ANNUAL REPORT 2013-'14

राष्ट्रीय परिवहन योजना एवं अनुसंधान केंद्र

National Transportation Planning and Research Centre

ദേശീയ ഗതാഗത ആസൂത്രണ ഗവേഷണ കേന്ദ്രം

natpac

(An Institution of Kerala State Council for Science,Technology and Environment)
Sasthra Bhavan,Pattom-695004,Thiruvananthapuram

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National Transportation Planning and Research Centre
(An Institution of Kerala State Council for Science, Technology and Environment)
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Message from the Director…

It is my pleasure to present to you, on behalf of the Staff of National Transportation Planning and Research Centre, our Annual Report for 2013-'14. 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 sector.

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 2013 to March 2014. During this year, the Scientists of the Centre handled 17 R & D Projects and 30 Sponsored Studies.

To revamp the urban transport scenario of Cochin City, NATPAC assessed the pedestrian facilities in Cochin city and proposed suitable improvement schemes. The Centre carried out pedestrian and bicycle friendly urban transport study for Thiruvananthapuram, Kollam, Thrissur and Kozhikode corporations in Kerala. NATPAC examined the extent to which the existing transport system gives access to the society. To reduce the traffic congestion at Seematty junction area in Kottayam, NATPAC prepared the traffic improvement plans. As part of Statutory Town Planning Schemes, the Centre prepared Transport Infrastructure Development Plans for various towns of Kerala.

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, we are on the fast road to uncontrollable air

pollution. Emissions from passenger vehicles are increasing despite attempts to make engines more fuel efficient and the addition of antipollution devices. NATPAC analysed the impact of vehicular emission on people like traffic police, drivers and road side vendors who are subjected to continuous exposure to heavy traffic.

The work we are doing in the area of tourism also deserves to be highlighted. NATPAC prepared suitable design and specifications for the tourism sign boards in Kerala and implemented the signage scheme. Different types of retro-reflective signboards in accordance with the Code of Practice for Road Signs and MoRTH's (Ministry of Road Transport and Highways) specifications for roads and bridges were installed on the National Highways, Main Central Road, and other roads across the State.

Critical appraisal of the highway development projects was significant to the highway research in the State. NATPAC brought out quantified results in figures and facts to substantiate the performance of State Highways. The Centre explored the possibility of using waste plastic in road construction and evolved guidelines/specifications for the use of waste materials in road construction. We also explored the possibility of using natural and artificial fibres in bituminous mixes.

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 assessed the utilisation of waterways for navigation with sufficient infrastructures such as fairway, terminals, navigational aids and fleets. The Centre addressed the issues related to Water Transportation such as transportation of dangerous goods, environmental, intermodal, 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 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 pioneer 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 that this report demonstrates the 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
DIRECTOR

SUMMARY OF PROJECTS

1. *Pedestrian Friendly Urban Transport System for Cochin City*

At the instance of Town and Country Planning Department, Government of Kerala National Transportation Planning and Research Centre (NATPAC) assessed the adequacy of pedestrian facilities in Cochin city and proposed suitable improvement schemes for augmentation of pedestrian facilities and also to integrate pedestrian access with transport terminals and metro rail stations in Cochin city.

Pedestrian facilities and amenities in the study area were evaluated in quantitative and qualitative terms using walkability Index. Walkability is a measure that indicates how friendly an area is to walk for people. Factors affecting walkability include: presence or absence of quality footpaths, traffic conditions, land use pattern, building accessibility and pedestrian safety concern among others.

Walkability Index of Cochin city as a whole was arrived at as 0.53 which is considered to be 'average'. Marine Drive Road has walkability index of 0.64 which is rated as 'Good' followed by M.G Road, Rajaji Road and South Railway Station Road having walkability index of 0.56 (rated as average). Low walkability index of 0.27 was recorded for Convent Road, which is closely followed by Madhavan Nair Road with 0.29. Walkability Index of major roads in Cochin is shown in **Figure 1.**

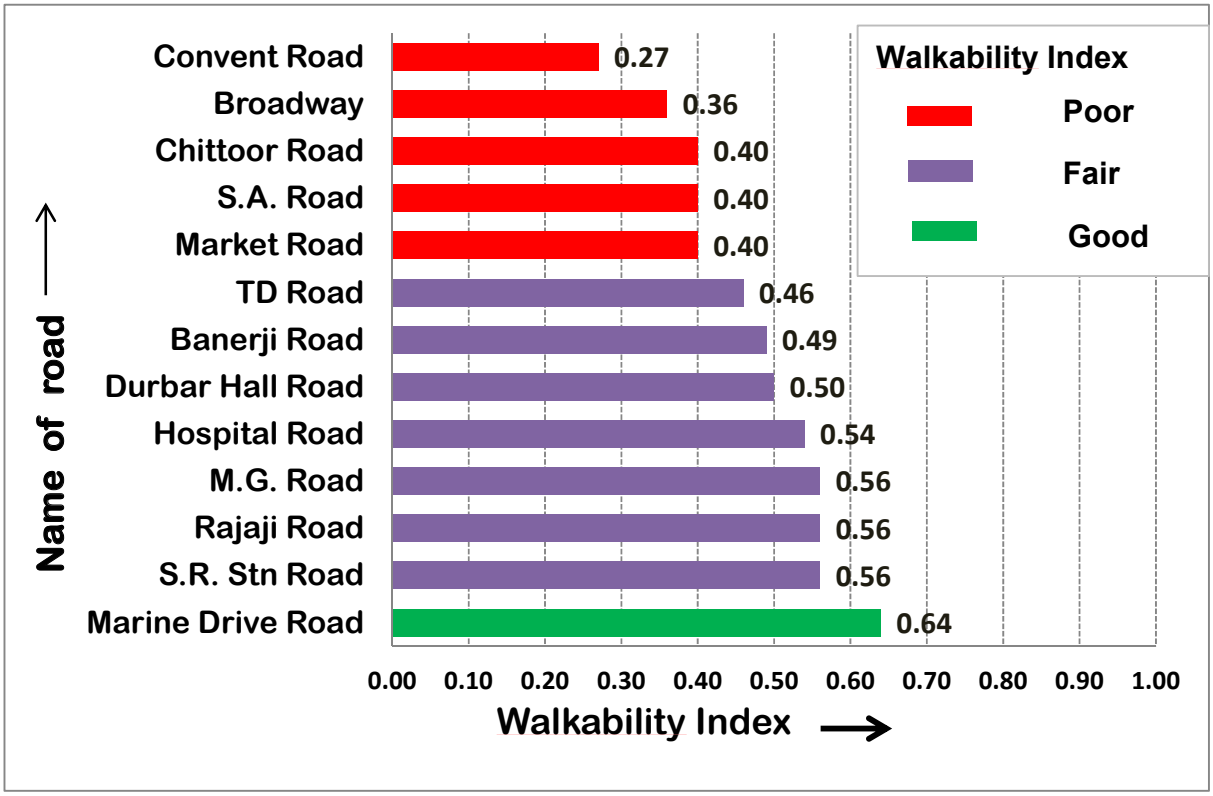

Figure 1: Walkability Index of major roads in Cochin City

In order to ensure Cochin City a pedestrian friendly environment, an improvement plan has been worked out which includes development of adequate width of walkways, crossing facilities, and integration of pedestrian facilities with transit centers. The improvement schemes are proposed in two stages namely at-grade improvement and grade-separated pedestrian facilities. The roads selected for pedestrian facilities are Marine Drive Road, Bannerji Road, Mahatma Gandhi Road, Sahodaran Ayyappan Road, Durbar Hall Road and Chittoor Road.

A clear walking zone of 1.8 meter wide footpath with vertical clearance of 2.2 meter needs to be ensured at all major travel corridors. This will enable persons in wheel-chair to move freely on the footpath. Paved surface, continuous walkway and railing barriers with clear walking zone will enhance the walkability of the city and increase the patronage of public transport system.

Keeping in view the immediate requirements and expected pedestrian flow with the commissioning of the Metro Rail project in 2016, an integrated pedestrian infrastructure has been worked out for Cochin city. All lateral and cross-walk facilities are proposed as 'disabled person friendly' by providing ramps and table-top crossing facilities. Adequate pedestrian amenities and street furniture are recommended to enhance the walkability of the Central Business District area of Cochin.

Plate 1:Pedestrian facilities proposed for M.G.Road in Cochin

It is estimated that a total cost of Rs. 55 crores will be required for implementation of short term pedestrian facilities in the city which include provision of pedestrian footpaths for major road corridors, cross-walk facilities, street furniture, pedestrian amenities, landscaping of central dividers, traffic islands, rehabilitation of existing drains/ construction of side drains, junction improvements and construction of foot over bridges at 3 locations.

As a long term measure, a skywalk facility (1,100 meter long) connecting High Court Jetty with Madhava Pharmacy Metro Station is recommended to ensure integration of pedestrian access with transit stations. It is also recommended that the city authorities should evolve a permanent mechanism for regular upkeep and maintenance of pedestrian infrastructures in the city.

2. *Pedestrian and Bi-Cycle Friendly Urban Transport System for Four Major Cities in Kerala*

Town and Country Planning Department, Government of Kerala entrusted National Transportation Planning and Research Centre (NATPAC) the task of carrying out pedestrian and bicycle friendly urban transport study for Thiruvananthapuram, Kollam, Thrissur and Kozhikode corporations in Kerala .

