities were identified. Separate origin and destination chart was prepared for all 44 identified goods and total amount of each goods in tonnes was also calculated. It is estimated that the total cargo on roads is 24102tonnes/day and the annual cargo movement is 79.54 lakh tonnes. The perishable goods include fruits, vegetables, milk, milk products, fish, meat, eggs, bakery items, medicines, chemicals, drugs, glass and ice. The calculated divertible traffic that can be transported through inland waterway is 21508.06 tonnes/day. The annual divertible traffic is determined as 70.98 lakh tonnes.

The total length of study stretch for road transport is 313 km and for water transport 205 km. The fuel demand for transporting the cargo through roadways is determined as 2,95,736 liters and for waterways is 67,597 liters respectively. Total emission by roadway and waterway are calculated as 1368.19 MT and 102.41 MT respectively. The difference in emission between these two modes or in other words the estimated carbon footprint is 1265.78 MT.

The carbon credit for waterways is assumed as 3 € dollars/t of CO_2 (i.e 3x77.34=Rs.232.02). The annual carbon credit for transporting cargo through inland waterway is Rs.29.37 crores. By diverting the cargo movements by different scenario such as 50%, 40%, 30%, 25% and 20% of the annual volume of potential cargo, the corresponding carbon credits is given in **Table 19.**

Table 19: Carbon Credit under different scenario

CASES	DIVERTIBLE GOODS (T)	INLAND NAVIGATION		ROAD TRANSPORT		CARBON CREDIT (CRORE)
		FUEL (L)	EMISSION (T)	FUEL (L)	EMISSION (T)	
CASE 1**(50 %)**	3976830.0	37874.57	57381.19	165701.25	766598.67	**16.46**
CASE 2 **(40%)**	3181464.0	30299.66	45904.95	132561.00	613278.94	**13.16**
CASE 3 **(30%)**	2385900.0	22722.86	34425.86	99412.50	459921.04	**9.87**
CASE 4 **(25%)**	1988415.0	18937.29	28690.59	82850.63	383299.34	**8.23**
CASE 5 **(20%)**	1590732.0	15149.83	22952.48	66280.50	306639.47	**6.58**

From opinion survey, it is observed that most of the people were not interested to use the inland water transportation, as it takes a lot of time to reach the destination. More than 30% of the respondents disagree with this new concept & 20% people get doubted about the implementation of the idea. About 20% of the respondents strongly agree for implementation. Remaining 30% offered no comments.

The continuous accumulation of carbon dioxide in the atmosphere has contributed to what is known today as Global Warming. As a method to decrease the amount of pollution and as a means of economy for the developing country, the use of inland waterways has to be considered.

This is the first study done in Kerala on carbon credit for inland water transport. The cargo movement through inland waterways is technically as well as financially feasible. Inland water transportation is better than road transportation on the basis of pollution caused and much environmental cost can be saved by using the inland water transportation.

34. Improvement of Kovalam - Akkulam Canal Stretch in Thiruvananthapuram Region for Inland Navigation, Tourism and Recreational Purposes

The waterway stretch in the Kovalam- Akkulam region popularly known as Parvathy Puthanar is now non –operational due to siltation, insufficient width, the settlers on the canal banks and other environmental issues. A study was taken up by NATPAC to revive the Kovalam-Akkulam stretch of T S Canal for Inland Navigation and Tourism Promotion and also to ensure sustainable development along the route.

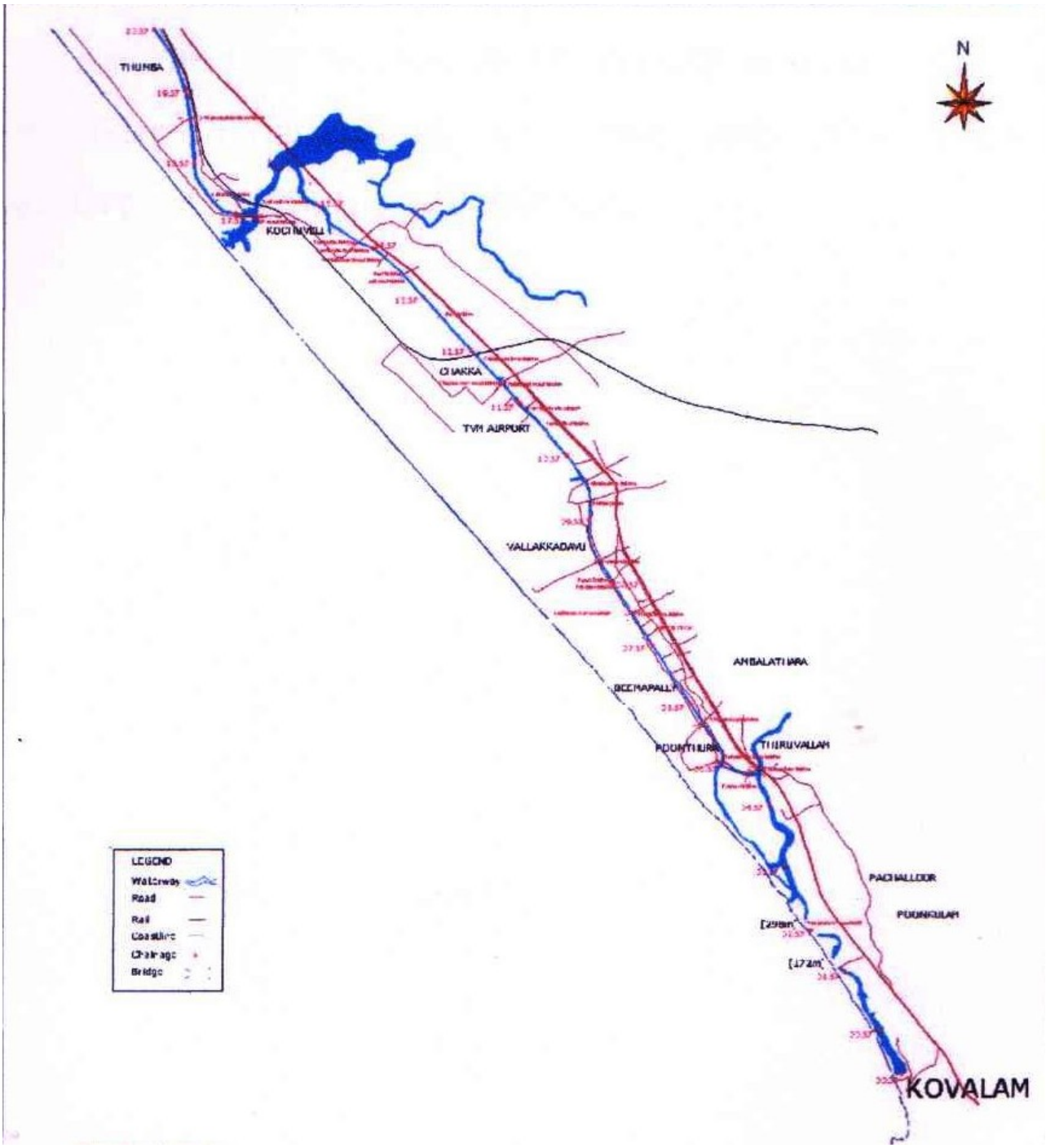


Figure 51: Study Area Map of Kovalam – Akkulam Canal

The impediment portion of Parvathy Puthanar between the tourism destinations Kovalam and Akkualm having a length of 17.82 km, passing through Thiruvallom, Edayar Island, Poonthura, Panathura, Muttathara, Chakka and Karikkakom, is taken as the study area **(Figure 51).** The canal which is completely filled with sand near the Panathura Subramanya Swami Temple of about 200m is the major bottleneck of navigation.

The methodology adopted for the study consisted of reconnaissance survey, hydrographic and topographic survey, socio-economic survey and studying environmental status and issues. Development proposals were identified to make the canal navigational which includes dredging, widening, bank protection, reconstruction/modification of cross-structures with adequate clearance, design of sewage pipeline, disposal of solid waste, provision of navigational aids and sanitation facilities etc. The standard rates are adopted to estimate the project implementation cost.

Cross Structures

It is observed that there are 10 road bridges, 2 rail bridges, 6 foot bridges, 1 aqueduct and 1 lock exists in this section. The horizontal and vertical clearance of NW 3 standards are 32m and 5 m for the cross structures. Out of 20 cross structures, one road bridge i.e, the bridge connecting new airport terminal is obeying the standard and rest of the structures are to be reconstructed/modified. In addition to this, one road bridge is proposed to build at Panathura to connect the approach road. The details of cross structures are given in **Table 20**

Table 20: Details of existing Cross Structures

Sl. No	Chainage (km)	Name of Bridge	No. of Span	Horizontal Clearance (m)	Vertical Clearance (m)
1	1.32	Akkulam Road Bridge, RCC	3	12.6	4.5
2	2.94	Vazhavila old Foot Bridge, RCC	3	7.2	3.8
3	2.94	Vazhavila New Road Bridge RCC	3	17.8	3.8
4	3.38	Karikkakam Road Bridge, Steel	3	9.7	1.5
5	3.73	Karikkakam Foot Bridge 1, RCC	3	7.2	3.8
6	4.52	Karikkakam Foot Bridge 2,RCC	3	9	3.74
7	5.25	Chakka Rail Bridge1, RCC	3	12.6	3.9
8	5.25	Chakka Rail Bridge2, RCC	3	11.3	3.7
9	5.78	Chakka Road Bridge1, RCC	3	18.6	4
10	5.79	Chakka Rail Bridge2, RCC	3	19	3.8
11	6.25	New Airport Road Bridge, RCC	10	32	8
12	6.59	Kairali Foot Bridge, RCC	1	20	4.5
13	7.61	Vallakadavu Road Bridge, RCC	1	7.5	2.8
14	7.88	Puthanpalam, Road Bridge, RCC	1	10	2.2
15	8.76	Ponnara Road Bridge, RCC	1	15	4.5
16	11.48	SM Lock, Road Bridge, Lock	1	5	5
17	12.1	Moonattumukku Road Bridge, RCC	3	11	6.5
18	12.55	Edayar Foot Bridge , RCC	3	9	5
19	12.55	Edayar Road Bridge, Steel	3	7.5	5
20	15.06	Panathura Wooden Bridge	1	4.5	2

Dredging

The dredging quantities have been estimated from the results of hydrographic survey. The State Irrigation Standard, 14m uniform width and 1.7m draft is adopted for estimation. The estimated dredging and soil cutting quantities **is 271903m^3.**

Bank Protection

Traditional and economically cheaper measures like Random Rubble masonary or stone boulders strengthened with coir grid type is suggested and the length of 25.98 kms of the canal has to be protected.

Population, Water Demand, Wastewater and Solid waste generation

The number of residents between Akkulam - Muttathara is 1,910 and that along Muttathara - Kovalam is having population of 512 and the total population is 2,422. The population projection for the year 2025 is calculated based on the Kerala Population growth rate. The amount of solid waste, wastewater and water demand for the projected population is calculated.

It is estimated that the projected population is 2,473 and the wastewater generation and solid waste will be 1692.46 lakhs litres and 676.98 kgs for the year 2025.

Waste Management

The appropriate disposal method of solid waste is shown in **Table 21.**

Table 21: Solid Waste Disposal Method

Sl. No.	Chainage (km)	Location	Disposal Method
1	3.2	Near Beach & Lake resort	Composting
2	5.3	Edayar Island	Composting/Land filling
3	8.5	Muttathara	Composting/Land filling
4	14.9	World Vegetable Market	Composting

Water Sample Results

Water samples were collected at 9 locations along the canal. The summarised results of water sample analysis are given in **Table 22.**

Table 22 : Results of Water Sample Analysis

Sample station/ Parameter	Akkulam boat club	Near Chakka bridge	Muttathara pipeline 1	Muttathara pipeline 2	SM lock bridge	B&L resort	Near Temple1	Near Temple2	Near Quarry Site
Temperature	29.4	29.5	29.6	29.9	29.5	29.5	29.7	29.4	29.6
ph	7.03	6.76	6.59	6.6	6.86	6.87	6.99	7.0	7.1
Conductivity (ms/cm)	8376	530	563.7	525	497	526	1834	1819	2613
TDS (PPM)	9356	685	748	683	718	654	1906	1968	3215
Turbidity (NTU)	643	263	106	154	112.6	98.4	140.2	151	559
Total hardness (mg/L)	3750	125	15	60	70	65	750	1000	1250
Ca (mg/L)	701.4	40	7.02	20.04	14.02	12	200.4	150.3	400.8
Mg (mg/l)	486.2	6.08	6.08	2.43	8.51	8.51	60.7	160	60.7
Chloride (mg/l)	4189	70.4	105.6	35.2	70.4	70.4	633	528	1002
Alkalinity (mg/l)	70	122	102	102	96	80	74	72	86
Iron (mg/l)	0.132	0.35	0.37	1.20	0.18	0.08	0.08	0.11	0.1
Sulphite (mg/l)	407.4	34.0	45.14	34.3	33.0	40.3	227	227	275
Nitrite (mg/l)	243.6	66.7	26.16	19.0	57.2	71.4	61.0	304.0	497.0
E-Coli (CFUml-1)	260	26500	29000	42000	14000	1420	90	360	30

Navigation Aids

Proposed locations for installing the signage are shown in **Table 23.**

Table 23: Location of Signages and Markings

Sl.No	Place	Item
1	Kovalam Left Bank	Direction, place, distance & information
2	Beach and Lake resort	Direction, place, distance & information
3	Thiruvallom	Direction, place & distance
4	Edayar	Direction, place, distance & information
5	Vallakadavu	Direction, place & distance
6	Muttathara	Direction, place, distance & information
7	Air port bridge	Direction, place & distance
8	Karikkakam Temple	Direction, place & distance
9	Akkulam bypass	Direction, place & distance
10	Akkulam Boat Club	Direction, place, distance & information

On both sides of the canal, 20 fixed shore structures and 50 floating buoys are required as navigation aids. The overall cost for improving the canal section between Kovalam and Akkulam section of Parvathy Puthanar is estimated at ₹ 152.5 Crores

35. Canal Bank Erosion due to Boat Wake Waves in Alappuzha and Kuttanad Region

Government of Kerala spends crores of rupees as compensation for loss of life, property and crops due to canal bank erosion and breaching in Alappuzha area. NATPAC carried out a study to understand the soil characteristics and related possibilities of bank erosion. The objectives of the study are to:

- Identify severe bank erosion prone areas
- Study the characteristics of soil and possibility of breaching of canal banks
- Collect soil samples at various locations and to conduct detailed tests for identifying various characteristics of soil
- Identify bank erosion prone areas by developing a vulnerability index for detailed bank erosion study.

The methodology adopted for the study consisted of literature review, identification of locations, secondary data collection, soil sample collection and analysis. Three canals in Alappuzha and Kuttanad area were selected for the study. The identified canals are Kottayam-Alappuzha canal (23 kilometres), Alappuzha-Changanacherry canal (27 kilometres) and Kottayam-Vaikom canal (38 kilometres).

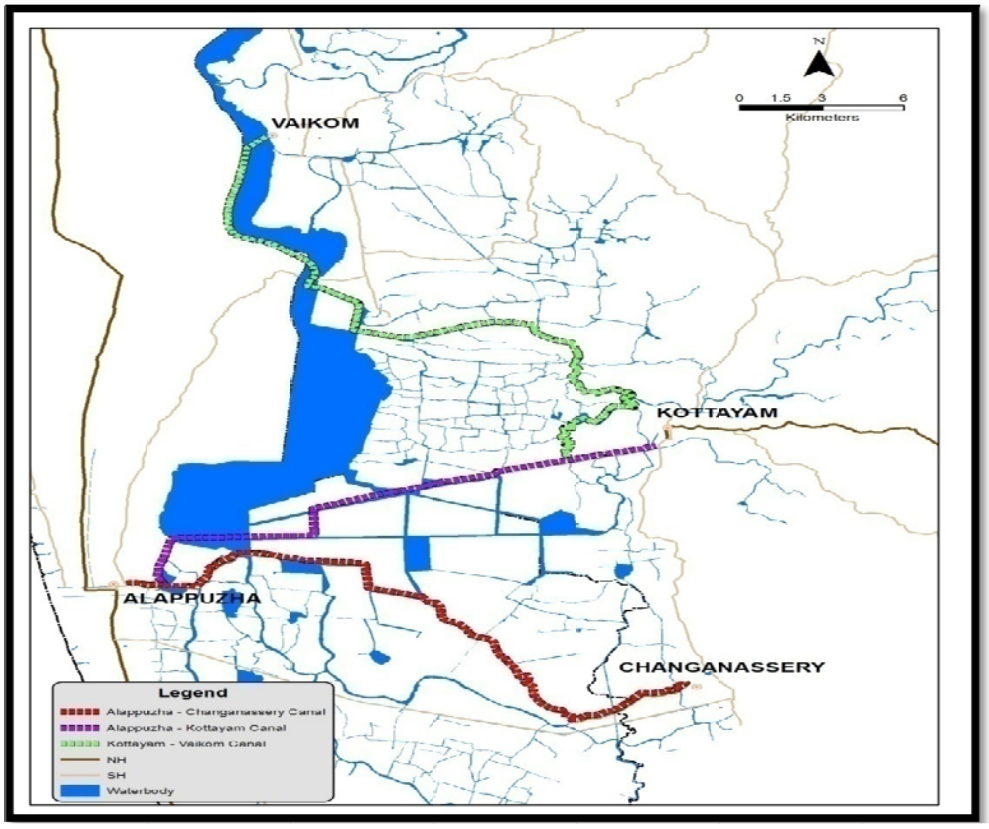


Figure 52: Study Area

Disturbed and undisturbed soil samples were collected from canal banks for laboratory testing. Particle size analysis using sieves, Bulk density, Atterberg limits - liquid limit, plastic limit, Unconsolidated Shear Strength and shear stress by Triaxial Compression test and unconfined compressive strength test were conducted.

Plate 8

Plate 9

Soil Sample Collection

Canal Embankment Breaching Vulnerability Index (CEBVI)

Analysis zone of embankment breaching was delineated based on a multi-criteria analysis **(Figure 52)** using bank materials and geotechnical attributes. Variables such as bank materials, geotechnical attributes and geometry of embankment either individually or in combination is known to be associated with the embankment breaching. According to the degree of embankment breaching during storms, simple weightings were calculated for all of the input variables leading to a multi-criteria approach. Weighting systems based on the values from 0 – 4, where, '4' means very highly vulnerable, '3' highly vulnerable, '2' moderately vulnerable, '1' less vulnerable, and '0' very less vulnerable was incorporated.