The objectives of the study are **:**

- To assess the existing pedestrian infrastructures in central area.
- To conduct traffic surveys on major roads in the study region and identify Pedestrian -Vehicle conflict points in the road network.
- To collect data pertaining to qualitative and quantitative assessment of pedestrian facilities as well as their travel characteristics like Origin Destination of trips, purpose, factors which affect travel choice etc.
- To formulate suitable proposals for improving pedestrian mobility and integration of pedestrian access with transport centers and traffic generators.

The methodology adopted for the study consisted of site appreciation, data collection from secondary sources, primary surveys, identification of short comings in the existing pedestrian

facilities, evaluation of pedestrian infrastructures in selected cities using walkability index for different road corridors, assessment of level of service of non motorized transport facilities for different cities, integration of pedestrian access with major transport terminals, work centres, and major activity areas of the city and to prepare cost-estimate for various schemes, prioritization and phasing of the schemes for implementation.

The proposals include: at-grade improvements to reduce vehicle-pedestrian conflicts by engaging segregated bus bays, widening of footpaths, provision of new walkways, reallocation of road space for pedestrians, integration of pedestrian facilities with public transport systems, improving the condition of street furniture, landscaping, provision of pedestrian amenities like toilets, drinking water facilities at vantage points etc. It also includes provision of traffic signs, road markings, traffic signaling etc to improve pedestrian and cyclist activity on important corridors.

Salient features of the proposal for improving pedestrian mobility in Thrissur City

27.2 km of road network is chosen as the study area which includes all major roads like Swaraj Round, Shoranur road, Kunnamkulam road, Kodungalloor road, Ernakulam road and Kuruppam road. Major pedestrian movements of 5,000 were observed at Mathrubhumi Junction, followed by 4,500 movements at TUDA Junction, 3,000 movements at MO road Junction area, 2,700 movements at PO Junction area and 2,600 movements at Vadakkechira bus stand area.

Maximum lateral movement of about 4,000 pedestrians were observed on Municipal Office road between Swaraj Round and PO Junction, followed by over 2,700 pedestrians between Swaraj Round and Vadakkechira Bus stand, 2,600 pedestrians between PO Junction and Mathrubhumi Junction and 1,900 pedestrians between Swaraj Round and Patturaikkal Junction. Swaraj Round and the major deviating roads had generated the maximum pedestrian movements in Thrissur city. The number of cycles plying on the major road corridors in the city is very less.

Walkability Index for major corridors in the study area is presented in **Figure 2**. Taking the study area as a whole, Walkability Index of the study area was found to be 0.50 which is considered to be average.

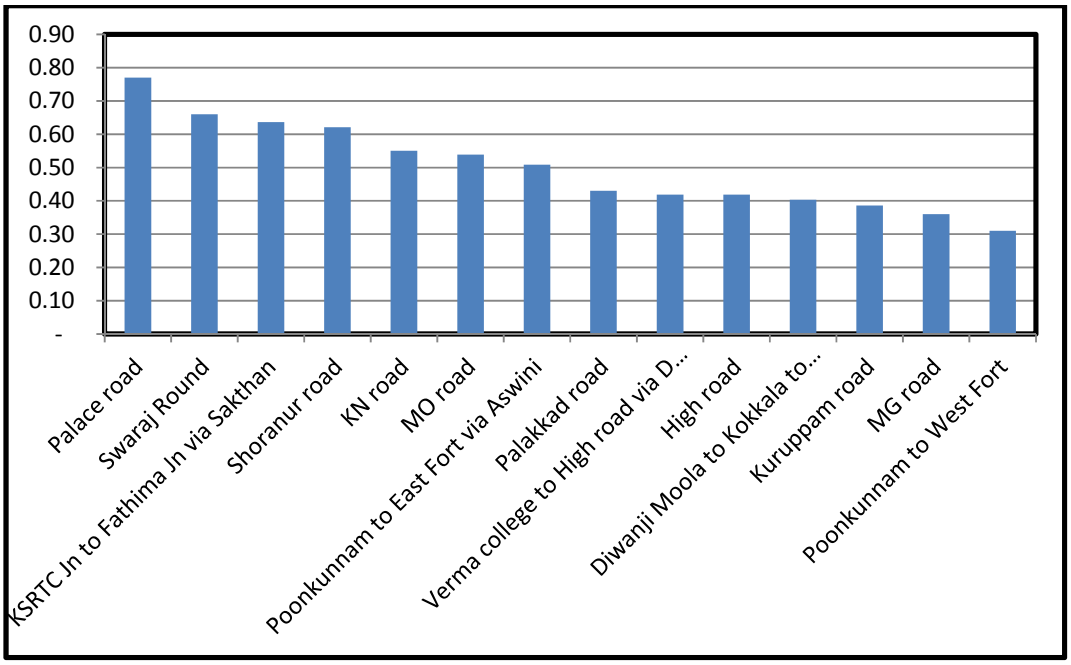

Figure 2 : Walkability Index of major roads in Thrissur City

To make the footpath pedestrian friendly, the following measures were suggested by NATPAC:

(i) Finished level of footpath should not exceed 150mm from the finished road surface.

(ii) Footpaths should have a vertical clearance of 2.2m with hand rail.

(iii) Greening of pedestrian walkways is an essential component for all streets to provide shade to pedestrians and reduce heat radiation. Open Tree pits on the footpath are essential for providing breathing space for the trees, which are not pedestrian friendly. In such situations, porous cement concrete tree grating are recommended.

(iv) Landscaping is essential at all the medians as well at all the channelizing islands wherever provided.

(v) Bus shelter along the footpath to be designed in such a way that it ensures a minimum 1.8m clear walking space for the pedestrians. Segregated bus buys are recommended to avoid least obstruction to other traffic .

(vi) Zebra crossings should end at footpath and have a width of 2 to 4 m depending upon the number of pedestrian crossings.

(vii) Kerb ramps should be made at locations where zebra crossing meets the footpath to make the road pedestrian friendly to all walks of people including handicapped people.

(viii) Pedestrian guidance measures like pedestrian oriented street lighting, pedestrian oriented directional service and warning and tourist signages need to be installed without hindering the clear walking zone of the pedestrians.

(ix) Bus bays, signages, drinking water facility, pedestrian amenities etc. need to be provided at appropriate places.

(x) Street lighting should be provided at a gap of 30m in all the pedestrian intense areas on either side.

To maximize bicycling opportunities, cities must build a network of safe and comfortable routes using a mix of bike lanes, bike boulevards, cycle tracks, and bike paths that connect residents to potential destinations. It is suggested, in all the new development schemes including construction of new roads, widening of roads, cycle track need to be made part of the developments.

3. Accessibility and Mobility Indicators for Thiruvananthapuram Urban Region

Accessibility and mobility are becoming key elements in analyzing the efficiency of transportation systems. NATPAC has attempted the development and demonstration of performance-based accessibility measures that can be used to understand how accessibility to employment opportunities is distributed in the CBD area of Thiruvananthapuram city, Kerala using gravity based approach. These measures were used to examine the extent to which the existing transport system gives access to the society. Hansen's Index was formulated for this purpose.

The accessibility to employment opportunities by personalized mode (two - wheeler and car) and public transport was calculated for each ward in the study area ((**Figure**:**3**). Arc GIS software was used to represent Hansen's index. Accessibility index was calculated using distance, cost and time of travel as impedance functions. Service area analysis was done using Network Analyst extension in Arc GIS software. This helped to analyse the employment opportunities available within the service area covered by each mode. The wards were categorized based on the level of accessibility using Arc GIS software.

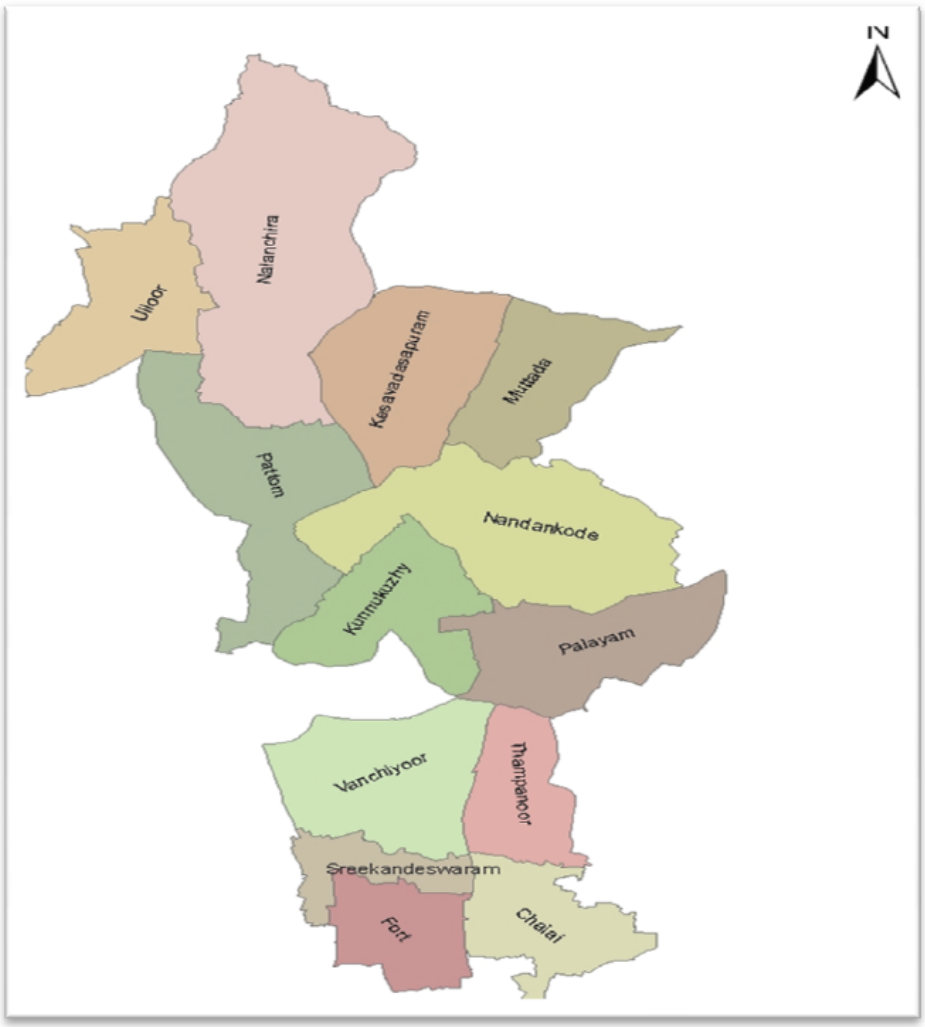

Figure 3: Study Area

The data collection included the collection of both primary data and secondary data. The primary data consists of household details and trip characteristics which were obtained from the household survey conducted in the study area. The secondary data consists of population details, employment opportunity details, and land use characteristics of the study area. Household data was collected from 1,329 houses. The data collected were sorted, coded and then fed to preliminary analysis.

Per Capita Trip Rate (PCTR) value was calculated for each zone and the zones showing highest and lowest PCTR value were noted. From the mode choice analysis it was found that two - wheeler is the predominant mode used for transportation and accounts for 26% of the mode share. Car has a mode share of 23% and public transport has a share of 14%. It is clear that, in this study area, there is a heavy dependence on personalized modes. Also people prefer walking for short distance trips

which included shopping. Walking accounts for 17% of total trips produced in the study area. The purpose wise distribution of trips indicated that work, education and shopping accounts for 33%, 18% and 25% respectively. Work has the major share for attracting the trips from household. Therefore, when calculating the accessibility parameter, accessibility to employment opportunities was given the prime importance. From the preliminary analysis it was found that average trip length for bus, car and two- wheeler are 9.3 km, 5.9 km and 4.1 km respectively and it was found that trip length for buses shows a higher value when compared to other modes. As the cost of travel for personalized modes are high they are used only for trips covering shorter lengths.

The primary and secondary data collected were analysed to obtain the accessibility to employment opportunities. Also service area analysis was performed using Arc GIS software. For assessment of accessibility to employment opportunities a Hansen measure was adopted in this study. 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. The normalized version of Hansen's index by giving weights was used.

Using Arc GIS software, the base map of the study area was created and geo-referenced. The centroid of each ward was marked and the shortest distance between the centroids was calculated using network analyst tool.

Service area analysis was performed to calculate the employment opportunities available within 5, 10 and 15 minute interval for different modes of transportation. Service area map of the study area was also created showing the variation in area covered by different modes.

It was inferred that the land use pattern and the transportation facilities available in an area influences the accessibility to different opportunities. Accessibility is high near to the down town areas in the city. The distance (or impedance offered) to the employment zones plays a crucial role in the level of accessibility of a particular zone. Thus accessibility is high in the city centre and as the distance increases, level of accessibility decreases. Also the mode share of two - wheeler was found to be the highest when compared to other modes of transportation and the same showed greater accessibility to employment opportunities. This is due to the fact that the travel time is more

for other modes due to heavy traffic congestion in peak hours. The accessibility by public transport is lower when compared with personalized modes. Therefore people show lesser interest for preferring the public transport which in turn increases traffic congestion and reduces the capacity of the road. This results in increased travel time and travel cost. Measures like mass rapid transit systems have to be adopted to increase the mode share of public transport.

4. Traffic and Transportation Studies for Irinjalakuda and Chavakkad towns in Thrissur District

At the instance of Town and Country Planning Department, Government of Kerala, National Transportation Planning and Research Centre (NATPAC) has been entrusted with the task of carrying out Traffic and Transportation Study for Irinjalakuda and Chavakkad towns in Thrissur District, Kerala.

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 Towns. Following are the tasks carried out for the study:

(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".

Irinjalakuda Town

Irinjalakuda town has a geographical area of 33.57 sq km with a population of 60,507 and density of 1,802 persons per sq km as per 2001 census. Major roads in the town were found to be carrying traffic volume more than their carrying capacity.

Traffic volume at major intersections: Tana Junction witnessed the maximum peak hour traffic flow of 3,027 Passenger Car Unit (PCU) followed by 2,153 PCU at Chandakunnu Junction, 2,144 PCU at bus stand Junction and 2,098 PCU at Mapranam Junction.

Most of the parking in Irinjalakuda was found to be in the bus stand area, Tana Junction area, Colonypadi area and Chandakunnu Junction. Majority of the vehicles parked in parking corridors on NH were found to be for short duration of less than 30 minutes. Pedestrian movements were observed to be high on all the arms of Chandakunnu, Tana and Bus stand Junctions.

Inter-city passenger traffic: 2,16,185 inter-city passenger trips were performed in the study region on a reference day consisting of 1,17,455 bus passenger trips (54.33%), 44,436 car trips (20.55 %), 36,344 two-wheeler trips (16.81%) and 17,950 auto trips (8.30%). 86 per cent of total trips were found to be interacting with the town while 14 per cent of the total trips were bypassing the town.

Inter-city goods transportation: 38% of total inter-city goods movements out of 3,161 tonnes were found to be of divertible nature, which, are passing through the Central Business District (CBD) area of the city due to non-availability of bypass.

Traffic projection: The projected traffic on the existing road network within the CBD area implies that the existing road network would not be able to handle the traffic in the horizon years without upgradation of the transport infrastructure facilities.

Road development plan for Irinjalakuda town: The road development plan envisages hierarchical pattern of road network conforming to the following categories of road system (**Figure 4**).

(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.

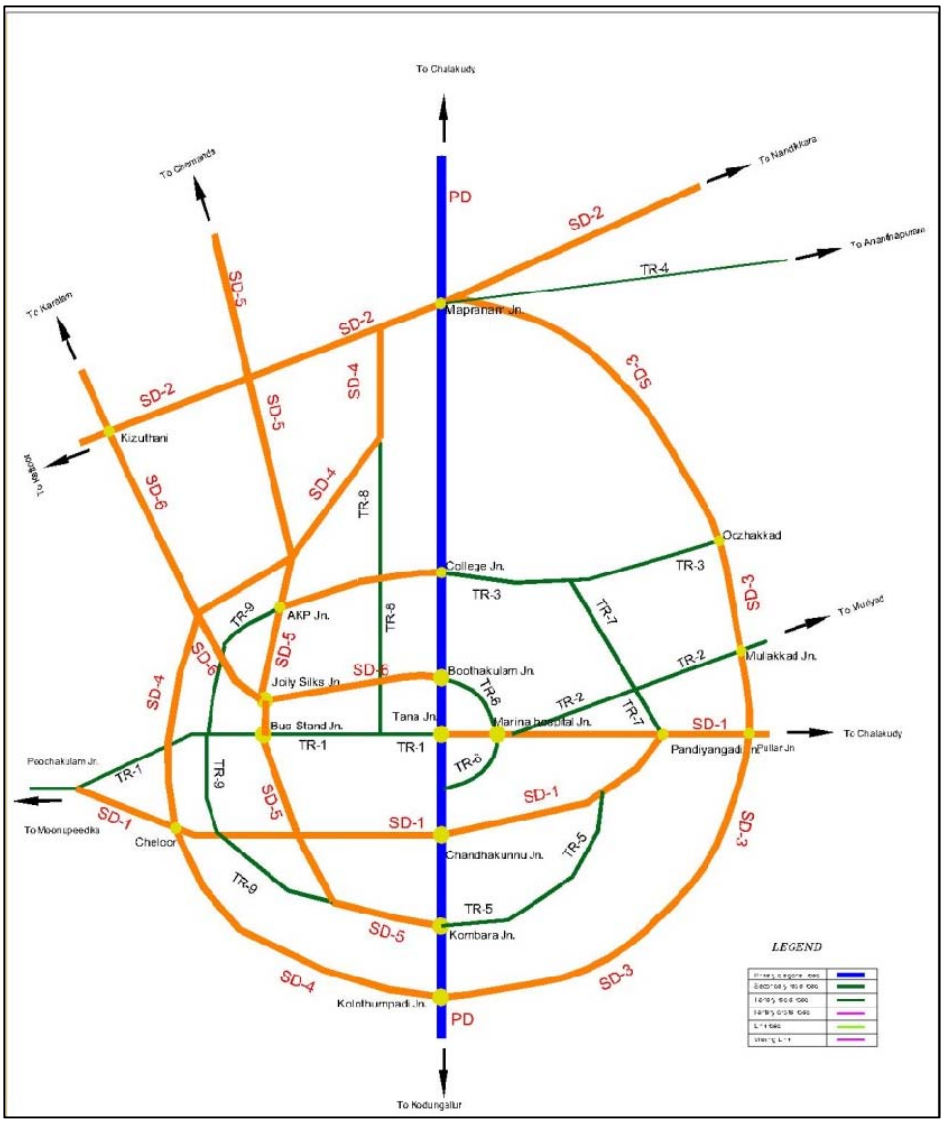

Figure: 4:Conceptual Road Network Proposed for Irinjalakuda Town

Chavakkad Town

Chavakkad municipality has a geographical area of 12.41 sq km with a population of 39,095 and density of 3,150 persons per sq km as per 2011 Census.