Based on the importance and stability of materials leading to embankment breaching, each set of continuous data (e.g., for each indicator) were ranked from 1 – 5. After deriving the normal weights and ranks, all individual parameters were integrated with one another in a linear model in order to demarcate CEBVI in the study area. The equation of CEBVI is as follows:

CEBVI = (RST*WST)+(R BD * W BD)+(R SF * W SF)+.....+(R TH * W TH)+ (R BW * W BW) +(R BS * W BS) +(R WH * W WH) ……(Equation 1.)

Where

R = Rank Value,
W = Weight Value,
AV =Absolute Value,
ST =Soil Texture,
BD = Bulk Density,
SF = Safety Factor,
TH= Top Height,
BW = Base Width of Embankment,
BS = Bank Slope,
WH = Water Height.

The result of the CEBVI showed that the highest score is less potential for embankment breaching and/or river bank erosion. The score of vulnerability Index for each indicator is plotted by an amoeba diagrams to compare all indicators of CEBVI model against each other.

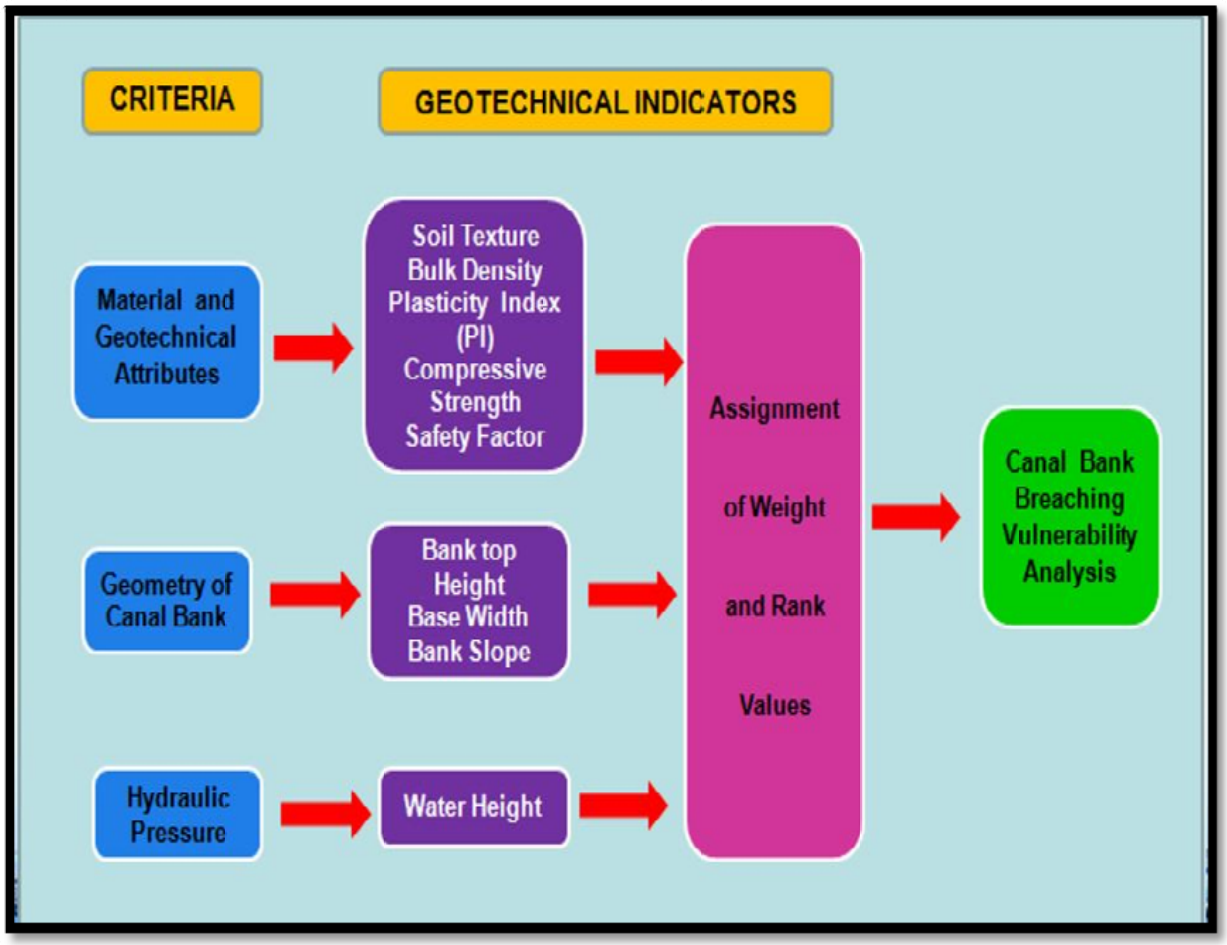


Figure 53: Methodological Approach of CEBVI

36. Investigation of Major Accident Spots and Accident Causative Analysis

The accident situation in Kerala is relatively more serious due to rapid growth of vehicles and inadequacy of road related infrastructure. The factors that lead to accidents are broadly classified into six groups and is abbreviated as TRAVEL.

(i) Traffic related (T)
(ii) Road related (R)
(iii) Accident Victim (Passenger, driver, other road user i.e. human) related (A)
(iv) Vehicle related (V)
(v) Environment related (E)
(vi) Legal (Acts and Rules) related (L)

Some of the road factors could be sight distance, super elevation, vertical alignment, road signs and markings, intersection design, street lighting etc. Poor maintenance of roads and lack of precautionary measures are also major causes of accidents.

Any defect in vehicle braking system, lighting system, tyres, lack of periodical maintenance etc. may also cause accidents. The human factors can be age, sex and marital status of the driver, influence of drugs and alcohol, rash and negligent driving behavior, long PIEV time (Perception, Intellection, Emotion & Volition), poor health etc. Some of the environmental related factors are rain, noise disturbances, presence of smoke, fog etc. The legal aspects can be parking rules, overtaking rules, sudden and unexpected change in traffic regulations.

Among the above mentioned factors, road related factors are relatively constant over a short period of time. Vehicle related factors at macro level are also by and large stable. Environment related factor, though dynamic in nature; also have a fixed pattern over a short period. However, traffic and human related factors are quite dynamic and may change every month, every day and even every hour.

The role of certain factors is direct and major in causing an accident. Some factors are controllable and certain factors need major policy decision and require long time to make a favorable impact. Therefore, each factor should be examined carefully and corrective steps are to be taken accordingly. **Table 24** provides a systematic classification of factors which may cause an accident.

Road related factors are the most important factors which determine the accident risk. Elements of road geometry require careful design and take longer time to implement.

Table 24
Accident Causative and Influencing Factors

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

Accident reconstructive study for selected major accidents that took place in Kerala were done by NATPAC to identify major, minor and contributory causes of accidents. NATPAC analysed the traffic police data and information given in FIR to identify the cause of an accident. The context analysis of accident reports as published in local newspaper have also been carried out by the Centre.

Eight major fatal accidents that occurred in the State during 2014 – '15 are investigated in detail and reconstruction was made with the help of computer simulations to ascertain various causative factors contributed to the fatal accident. The accidents in which detailed studies were carried out are:

a	Two-wheeler v/s Truck, 31st January 2014	2 Fatalities	-
b	Duster SUV v/s Loaded Container Truck, 11th March 2014	1 Fatality,	3 Injuries
c	Volvo Bus (Kallada Travels) v/s Maruthi 800, 3rd April 2014	4 Fatalities,	1 Injury
d	Mini Tourist Bus fell down at Hair pin, 19th April 2014	-	5 major injuries, 26 minor injuries
e	Private Bus v/s Passenger Auto v/s Two-wheeler, 9th August 2014	4 Fatalities,	1 Injury
f	Loaded Mini-Truck v/s Scorpio Car, 2nd October 2014	3 Fatalities,	5 Injuries
g	Loaded LPG Bullet Tanker v/s Nano Car, 22nd October 2014	1 Fatality,	-
h	Alto Car v/s Loaded LPG Bullet Tanker, 1st January 2015	6 Fatalities,	1 Injury

On detailed inspection and simulation studies of these accidents, the root cause behind the accidents was determined. There existed unsafe road geometrics, absence of street lighting etc. in some cases. However, the cases that have been investigated are clear instances of human fault. Detailed reports on each accident cases including the causative factors, contributing circumstances, infrastructural lacks, enforcement related issues etc. have been prepared and submitted to Kerala Road Safety Authority and other concerned departments to initiate necessary actions.

37. Traffic Management Measures in Maruthamkuzhy Area for Accident Control

Maruthamkuzhy Junction in Trivandrum district is now a place of great concern due to the occurrence of a number of accidents. NATPAC suggested adequate measures to mitigate this problem.

Existing Traffic Scenario at Maruthamkuzhy

One-way regulation is implemented from Kochar road to Maruthamkuzhy bus stop (near market) via New Maruthamkuzhy Bridge. Violation of this regulation is frequently done by many motorists, especially two-wheelers. A local road is connected to the newly constructed road near the new Maruthamkuzhy Bridge and the adjoining area is mainly residential. There is a market near the Maruthamkuzhy bus stop. Both these factors are likely to increase the tendency of people to violate one-way traffic regulation implemented here.

Recommendations

Strict enforcement of one-way needs to be ensured for the marked stretch throughout the day. It has to be kept in mind that a stretch declared as one-way needs to be a one-way for 24x7. The following measures should be adopted for the ease of traffic operation and reducing the probability of occurrence of accidents.

- Deploying more policemen for ensuring proper enforcement of the one-way regulation and traffic control measures. This should be preferably adopted near the PTP road junction and Kochar road junction in addition to the existing one at Maruthamkuzhy junction.

- Surveillance cameras should be installed along the one-way stretch and penalty should be charged from those people who violate the existing traffic regulations.

- Additional sign boards should be properly positioned which will reduce the confusion among the motorists. The sign board should be clearly visible and adequately designed.

- The presence of raised manhole on the road is a serious threat to the traffic especially two wheelers. So these manholes should be properly and visibly demarcated.

- The movement of vehicles from Kochar road junction to Maruthamkuzhy junction via old bridge is currently maintained as two-way. It is recommended to prevent the right turn movement of vehicles from Kochar road junction to Maruthamkuzhy old bridge, which will considerably reduce the congestion. This measure may be ensured atleast during peak periods.

- The bus stop on the Maruthamkuzhy junction towards Sastamangalam needs to be shifted to a location after the old bridge.

Plate 10: 'No right turn' board installed as recommended by NATPAC

38. Two Wheeler Accidents in Youth – Causative Factors and Mitigative Measures

Two wheeler riders form one of the most vulnerable road user categories in today's intense traffic condition. Reports show that two wheelers are involved in a huge proportion of the road accidents in India. Every year more than 30% of the total accidents involve two wheeler riders, resulting in fatality, severe permanent or temporary injury and damage to property. The scenario in Kerala is not different from the overall trend in the country.

There is an extensive use of two wheelers among youth in Kerala. The aim of the study was to identify the causative factors for traffic accidents in two wheeler riding youth in Kerala and to suggest corrective measures to ensure safety and health.

The study aimed at understanding the perception of youth (18-40 years of age) regarding safe riding and an understanding of the factors which adversely influence the safety of two wheeler riders. The objectives of the study are:

- To identify and enlist the factors that cause accidents in two wheeler riding youth in Kerala

- To model the safety perception of two wheeler using young riders in the state
- To suggest measures to mitigate accidental fatality and casualty based on the inferences of the analyzed results

Based on the literature reviewed, the causative factors for two wheeler accidents in youth were classified. A pilot questionnaire survey (n=250) was conducted and the tool was modified suitably, followed by a questionnaire survey (N=8200) among the two wheeler riding youth in Kerala. The collected data was edited, coded and analyzed using one-way ANOVA to determine significant difference in the distribution of attributes. A confirmatory factor analysis followed by a structural equation modeling was conducted to determine the cause-effect relation of safety perception of two wheeler riding youth in Kerala.

Significant causative factors for two wheeler accidents in youth are:

- Potholes and subsequent water ponding, unexpected movement of pedestrians and animals, erratic riding with no lane discipline, lack of awareness of traffic rules, regulations and safe riding practices, obsolete training and lack of enforcement
- Use of Modern two wheelers with advanced technology by aggressive riders with inadequate knowledge about road infrastructure or the vehicle being used
- Presence of increased number of stage carriages, private cars.

The structural model developed points to the fact that the highest influencing factor towards two wheeler accidents among youth is the rider culture which has to be proactively addressed in order to ensure safety. The training and licensing system of two wheeler riders has to be modified to international standards. Enforcement has to be strengthened and surveillance should be enacted to identify and penalize two wheeler riders who jeopardize safety.

EXTENSION SERVICES

1. Road Safety Education Through Schools

NATPAC in association with Kerala Road Safety Authority (KRSA) conceptualized a new Road Safety Training Programme "**Road Safety Education through Schools in Kerala**" which will help effectively in reducing the accident rate among children and also in saving the life of other road users. Through this training programme school teachers of the State are trained on the different facets of road safety. The State level launching of this training Hon'ble Minister for Education, Govt. of Kerala on 24th February 2014 at Loyola College, Thiruvananthapuram.

- Training to school teachers in Ernakulam District was conducted at Renewal Centre, Kaloor on 12–13 June 2014. The programme was formally inaugurated by Smt.R.Nishanthini IPS, Deputy Commissioner of Police, Kochi City. Shri.K.Shinemon, Deputy Director of Education was the chief guest. 94 teachers representing various schools of Ernakulam District attended the training course.

- In Kannur District the training programme was conducted at Sikshaksadan from 19-20 June 2014. The programme was inaugurated by Shri.P.N.Unnirajan IPS, District Police Chief, Kannur, in the presence of Regional Transport Officer, Kannur and Administrative Officer, DDE Office, Kannur. 108 teachers from various schools of Kannur District attended the training programme. Shri.Dinesan Madathil, Deputy Director of Education, Kannur delivered the valedictory address.

- The two day training programme from 26-27 June 2014 in Thrissur District was inaugurated by Shri.C.K.Asokan, Regional Transport Officer, Thrissur at Hotel Elite International. Shri.Subash C Kumer, Deputy Director (in charge), Education, Thrissur was the chief guest. 107 teachers from various schools of Thrissur District attended the training. The two day training was concluded with a valedictory session presided over by Shri.P.Prakash IPS, Thrissur City Police Commissioner.

Plate 11
Smt.R.Nishanthini IPS, Deputy Commissioner of Police, Kochi City inaugurating the Teachers Training Programme in Ernakulam District

Plate 12
Shri.P.N.Unnirajan IPS, District Police Chief, Kannur inaugurating the Teachers Training Programme in Kannur District

- Road Safety Training for school teachers in Palakkad District was conducted at District Panchayat Auditorium, Palakkad on 4th – 5th July 2014. The programme was formally inaugurated by Shri. G Somasekar, District Police Chief, Palakkad. Smt.P.Girija, District Educational Officer was the chief guest. 104 teachers representing various schools of Palakkad District attended the training programme.

- The two day training programme conducted on 15th - 16th July 2014 for Kozhikkode District was inaugurated by Shri.A.V.George, Commissioner of Police, Kozhikkode at Navjyothis Renewal Centre, Kozhikkode. Shri.C.Janardhanan, Executive Director, 'KARMA', Kozhikkode spoke on the occasion. 76 teachers from various schools of Kozhikkode District attended the training programme.

- In Malappuram District the training for school teachers was conducted on 29th - 30th July 2014 at Sajidha Tourist Home, Kottakkal. Shri.S.Sasikumar IPS, District Police Chief, Malappuram inaugurated the training programme. 86 teachers from various schools of Malappuram District attended the training programme.

- Training for school teachers in Pathanamthitta District was conducted at Oyster Convention Centre, Thiruvalla on 29th - 30th August 2014. The programme was formally inaugurated by Dr.Srinivas S IPS, District Police Chief, Pathanamthitta. Shri.Abey John, RTO, Pathanamthitta and Shri.Mathew P S, Deputy Director, Education, Pathanamthitta were the chief guests. 101 teachers representing various schools of Pathanamthitta District attended the training programme.

Plate 13
Shri. G.Somasekar IPS, District Police Chief, Palakkad Inaugurating the Teachers Training Programme in Palakkad District

Plate 14
Shri.A.V.George, Commissioner of Police, Kozhikkode inaugurating the Teachers Training Programme in Kozhikkode District

Plate 14
Inaugural address by Shri. S.Sasikumar IPS, District Police Chief, Malappuram

Plate 15
Inaugural address by Dr.Srinivas S IPS, District Police Chief, Pathanamthitta

2. Safe Road to School

School based Road Safety education is an effective method to combat the growing problem of road crashes. It improves the road user behaviour among children as they grow from pedestrian to bus user, to cycle rider, to two wheeler rider and to car driver. It ensures greater safety for future generation.

- NATPAC in association with Kerala Road Safety Authority (KRSA) have taken up a well formulated "***Safe Road to School***" programme. NATPAC organised one day programme on 'Safe Road to School (SRS)' at Vyasa Vidya Bhavan, Thiruvananthapuram on 26th April 2014. 60 students underwent the training.

Plate16
A Class on 'Road Safety' at Sri Vyasa Vidya Bhavan

- NATPAC organised one day programme on 'Safe Road to School (SRS)' at Velamanoor UP School, Kollam on 11th July 2014. Shri.T.V.Satheesh, Rtd. Superintendent of Police, Kerala & Consultant, Road Safety, NATPAC inaugurated the School Road Safety Cell of Velamanoor UP School. 200 students attended the training. A unique feature of this programme was the participation of parents and school management committee members.

- NATPAC organised one day programme on 'Safe Road to School (SRS)' at Velamanoor UP School, Kollam on 11th July 2014. Shri.T.V.Satheesh, Rtd. Superintendent of Police, Kerala & Consultant, Road Safety, NATPAC inaugurated the School Road Safety Cell of Velamanoor UP School. 200 students

Plate 17
View of the dais

attended the training. A unique feature of this programme was the participation of parents and school management committee members.

- Road safety Training Programme for the Road Safety Cell members of Cotton Hill Girls HSS was organised on 24th July 2014. 85 members of the Road Safety Cell and 10 teachers attended the training.

- NATPAC organised one day training on Road Safety at Govt. H.S.S, Calicut University Campus, Thenjippalam on 20th August 2014. 425 students and 25 teachers attended the training.

- Road Safety Training Programme was organised at Crescent H.S.S, Adakkakundu, Kalikavu in Malappuram District on 22nd August 2014. 270 students attended the training. The School Road Safety Cell was inaugurated by School Manager during this occasion and uniforms were distributed to the Road Crossing Wardens.

- NATPAC organised one day training on Road Safety at Sree Saraswathy Vidyalayam, Ooruttambalam in Thiruvananthapuram District on 19th September 2014. The programme was inaugurated by Smt. B.G.Sreedevi, Director, NATPAC.

Plate 18
Smt.B.G.Sreedevi,Director,NATPAC;Shri. Chandrasenan, S.I of Police, Maranallor Station and Shri T Prabhakaran Nair, Secretary, Sree Saraswathy Vidyalayam at the inaugural session of Road Safety Training

Plate 19
Distribution of road safety gadgets to Road Crossing Wardens

- Road Safety Training Programme was conducted at LVUPS Venkulam, Varkala on 16th October 2014. 250 students attended the training.

- Road Safety Training Programme was conducted at Ansar Public School, Perumpilavu, Thrissur on 26th November 2014. Shri.Krishnakumar, Circle Inspector, Kunnamkulam inaugurated the programme. Students of 8th, 9th and 10th Standards and Student Police Cadets attended the training.

- Training on Road Safety was organised at Chaldean Syrian Higher Secondary School, Thrissur on 28th November 2014. Shri. K.K.Sajeev, Circle Inspector, Thrissur East inaugurated the programme. 100 members of the School Road Safety Cell and teachers attended the training.

Plate 20
Shri. K.K.Sajeev, Circle Inspector, Thrissur East inaugurating the SRS programme at Chaldean Syrian Higher Secondary School

- Training on Road Safety was organised at SNV HSS & VHSS, Angadical South, Pathanamthitta for Scout and Guide Students Cadets on 29th December 2014.

3. Driving School Instructors Training Programme

The Centre organized a one day training programme for driving school instructors on 14th May 2014 at Bodhana Auditorium, Thiruvalla (Pathanamthitta District) by considering the fact that driving instructors play a pivotal role in tutoring the upcoming generation. Smt.B.G.Sreedevi, Director, NATPAC inaugurated the training programme. She briefed about driving instructors' responsibilities and specific objectives of this training programme.

The inaugural session was attended by Shri.P.T.Eldho,Dy.Transport Commissioner, South Zone; Shri.P.D.Sunil Babu, Zonal RTO, Enforcement and Shri.Thampi S Durgadeth, DYSP, Thiruvalla. The Training Programme comprised of five Technical Sessions. Technical Session-I was based on "Defensive Driving Techniques" by Dr.G.Ravikumar, Scientist-F, NATPAC.

The theme of Technical Session-II was "Key Risk Factors and Safe Driving Techniques" by Shri.T.V.Satheesh, Rtd. Superintendent of Police, Kerala & Consultant, Road Safety, NATPAC. Technical Session-III focussed on "Requirement and Functioning of Driving School" by Shri.Viji Kumar, MVI, Pathanamthitta.Technical Session-IV highlighted upon "Traffic Control Devices and Road Regulations" by Shri. T.V.Sasikumar, Consultant, Road Safety, NATPAC. Technical Session-V was on the topic "Know Your Road" by Shri. Subin.B, Scientist-B, NATPAC.

Plate 21
View of the dais

Plate 22
A View of the participants

The session covered the Functional Classification, Design Speed and Road Geometrics. A total number of 210 instructors from different driving schools attended the training.

4. Training Programme for School Bus Drivers

NATPAC in association with Kerala Road Safety Authority organised ***'Road Safety Training Programme for School Bus Drivers'.***

- 'Road Safety Awareness Training Programme' for school bus drivers was conducted at St. Mary's Higher Secondary School, Pattom, Thiruvananthapuram on 25th May 2014. The programme was jointly organised by Thiruvananthapuram City Police and NATPAC. City Police Commissioner inaugurated the programme. About 95 drivers from various schools attended the training programme.

- Training to school bus drivers in Kollam District was organised by NATPAC in association with Kollam City Police at AR Camp, Kollam on 31st May 2014. The programme was inaugurated by Shri.Debeshkumar Behara, Kollam City Police Commissioner. 220 persons including drivers, attendants and school management representatives participated in the training programme.

- Training to school bus drivers in Kottayam District was organised in association with District Police, Kottayam at BCM College Auditorium on 14th June 2014. The programme was inaugurated by Shri.Thiruvanchoor Radhakrishnan, Hon'ble Minister for Transport and Forest, Govt. of Kerala. About 250 school bus drivers, attendants and representatives from various schools participated in the training programme.

Plate 23
Shri.Thiruvanchoor Radhakrishnan, Hon'ble Minister for Transport, Cinema & Forest, Govt. of Kerala inaugurating the Training Programme for School Bus Drivers at Kottayam.

5. State level conclusion of Phase – I of 'Road Safety Education through Schools in Kerala'

The State level conclusion of Phase – I of 'Road Safety Education through Schools in Kerala' was conducted at Hotel Aida, Kottayam on 29th - 30th September 2014. The programme was inaugurated by Shri.Thiruvanchoor Radhakrishnan, Hon'ble Minister for Transport, Cinema and Forest, Govt. of Kerala on 29th September 2014. Smt.B.G.Sreedevi, Director, NATPAC presided over the function.Smt.Jessy Joseph, Dy.Director, Education, Kottayam and Shri.B.J.Antony, Regional Transport Officer, Kottayam, spoke on the occasion.

122 teachers from various schools of Kottayam District and 9 Assistant Project Officers (APO) under Rashtriya Madhyamik Shiksha Abhiyan (RMSA) from nine Districts attended the training.

The programme 'Road Safety Education through Schools in Kerala' was launched by NATPAC as part of a State-wide initiative to sensitise teachers and students to road safety. NATPAC covered 11 districts in the State, except Kasargod, Wayanad and Idukki and trained 1174 teachers

Plate 24

Shri.Thiruvanchoor Radhakrishnan, Hon'ble Minister for Transport, Cinema and Forest, Govt. of Kerala inaugurating the State level conclusion of Phase – I of 'Road Safety Education through Schools in Kerala' in Kottayam District

6. Road Safety Youth Leadership Programme

- The Centre in association with Kerala Road Safety Authority organised a one day training programme for Higher Secondary Students on 17th July 2014 at Government VHSS Aruvikkara, Thiruvananthapuram as part of the School Health Programme on traffic awareness. 50 students attended the training.

- Training on Road Safety for nursing students was organised on 21st August 2014 at Government Nursing School, Beach Road, Kozhikkode. 200 nursing students attended the training.

- NATPAC organised Road Safety Awareness Programme for National Service Scheme (NSS) volunteers at Sree Guruvayurappan College, Kozhikode on 7th October 2014. 200 volunteers attended the training.

- The Centre in association with Kerala State Youth Welfare Board organised a one day workshop for District Level Officers and Co-ordinators of Kerala State Youth Welfare Board on 9th October 2014 at Sasthra Bhavan, Pattom. The programme was inaugurated by Shri.Radhakrishnan Nair, Member Secretary, KSYWB. Key Note address was delivered by Smt.B.G.Sreedevi, Director, NATPAC.

Plate 25
Smt.B.G.Sreedevi, Director, NATPAC; Dr.G.Ravikumar, Scientist-F, NATPAC and Shri.Radhakrishnan Nair, Member Secretary, KSYWB at the inaugural session of workshop

- The Centre organised Road Safety Training Programme for Ist year Engineering students of Royal College of Engineering and Technology, Akkikavu, Thrissur on 27th November 2014. 150 students attended the training.

- NATPAC organised Road Safety Training Programme for National Service Scheme (NSS) Students at CMMM College for Advanced Studies, Varkala on 23rd December 2014.

7. International Car Free Day

The Centre observed International Car Free Day on 21st September 2014 with ESAF partnership. The Ramanilayam road in Thrissur was made traffic free. Shri.Jacob Job IPS, Police Chief, Thrissur inaugurated the programme.

Students from different institutions and youth associations participated in the programme. Cycle road show was also organized. The programme was aimed at encouraging motorists to consider more environmental friendly alternatives, to encourage active transportation like

walking and cycling; to reduce traffic congestion, reduce transport related green house gas emission and thereby improving the quality of life.

Plate 26
View from cycle road show

8. Road Safety Training for Various target Groups

i. Training on Road Safety for school children, Bhoothakulam Govt. HSS, Kollam on 11th July 2014.

ii. Training on Road Safety for school children, Chavara Cultural Centre, Kozhikkode on 17th July 2014. 120 students attended the training.

iii. Training on Road Safety for school children, Mahatma Girls High School, Cherthala on 18th July 2014.

iv. Class on 'Students and Road Safety' for Student Police Cadets (SPC), Kochi as part of the 4th Anniversary Celebrations of the Student Police Cadets on 2nd August 2014.

v. Training on Road Safety for police drivers, Toyota Training Centre, Kozhikode on 21st August 2014. The programme was inaugurated by Shri.A.Abdul Razak, Asst. Commissioner of Police (Traffic), Kozhikode. 35 police drivers attended the training.

vi. Road Safety Training for school children, Sree Saraswathy Vidyalayam, Ooruttambalam on 26th August 2014.

vii. Training on Road Safety for Kerala Bn. NCC, Pathanamthitta on 9th September 2014.

viii. Road Safety Training for State Excise Academy, Thrissur on 22nd - 23rd September 2014.

ix. Training on Road Safety for school children, Govt. Higher Secondary School, Vilavoorkal on 6th October 2014.

x. Training on Road Safety, Staff Training Centre, KSRTC, Attakulangara on 28th October 2014 as part of Refresher Training Programme for KSRTC Vehicle Inspectors and Drivers.

xi. Training on Road Safety, Police Training College, Thiruvananthapuram on 29th and 30th October 2014.

xii. Road Safety Awareness Programme for members of 'Unarvu', a forum for senior citizens sponsored by Govt. of Kerala, at Samskrithi Bhavan on 15th November 2014. 250 senior citizens attended the session.

9. Road Safety Awareness to Higher Secondary Students in Kerala

Road Safety awareness is important in achieving a safe system and the involvement of Higher Secondary Students is crucial as active contributors to a community. NATPAC launched a new programme – 'Road Safety Awareness to Higher Secondary Students in Kerala' with the support of Department of Higher Secondary Education and School authorities. The State level launching of this programme was done by Shri.A.Noushad, Regional Deputy Director, Higher Secondary Education, Kozhikkode at St.Joseph Higher Secondary School, Kozhikkode on 7th October 2014.

Plate 27
State level inauguration of 'Road Safety Awareness to Higher Secondary Students in Kerala' by Shri.A.Noushad, Regional Deputy Director, Higher Secondary Education, Kozhikode

Plate 28
View of the participants

The inaugural session was attended by Fr.K.Devasi, Principal and Shri.C.Janardhanan, Executive Director, KARMA, Kozhikkode. 210 students attended the training. The training will equip students to:

→ Critically analyse the behaviours of road users and to plan, carry out and evaluate actions that lead to safer journeys

→ Practice driving in different conditions

→ Develop confidence and safe driving skills as a matter of habit so that they can devote more attention to observe and avoid hazards

→ Critically analyse a variety of simulated situations and transport environments and to suggest strategies to manage these safely

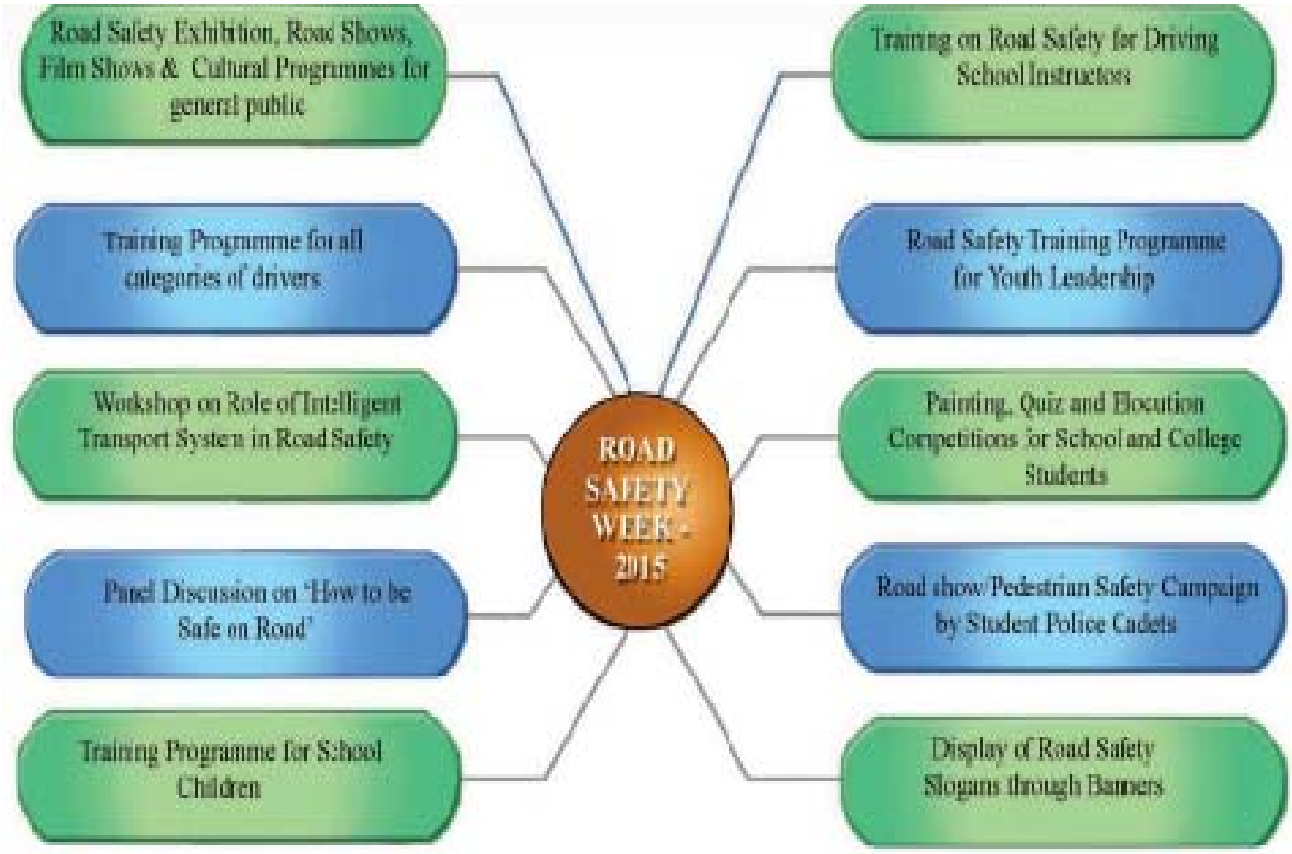
- Road Safety Training to Higher Secondary Students was conducted at Govt.Higher Secondary School, Vilavoorkal, Thiruvananthapuram on 14th November 2014. 150 students attended the training.

Plate 29
A class on 'Road Safety' at Govt.Higher Secondary School, Vilavoorkal

- Road Safety Training to National Service Scheme (NSS) volunteers was conducted at KPSPM VHSS, East Kallada, Kollam on 22nd December 2014. In the afternoon session the volunteers were taken to Chittumala junction for evaluating road safety issues. Road show was also conducted by the volunteers which was flagged off by Sub Inspector of Police, East Kallada. 55 volunteers attended the training.

Plate 30
Road Show by NSS volunteers

10. ROAD SAFETY WEEK - 2015



Activities conducted by NATPAC during 26th Road Safety Week:

Trivandrum District

- Display of Road Safety Slogans through banners at different locations of Thiruvananthapuram District.

Plate 31(a)

Plate 31(b)

Road Safety banners

- Workshop on 'Role of Intelligent Transport System in Road Safety' at Sasthrabhavan, Pattom, Thiruvananthapuram on 14th January 2015. The programme was inaugurated by Shri.Oommen Chandy, Hon'ble Chief Minister of Kerala. Hon'ble Chief Minister also released NATPAC's News Letter on Road Safety 'Safe Savari' and booklets on 'Road Safety'. Shri.K.Muraleedharan, MLA, Kerala Legislative Assembly presided over the function. Keynote Speech was delivered by Shri.P.Marapandiyan IAS, Executive Vice

President, KSCSTE. Shri.K.S.Balasubramanian IPS, Director General of Police, Govt. of Kerala, Shri.Senkumar IPS, Director General of Police, Govt. of Kerala, Smt.B.G.Sreedevi, Director, NATPAC and Shri.Arun Kumar Sinha IPS, ADGP (Traffic), Govt. of Kerala addressed the audience. Shri.George Luice, Councillor, Thiruvananthapuram Corporation felicitated the function.

Plate 32

Smt.B.G.Sreedevi, Director, NATPAC; Shri.K.Muraleedharan, MLA; Shri.Oommen Chandy, Hon'ble Chief Minister of Kerala; Shri.P.Marapandiyan IAS, EVP, KSCSTE; Shri.K.S.Balasubramanian IPS, DGP, Govt. of Kerala and Shri.George Luice, Councillor, Thiruvananthapuram Corporation at the inaugural session of Workshop on 'Role of Intelligent Transport System in Road Safety'

Plate 33

Inauguration of Workshop by Hon'ble Chief Minister of Kerala

Plate 34

Releasing of News Letter on Road Safety

Plate 35

Shri.Arun Kumar Sinha IPS, ADGP (Traffic), Govt. of Kerala addressing the audience

Plate 36

Opening remarks by Shri.Senkumar IPS, DGP, Govt. of Kerala

In the technical sessions, presentations on the role of Intelligent Transport System in the areas of Road Safety were made. The discussions were moderated by Shri.T.Elangovan, Scientist G, NATPAC.

The workshop was intended to formulate an action plan to use latest technologies under ITS for preventing road accidents. Display and demonstration of latest Intelligent Transport System Products was also arranged.

Plate 37(a)

Plate 37(b)

Display of Intelligent Transport System Products

Technical Presentations made during the Workshop

Sl.No.	Name	Designation	Topic
1	Shri.T.P.Senkumar IPS	Director General of Police (Prisons),Govt. of Kerala	Pattern of Road Safety Aspects in Kerala and Application of ITS
2	Shri.Rajat Mishra	Efkon India	Electronic Enforcement of Traffic and Transportation
3	Dr.Rajesh Krishnan	ITS Planners & Engineers	ITS for Road Safety – An International Perspective
4	Shri.V.Muralidharan	C-DAC, Thiruvananthapuram	Wireless Traffic Controller and Red Light Violation Detection

- Painting, Quiz and Elocution Competitions for school and college students at Sasthra Bhavan, Thiruvananthapuram on 16th January 2015. More than 150 students participated in the programme.

Plate 38
Painting Competition

Plate 39
Quiz Competition

Plate 40
Elocution Competition

Plate 41
Distribution of prizes by Prof. George Varghese, Director, KSCSTE

- 20 minutes Street Drama on Road Safety, 'Yathraykkappuram' for general public from 16th January 2015 to 17th January 2015 at different locations of Thiruvananthapuram City viz. East Fort, Poojappura, Shangumugham beach and Kanakakunnu palace.