Traffic volume at major intersections: Traffic volume at major intersections in the town varied between 220 PCU and 3,551 PCU. Mammiyoor junction witnessed the maximum peak hour traffic flow of 3,551 PCU.

Traffic volume and capacity utilization: Kunnamkulam road and Thrissur road within the town are found to be carrying traffic volume exceeding their carrying capacity. The NH stretch between

Chavakkad and Mullathara centre carried traffic 1.4 times the capacity, while the traffic volume on the southern portion of NH is nearing the capacity. On the bypass road, carrying capacity of the south portion is saturated at present while the north portion is nearing the saturation level.

Major parking activities in Chavakkad are concentrated on the Ponnani road, Kunnamkulam road and the bypass road. Majority of the vehicles parked on NH were found to be for short duration of less than 30 minutes. High volume of pedestrian cross walks were recorded around Bus stand Junction, Muthuvattoor Junction and Chavakkad central area.

Inter-city passenger traffic: An estimated 1.68 lakh inter-city passenger trips were performed in the study region on a reference day consisting of 83,678 bus passengers (50%), 36,021 car users (21.4 %), 31,277 two-wheeler trips (18.6%) and 17,460 auto trips (10.4%).

Inter-city goods transportation: On an average day 959 tonnes of goods traffic originated from the study region and 763 tonnes of goods traffic terminated in the study region. Nearly 4,800 MT of traffic (73%) are through traffic which can be diverted if bypass is developed.

Traffic projection: The projected traffic on the existing road network within the CBD area implies that the existing road network would not be able to handle the traffic in the horizon years without upgradation of the transport infrastructure facilities.

Road development plan for Chavakkad town: The proposed network conforms to a Grid-iron Pattern **(Figure 5)**. This would involve developing the existing roads with the following hierarchical pattern:

(i) Primary Distributor Road

(ii) Secondary Distributor Road

(iii) Tertiary Road

The National Highway being the major travel corridor of the town, it is proposed to be of four lane standards and the section within the town would serve as Primary Distributor Road. Apart from this, eight north-south corridors and seven east-west corridors are proposed with the status of Secondary Distributor or Tertiary road category.

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

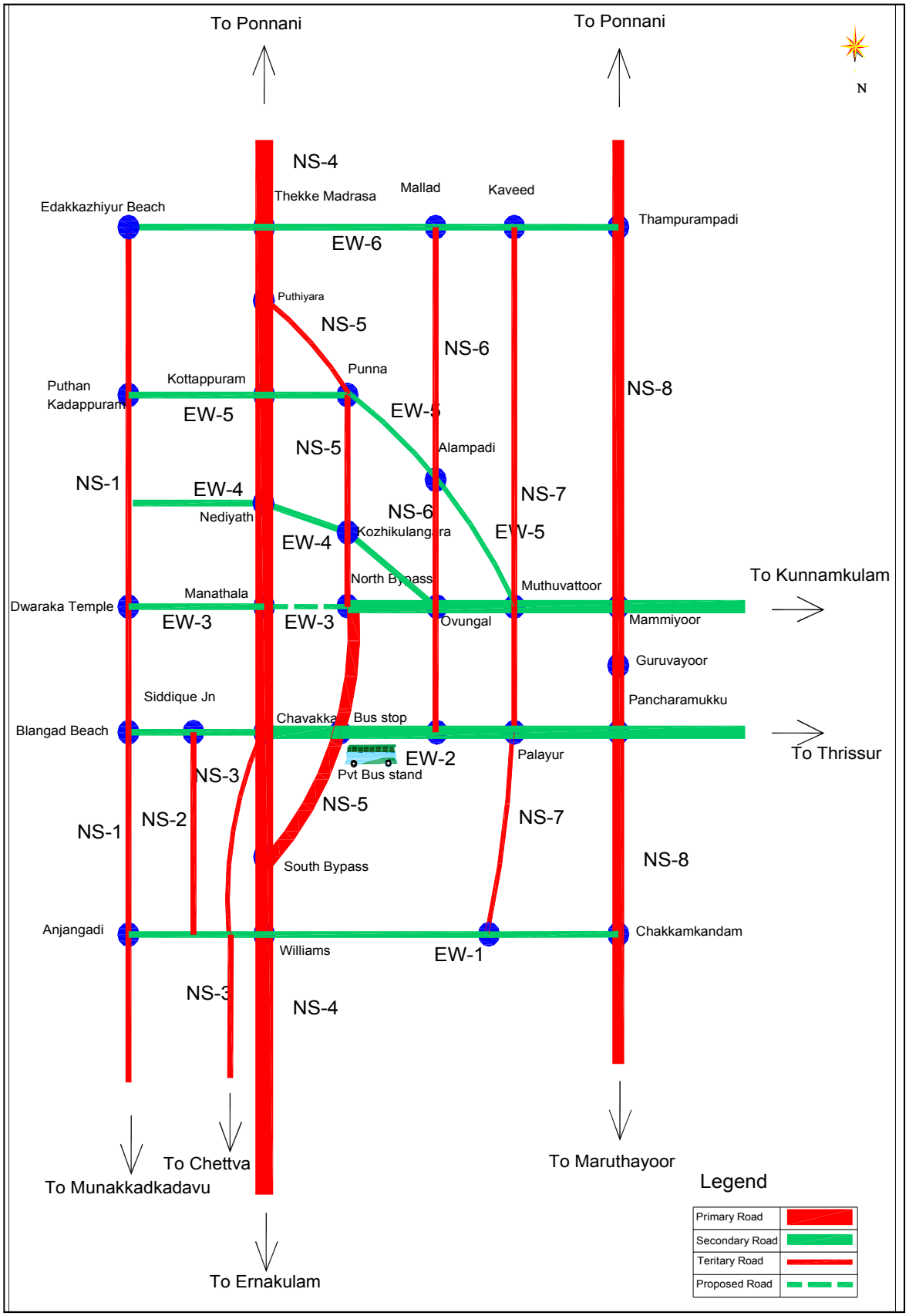

Figure 5 : Conceptual Transport Development Plan for Chavakkad Town

5. Traffic Improvement Plan for Seematty Junction Area in Kottayam

With the aim of reducing the traffic congestion at Seematty junction area in Kottayam, NATPAC undertook a study and prepared the traffic improvement plan. The study area covered the intersections of Seematty and Baker junctions in the MC Road which are the two busy intersections in the heart of Kottayam town, hardly 100 m apart.

Preliminary reconnaissance and extensive field surveys including traffic surveys and topographic surveys were conducted. Classified traffic volume counts were carried out at Seematty junction (**Figure 6**) and Baker intersections (**Figure 7**) to understand the efficiency at which the system works and the general quality of service offered to the road users. From the traffic survey it was found that, Seematty Junction witnessed a peak hour traffic flow of 5,074 Passenger Car Unit (PCU). For the Baker junction, the morning peak hour was from 9 AM to 10 AM corresponding to peak hour traffic of 5,268 PCU. Traffic studies shows that the Seematty - Nagampadom Road witnessed the maximum peak hour traffic flow of 1,550 PCU.

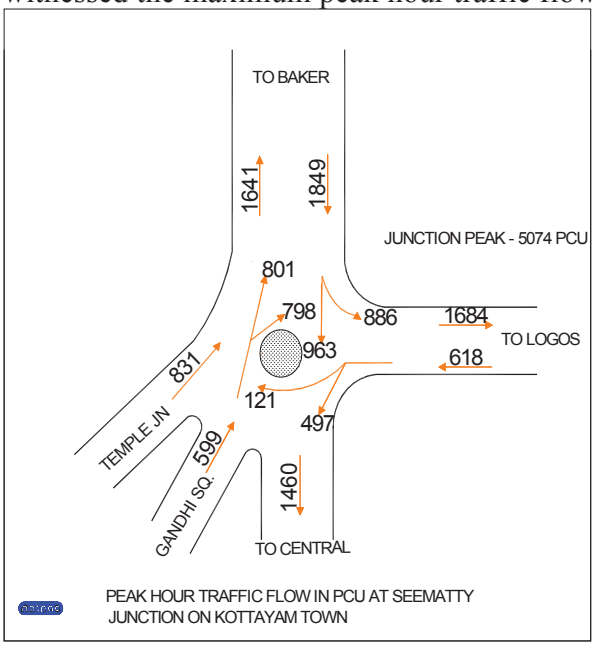

Figure 6: Peak hour flow at Seematty Junction

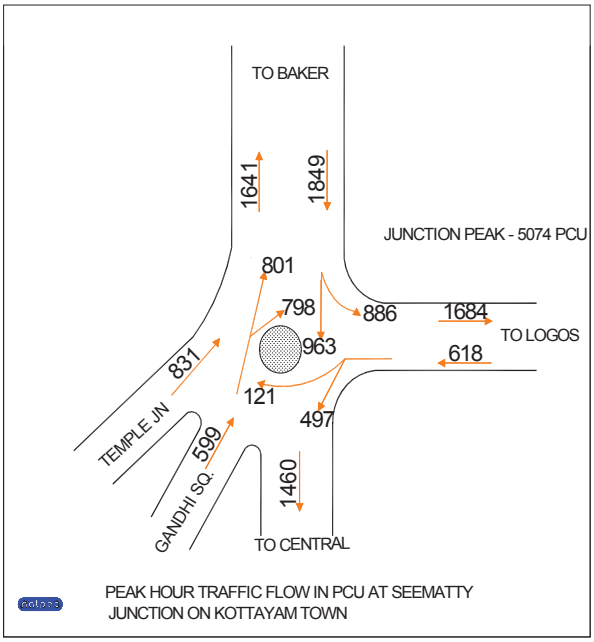

Figure 7: Peak hour flow at Baker Junction

Pedestrian surveys were also conducted at the various arms of the two intersections and it was found that the peak hour volume of pedestrian movement was in the range of 1250-1400. The PV^2 value was also above the limiting value of $1x10^8$ warranting introduction of controlled crossing.