Plate 42(a)

Plate 42(b)

View from Street Drama on Road Safety -'Yathraykkappuram'

- Road show/Pedestrian Safety Campaign by Student Police Cadets in association with Kerala Police (Peroorkada) on 17th January 2015 at Peroorkada, Thiruvananthapuram. Road Safety T-Shirts and Caps were also distributed to the Student Police Cadets.

Plate 43(a)

Plate 43(b)

Road show by Student Police Cadets

Plate 44(a)

Plate 44(b)

Pedestrian Safety Campaign by Student Police Cadets

- Film show on 'Road safety' at Kariavattom for school and college students on 17th January 2015.

Plate 45(a)

Plate 45(b)

Film Show on Road Safety

Palakkad District

- Road Safety Exhibition, Road Shows and Film Shows for general public at different locations of Palakkad district.

- 'Training Programme for all categories of drivers' at District Panchayath Hall, Palakkad on 11th January 2015. The programme was inaugurated by Shri.P.V.Rajesh, Municipal Chairman, Palakkad. Shri.V.S.Muhammad Kasim. DYSP, Palakkad presided over the function. Eye test for the participants were also conducted with the initiative of Ahalya group of medical institutions.

Plate 46

Inauguration of 'Training Programme for drivers' by Shri.P.V.Rajesh, Municipal Chairman, Palakkad

Plate 47

Presidential Address by Shri.V.S.Muhammad Kasim. DYSP, Palakkad

- Half day panel discussion on "How to be Safe on Road" at Jobys Mall, Palakkad on 12th January 2015. The discussion was moderated by Shri.T.R.Ajayan, former MD, Malayalam Communications. Experts whoparticipated in the panel discussion includes: Shri. T.K. Balachandran, Rtd. District Judge; Dr.A.K.Raji, Professor, N.S.S College of Engineering, Palakkad; Shri.Mujeeb, MVI, Palakkad; Shri.Muhammad Kasim, DYSP, Palakkad; Shri. Binu R; Traffic Police, Palakkad; Shri. N. Vidhyadharan, Bus Operators Association and Shri.Arumukhan C, AE, Road Safety Department, Palakkad. The main objective of the Panel Discussion was to allow participants of diverse professional background to share their perspectives and actions needed for enhancing Pedestrian Safety in the State of Kerala.

Plate 48
Shri.T.R.Ajayan giving his opening remarks in the panel discussion on"How to be Safe on Road"

- Public meeting near Municipal bus stand in Coimbatore road, Palakkad on 12th January 2015. Nadanpattu and folk dance on Road Safety was also performed by Shri.Janardhanan and party.

Plate 49(a)

Plate 49(b)

Nadanpattu and folk dance on Road Safety

- Safe Road to School (SRS) at P.M.G.H.S.S Palakkad on 13th January 2015. 150 students underwent the training. Painting and Quiz competition were also conducted for the students.

<u>Malappuram District</u>

- Road Safety exhibition, Road Shows, announcement of Road Safety Slogans and Rules and Film shows for general public at different locations of Malappuram district in association with Malappuram Traffic Police.

Plate 50
Announcing Road Safety Slogans

Plate 51
View from Motor Cycle Road Show

- Safe Road to School (SRS) at Municipal Town Hall, Malappuram for Student Police, NCC Cadets, Scout and Guide volunteers of M.S.P.H.S.S Malappuram, G.B.H.S.S Malappuram and G.G.H.S.S Malappuram on 14th January 2015. 190 students attended the training programme.

Plate 52
Class on 'Road Safety' at Municipal Town Hall, Malappuram

Plate 53
Distribution of Road Safety materials to Teachers

- 'Training Programme for drivers' at Municipal Town Hall, Malappuram on 14th January 2015. 75 drivers including Autorickshaw, Taxi and Heavy Vehicles attended the training.

- Safe Road to School (SRS) at Municipal Town Hall, Manjeri for Student Police, NCC Cadets, Scout and Guide volunteers of N.S.S.E.M.H.S.S Manjeri, G.H.S.S Manjeri, H.M.Y.H.S.S Manjeri, H.M.A.U.P School Thurakkal and Boys HSS Manjeri on 15th January 2015. The programme was inaugurated by Shri.C.P.Mohammed, MLA. 150 students attended the training programme.

- 'Training Programme for drivers' at Municipal Town Hall, Manjeri on 15th January 2015. 75 drivers including Autorickshaw, Taxi and Heavy Motor Vehicles attended the training. The Training Programme comprised of four Technical Sessions viz., Safe Driving Techniques, Over Speed Consequences, Rules of Road Regulation and Traffic Control Devices.

Thrissur District

- Road Show at the Town Hall premises of Thrissur on 16th January 2015. The Road Show was flagged off by Shri.Vijayakumar IPS, Supdt. of Police, Thrissur Rural.

Plate 54

- Half day panel discussion on "How to be Safe on Road" at K Karunakaran Memorial Town Hall, Thrissur on 16th January 2015. The programme was inaugurated by Shri.Sivavikrom, IPS, Asst.Commissioner of Police, Thrissur. About 75 delegates representing different Trade Unions, Police Department and students from Government Engineering College, Thrissur participated. The discussion explored the factors that put young people at particular risk on the road.

Plate 55
Inauguration of Panel Discussion on 'How to be Safe on Road' by Shri.Sivavikrom, IPS, Asst.Commissioner of Police, Thrissur

- Driving school instructors training programme at K Karunakaran Memorial Town Hall, Thrissur on 16th January 2015. The programme was inaugurated by Shri.Sasi, AMVI, Thrissur. A total number of 50 instructors from different driving schools in Thrissur attended the training.

Plate 56
Inaugural address by Shri.Sasi, AMVI, Thrissur

- Film show on Road Safety near Sakthan Bus Stand, Thrissur on 16th January 2015 for general public.

Plate 57
Film show for general public

- Safe Road to School (SRS) at K Karunakaran Memorial Town Hall, Thrissur on 17th January 2015 for Student Police and NCC Cadets of C.M.S.H.S.S and St.Thomas H.S.S Thrissur. The programme was inaugurated by Shri.Jacob Job IPS, City Police

Commissioner, Thrissur. Dr.G.Ravikumar, Scientist-F, NATPAC; Shri.Muhammed Ariff, District Nodal Officer, S.P.C and Shri.Joy K F, St.Thomas H.S.S spoke on the occasion. 130 students attended the training programme.

Plate 58
Inauguration of SRS by Shri.Jacob Job IPS, City Police Commissioner, Thrissur

Plate 59
A View of the participants

- Road Safety and Youth Leadership Programme (RSYLP) at K Karunakaran Memorial Town Hall, Thrissur on 17th January 2015. The programme was inaugurated by Shri.Christopy Marokky, Road Safety Activist, Thrissur. Shri.Girijavallabhan, SI, Traffic and Shri.Sivavikram IPS, ACP, Thrissur spoke on the occasion. Nearly 100 participants representing Youth Clubs and students from Engineering colleges participated.

Ernakulam District

- Road Shows, announcement of Road Safety Safety Slogans, Road Safety Film Shows and display of Road Safety Slogans through banners at different locations of Ernakulam district. The Road Show on 11th January 2015 was flagged off by Shri.A M Rafeek, Dy.Commissioner of Police, Kochi. Road safety films were shown to general public at the Durbar Hall Ground.

Plate 60
Flagging off the Road Show by Shri.A M Rafeek, Dy.Commissioner of Police, Kochi

- Seminar on 'Road Safety'at Thrikkakara Municipal Community Hall, Kakkanadu on 12th January 2015. The seminar was inaugurated by Shri.Benny Behanan, MLA, Thrikkakara. Shri.P.A.Mohammed Ali, Chairman, Municipal Council, Thrikkakara presided over the function. Shri.K.G.James IPS, City Police Chief, Cochin; Shri.Bijo Alexander, ACP; Smt.P.R.Sreekala, District Youth Programme Officer, Ernakulam; Shri.M.A.Mohan; Shri.M.V.Prabhu Kumar and Shri.V.D.Suresh, Municipal Councillors spoke on the

occasion. About 200 participants representing different residents associations, students, auto-taxi drivers and driving school instructors actively participated and explained the practical problems faced especially in the city areas.

- Painting and Quiz Competitions for the students of Ernakulam district on 12th January 2015 at SRV High School, Ernakulam. The Competitions were inaugurated by Shri.Baby Vinod, Assistant Commissioner of Police, Traffic West, Kochi City. More than 100 students participated in the programme.

Plate 60
Inaugural Address by Shri.Baby Vinod, ACP Traffic West, Kochi City

Plate 61
Painting competition

Plate 62
Distribution of prizes by Smt.K.Subhadra Valli Amma, District Education Officer

- Seminar on 'Road Safety' at Muvattupuzha Municipal Town Hall, Ernakulam on 13th January 2015. The seminar was inaugurated by Shri.M.O.Sajan, Joint RTO, Muvattupuzha. Shri.Vishal Johnson, CI, Muvattupuzha; Shri.P.Prem Chand, Advocate; Shri.Shymon Joseph, NSS Programme Officer, Nirmala College and Smt.Sreekala P.R, District Youth Programme Officer spoke on the occasion. About 450 participants including NSS volunteers, SPC, NCC, Youth Coordinators, NSS Programme Officers and drivers participated.

Plate 63
Inaugural Address by Shri.M.O.Sajan, Joint RTO, Muvattupuzha

Plate 64
A view of the participants

Pathanamthitta District

- Road Shows, public speeches and announcement of Road Safety Slogans at different locations of Pathanamthitta District.

Plate 65(a)

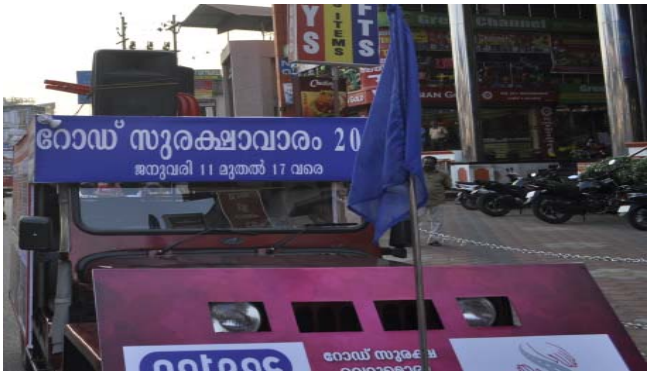


Plate 65(b)

View from Road Show

- Road Safety Awareness Programme for students and general public on 14th January 2015 at YMCA Hall, Pathanamthitta. The programme was inaugurated by Shri.Reghu Kuttan Pillai, Councilor. Smt.Usha Rajan, Municipal Councilor; Shri.A.Salim, President, Merchant Association, Thiruvalla and Shri.M.Soman, ASI, Thiruvalla spoke on the occasion.

Plate 66
A Class on 'Road Safety' at YMCA Hall, Pathanamthitta

- Painting and Quiz Competitions for the students of Thiruvalla Education district on 14th January 2015 at SGMS High School, Kayamkulam Road, Thiruvalla. 46 students participated in the programme.

Plate 67
Distribution of prizes by Smt.P.Ramani, District Education OfficerThiruvalla

- Seminar on 'Road Safety' at Govt. Girls High School, Adoor on 15th January 2015. The seminar was inaugurated by Shri.Chittayam Gopakumar, MLA, Adoor. Shri.Ooman Thomas, Adoor Municipal Chairman presided over the function. Shri.A Nazeem, DYSP, Adoor; Shri.V M Tharakan, NSS District Coordinator; Shri.K.V. Madhusudhanan Pillai, Joint RTO, Adoor and Dr.G.Ravikumar, Scientist-F, NATPAC spoke on the occasion.

Plate 68
Shri.Chittayam Gopakumar, MLA, Adoor inaugurating the Seminar on 'Road Safety'

About 200 participants including NSS volunteers, Student Police Cadets, auto/taxi drivers, NSS Programme Officers, Police officers and office bearers from different residents associations participated.

Kottayam District

- Seminar on 'Safe use of Road' at St.Antony's UP School, Arunoottimangalam near Kaduthuruthy on 16th January 2015. The seminar was inaugurated by Shri.Monce Joseph, MLA, Kaduthuruthy. Rev.Fr.Joseph Keezhangadu, Manager, St.Antony's School presided over the function. On this occasion the inauguration of 'School Road Safety Cell' was done by Smt.Nirmala Nimmi, District

Plate 69
Shri.Monce Joseph, MLA, Kaduthuruthy inaugurating the Seminar on 'Road Safety' by lighting the traditional lamp

- Panchayath President, Kottayam and the 'Cub Bull - Bull Scout Camp' was inaugurated by Shri.K.Vasudevan Nair, Mulakkulam Grama Panchayath President.
- Road Shows, announcement of Road Safety Safety Slogans, Road Safety Film Shows and display of Road Safety Slogans through banners at different locations of Kottayam district. The Road Show on 16th January 2015 was flagged off by Shri.A Ajith, Dy. Superintendent of Police, Kottayam.

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Plate 70
Flagging off the Road Show by Shri.A Ajith, Dy. Superintendent of Police, Kottayam

- Painting and Quiz Competitions for the students of Kottayam Education district on 16th January 2015 at Dy.Director Education Office, Kottayam. The Competitions were inaugurated by Shri.M.P.Dinesh IPS, District Police Chief, Kottayam. 126 students participated in the programme.

1. Road Show and Motor Cycle Rally in Pala town on 17th January 2015 in association with Pala Janamaithri Police and Bullet Club. The Road Show and Motor Cycle Rally was

flagged off from Lalam Bridge by Shri.Kuriakose Padavan, Chairman, Pala Municipal Council

Plate 71
Flagging off the Road Show by Shri.Kuriakose Padavan, Chairman, Pala Municipal Council

Plate 72
View from Motor Cycle Rally

- Seminar on 'Safe use of Road' at Alphonsa College, Pala on 17th January 2015 in association with Janamaithri Police, Pala, NSS Unit, St.Thomas College and Student Police Cadets, Alphonsa College. The seminar was inaugurated by Shri.Kuriakose Padavan, Chairman, Pala Municipal Council.Sr.Jansamma Thomas, Principal, Alphonsa College; Shri.D.S.Suneesh Babu, DYSP, Pala; Shri.Jimmi Joseph, Opposition leader, Pala Municipal Council; Sr.Riya, NSS Programme Officer, Alphonsa College; Shri. K .P.Jose , CI, Pala and Shri.K.P. Thomson, SI, Pala spoke on the occasion. About 350 participants including drivers, janamaithri members, blood donation groups, residence association representatives, members of District Youth Welfare Board and NSS volunteers participated.

Plate 73
Shri.Kuriakose Padavan, Chairman, Pala Municipal Council inaugurating the Seminar on 'Safe use of Road'

- 'Road Safety Training Programme for School Children' at CMS High School, Mundakkayam in connection with the Valedictory function on 17th January 2015. Shri.K.Kuriakose, DYSP, Mundakkayam was the chief guest.

<u>Kozhikode and Wayanad Districts</u>

- Painting Competition at Government U.P.School, Kallayi, Kozhikode on 12th January 2015.

- Display of Road Safety Slogans through banners at different locations of Kozhikode and Wayanad districts and distribution of road safety materials to general public.

Plate 75(a) *Plate 75(b)*

Road Safety Banners

- Road Safety Awareness Programme for Higher Secondary Students at Kozhikode.

  → Sevamandir Higher Secondary School, Ramanattukara on 13th January 2015

  → Government Higher Secondary School, Kuthuparamba on 14th January 2015

  → Government Higher Secondary School, East Hill on 14th January 2015

11. In-House Training Programmes conducted

- Training Programme on "ERDAS IMAGINE – 2014", by Intergraph, Chennai for Scientists and Technical Staff on 28-30 April 2014.

- Training Programme on "GS 14 and CS10 of DGPS", by Elcome Technologies,Thiruvananthapuram for Scientists and Technical Staff on 9th May 2014.

Plate 76
Hands on training in DGPS

- Technical Presentation on "Roughometer Device" (A portable high speed device used for measuring pavement roughness), by Ms TEISEI International, Secunderabad for Scientists and Technical Staff on 6th June 2014.

- Training on 'iRAP Road Safety Assessment' – collection of data, coding and assessment model development for Scientists and Technical Staff on 31st July 2014. The Resource Persons were Mr. Luke Rogers, Senior Road Safety Expert, iRAP, Australia and Mr.Jigesh Bhavsar, Road Safety Engineer, iRAP – India Project.

Plate 77
Training on 'iRAP Road Safety Assessment'

2. Training on 'Traffic Engineering Design and Road Geometrics' was given to young scientists by Shri. T. Elangovan, Scientist – G on 5th and 11th December 2014.

Plate 78
Shri.T.Elangovan interacting with young scientists

- Training on 'Auto CAD Civil 3D' was given to scientists by BIMIT – CAD & BIM Training Services - India on 26th - 28th February 2015.

Plate 79
Training on 'Auto CAD Civil 3D

- Presentation on 'Road Safety Design' to scientists by Mr.Luke Rogers, Senior Road Safety Engineer, iRAP Asia Pacific on 19th March 2015.

Plate 80
Presentation on 'Road Safety Design'

- Lecture on 'Noise and Vibration studies in different metropolitan cities' by Dr.Nasim Akhtar, Sr.Scientist, CRRI on 20th March 2015.

Plate 81
Dr.Nasim Akhtar interacting with scientists

12. Exhibitions

i. NATPAC secured 2nd position in the General Category of the Science and Technology Expo conducted in connection with Swasraya Bharat – 2014, organised by Swadeshi Science Movement – Kerala at College of Agriculture, Padannakkad, Kasargode, 14th - 19th October 2014.

ii. Road Safety Exhibition and audio-visual programmes at Sree Narayana Central School, Nedungolam, Kollam, 21st – 22nd November 2014.

13. Meetings

1. NATPAC organised Stakeholders meeting as part of preparing a Comprehensive Mobility Plan (CMP) for Thiruvananthapuram City on 7th November 2014 at Sasthra Bhavan, Pattom. Dr.Shashi Tharoor, MP gave special address on the various schemes and initiatives that need to be undertaken to have an integrated and strategic vision as far as

transportation in the city is concerned. Prof.V.N.Rajasekharan Pillai, Executive Vice President, KSCSTE also addressed the gathering.

Plate 82
Smt.B.G.Sreedevi, Director, NATPAC; Shri.P.K.Venugopal, Chairman, TRIDA; Dr.Shashi Tharoor, MP;Shri.Sheikh Pareeth IAS and Prof.V.N.Rajasekharan Pillai, Executive Vice President, KSCSTE at the Stakeholders meeting for CMP

Shri.N.Seshadri, Vice President, Urban Mass Transport Company Ltd., Bengaluru and Shri. S.Shaheem, Scientist – E1, NATPAC briefed on the significance of CMP. Senior officials from Government and Non-Government organisations participated. Urban Mass Transit Company (UMTC) Ltd. and NATPAC made presentations highlighting the need for CMP and its status. Suggestions like shared parking utilising educational institutions and other vacant public places and introduction of bus services connecting airport to various places in the city came up. The main objective highlighted in the meeting was to have a sustainable approach of land conservation and road transportation development.