Topographic surveys were conducted with the help of Total Station, based upon which the base plan of the area was prepared. Considering the traffic and land availability, an improvement plan (**Figure 8**) was prepared for the junction. The proposed plan aimed at provision of adequate width for leading arms and also provision of sufficient radii at entry and exit points. Channelisers and medians were also proposed at required locations.

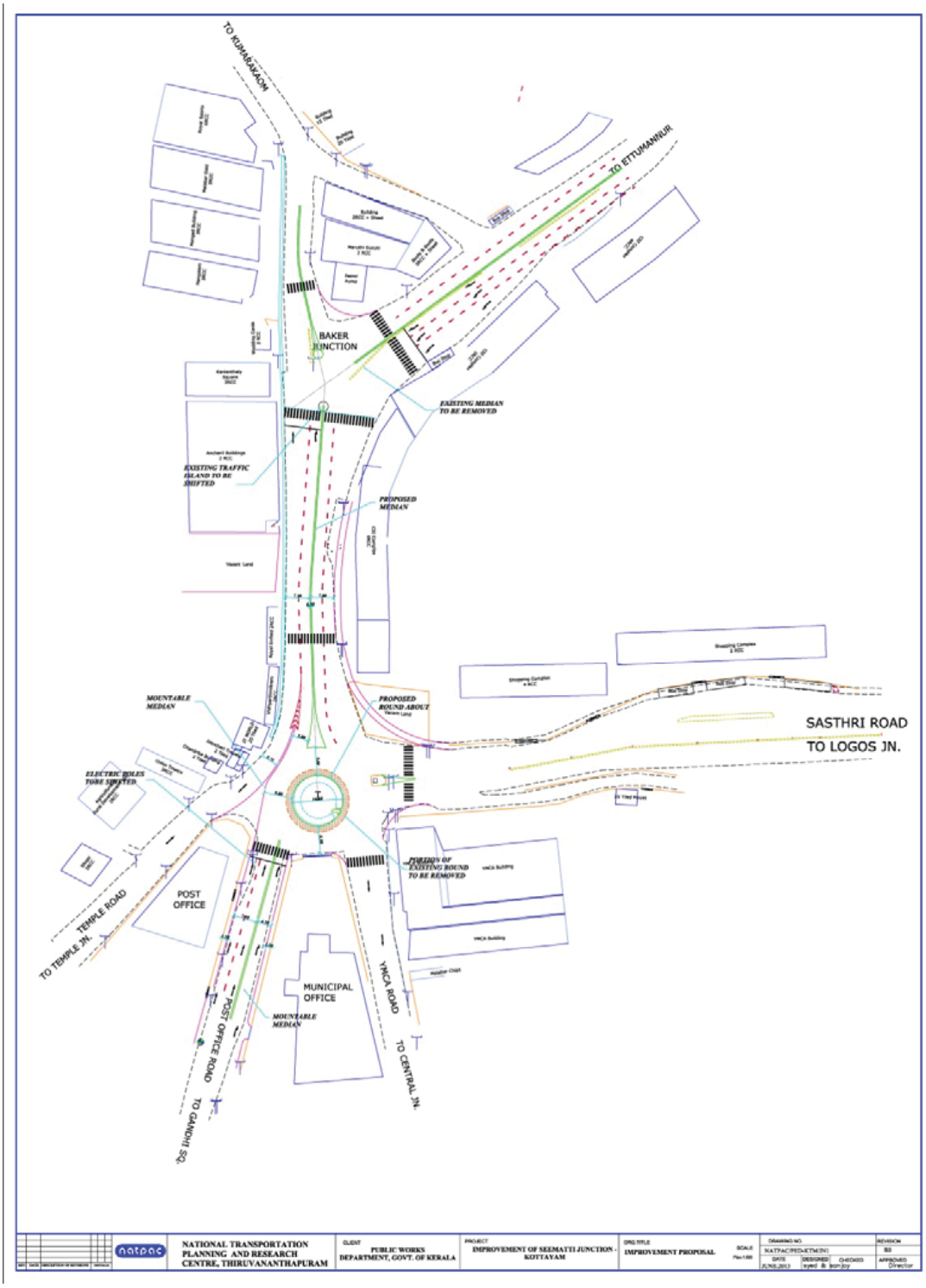

Figure 8: Improvement Plan

6. *Traffic and Transportation Studies for Chengannur Municipality*

As part of Statutory Town Planning Schemes, District Town Planning Office entrusted NATPAC the task of carrying out traffic and transportation study for Chengannur town **(Figure 9).** The study was aimed at compiling the base year traffic and transportation data in Chengannur Municipality to provide input for the preparation of development plan for the town. The MC Road passes through the centre of Chengannur Municipality and runs for a distance of 4.75 km within the Municipality boundary.

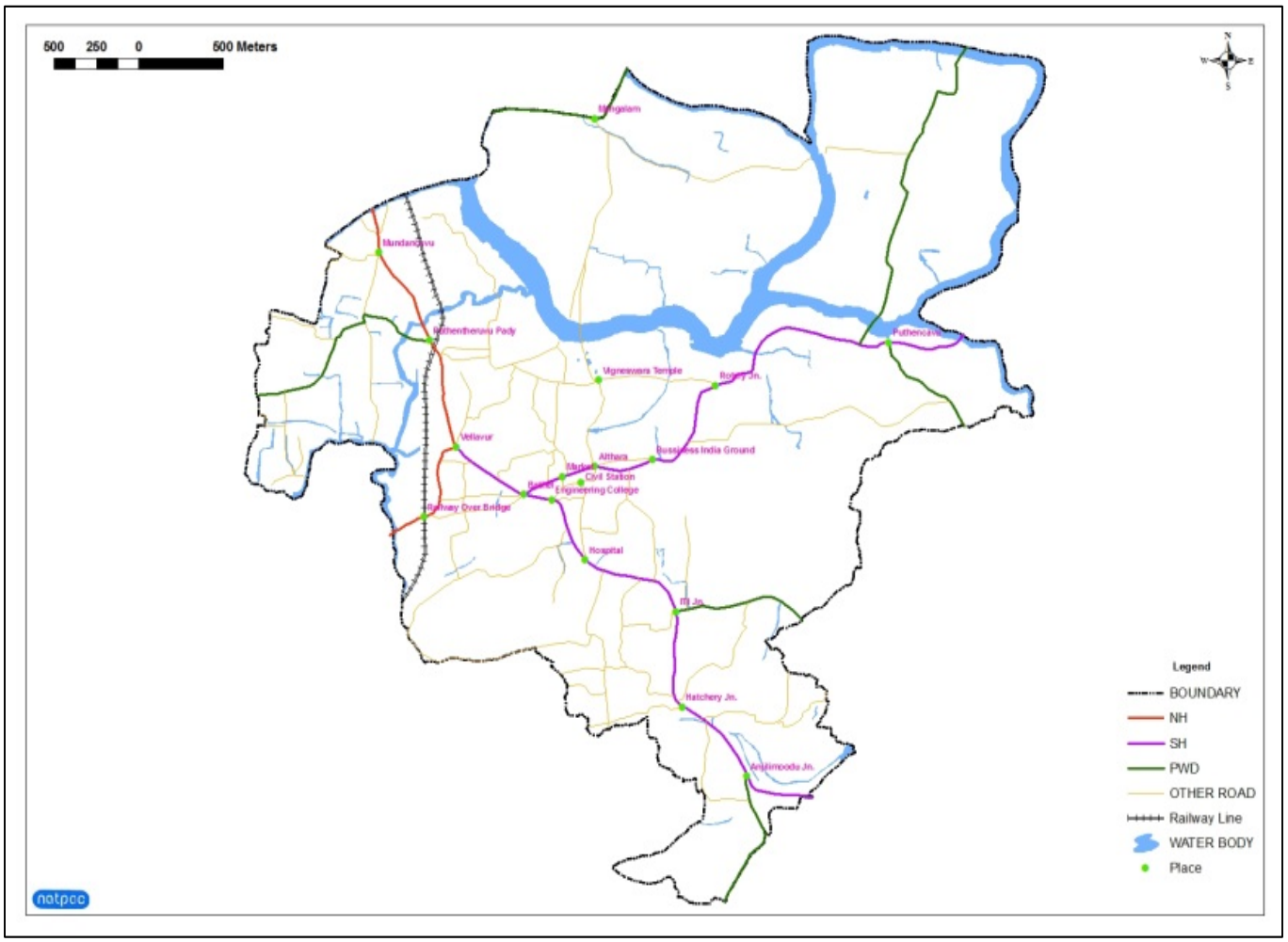

Figure 9 : Map of Study Area

Findings

- From the Speed and Delay survey, it was found that the delay was maximum (190 seconds) in MC Road due to congestion, intersection and narrow bridges at Puthentheruvupadi and Erapuzha.