2. As part of preparing a Comprehensive Mobility Plan (CMP) for Kozhikode City NATPAC organised Stakeholders meeting on 11th November 2014 at Malabar Palace Hotel, Kozhikode. About 40 officials representing various Govt. Departments/Agencies participated in the meeting and came out with suggestions for improving the transport scenario in Kozhikode City. The meeting was chaired by Shri.T.Elangovan, Scientist-G, NATPAC. Special addresses were made by Shri. V.K Akber, Superintendent of Police (Traffic); Shri.A.M.Jayan, Secretary, Kozhikode Development Authority and Shri. Anand Elamon, Project Manager, Kerala Monorail Corporation Ltd, Kozhikode. Shri.N.Seshadri, Vice President, Urban Mass Transport Company Ltd., Bengaluru and Shri. S. Shaheem, Scientist – E1, NATPAC briefed on the significance of CMP.

Various development proposals to be included in the Comprehensive Mobility Plan were discussed during the meeting. Shifting the vegetable market from Palayam to the Vengeri Wholesale Vegetable Market at Thadampattuthazham, construction of a multi-storeyed parking facility in the Mananchira area, construction of flyovers at the Thondayad and Malaparamba junctions and setting up of bus terminals at Meenchantha and Medical College were some of them.

Plate 83
Meeting in progress

14.Participation In Workshops, Seminars/Conferences And Other Training Programmes

Name of Programme	Organised by	Date	Venue	Participants
Seminars/Conferences				
Road Safety Partnership (GRSP) Asia Seminar'	GRAP and ADP at Manila (Philippines)	23.06.2014 – 24.06.2014	Manila (Philippines)	T.Elangovan
'You the Training Professionals'	Trivandrum Management Association	27.06.2014	Thiruvananthapuram	S Shaheem
IWT Summit		29.08.2014	Bullroom Crowne Plaza, Kochi	B.G.Sreedevi
Urbanisation Policy for Kerala	Institute of Town Planners (India)	28.08.2014	Thiruvananthapuram	T.Elangovan
Stake Holders Meet on "Ambient noise level mapping of Thiruvananthapuram City"	Kerala State Pollution Control Board and Central Road Research Institute, New Delhi	18.08.2014	Thiruvananthapuram	B.G.Sreedevi P.Kalaiarasan
Stake Holders Meet on "Consultation of Urban Governance"	Institute of Sustainable Development and Governance (ISDG)	13.10.2014	Press Club, Thiruvananthapuram	P.Kalaiarasan
Demonstration Project on "Mobile desalination plant in backwaters of Kerala"		14.10.2014	Thiruvananthapuram	T.Elangovan
Panel discussion on 'Climate Change Innovation Programme'	Department of Environment and Climate Change	24.11.2014	Taj Vivanta, Thiruvananthapuram	B.G.Sreedevi P.Kalaiarasan
'TRIMA 2014'	Trivandrum Management Association	25.11.2014 – 26.11.2014		B.G.Sreedevi George Koshy K Mohanakumar

Name of Programme	Organised by	Date	Venue	Participants
Urban Mobility India Conference 2014	Institute of Urban Transport – India	25.11.2014 – 28.11.2014	New Delhi	T.Elangovan
International Conference on "Road Safety Scenario and Way forward"	Indian Roads Congress, World Bank and PIARC, France	29.11.2014 – 30.11.2014	New Delhi	T.Elangovan
'Utbhav' - 2014	Dept. of Civil Engineering	09.01.2015		B.G.Sreedevi
Annual Session of Indian Roads Congress	Indian Roads Congress	18.01.2015 – 21.01.2015	Bhubaneswar	T.Elangovan
Capacity Building Programme on 'Sustainable Urban Transport' of IUT (India)	IMG, Trivandrum	24.02.2015 – 27.02.2015		Anish Kini
Workshops				
'Workshop on Hazards of Lightning and Protection Strategies for Kerala'	Centre for Innovation in Science and Social Action (CISSA) and KSCSTE	30.04.2014	Thiruvananthapuram	B.G.Sreedevi P.Kalaiarasan
'Workshop on Kerala State Action Plan on Climate Change'	Department of Environment, GoK	17.06.2014	Thiruvananthapuram	P.Kalaiarasan
'6th Annual IRAP Asia-Pacific Road Safety Workshop'	IRAP Asia-Pacific	25.06.2014	Manila (Philippines)	T.Elangovan
'Two Day Workshop on KOHA', the Open Source Library Management Software	KLA Centre for Professional Development	13.12.2014 – 14.12.2014	KLA Head Quarters, Thiruvananthapuram	Veena K S
Road Safety Capacity Building and Programme Management	Kerala Road Safety Authority and KSTP	30.01.2015	Thiruvananthapuram	T.Elangovan
Capital Region Development Phase – II	TRIDA	11.02.2015	Govt. Guest House, Thiruvananthapuram	B.G.Sreedevi T.Elangovan V S Sanjay Kumar
'URBAN 2020'	Thiruvananthapuram Corporation	16.03.2015	Govt. Guest House, Thiruvananthapuram	V S Sanjay Kumar
Workshop on 'KSDI Portal'	Kerala State Spatial Data Infrastructure (KSDI)	03.03.2015	IMG Thiruvananthapuram	M S Saran Deepa Radhakrishnan
User Interaction Workshop on "Land Resource Information System for Thiruvananthapuram"	Kerala State Land Use Board	20.03.2015	IMG Thiruvananthapuram	M S Saran Deepa Radhakrishnan
Workshops				
"EPF and Employees"	CAP	15.06.2014	Thiruvananthapuram	D Shaju

15. GUIDANCE TO STUDENTS' PROJECT WORK AND THESIS

The list of guidance provided by the Scientific Divisions to students from various National Institutes and reputed Professional Colleges during this period is given below:

Name of the Institution	Course	No.of Students	Topic
Director's Office			
National Institute of Technology, Surathkal, Karnataka	M.Tech	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	1	Utilisation of Jarofix and other waste material for road construction
Cochin University of Science and Technology	M.Tech	1	Study on the influence of subgrade soil on the strength of inservice flexible pavements
Traffic and Transportation Division			
Sarabhai Institute of Technology, Vellanadu	B.Tech (Civil)	5	Traffic Management Plan for Nedumangad Town
National Institute of Technology, Trichirapally	M.Tech (T&T.E)	1	Pedestrian Safety- Identification of critical locations & improvement – a case study of Thiruvananthapuram City
College of Engineering, Thiruvananthapuram	M.Plan (Housing)	1	Planning of pedestrian mobility for multiple activity area –A case study of Trivandrum
College of Engineering, Thiruvananthapuram	M.Tech (T&T.E)	1	Walkability of Pedestrians and modeling pedestrian flow speed
School of Planning & Architecture, New Delhi	M.T.P (Trpt.Planning)	1	Role of Insurance Sector in Funding of Road Safety
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (T&T.E)	1	Promoting Non-Motorised Modes of Transport – a Case Study of Kozhikode City
College of Engineering, Thiruvananthapuram	M.Tech (T&T.E)	1	Estimation of vehicular emission – a Case Study of Trivandrum City
National Institute of Technology, Kurukshethra	M.Tech (Transport Engineering)	1	Quick Response Travel Demand Estimation Techniques for Cities of Kerala

National Institute of Technology, Kurukshethra	M.Tech (Transport Engineering)	1	Impact of weather on traffic flow and travel demand in selected corridors in Kerala
National Institute of Technology, Kurukshethra	M.Tech (Transport Engineering)	1	Congestion Charging in CBD areas – A case study
National Institute of Technology, Surathkal, Karnataka	M.Tech (Transport Engineering)	4	Strategies for Parking Management in Cities
National Institute of Technology, Trichirapally	M.Tech (Transport Engineering)	4	Pedestrian and bicycle friendly transport system for cities in Kerala
SV National Institute of Technology, Surat	M.Tech (Transport Engineering)	2	Congestion pricing in cities of Kerala
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Trpt.)	1	Determination of congestion charges for car users in` CBD area of Trivandrum City
National Institute of Technology, Karnataka, Surathkal	M.Tech (Trpt.)	1	Assessment of safety of roads in Kerala using iRAP Model
National Institute of Technology, Karnataka, Surathkal	M.Tech (Trpt.)	1	Influence of monorail on travel behaviour of users – A case study of Thiruvananthapuram
National Institute of Technology, Kurukshethra	M.Tech (Transport Engineering)	1	Urban Travel Characteristics in cities of Kerala
National Institute of Technology, Kurukshethra	M.Tech (Transport Engineering)	1	Effects of weather on traffic flow characteristics
National Institute of Technology, Karnataka, Surathkal	M.Tech (Trpt.)	1	Mode choice behaviour of urban commuters due to LRT System– A case study of Thiruvananthapuram
College of Engineering, Trivandrum	M.Plan (Urban Design)	2	Planning of elevated walkway between KSRTC Central Station – East Fort in Thiruvananthapuram City
National Institute of Technology, Karnataka, Surathkal	M.Tech (Trpt.)	1	Parking demand management for Light Rail Transit Corridors in Trivandrum
Visvesraya National Institute of Technology, Nagpur	M.Tech (Transport Engineering)	2	Report on Congestion Pricing
College of Engineering, Thiruvananthapuram	M.Tech (Trpt.)	1	Walkability of pedestrians and modeling pedestrian flow speed

St.Joseph's College of Engineering & Technology, Pala	B.Tech (Civil)	4	Preparation of TOD for Kochi Metro alignment
Carmel Higher Secondary School, Trivandrum	SSLC	6 students – Project work for National Level Science Popularization Project	Vehicular emission and climatic change – A case study of Trivandrum City
School of Architecture and Planning, Anna University, Chennai	MTP	1	Planning for Non Motorised Transport in Cities
Cochin University of Science and Technology	B.Tech (Civil)	1	Impact of higher FAR ratio in commercial areas
Cochin University of Science and Technology	B.Tech (Civil)	1	Parking demand assessment for LRT Stations in Thiruvananthapuram
Sarabhai Institute of Science and Technology, Thiruvananthapuram	B.Tech (Civil)		Planning and design of outer ring road in Thrissur
Younis Kunju College, Kollam	B.Tech (Civil)		Traffic Operation Plan for Attingal town
Cochin University of Science and Technology	B.Tech (Civil)		Estimation of parking demand for proposed Kozhikode light metro station
Pankaja Kasturi College of Engineering & Technology, Thiruvananthapuram	B.Tech (Civil)		Inter-city travel characteristics of road users in Thiruvananthapuram city
College of Engineering, Punnapra	B.Tech (Civil)		Parking management strategies for Kesavadasapuram – Pattom stretch of NH-47 in Thiruvananthapuram city
Regional Transportation Division			
Visweswarayya National Institute of Technology, Nagpur	M.Tech	1	Activity Based Travel Demand Modelling for Thiruvananthapuram Urban Area
Visweswarayya National Institute of Technology, Nagpur	M.Tech	1	Socio-Economic Valuation of Traffic Delays of a Selected Corridor
Visweswarayya National Institute of Technology, Nagpur	M.Tech	1	Evaluation of Accessibility and Mobility Levels of Thiruvananthapuram
Indian Institute of Information Technology and Management-Kerala (IIITM-K)	M.Sc Geoinformatics	1	Forecasting Urban Growth Based on GIS, Remote Sensing and Statistical Model for Chalakudy City in Kerala

Mangalam College of Engineering, Kottayam	B.Tech (Civil)		Traffic Improvement Schemes for Ettumanoor Junction
Water Transportation Division			
Indian Maritime University	M.B.A (Port & Shipping)	1	Comparative analysis of Road ways and Water ways with special reference to Elloor Industrial area to Cochin Port
Rajadhani Institute of Engineering and Technology, Attingal	B.Tech	1	Improvement of Akkulam – Kovalam Section of TS Canal
Sree Budha College of Engineering for Women, Pathanamthitta	B.Tech (Civil)	4	Vehicular Emission – Study and its effects in Thiruvananthapuram City
St.Joseph's College of Engineering & Technology, Pala	B.Tech (Civil)	4	Study on impacts of vehicular emission on human beings in Thiruvananthapuram City
College of Engineering, Thiruvananthapuram	M.Tech (Env.)	2	Revitalization of T.S Canal for Inland Navigation and Tourism Promotion in Akkulam – Kovalam Stretch
St.Joseph's College of Engineering & Technology, Pala	B.Tech (Civil)	6	Environmental Impacts of air pollution in Thiruvananthapuram City Centre
College of Engineering, Trivandrum	M.Tech (Env.)	2	Life Cycle Assessment of Dairy Products, Milma Dairy Plant – A case study
Sree Budha College of Engineering for Women, Pathanamthitta	B.Tech (Civil)	7	Impacts of vehicular pollution on human beings – A case study
St.Joseph's College of Engineering & Technology, Pala	B.Tech (Civil)	4	Estimation of Carbon Credit for Inland Water Transportation of NW3
CEPT, Ahmedabad	PG in Urban & Regional Planning	1	Inland Waterways and its sustainable development
Highway Engineering Division			
College of Engineering, Thiruvananthapuram	M.Plan	1	Feasibility study of Monorail system in Trivandrum
Marian Engineering College, Thiruvananthapuram	B.Tech (Civil)	4	Use of Fibre reinforced Bituminous mixes in road construction
Marian Engineering College, Thiruvananthapuram	B.Tech (Civil)	4	Use of fly ash in Bituminous mixes

GISAT Engineering College, Kottayam	B.Tech (Civil)	4	Use of plastic waste in road construction
Pankaja Kasthuri College of Engineering	B.Tech (Civil)	5	Capacity Analysis of SH – 1
Marian Engineering College, Thiruvananthapuram	B.Tech (Civil)	6	Performance of glass fibre reinforced SMA
SCMS School of Engineering and Technology, Kochi	B.Tech (Civil)	4	Mix design for coir fibre reinforced bituminous concrete
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M.Tech (Transportn. Engineering)	6	Pavement materials and testing on mixes
Amritha Vishwa Vidyapeetham	B.Tech (Civil)	6	Performance of coir fibre reinforced SMA
Mar Baselios College of Engineering and Technology, Thiruvananthapuram	B.Tech (Civil)		Traffic Analysis and Management Measures for Pettah Junction in Thiruvananthapuram
Extension Services Division			
Sree Budha College of Engineering and Technology for women, Elavamthitta	B.Tech (Civil)	5	Capacity Estimation of MC Road
Marian Engineering College, Kazhakuttam	B.Tech (Civil)	6	Improvement of Kochulloor to Medical College Section of NH - 47
Sarabhai Institute of Science and Technology, Vellanad	B.Tech (Civil)	5	Traffic Improvement Plan for Nedumangadu Town
Gurudeva College of Engineering and Technology, Puthuppally	B.Tech (Civil)	5	Road Safety Audit of Pothencode to Thycaud section of MC Road
St.Joseph's College of Engineering & Technology, Pala	B.Tech (Civil)	4	Parking management system for MG road in Thiruvananthapuram city
National Institute of Technology, Tiruchirapally	M.Tech (Transport Engineering)	1	Analysis of pedestrian and bicycle movements in Kozhikode city
St.Joseph's College of Engineering & Technology, Pala	B.Tech (Civil)	4	Intermodal split of goods transportation in Kerala
College of Engineering , Kidangoor, Kottayam	B.Tech (Civil)	6	Accident Analysis in Kottayam District using GIS
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M.Tech (Transportation Engineering)		Pedestrian accident prediction modeling of selected road stretch in Kerala
Rajiv Gandhi Institute of Technology (RIT), Kottayam	M.Tech (Transportation Engineering)		Parking Demand Management Strategies for major land uses on selected road corridors in Thiruvananthapuram city

16. PRESENTATION OF PAPERS IN SEMINARS/WORKSHOPS

B G Sreedevi, "*Use of waste plastic for Road Construction".* Dept. of Environment, Govt. Secretariat, Thiruvananthapuram, 12th June 2014.

B G Sreedevi, Presentation made in the Workshop on "*Kerala State Action Plan on Climate Change".* Dept. of Environment, GoK, 17th June 2014.

B.G.Sreedevi,"*Role of Infrastructure in Economic Development".* DC School of Management, KINFRA, Trivandrum, 21st July 2014.

B.G.Sreedevi,"*Industrial Corridor for Kerala".* Live Telecast of the launch of the 'Make in India' campaign by Prime Minister of India, organised by CII at Hilton Garden Inn, Trivandrum, 25th September 2014.

B.G.Sreedevi, "*Development of Capital Region in terms of Infrastructure".* Seminar organised by The Trivandrum Chamber of Commerce & Industry at the Chamber Hall, Trivandrum, 4th November 2014.

B.G.Sreedevi, "*Sustainable Urban Transport*". Department of Architecture, College of Engineering, Trivandrum, 19th November 2014.

B.G.Sreedevi, P.Kalaiarasan, *"Study on Ambient Air Quality and its contribution to climate change in Kerala".* Department of Environment and Climate Change, Thiruvananthapuram, 12th December 2014.

T.Elangovan, *"Water and Energy Security for Transportation".* National Conference on Water and Energy Security – Issues, Challenges and Potentials at Ernakulam, 22nd August 2014.

Uthara, K, Elangovan, T, Sachdeva, S N, "*Impact of weather on traffic and travel behaviour of commuters*". International Conference on 'Recent Trends and Challenges in Civil Engineering' (RTCCE – 2014), organised by Motilal Nehru National Institute of Technology, Allahabad, 12th – 14th December 2014.

Sara Abraham, Elangovan, T, Sachdeva, S N, "*Development of Quick Response Travel Demand Estimation Technique for small towns*". International Conference on 'Recent Trends and Challenges in Civil Engineering' (RTCCE – 2014), organised by Motilal Nehru National Institute of Technology (MNNIT), Allahabad, 12th – 14th December 2014.

V S Sanjay Kumar, "*Valuation of Travel Time Delays".* National Conference on "RECENT ADVANCES in CIVIL ENGINEERING" (RACE '14), organised by Younus College of Engineering, Kollam, 21st - 22ndAugust, 2014.

V S Sanjay Kumar, "*Tour generation model- An Activity Based Approach".* National Conference on "RECENT ADVANCES in CIVIL ENGINEERING" (RACE '14), organised by Younus College of Engineering, Kollam, 21st - 22ndAugust, 2014.

V S Sanjay Kumar, (1)*"Socio-economic valuation of Traffic Delay".* (2)*"Activity Based Travel Demand Modelling of Thiruvananthapuram Urban Area".* (3) *"Public Transport Accessibility Analysis for Thiruvananthapuram Urban Area".* 11th International Conference on Transportation Planning and Implementation Methodologies for Developing Countries (TPMDC – 2014), organized by IIT Bombay, 10th – 12th December 2014.

P.Kalaiarasan, "*Improvement of Kovalam-Akkulam Canal section in Thiruvananthapuram region for Navigation, Tourism promotion and Recreational Purposes ".* Workshop on National Wetland Conservation Program, organised by Department of Environment, Kerala at Govt Guest House, Thycaud, 4th July 2014.

P Kalaiarasan, *"Improvisation of Climate friendly Transportation".* Dept. of Environment, Government Secretariat, Thiruvananthapuram, 12th June 2014.

P.Kalaiarasan; B.G.Sreedevi, *"Planning Intervention for Revitalization of Inland Waterways for Transport – A case study of Parvathy Puthanar Canal in Thiruvananthapuram".* 27th Kerala Science Congress organised by Kerala State Council for Science, Technology & Environment (KSCSTE) in association with National Transportation Planning and Research Centre (NATPAC), Camelot Convention Centre , Alappuzha, 27th - 29th January 2015.

Veena K S, "*Preservation of Digital Collections in Libraries – Problems and Perspectives".* National Seminar on Technology Management in Libraries organised by Kerala Agricultural University, College of Horticulture, Thrissur, in collaboration with the Academic Library Association (ALA) and Kerala Library Association (KLA) and sponsored by the Kerala State Council for Science Technology and Environment (KSCSTE) at KAU, Thrissur, 29th – 30th August

Shijith P P; S N Sachdeva; B.G.Sreedevi, "*Study on the use of Industrial Waste for Sustainable Road Construction – A case study on Jarosite and Mild Steel Slag".* 27th Kerala Science Congress organised by Kerala State Council for Science, Technology & Environment (KSCSTE) in association with National Transportation Planning and Research Centre (NATPAC), Camelot Convention Centre , Alappuzha, 27th - 29th January 2015.

Nija Bind T A; B.G.Sreedevi; Benny Mathews Abraham, *"Prediction of Structural Performance of State Highway 1 with respect to subgrade soil properties".* 27th Kerala Science Congress organised by Kerala State Council for Science, Technology & Environment (KSCSTE) in association with National Transportation Planning and Research Centre (NATPAC), Camelot Convention Centre , Alappuzha, 27th - 29th January 2015.

Shaheem S, *"Traffic management measures for Palakkad town''Traffic management measures for Palakkad town".* Workshop organised by Malayala Manorama, 20th March 2015.

Salini P N; B Anish Kini; T Elangovan, "*Enhancing the public transport patronage for Technopark in Thiruvananthapuram".* Technical paper in the category of contest of best paper award. 27th Kerala Science Congress organised by Kerala State Council for Science, Technology & Environment (KSCSTE) in association with National Transportation Planning and Research Centre (NATPAC), Camelot Convention Centre , Alappuzha, 27th - 29th January 2015.

Arun Chandran; Ebin Sam; T Ramakrishnan; T Elangovan; B.G.Sreedevi, *"Evaluation of Pedestrian Infrastructure for Kochi City".* 27th Kerala Science Congress organised by Kerala State Council for Science, Technology & Environment (KSCSTE) in association with National Transportation Planning and Research Centre (NATPAC), Camelot Convention Centre , Alappuzha, 27th - 29th January 2015.

PAPERS PUBLISHED IN REFERRED JOURNALS

Ebin Sam. "*Willingness to Shift from Car to Bicycle – A case study of Calicut City*", International Journal of Engineering Research and Technology, Volume 3, Issue 11, November 2014.

Satheish B. Nair, B.G. Sreedevi, Salini P.N, Kalaiarasan P. '*Traffic Management at Interstate Check Posts – Case Study of Walayar Check Post in Kerala'*, Indian Highways, August 2014, Page 35-47.

17. INVITED TALKS/MEDIA INTERACTIONS

Media Interactions

B G Sreedevi, Director

- '*Discussion on Mattanchery Toll Bridge*'. Mathrubhumi Channel on 5th April 2014.
- '*Seat Belt'*. Discussion in Manorama Channel on 13th June 2014.
- '*Railway Budget Discussion'*. Amrita TV on 8th July 2014.
- '*Road Development'*. Kerala Vision Channel on 8th August 2014.
- *'Draft of new Motor Vehicles Act'*. Phone-In Programme in Doordarshan on 14th September 2014.
- '*Draft of new Motor Vehicles Act'*. Discussion in Media One Channel on 14th September 2014.

- '*Comprehensive Mobility Plan'*. Manorama Channel on 30th September 2014.
- *'Road Development in Kerala'*. Media Plus Channel on 6th October 2014.
- *'Road Infrastructure Development'*.Discussion in Asianet Plus Channel on 20th October 2014
- *'Railway Budget Discussion'*. All India Radio on 23rd February 2015.
- *'Railway Budget Discussion'*. Amritha TV on 26th February 2015.

Invited Talk

B G Sreedevi, Director

- '*Road Safety'*. Talk delivered at Driving School Instructors Training Programme, organised by NATPAC at Bodhana Auditorium, Thiruvalla (Pathanamthitta Dt.), 14th May 2014.
- *'Union Budget Expectation'*. Panel Discussion organised by DC School of Management and Mathrubhumi Channel, 13th June 2014.
- Discussion on '*Urban Governance'*. Organised by Institute of Sustainable Development and Governance at Press Club, Thiruvananthapuram, 13th October 2014.
- Inaugural address at the awareness class on '*How to reduce electricity bill'*. Organised by P.T.P. Avenue Residence Association, 23rd November 2014.
- Presentation in National Conference on *Recent Engineering Advances and Trends (NCREAT 2015)*. Organised by Pankajakasthuri College of Engineering & Technology, PKCET, 20th March 2015.

T.Elangovan, Scientist-G

- *'Star Rating of roads being built in Kerala, India'*. Talk delivered at the Asia Pacific Road Safety Workshop, Manila on 25th June 2014.
- *'Integrated Transport System with special reference to Kollam Town'*. Talk delivered at Quilon Management Association, Kollam, 5th August 2014.
- Moderator. Panel Discussion on '*Public Transport Policy'* with special focus on 'Bus Transportation', organised by NATPAC at Mascot Hotel, Thiruvananthapuram, 7th August 2014.
- Chairman. Technical Session on *'Transportation Engineering'*, National Conference on Technological Trends -2014 at College of Engineering, Thiruvananthapuram, 23rd August 2014.

- 'S*ustainable Transport Development*'. Talk delivered at short term course on '*Urban Design and Mobility*', organised by Architectural Department, College of Engineering, Trivandrum, 12th November 2014.

- 'R*oad Safety Action Plan for Kerala State*'. Talk delivered before *the Road Safety Committee* constituted by the Supreme Court of India as member of the State delegation, 15th December 2014.

- '*Integrated Planning of Urban Infrastructure'*. Resource Person for '*Capacity Building Programme on Sustainable Urban Transport'* at IMG, Trivandrum, 25th February 2015.

- '*Traffic Engineering and Management'*. Resource Person for '*Capacity Building Programme on Sustainable Urban Transport'*. Organised by IUT (India) and Ministry of Urban Development, Govt. of India at IMG, Trivandrum, 26th February 2015.

Shaheem.S, Scientist-E1

- 'I*ntroduction to Comprehensive Mobility Plan*'. Talk delivered at short term course on '*Transportation System Management and Operations*', organised by Mar Athanasius College of Engineering, Kothamangalam, 17th November 2014.

- 'S*ustainable Urban Transport for Thrissur City*'. Talk delivered at '*Thrissur Next-Urban Design*', organised by IAA and College of Engineering, Thrissur, 22nd November 2014.

P.Kalaiarasan, Scientist-C

- Trained the Kerala Government Officials on the subject modules of *'Public Transport'* and *'Environmental Impact Assessment*' as a Faculty of Institute of Urban Transport (IUT), Delhi at IMG, Thiruvananthapuram, 24th – 27th February 2015.

- *'Administrative and Legislative Control of Environmental Pollution - Important Environmental Rules and Regulations'.* Resource Person for 'Engineering Students Improvement Programme'. RIT, Kottayam, 2nd March 2015.

Salini P N, Scientist-C

- *'Pavement Materials, Tests and Characterisation'.* As part of Training Programme on 'Design, Construction and Maintenance of Roads', sponsored by Transportation Engineering Research Centre (TRC). College of Engineering, Thiruvananthapuram, 7th January 2015.

- *'Functional and Structural Evaluation of Pavements'.* As part of Training Programme on 'Design, Construction and Maintenance of Roads', sponsored by Transportation Engineering Research Centre (TRC). College of Engineering, Thiruvananthapuram, 9th January 2015.

18. NOMINATIONS TO TECHNICAL COMMITTEES/ADVISORY BODIES

B G Sreedevi; Director

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, Committee for preparation of revival package for Kerala State Road Transport Corporation (KSRTC), Government of Kerala

Expert member of two Committees of Trivandrum Development Authority, Government of Kerala

Member, Kerala Road Safety Authority (KRSA), Government of Kerala

Executive Committee Member, Kerala Road Safety Authority (KRSA), Government of Kerala

Core Advisory Group Member of Energy Management Centre (EMC), Government of Kerala

Member of Road Safety & Design Committee (H-7), 2012-15, Indian Roads Congress. (National Level)

Member, H-5 Committee -2015-'17, Indian Roads Congress. (National Level)

Member, Panel of Experts for Assessment Promotion to staff of Rajiv Gandhi Centre for Bio-Technology, Government Of India, 2013, 2014

Convener of the working group on 'Roads, Bridges and Road Transport' of Kerala State Planning Board, Government of Kerala

Member, Technical Committee 'Kozhikode City Road Improvement Project', Kerala Road Fund Board, Government of Kerala, 2014

Member, Board of Studies in 'Environmental Studies' Cochin University of Science and Technology 2011-2015

Member, 'Building Committee of SrinivasaRamanujan Institute for Basic Sciences (SRIBS), Government of Kerala, 2014

Member, 'Technical Committee, for introducing PRT in Trivandrum', INKEL, Govt. of Kerala , 2014

Member, Electric Mobility Mission Program , Power Dept., Government of Kerala,2014

- Chairperson, Building Committee, Jawaharlal Nehru Tropical Botanical Garden & Research Institute, Thiruvananthapuram, 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 -2015
- Expert member for the selection committee of project manager, Kerala Road Fund Board, 2015
- Management Committee member of SrinivasaRamanujam Institute for Basic Sciences (SRIBS), Kottayam, 2015, constituted by KSCSTE
- Chairperson, Organizing Committee, 27 th Kerala Science Congress, Jan, 2015.

T.Elangovan, Scientist-G

- Nominated as Council Member of Indian Roads Congress for the year 2015 at 75th Annual Session held at Bhubaneswar on 19th January 2015.

P Kalaiarasan, Scientist-C

- Nominated as Member for Technical cum Advisory Committee of Kerala Forest Department for procuring Satellite Imageries and GIS software.

27th KERALA SCIENCE CONGRESS

27 Kerala Science Congress

Kerala State Council for Science, Technology & Environment (KSCSTE) organized the 27th Kerala Science Congress in association with National Transportation Planning and Research Centre (NATPAC) at Alappuzha in Camelot Convention Centre from 27th to 29th January 2015. The Focal Theme of 27th KSC was 'Traditional Industries' in order to focus on the role of technological innovations in making the traditional industry competitive and sustainable.

The programme was formally inaugurated by Shri.Oommen Chandy, Hon'ble Chief Minister, Government of Kerala. Shri. K. C. Venugopal, Hon'ble MP presided over the function. Shri. K. C. Venugopal presented this year's Kerala State Young Scientist Award to Young Scientist Awardees.

Hon'ble MP also released the abstract of Proceedings of 27th Kerala Science Congress.

Dr.Tessy Thomas, Director, Advanced System Laboratory, DRDO, Hyderabad and Chairperson of 27th KSC delivered the keynote address. Dr. T. Ramaswamy, Former member Secretary, Central Science and Technology Department ; Dr. K. K. Ramachandran, Member Secretary, KSCSTE; Dr. K. R. Lekha, Head, Women Scientists Division, KSCSTE and General Convenor and Smt. B. G. Sreedevi, Director, NATPAC and Chairperson, Organising Committee spoke on the occasion.


NATIONAL TRANSPORTATION PLANNING AND RESEARCH CENTRE
SASTHRA BHAVAN, PATTOM, THIRUVANANTHAPURAM-695 004, KERALA, INDIA
TAKE CARE AT CROSSINGS


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Science Congress
VALEDICTORY SESSION
Kerala Scien
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CE CONGRESS- Pa

Six veteran science personalities like Dr. P. K. Iyengar, Dr. G. N. Ramachandran, Dr. E. K. Janaki Ammal, Shri. P. T. Bhaskara Panicker, Dr. P. K. Gopalakrishnan and Dr. P. R. Pisharoty were remembered on the occasion. A National Science Exhibition was also organised during 27 – 30 January 2015 as part of the 27th Kerala Science Congress at Sanatana Dharma Vidyasala (SDV) Centenary Auditorium and School Ground, Alappuzha. A session on Children's Science Congress was also organised on the 3rd day.

Valedictory session chaired by Shri.Ramesh Chennithala, Hon'ble Minister for Home, Govt. of Kerala was held on 29th January 2015 at 2.00pm in the Grand Hall of Camelot Convention Centre. Shri.P.J.Kurian, Deputy Chairman, Rajyasabha; Shri.K.C.Venugopal, Hon'ble MP; Dr.Tessy Thomas, Director, Advanced System Laboratory, DRDO, Hyderabad; Dr. K. K. Ramachandran, Member Secretary, KSCSTE; Prof.George Varghese, Director, KSCSTE; Smt. B. G. Sreedevi, Director, NATPAC and Dr.K.R.Lekha, Head, Women Scientists Division, KSCSTE spoke on the occasion. The science congress proved to be a platform for interlinking the research community and for expanding the knowledge base for the society in general.

27th Kerala Science Congress Sub-Committees

Smt.Dr.B.G.Sreedevi ,Director	-	Chairperson,Organizing committee	
Registration Committee		**Technical Sessions Committee**	
Sri.M S Saran Scientist - C	Co-convenor	Sri.Dr. G Ravikumar Scientist - F	Co-convenor
Sri.R J Sanjai Technical Officer	Co-convenor	Smt.N M Sabitha Scientist - C	Co-convenor
Smt.Deepa Radhakrishnan Technical Officer	Member	Sri.M S Saran Scientist - C	Member
Reception Committee		Sri.B Subin Scientist - C	Member
Sri.K.George Koshy Registrar	Convenor	**Technical Paper Evaluation Committee**	
Sri.K C Wilson Scientist - C	Co-convenor	Smt.P N Salini Scientist - C	Co-convenor
Smt.N M Sabitha Scientist - C	Co-convenor	Sri.B Anish Kini Scientist - B	Member
Sri.T. Mohan Technical Assistant	Member	**Exhibition,Poster And Venue Arrangement Committee**	
Sri.R J Sanjai Technical Officer	Member	Sri.Dr. G Ravikumar Scientist - F	Convenor
Sri.T. Vijayan PA to Registrar	Member	Sri.B Subin Scientist - C	Co-convenor
Sri. Muhammed Naserudeen Office Assustant	Member	Sri.S. Ramachandran Technical Officer	Co-convenor
Focal Theme and Memorial Lectures Committee		Sri.V. Jayawardhanan Technical Officer	Co-convenor
Sri.B Anish Kini Scientist - B	Co-convenor	Sri.R Chandra Prathap Scientist - B	Co-convenor
Sri.C. Muraleedharan Pillai Technical Officer	Member	**Public Relations, Entertainment & Press**	
PG Students Interactive Session Committee		Sri.Santhosh Kadavy Scientist - B	Co-convenor
Sri.Arun Chandran Scientist - C	Co-convenor	Sri.Dr. G Ravikumar Scientist - F	Member
Smt.U Salini Scientist - B	Member	**Children Science Congress Committee**	
Sri.S Ebin Sam Scientist - B	Member	Smt.U Salini Scientist - B	Co-convenor

Food and Refreshment Committee	
Sri.S Shaheem Scientist - E1	Convenor
Sri.Dr. G Ravikumar Scientist - F	Co-convenor
Sri.K.M.Syed Mohammed Principal Technical Officer	Co-convenor
Transportation Committee	
Sri.D Robinson Scientist - F	Convenor
Sri.P Kalaiarasan Scientist - C	Co-convenor
Sri.A Jegan Bharath Kumar	Co-convenor
Sri.V S Sanjay Kumar Scientist - E1	Member
Sri.Arun Chandran Scientist - C	Member
Smt.K S Veena Scientist - B	Member
Sri.S Ebin Sam Scientist - B	Member
Sri.Santhosh Kadavy Scientist - B	Member
Sri.M.S. Radhakrishnan Technical Officer	Member
Smt.Deepa Radhakrishnan Technical Officer	Member

Accomodation Committee	
Sri.V S Sanjay Kumar Scientist - E1	Convenor
Sri.Sreekanth P Krishnan Technical Consultant	Co-convenor
Sri.P Kalaiarasan Scientist - C	Co-Convenor
Smt.N M Sabitha Scientist - C	Member
Sri.Arun Chandran Scientist - C	Member
Smt.Deepa Radhakrishnan Technical Officer	Member
Publication Committee	
Smt.K S Veena Scientist - B	Co-convenor
Sri.S Ebin Sam Scientist - B	Co-convenor
Finance Committee	
Sri.K.Mohanakumar Deputy Registrar	Convenor
Sri.K.George Koshy Registrar	Co-convenor
Smt.Arya.S.K Office Assistant	Member
Smt.Maya Devi.M Office Assistant	Member

INFRASTRUCTURE

1. *Testing Facilities and Equipments*

NATPAC `s research laboratory is well equipped with the state of the art equipments for testing of highway materials, pavement evaluation, mix design, etc. There are facilities for aggregate testing, bitumen and emulsion testing, bituminous mixes testing and pavement evaluation. There is also a geotechnical lab for soil testing, which houses equipments for routine testing of soil.

Our Traffic Engineering laboratory has speed radar gun and several softwares used for traffic modeling and analysis.The Environmental Engineering lab includes equipments for air quality monitoring noise-level meter, and measurement of meteorological parameters.