- After the Traffic volume survey, it was seen that on MC Road the traffic is very high especially in the CBD area. The maximum daily traffic has been found to be 34,111 Passenger Car Unit (PCUs) for the Engineering College junction –Bethel link followed by Bethel - Vellavoor junction link with 33,273 PCU, ITI junction – Hospital junction link with 30,077 PCU and Hospital junction - Engineering College junction with 29,546 PCU.

- The link road from Hospital junction- EC Junction was found to have maximum on street parking accumulation and majority of the vehicles parked at most of parking corridors were found to be for short duration of less than 30 minutes.

- The pedestrian survey conducted shows that a maximum of 1152 pedestrian lateral movements occurred at KSRTC stand followed by 1,076 pedestrian movements at Railway Station and a high volume of 995 pedestrian cross movements occurred at Vellavoor Junction.

- In Chengannur, a total of 2,81,433 passenger trips were performed as inter-town trips in the study region on a reference day, out of which, 90,519 internal - external trips constituting 32.16% of total trips occurred. A total of 1.18 lakhs trips were external – internal trips constituting 41.85% cent of the total trips. External – external trips, which are bypassable, to the tune of 73,144 trips were performed through the study region and they were 26% of the total trips. Inter-town movement of goods to the tune of 15,562 tonnes was carried out over the study region. The major traffic generator of goods traffic within the study region was the CBD area with 3,306 tonnes (21.24%) with most of them bound for other Districts within the State. A total of 1,320 tonnes of goods traffic was generated from remaining Alappuzha area. Goods traffic generated from other districts formed 63.02% of the total volume while the goods traffic from other states was to the tune of 706 tonnes. In the case of goods traffic attraction,CBD area had the dominant share with 2,947tonnes. Among the external zones, 23.54% of the goods traffic terminated in Alappuzha District, while 54.5% constituted the goods volume to other districts. Goods bound to other states were 318.3 tonnes constituting 2.05% of the total volume.

Road Development Plan formulated for the town

- ***Primary distributor road*** – providing connectivity to state and district headquarters. In Chengannur, MC Road and SH-10 are the primary distributor roads (**Figure 10**).

- ***Secondary distributor road*** – Providing connectivity to neighbouring towns within and outside district. In Chengannur, Mulakkuzha road, Kombanad Road, Kidanganoor Road, Parumala Road and Venmony Road are the secondary distributor roads.

- ***Tertiary road*** – providing connectivity to town centre and growth centres.

- ***Local roads*** – connecting residential areas with the above categories of roads.

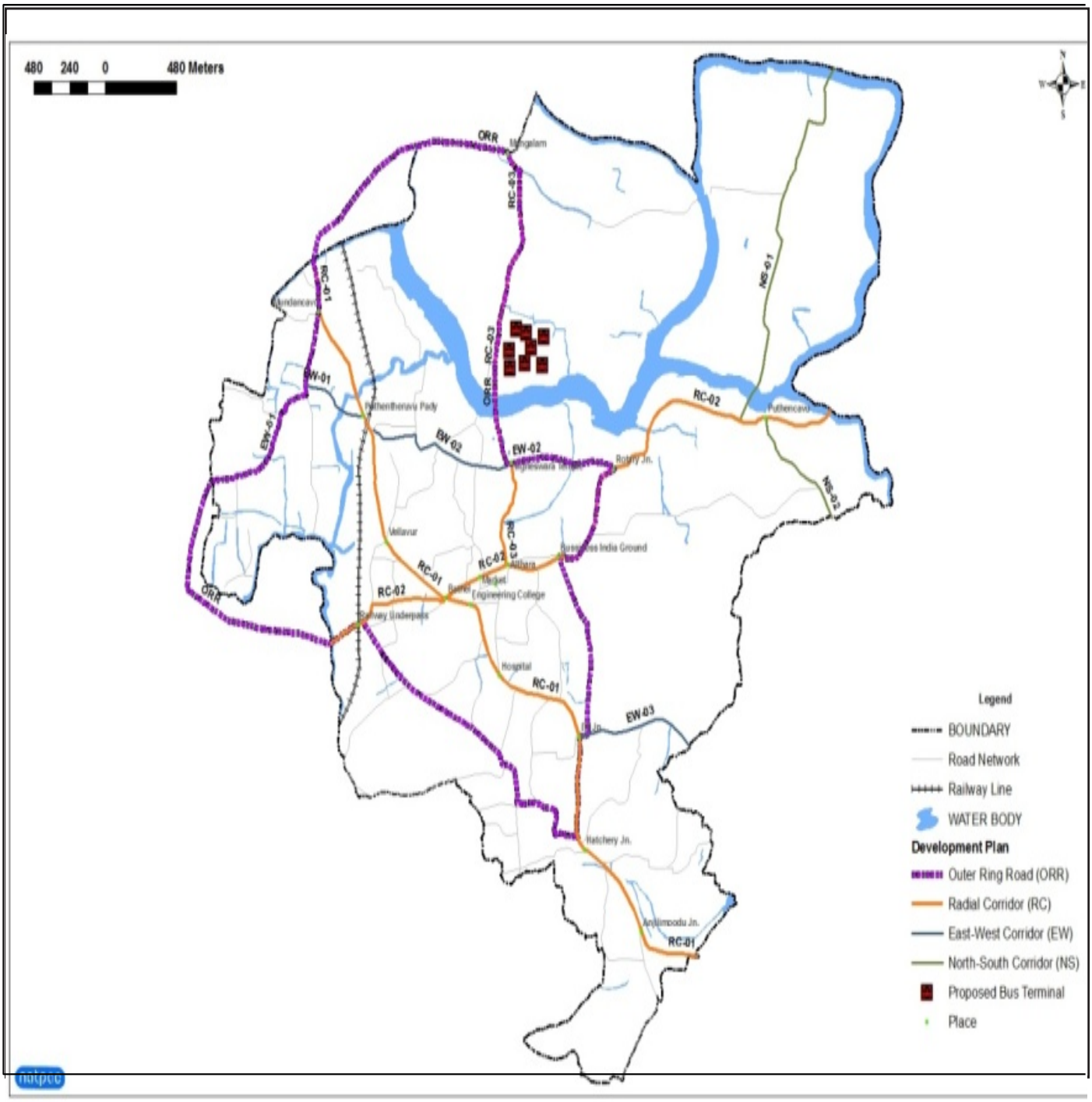

Figure 10 : Proposed Transport Development Plan for Chengannur Municipality

7. *Traffic and Transportation Studies for Ettumanoor Town*

At the instance of Ettumanoor Gramapanchayat, National Transportation Planning and Research Centre (NATPAC) compiled baseline traffic data in Ettumanoor town which could act as a feeder to the preparation of development plan for the town (**Figure 11**).

Salient Findings

- From the Speed and Delay survey, it was found that in MC Road from Adichira to Pattithanam, the journey speed and running speed was found to be as low as 17.86kmph and 24.18kmph respectively. In Pala Road, the journey speed was noted as 21.69kmph while the running speed was 30.46kmph.