NATPAC has a collection of facilities for conducting topographic survey and modern surveying instruments including DGPS and total station apart from echo sounder used for hydrographic surveying. The list of equipments/ softwares available with NATPAC includes:

Sl. No.	Item
a) Highway Engineering Laboratory	
Soil Testing Equipments	
1.	Soil sieves
2.	Mechanical sieve shaker(motorized)
3.	Liquid limit test apparatus
4.	Shrinkage limit test set
5.	Compaction test equipment-light & heavy
6.	Automatic motorized universal compactor
7.	Core cutter for field density test
8.	Sand pouring cylinder (10cm,15 cm & 20 cm dia) for field density test
9.	CBR test equipment
10.	Rapid moisture content - Infrared moisture meter
11.	Rapid moisture content - Calcium carbide test apparatus
12.	Post hole auger
13.	Direct Shear Test
14.	Triaxial Shear Test
15.	Unconfined Compression Test
16.	Consolidation Test
17.	Permeability Test
18.	Specific gravity test – Density bottle
19.	Hydraulic extruder (Electrically operated)
Aggregate Testing Equipments	
20.	Aggregate sieves
21.	Aggregate Impact Value test equipment
22.	Los angles abrasion testing machine
23.	Stripping value test equipment
24.	Specific gravity test - Density basket
25.	Shape test - Thickness gauge & Length gauge, Angularity number test mould

Tests on Bitumen	
26.	Penetration test equipment
27.	Flash & fire point Test apparatus
28.	Softening point test - Ring & ball apparatus
29.	Ductility testing machine
30.	Standard Tar Viscometer
31.	Brookfield Viscometer
Tests on Mixes	
32.	Marshall stability test equipment.
33.	Motorized centrifuge extractor
34.	Core cutting machine - (100mm dia. core bit)-undisturbed sampling of bituminous pavement.
35.	Wheel rut test equipment
36.	Wheel rut test shaper
37.	Automatic bituminous mix compactor
38.	Automatic Marshall stability test equipment
Test on Pavement	
39.	Fifth Wheel type Bump Integrator
40.	MERLIN - Machine for evaluating roughness using low cost instrumentation
41.	Benkelman beam test equipment - 2 nos.
42.	Portable wheel weigh bridge/pad
General Accessories	
43.	Thermostatically controlled drying oven 0-150^{0}C
44.	Thermostatically controlled water bath
45.	Electronic balances - 300 g, 3kg, 50 kg, 250kg
46.	Soaking tank
47.	Heater
48.	Stove – 2 nos.
49.	Semiautomatic balance 10 kg - 2 nos.
50.	Plastic shredder
51.	Traffic safety appurtenances
b) ***Traffic Engineering Laboratory***	
52.	Noise level meter
53.	Speed Radar
54.	Distometer
c) Topographic Survey	
55.	DGPS
56.	Single Frequency GPS-5 Nos.
57.	Total stations-3 Nos.
58.	Automatic levels-2 Nos.
59.	Theodolite
60.	High end plotters -2 Nos.
61.	Electronic Total Station
d) Environment Laboratory	
62.	CO Analyzer
63.	CO2 Analyzer
64.	NO2 Analyzer
65.	CH4 Analyzer

66.	Cup Anemometer
67.	Wind vane
68.	Wind logger
69.	RH meter
70.	Thermo couple sensor
71.	Spectro photo meter
72.	Respirable Dust Sampler (APM 460)-2 Nos.
e) Water Transport Laboratory	
73.	Echo sounder
74.	Distometer
f) General Accessories for Laboratory	
75.	Thermostatically controlled drying oven 0-150^{0}C
76.	Thermostatically controlled water bath
77.	Electronic balances - 200 g, 2 kg, 50 kg
78.	Soaking tank
79.	Heater
80.	Semiautomatic balance 10 kg - 2 nos.
81.	Traffic safety appurtenances
82.	Power generator- 2 nos.
83.	External car battery-3 nos.
84.	Digital Thermometer
g) Application Softwares	
85.	MX ROAD
86.	AUTO CAD
87.	ARC GIS
88.	3D MAX
89.	TALLY
90.	STAD PRO
91.	HDM IV
92.	SPSS
93.	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 has a vast collection of books on Transportation, Traffic Engineering, Transport Economics, Urban and Regional Planning, Water Transport, Environment, Management, Operations Research, Geography, Statistics, Economics and allied subjects of both Indian and International authors . In addition to these, 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, like Science India, Safety Messenger, etc. 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-

Indian Institute of Technology; National Institute of Technology; Rajiv Gandhi Institute of Technology, Kottayam; Saintgits College of Engineering, Kottayam; Neharu Yuva Kendra, Kollam; School of Planning and Architecture, Bhopal; College of Engineering, Thiruvananthapuram; ITS Planners and Engineers, Hyderabad; Baselios Mathews College of Engineering, Sasthamcotta; Mar Baselious 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, Thiruvananthapuram; Marian Engineering College, Thiruvananthapuram; Cochin University of Science and Technology;St Joseph's Collage of Engineering and Technology;Pankaakasthuri Collage of Engineering and Technology Amritha Viswa Vidhyapeetham;School of Architecture and Planning Chennai;Collage of Engineering and Management Punnapra, Alappuzha;Mangalam Collage of Engineering Ettumanoor; Younus Collage of Engineering and Technology Kollam; Centre for Environmental Planning and Technology Ahamadhabad; SCMS School of Engineering and Technology Cochin; Indian Institute of Information Technology and Management Kerala TVM;Ranganatham Architecture Collage Coimbatore; Sree Budha Collage of Engineering Pattoor.

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, 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 Vice Chancellor, Cochin University of Science and Technology	-	Member
14.	The Vice Chancellor, Kerala Agricultural University	-	Member
15.	The Secretary to Government, Finance Department, Govt. of Kerala	-	Member
16.	The Secretary to Government, Planning and Economic Affairs Department, Govt. of Kerala	-	Member
17.	The Director, Vikram Sarabai Space Centre, Thiruvananthapuram	-	Member

18.	The Director, NIST, Formerly (RRL-T), Thiruvananthapuram	-	Member
19.	The Director, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram	-	Member
20.	The Member Secretary (nominated by Government)	-	Member
21.	Director, TBGRI, Trivandrum	-	Member
22.	Director, KFRI, Peechi, Thrissur	-	Member

The 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, TBGRI, 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	-	Members
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 04/28, East End Apartments Mayoor Vihar, Phase – 1 Extension, New Delhi – 110 096	-	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.	Dr.G.Ravikumar, Scientist –F NATPAC	-	Member
4.	Sri.G Rajiv Additional Secretary, Dept of Environment, GoK	-	Member
5.	Director, JNTBGRI	-	Member
6.	Registrar, NATPAC	-	Member

v. Information Officers as per the Right to Information Act

1	Public Information Officers (Scientific and Technical Matters)	:	Shri. D.Robinson Scientist - F
2	Public Information Officers (Administrative Matters)	:	Shri P C Sivadas Dy Registrar (Admin) (Up to 31/10/2014) Shri. K Mohanakumar Dy Registrar (Finance) (From 01/11/2014)

3	Asst. Public Information Officer	:	Smt.T.S.Sangeetha Assistant
4	Appellate Authority	:	Smt.B.G.Sreedevi Director

vi. Internal Committees

a. Library Committee

Shri.D.Robinson, Scientist – F	-	Chairman
Shri.K.Mohanakumar, Deputy Registrar (Finance)	-	Member
Smt.P.N.Salini, Scientist – C	-	Member
Shri.S.Ebin Sam, Scientist – B	-	Member
Smt.K S Veena, Scientist – B	-	Convenor

b. Purchase Committee

Shri.D. Robinson, Scientist - F	-	Chairman
Shri.K.Mohanakumar, Deputy Registrar (Finance)	-	Member
Shri.Shaheem, Scientist – E1	-	Member
Shri.V S Sanjay Kumar, Scientist – E1	-	Member

c. Grievance Redressal Committee

Shri.K.George Koshy, Registrar	-	Chairman
Representative of Scientist- Dr.G.Ravikumar, Scientist - F	-	Member
Representative of Admn. & Accounts- Shri.P.C.Sivadas, Dy Registrar (Admin)	-	Member

Representative of Technical Cadre - Shri.T.Ramakrishnan, Technical Officer	-	Member
Representative of Women employees- Smt.Veena K S, Scientist - B	-	Member
A Subordinate Officer dealing with establishment and personnel matters - Smt.T S Sangeetha, , Office Assistant	-	Member Convenor

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

Smt.S Geetha, Technical Assistant Grade - 2	-	Chairperson
Smt.R.Padmini Nair, Accounts Officer, VSSC (Rtd.)	-	Member
Smt.P.N.Salini, Scientist – C	-	Member
Shri.T.Ramakrishnan, Technical Officer -5	-	Member
Smt.S K Arya, Office Assistant -1	-	Member Convenor

vii. General Administration

Research Council Meeting

The 16th meeting of the Research Council was held on 25th and 26th April 2014 at NATPAC under the chairmanship of Prof. (Dr.) Veeraraghavan

Management Committee Meeting

The Management Committee met on 21st August 2014 and 11th November 2014 at NATPAC under the Chairmanship of Director, Smt.B G Sreedevi

NATPAC Staff –as on 01.04.2015

	Dr.B.G.Sreedevi	-	Scientist G & Director

Scientific Staff

1	Dr. G Ravikumar	-	Scientist - F
2	Tomy Cyriac	-	Scientist - F
3	D Robinson	-	Scientist - F
4	Satheish B Nair	-	Scientist - F
5	D Sunder	-	Scientist - E2
6	S Shaheem	-	Scientist - E1
7	V S Sanjay Kumar	-	Scientist - E1
8	P Kalaiarasan	-	Scientist - C
9	B Subin	-	Scientist - C
10	P N Salini	-	Scientist - C
11	M S Saran	-	Scientist - C
12	N M Sabitha	-	Scientist - C
13	K C Wilson	-	Scientist - C
14	Arun Chandran	-	Scientist - C
15	K S Veena	-	Scientist - B
17	S Ebin Sam	-	Scientist - B
18	A Jegan Bharath Kumar	-	Scientist - B
19	R Chandra Prathap	-	Scientist - B
20	Santhosh Kadavy	-	Scientist - B
21	U Salini	-	Scientist - B
22	B Anish Kini	-	Scientist - B

Technical Staff

23	K. M. Syed Mohammed	-	Principal Technical Officer
24	S. Ramachandran	-	Technical Officer Grade -5
25	T. Ramakrishnan	-	Technical Officer Grade -5

26	C. Muraleedharan Pillai	-	Technical Officer Grade -5
27	V. Jayawardhanan	-	Technical Officer Grade -4
28	K. Satheesan	-	Technical Officer Grade -4
29	V.G. Sasi	-	Technical Officer Grade -3
30	M.S. Radhakrishnan	-	Technical Officer Grade -3
31	K. Devadethan Nair	-	Technical Officer Grade -3
32	E. P. Surendran Pillai	-	Technical Officer Grade -2
33	R J Sanjai	-	Technical Officer Grade -1
34	Deepa Radhakrishnan	-	Technical Officer Grade -1
35	T. Mohan	-	Technical Assistant Grade-3
36	S. Geetha	-	Technical Assistant Grade-3
37	R. Radhakrishnan Thampi	-	Technical Assistant Grade-2
38	Shyama.C	-	Jr. Library Assistant Grade-3

Administrative Staff

39	K.George Koshy	-	Registrar Grade- 2
40	K.Mohanakumar	-	Deputy Registrar Grade -1
41	T. Vijayan	-	PA to Registrar Grade -4
42	Abey George	-	PA to Registrar Grade- 4
43	D. Shaju	-	Section Officer Grade -1
44	R. Lekha	-	Typist cum Stenographer Grade-5
45	Arya.S.K	-	Office Assistant Grade – 1
46	Maya Devi.M	-	Office Assistant Grade – 1
47	Veena.S	-	Office Assistant Grade – 1
48	MuhammedNaserudeen.C	-	Office Assistant Grade – 1
49	Sangeetha.T.S	-	Office Assistant Grade – 1
50	Ramdas.M	-	Stenographer Grade – 1
51	Lajila.K.B	-	Stenographer Grade – 1
52	A. Praveen Kumar	-	Clerical Assistant Grade -1

53	G.Ragesh	-	Driver Grade - 2
54	A.Somaraj	-	Driver Grade - 2
55	Surendran Kulangara	-	Driver Grade - 1
56	Shijil P R	-	Driver Grade - 21
57	Sukhdev Kolay	-	Jr. Assistant / Sr.Helper
58	P. X. Mathew	-	Jr. Assistant / Sr.Helper
59	S. Jayakumar	-	Helper Grade -4
60	G. Suresh Kumaran Nair	-	Helper Grade -3
61	A.Anil Kumar	-	Helper Grade -2
62	Athira.S.Kumar	-	Helper Grade -1

Retirements

Shri. C Anbalagan
Technical Officer Grade-5
Superannuated on 30/04/2014

Shri. Ajith kumar V
Technical Officer Grade-5
Superannuated on 30/04/2014

Shri. Krishnamoorthy J
PA to Director Grade-5
Superannuated on 31/05/2014

Shri. P C Sivadas
Deputy Registrar (Administration)
Superannuated on 31/10/2014

Smt.Lekshmi P
Helper Grade-4
Superannuated on 30/01/2015

Shri. T Elangovan
Scientist-G
Superannuated on 31/03/2015

Shri.J.Krishnamoorthy, Retirement Function on 31st May 2014

Shri.P C Sivadas, Retirement Function on 31st October 2014

Smt.Lekshmi P, Retirement Function on 30th January 2015

Shri. T Elangovan, Retirement Function on 31st March 2015

New Recruitments

Shri. S Ebin Sam
Scientist-B
Joined on 03/04/2014

Shri. R Chandra Prathap
Scientist-B
Joined on 09/04/2014

Shri. A Jegan Bharath Kumar
Scientist-B
Joined on 09/04/2014

Smt.Deepa Radhakrishnan
Technical Officer Grade-I
Joined on 16/04/2014

Smt. U Salini
Scientist-B
Joined on 28/04/2014

Shri.Santhosh Kadavy
Scientist-B
Joined on 23/04/2014

Shri.Anish Kini
Scientist-B
Joined on 12/05/2014

Other News

1 A group of six IAS Trainees visited NATPAC on 4th June 2014 as part of their training in Institute of Management in Government (IMG), the Apex Training Institute of Government of Kerala. The delegation included:

1. Shri. Nooh P.B IAS, Assistant Collector (U/T), Collectorate, Pathanamthitta
2. Shri. Suhas S IAS, Assistant Collector (U/T), Collectorate, Ernakulam
3. Shri. Bala Murali D IAS, Assistant Collector (U/T), Collectorate, Kottayam
4. Dr. Adeela Abdulla IAS, Assistant Collector (U/T), Collectorate, Kannur
5. Dr. Navjot Khosa IAS, Assistant Collector (U/T), Collectorate, Thrissur
6. Shri. Seeram Sambasiva Rao IAS, Assistant Collector (U/T), Collectorate, Palakkad

2 Mr.Luke Rogers, Senior Road Safety Engineer, International Road Assessment Programme (iRAP), England visited NATPAC on 19th June 20141. Shri. Nooh P.B IAS, Assistant Collector (U/T),

3 NATPAC Staff Arts And Sports Club Association (NASAS) organised Onam celebration on 3rd September 2014 at K Karunakaran Transpark. The celebration was inaugurated by Shri.Biju Prabhakar IAS, District Collector, Trivandrum. The enthusiasm showed by the Staff in the Onam celebration was quite sportive.

4 *'Stress Management'*. Talk delivered by Dr.G.Ravikumar, Scientist – F, NATPAC at Sasthra Bhavan, Pattom on 13th November 2014.

5 NATPAC took part in Onam pageantry organised by Tourism Department, Government of Kerala on 11th September 2014. The theme of the float was 'Integrated Transport'.

6 Human Rights Oath taking ceremony was conducted in Natpac at 11 am on 10th December 2014, the international Human Rights day. B.G Sreedevi, Director delivered the oath to the staff of NATPAC

7 Shri.Mahesh Rajoria, General Manager and Shri. Hena Kausar, Asst. General Manager of Maruti Suzuki, India Ltd, visited NATPAC on 17th December 2014 to discuss about the road safety scenario of the State and the road safety programs and activities of NATPAC. M/s Maruti envisages developing model cities with safe roads in the country incorporating comprehensive road safety programmes.

8 *Mind Creating Reality – Experimental Evidences*'. Talk delivered by Prof.V.P.N. Namboori as part of the monthly lecture series jointly organised by NATPAC and Swadeshi Science Movement, Thiruvananthapuram at Sasthra Bhavan, Pattom on 9th October 2014.

9 *'Raman Spectroscopy for Medical Diagnosis'*. Talk delivered by Prof.V.Unnikrishnan Nair, visiting Professor, IISER, Thiruvananthapuram as part of the monthly lecture series jointly organised by NATPAC and Swadeshi Science Movement, Thiruvananthapuram at Sasthra Bhavan, Pattom on 13th November 2014.

10 NATPAC Staff Arts And Sports Club Association (NASAS) organised New Year Celebration on 1st January 2015 at Sasthrabhavan, Pattom.

11 ***Green Pesticides*** – Opportunities and Challenges q.Talk delivered by Dr.C.A. Jayaprakash, Principal Scientist (Entomology) & Head, Biopesticide Laboratory, Division of Crop Protection, CTCRI, Thiruvananthapuram as part of the monthly lecture series jointly organised by NATPAC and Swadeshi Science Movement, Thiruvananthapuram at Sasthra Bhavan, Pattom on 8th January 2015.