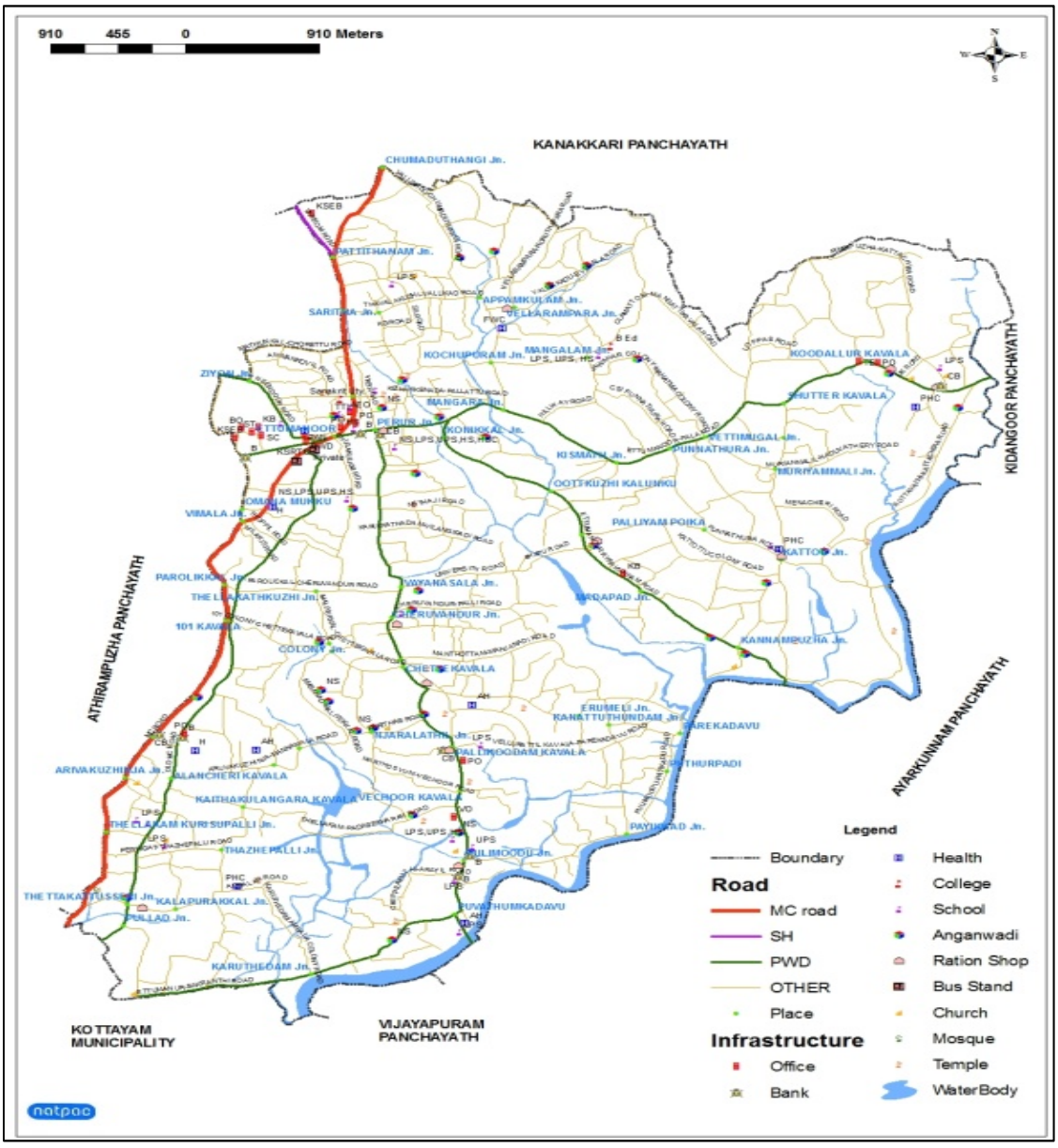

Figure 11: Base Map of Ettumanoor Town

- The daily traffic volume has been found to be maximum for the Central Junction-Pattithanam Junction link of MC Road amounting to 32,627 PCUs followed by 101 Kavala Central Junction link of MC Road with 26,245 PCU and SH-15 with 23,926 PCU. The daily traffic volume in Pala Road was 13,210 PCU. Neendoor Road had a daily traffic of 6,007 PCU while that in Peroor Road was 5,740 PCU.

- As far as the intersections were concerned, The Central Junction witnessed the maximum peak hour traffic flow of 4,220 PCU. Kurisupalli Junction has peak hour traffic of 3,283 PCU and Peroor Junction had peak hour traffic of 3,218 PCU. For Parakandam Junction and Pattithanam Junction, the peak hour traffic flows are 2,684 PCU and 2,563 PCU respectively.

- The O-D pattern of inter-town passenger traffic revealed that a total of 1,21,242 passenger trips were performed through the O-D survey point on the reference day. The zones within the study stretch (from Zone 1 to 6) attracted 24,733 trips while the total number of generated trips was 23,030. Kottayam district generated 64,335 trips and attracted 65,880 trips. Trips from other states were 1,611 and the number of trips bound to other states was 1,024. Out of the 8,569 tonnes of inter-town goods traffic observed through outer cordon survey station, maximum volume of 3,649 tonnes movements were observed in the case of construction materials which amounted to 42.6 per cent, followed by industrial goods with 24.1 per cent.

- It can be seen that the projected divertible traffic volume will reach 14,000 PCU by 2020 and 21,000 by 2030 which demands a four lane road. Apart from this, the traffic will become manifold during Sabarimala season. Thus it can be seen that there is wide scope for constructing a bypass for the MC road at Ettumanoor.

Proposed Plan

The road network pattern within Ettumanoor town resembles a radial pattern. Absence of adequate rings for these radii is the main cause of traffic problem in Ettumanoor. One of the major traffic aggravating factors in Ettumanoor is the location of entry and exit paths of both private and KSRTC bus stands directly leading to the CBD area. The number of trips operating is about 1,500 including 1,000 KSRTC buses and 500 private buses. In the long run, it is desirable to shift the bus terminals away from the CBD area and as a short term measure, the circulation of buses has been proposed as given in **Table 1.**

Table 1: Circulation of Buses Proposed

Direction	KSRTC Buses	Private Buses
Towards North & East	Existing entry - Bus stand - Pvt stand exit - Kurisupalli - Central Jn.	Kurisupalli - Pvt Stand - Kurisupalli - Central Jn / Thumbasseri
Towards South	Pvt stand entry - Bus stand (via new internal road) - Existing entry - Thumbasseri	-
Athirampuzha/Neendoor-Ettumanoor	Panchayat Office Jn - Kurisupalli - Bus stand (via new internal road)	Panchayat Office Jn - Kurisupalli - Pvt. stand

Apart from the circulation plan, a few roads has been identified to be developed as ring roads thereby to serve the purpose of bypass and hence to alleviate the congestion in the CBD area (**Figure 12**).

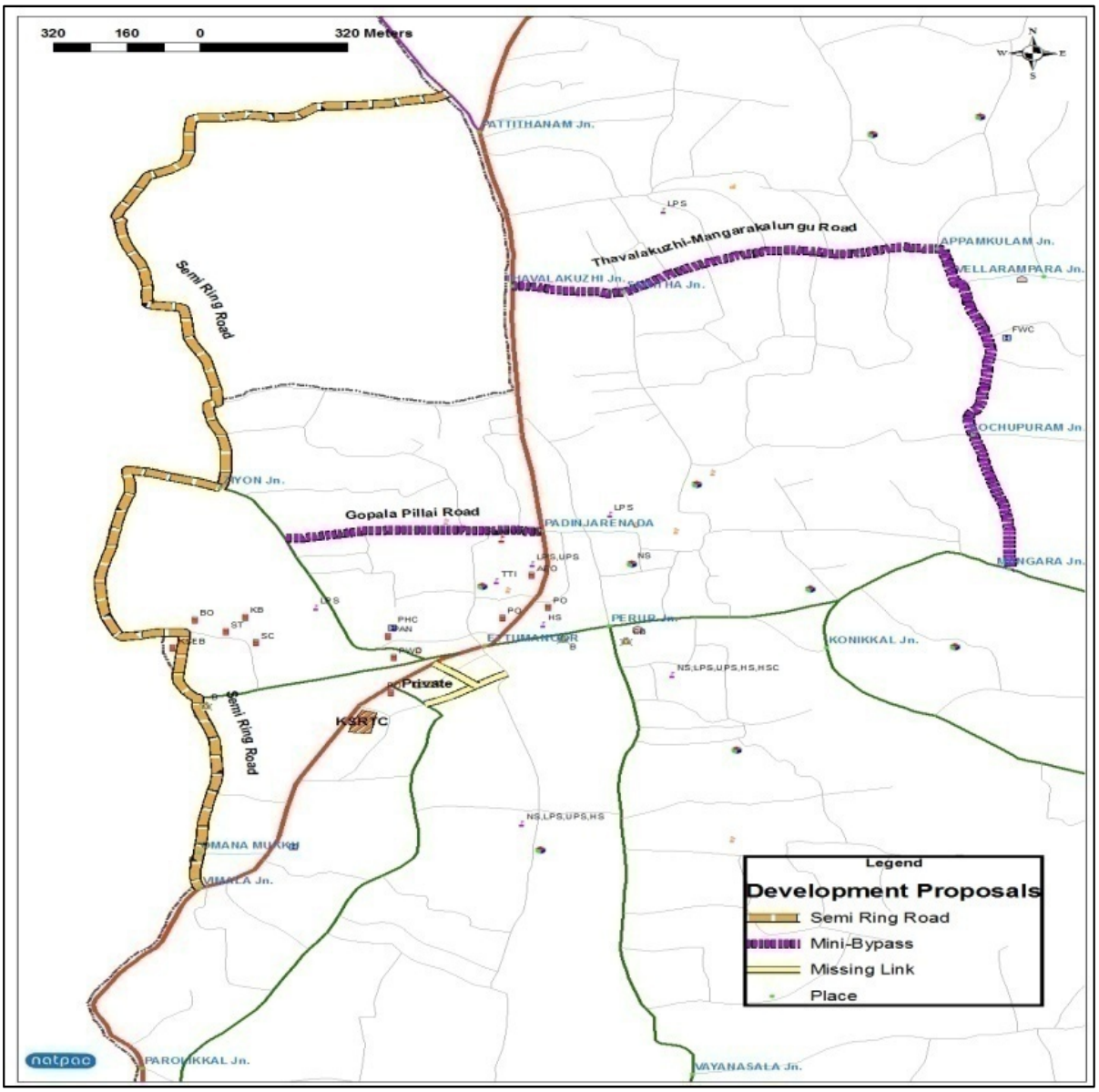

Figure 12: Proposed Transport Development Plan for Ettumanoor Town

8. *Traffic and Transportation Studies for Mavelikkara Municipality*

As part of Statutory Town Planning Schemes, District Town Planning Office entrusted NATPAC the task of carrying out traffic and transportation study for Mavelikkara Municipality. The scope of the study is confined within the area of Mavelikkara Municipality **(Figure 13).** The study aimed at compiling the base year traffic and transportation data in Mavelikkara Municipality which could act as a feeder to the preparation of development plan for the town.