12 Dr.Suresh Das, Executive Vice President, KSCSTE visited NATPAC on 3rd March 2015.

Studies Undertaken During 2014 -`15

Sl.No.	Code	Projects
1	177/2014-15	Evaluation of Fibre Reinforced Asphalt Mixes and its Suitability to Kerala Condition
2	178/2014-15	Forecasting Urban Growth Based on GIS, RS and SLEUTH Model for Major Cities in Kerala
3	179/2014-15	Accessibility Studies for Thiruvananthapuram Urban Region
4	180/2014-15	Periodic Updation of Price Indices for different Operations
5	181/2014-15	Study on Goods Transportation Freight Policy
6	182/2014-15	Study on the Performance of Highway Development Projects in Kerala
7	183/2014-15	Investigation of Major Accident Spots & Accident Causative Analysis
8	184/2014-15	Urban Travel and Traffic flow Characteristics in Kerala
9	185/2014-15	Two-wheeler Accident Causative Factors among Youth and its mitigate measures
10	186/2014-15	Study on the effect of geometric design standards on road safety - A case study of newly upgraded highways in Kerala
11	187/2014-15	Study on the impact of higher FAR ratio in the transportation network of major commercial corridors in Kerala
12	188/2014-15	Preparation of Detailed Road Network Map for Kerala using GIS, Remote Sensing and GPS
13	189/2014-15	Study on Non-major Ports of Kerala
14	190/2014-15	Estimation of Carbon Credit for Inland Water Transport for National Waterways - 3
15	191/2014-15	Formulation of long term strategies for parking management in urban areas
16	192/2014-15	Impact of weather on traffic flow characteristics and capacity of roads in different areas and terrains
17	193/2014-15	Other Studies suggested by Government/User Departments
18	194 -1/2014-15	Workshops, Seminars and Training Programmes, Transportation, Consumables and Miscellaneous

Consultancy / Sponsored Projects in 2014-`15

Sl.No	Code	Project Name	Sponsored by
1	C00611	Study on extension of NW-3 towards North of Kottappuram and towards South of Kollam	Inland Waterways Authority of India
2	C01213	Preparation of DPR for bus procurement under extended phase of JnNURM	Kerala State Road Transport Corporation
3	C01713	Transit Oriented Development Plan for Kochi MetroCorridor-KMRL	Kerala Metro Rail Ltd
4	C01813	Traffic and Transportation Study of Irinjalakkuda	Town Planning office Thrissur
5	C01913	Traffic and Transportation Study of Chavakkad	Town Planning office Thrissur
6	C02013	Improvement of Kovalam-Akkulam Canal	Irrigation Department, GoK
7	C02113	Traffic & Transportation Studies for selected 31 towns – Attingal Town, Kuthuparamba Town	Dept. of Town Planning Thiruvananthapuram/Kannur
8	C02213	Traffic and Transportation Study Nedumangadu Town	Dept. of Town Planning Thiruvananthapuram
9	C02313	Traffic & Transportation Studies for selected 31 towns – Varkala town	Dept. of Town Planning Thiruvananthapuram
10	C02413	Traffic and Transportation Study Mavelikkara	Dept. of Town Planning Alappuzha
11	C02513	Traffic and Transportation Study Chengannoor	Dept. of Town Planning Alappuzha
12	C02613	Pedestrian and bicycle friendly urban transport for the cities of Trivandrum, Kollam, Thrissur and Kozhikkode	Dept. of Town and Country Planning
13	C02713	preparation of DPR for the purchase of Boats under Extended JnNURM	Kerala Metro Rail Ltd
14	C02813	Improvement to Kallettumkara Over Bridge Jun.(Irinjalakkuda ROB)	Public Work Department,GoK
15	C02913	Preparation of DPR for Hill Highway-Package 1-Kasargode and Kannur	Kerala Road Fund Board/ Public Works Dept
16	C03113	Feasibility study for an elevated corridor in forest section of NH-766	Public Work Department,GoK
17	C03213	Strengthening & Modernisation of selected Tourist Information offices in Kerala state	Dept. of Tourism
18	C03313	Total Station Survey and base map –Attingal Bus Stand area	Dept. of Town Planning Thiruvananthapuram
19	C03413	Total Station Survey and base map –Central area Nedumangad	Dept. of Town Planning Thiruvananthapuram
20	C03513	Total Station Survey and base map preparation–Neyyattinkara Bus Stand area	Dept. of Town Planning Thiruvananthapuram
21	C03613	Fixing of GPS Bench mark along Kuppam-Valapattanam river	Centre for Water Resources Development and Management
22	C03713	Prepartion of Project Report for Construction of Thripunnithura Bypass and Combined Bypass for Thalassery and Mahe	Kerala State Electronics Development Corporation Limited/ Public Works Department
23	C00114	Traffic Solutions for Technopark - NH Access	Electronic Technology Park India (Technopark)
24	C00214	Traffic Solutions for Technopark- Proposed Bus Station at Technopark	Electronic Technology Park India (Technopark)
25	C00314	IISER-Measurement of Air Quality and Noise Level at proposed IISER Campus	Centre for Water Resources Development and Management

26	C00414	Comprehensive Mobility Plan – Trivandrum & Kozhikode	Kerala Rapid Transit Corporation
27	C00514	Preparation of base plan from Pallipuram to Kazhakoottam	Delhi Metro Rail Corporation
28	C00614	Development of internal road in Kinfra park, Adoor	Kerala Industrial Infrastructure Development Corporation
29	C00714	Feasibility study and preparation of DPR for elevated structure at Technocity	Electronic Technology Park India (Technopark)
30	C00814	Feasibility study for ropeway at Vazhikadavu near Vagamon	Tourism Department ,GoK
31	C00914	Implementation of District level Road Safety activities	Public Work Department,GoK
32	C01014	Mapping of Kowdiar Palace Compound	Dept. of Town Planning,TVPM
33	C01114	Estimation of vehicular emission in Thiruvananthapuram Urban Centre	Kerala State Pollution Control Board
34	C01214	Traffic survey at Akkulam toll plaza on NH 66 in Thiruvananthapuram	National Highways Authority of India
35	C01314	Improvements to Accident Prone Areas at Vattapara Curve	Public Work Department,GoK
36	C01414	Traffic Calming Measures for Improving Road Safety at KINFRA Industrial Park at Kanjikkode in Palakkad District	Kerala Industrial Infrastructure Development Corporation
37	RP 00110	Study of ambient air quality and its impacts on climate change in Kerala	Directorate of Environment and climate change
38	RP 00113	Safe Community Programme at Panchayath Level	Kerala Road Safety Authority
		Safe Road to School Programme	
		Accident Surveys, Database and Analysis	
		Study on Characteristics of Hazardous Material Transportation within Kerala	
		Pedestrian Safety: Improvement of Critical Locations in Thiruvananthapuram City	
		Study on Road Safety Funding & Role of Insurance Sector in Kerala	
		Evaluation of Post Road Accident Victims'Status	
		Mini Surveys in Malabar Region	
		Accident Reconstruction Studies of Selected Fatal Accidents	
		Road Safety Workshop, Seminars and Training Programmes for Drivers, Public, Traffic Police, Driver Training Colleges etc.	
		Production and Free distribution of Road Safety Education/Awareness Materials like: * Films * Road Safety Education Books & leaflets * Sticker, badges, calendars etc. * Display Boards, Banners etc.	
39	RP00213	Special Programme –Road Safety Education Through Schools	Kerala Road Safety Authority
40	RP 00213-03	Parking Management System for Major roads in Thiruvananthapuram city	Kerala Road Safety Authority

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 2015

Liabilities	Sch No	*As at 31.03.2015*	*As at 31.03.2014*	Assets	Sch No	As at 31.03.2015	As at 31.03.2014
Reserves & Surplus	4	1,45,91,710	1,50,77,437	Fixed Assets	1	1,45,91,710	1,50,77,437
Excess of exp over income		-					
Current Liablities	5	1,47,07,448	1,61,98,911	Current Assets	2	7,81,34,700	6,86,27,993
Unspent balance	6	5,15,38,045	4,71,90,061	Loans & Advances	3	8,21,00,793	8,37,50,979
Building Fund Account	4	9,39,90,000	8,89,90,000				
Total		**17,48,27,203**	**16,74,56,410**	**Total**		**17,48,27,203**	**16,74,56,410**

For Mohan & Mohan Associates
Chartered Accountants

MOHAN & MOHAN ASSOCIATES * CHARTERED ACCOUNTANTS * Reg.No.002925

R. Suresh Mohan
Partner
Membership No. : 013398
Firm Reg. No.: 002092S

Place : Thiruvananthapuram
Dated : 30.09.2015

For National Transportation Planning and Research Centre
Trivandrum

(Dy Regstrar) **(Regstrar)** **(Director)**

K. MOHANAKUMAR
DEPUTY REGISTRAR (FINANCE)
National Transportation Planning
and Research Centre (NATPAC)
Sasthra Bhavan Pattom P.O.
Thiruvananthapuram-695 004

K. GEORGE KOSHY
Registrar
National Transportation Planning
and Research Centre (NATPAC)
Sasthra Bhavan Pattom P.O
Thiruvananthapuram-695 004

Dr. B. G. SREEDEVI
DIRECTOR
National Transportation Planning
and Research Centre (NATPAC)
Sasthra Bhavan, Pattom
Thiruvananthapuram-695 004
Telephone: 0471-2548300
Mob. 9446342828

Place : Thiruvananthapuram
Dated:

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 31/03/2015

Expenditure	Sch No	Year ended 31.03.2015	Year ended 31.03.2014	Income	Sch No	Year ended 31.03.2015	Year ended 31.03.2014
To Infrastructure Strengthening (Plan)	10	2,37,57,150	2,51,56,738	By Grant from Government of Kerala	7	4,88,01,008	7,74,14,969
To Infrastructure Strengthening (Non Plan)	11	94,35,826	40,28,216	By Other Receipts	8	2,58,98,864	77,345
To Salaries and Allowances (Plan)	12	-	-	By Depreciation written back	1	43,65,296	42,51,112
To Salaries and Allowances (Non Plan)	13	4,15,06,896	4,83,07,359	By Income from Consultancy Project	9	5,82,75,752	1,38,23,678
To Depreciation	1	43,65,296	42,51,112				
To Consultancy Project Expenses		5,82,75,752	1,38,23,678				
Total		**13,73,40,920**	**9,55,67,104**	**Total**		**13,73,40,920**	**9,55,67,104**

For Mohan & Mohan Associates
Chartered Accountants

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

R. Suresh Mohan
Partner
Membership No. : 013398
Firm Reg. No.: 002092S

Place : Thiruvananthapuram
Dated : 30.09.2015

For National Transportation Planning and Research Centre
Trivandrum

(Dy Regstrar) (Regstrar) (Director)

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DEPUTY REGISTRAR (FINANCE)
National Transportation Planning and Research Centre (NATPAC)
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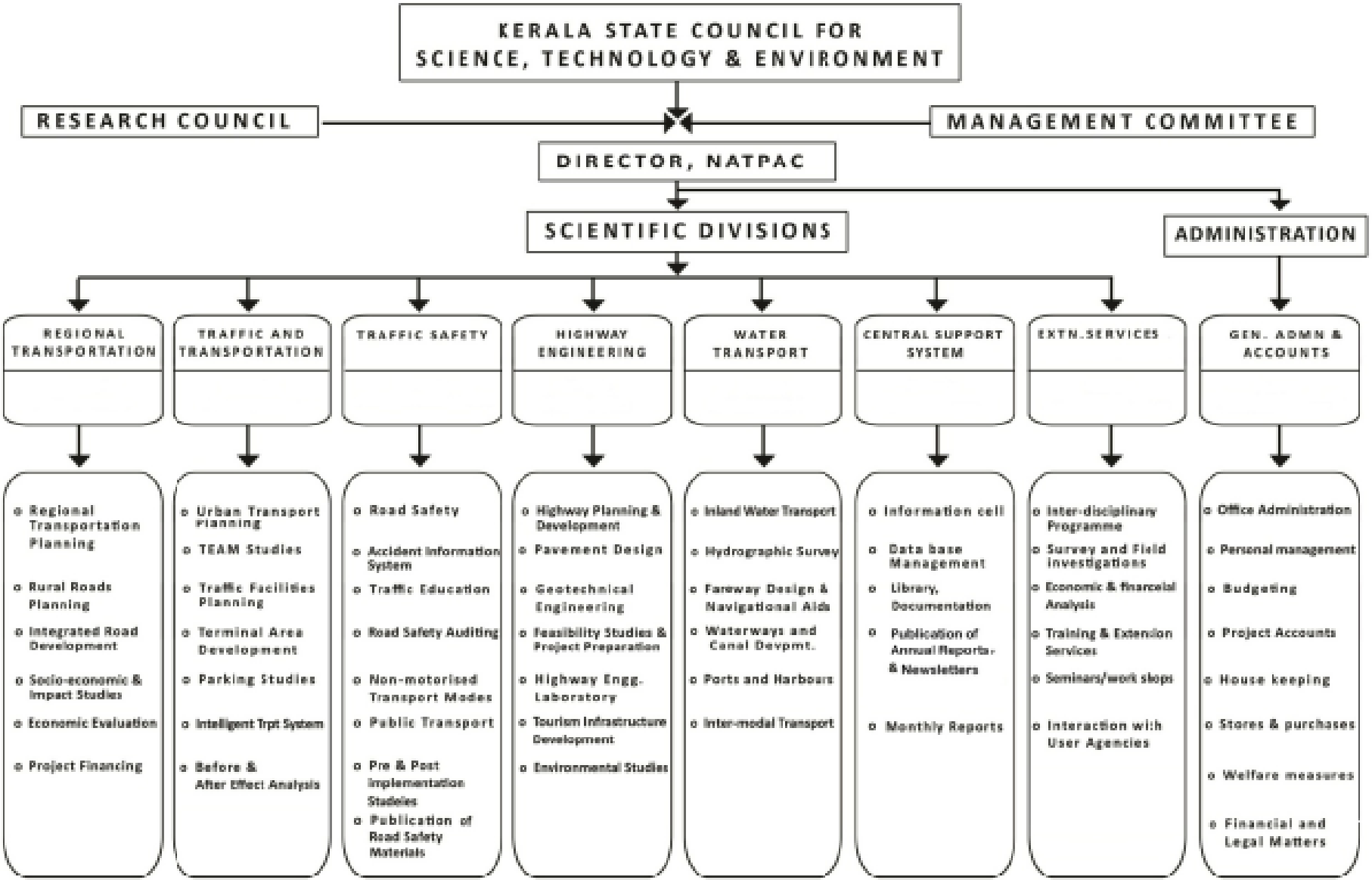
KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY & ENVIRONMENT
RESEARCH COUNCIL
MANAGEMENT COMMITTEE
DIRECTOR, NATPAC
SCIENTIFIC DIVISIONS
ADMINISTRATION
REGIONAL TRANSPORTATION
TRAFFIC AND TRANSPORTATION
TRAFFIC SAFETY
HIGHWAY ENGINEERING
WATER TRANSPORT
CENTRAL SUPPORT SYSTEM
EXTN.SERVICES
GEN. ADMN & ACCOUNTS
Regional Transportation Planning
Rural Roads Planning
Integrated Road Development
Socio-economic & Impact Studies
Economic Evaluation
Project Financing
Urban Transport Planning
TEAM Studies
Traffic Facilities Planning
Terminal Area Development
Parking Studies
Intelligent Trpt System
Before & After Effect Analysis
Road Safety
Accident Information System
Traffic Education
Road Safety Auditing
Non-motorised Transport Modes
Public Transport
Pre & Post Implementation Studeies
Publication of Road Safety Materials
Highway Planning & Development
Pavement Design
Geotechnical Engineering
Feasibility Studies & Project Preparation
Highway Engg. Laboratory
Tourism Infrastructure Development
Environmental Studies
Inland Water Transport
Hydrographic Survey
Fairway Design & Navigational Aids
Waterways and Canal Devpmt.
Ports and Harbours
Inter-modal Transport
Information cell
Data base Management
Library, Documentation
Publication of Annual Reports & Newsletters
Monthly Reports
Inter-disciplinary Programme
Survey and Field investigations
Economic & financial Analysis
Training & Extension Services
Seminars/work shops
Interaction with User Agencies
Office Administration
Personal management
Budgeting
Project Accounts
House keeping
Stores & purchases
Welfare measures
Financial and Legal Matters

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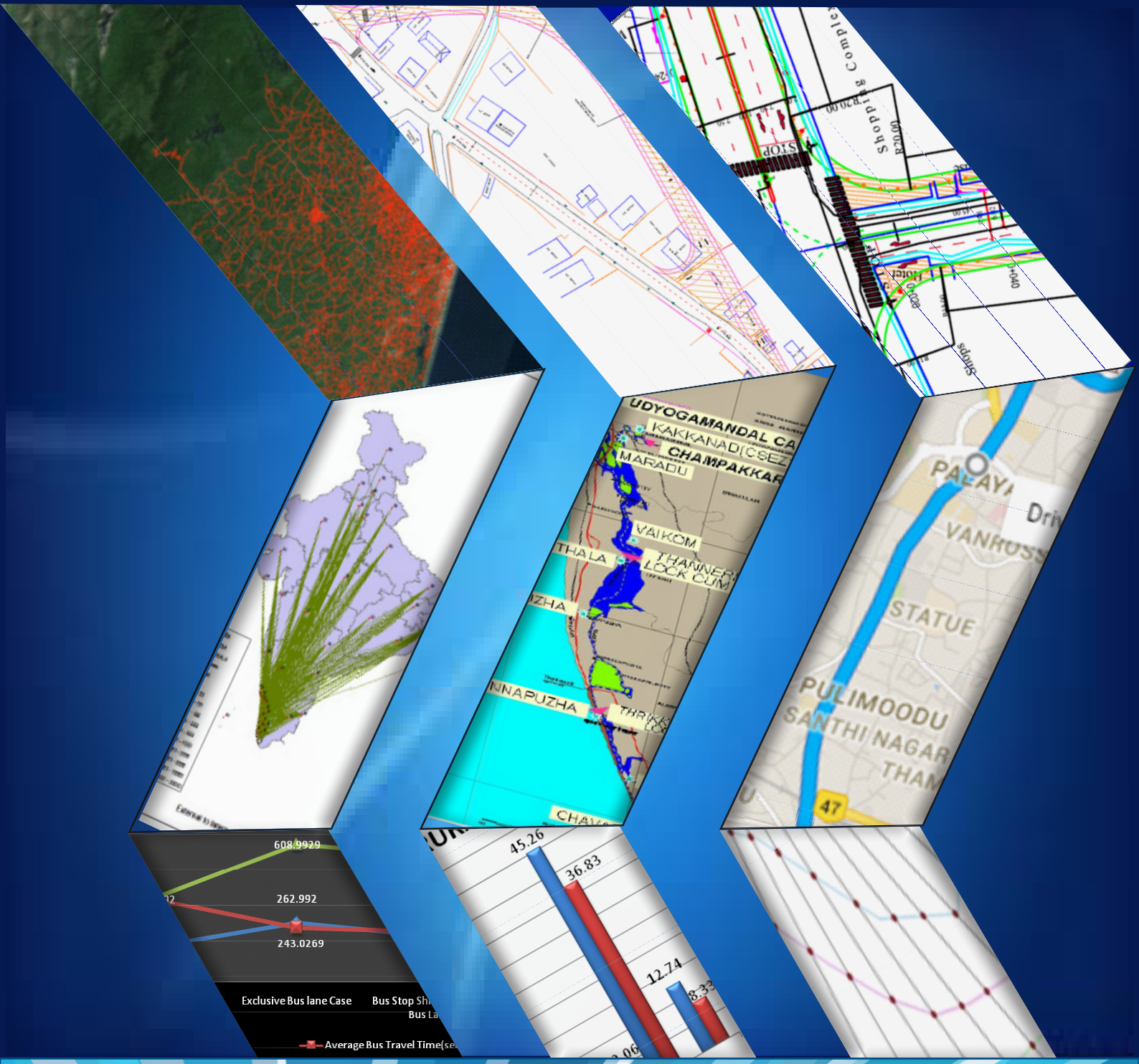

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National Transportation Planning and Research Centre

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