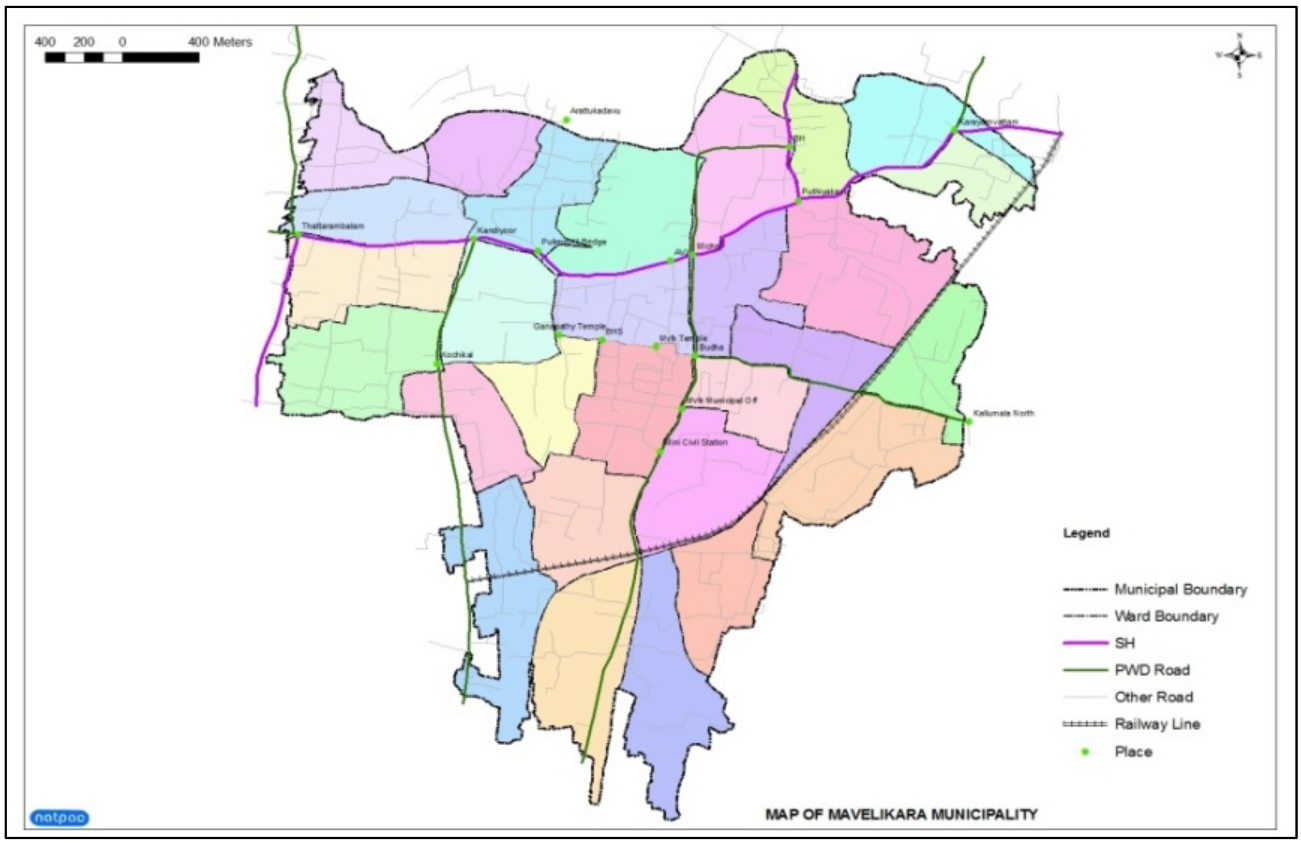

Figure 13: Base Map of Mavelikkara Municipality

Taking into consideration the traffic characteristics as well as the infrastructure options Transport Development Plan is prepared for Mavelikkara. The traffic scenario in Mavelikkara is reflected at the Mitchel Junction which is the core area of the town, at which the Krishnapuram road intersects with the Kayamkulam – Thiruvalla SH. The Central Business District (CBD) area is highly congested mainly due to improper parking and poor geometrics on the intersection.

Since the most important problem of Mavelikkara town is heavy traffic , especially near the CBD area, emphasis was given to develop alternative links to divert the bypassable traffic passing through the stretch. This would also help to reduce the inter mixing of intra-town and inter-town traffic on roads within the central part of the town. A road development plan has been formulated

for the town (Figure 14). It was proposed to develop a semi ring road for Mavelikkara municipality by utilizing the existing municipal roads, which could act as a mini bypass. The proposed road starts from Church junction near Puthiyakavu on SH10. The alignment moves through Kallumalla - Puthiyakavu road and at ch 0/850, deviates left and moves through Exchange-Railway Station road. The alignment joins with Mavelikkara –Kattanam road at ch 1/700 and after intersecting with Krishnapuram road at Budha junction (ch 2/800) the proposed road follows the Chettikulangara-Chunakara municipal road and crosses the Pulimoottil – JCT road at ch 3/600. At ch 4/400 the alignment meets with Kandiyoor – Earezha road and at ch 5/200 it joins with SH 6 at Kandiyoor junction.

The ring road can act as a bypass for traffic from SH 10, SH 6, Krishnapuram road, Kallumala road and Earezha road and can decongest the AR junction, Mitchel junction and Puthiyakavu junction. The ring road needs to be widened to 12 m width so as to enable easy bidirectional movement.

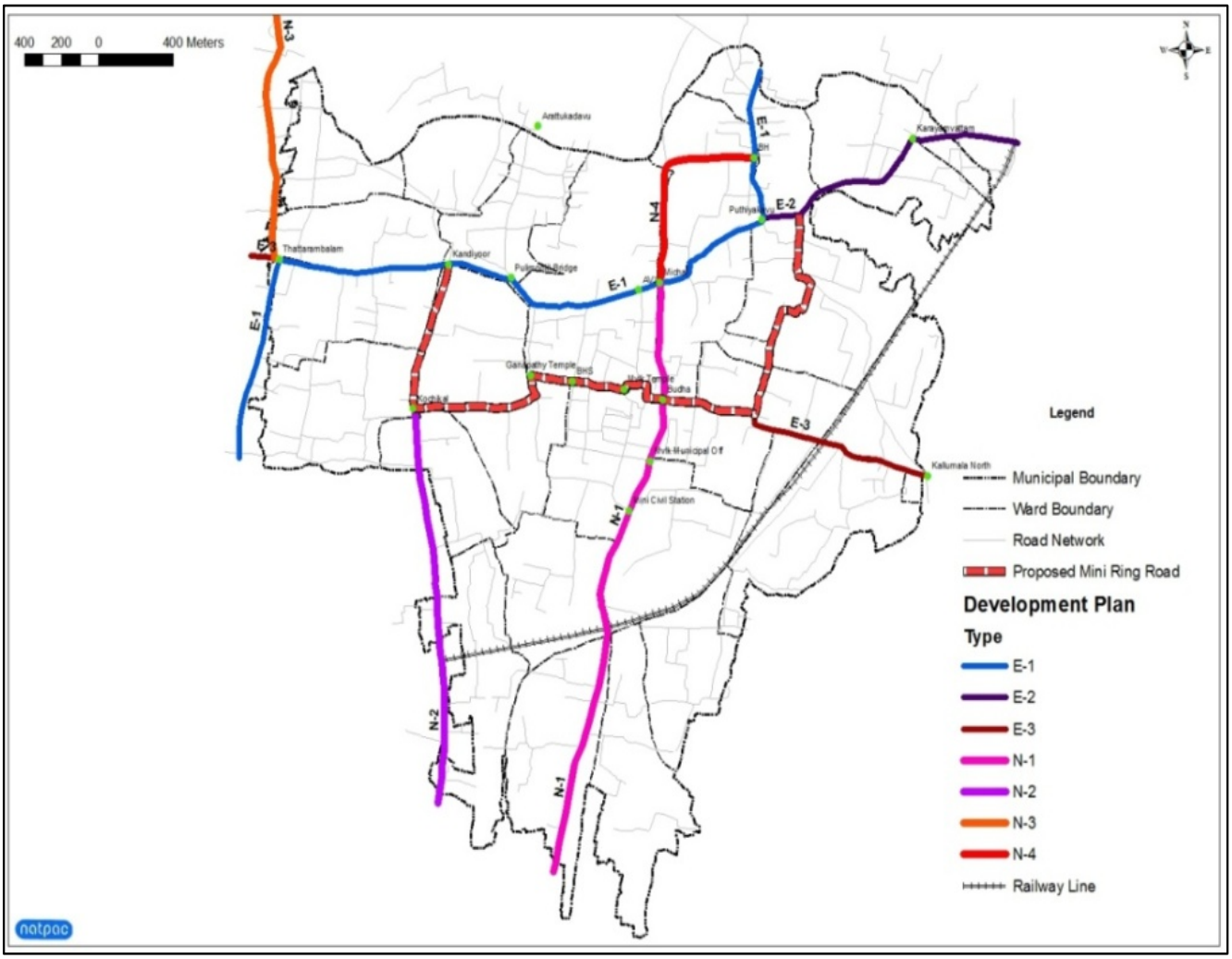

Figure 14: Proposed Transport Development Plan for Mavelikkara Municipality

9. *Annual Toll collection potential at Padannakkad on NH 17 in Kasargode District*

At the instance of National Highways Authority of India (NHAI), Kozhikode, National Transportation Planning and Research Centre (NATPAC) assessed the annual toll collection potential at Padannakkad R.O.B (Ch 90/695) on NH-17 in Kasargode district, Kerala. NATPAC carried out seven-day traffic surveys at the specified location and one-day origin-destination survey. The methodology adopted for the study consisted of:

(i) Estimation of average daily volume of tollable traffic
(ii) Assessing the seasonal variation in sale of petroleum products in the region
(iii) Estimation of seasonal variation in average daily tollable traffic
(iv) Collection of information on number of working days, holidays and disturbed days
(v) Estimation of month-wise tollable traffic
(vi) Estimation of tollable traffic with different entry tickets
(vii) Fixation of toll rate for different types of vehicles and entries
(viii) Estimation of annual toll collection.

Based on classified volume counts, the average daily volume of tollable traffic was estimated. To assess the seasonal variation in tollable traffic, sale of petroleum products in the influence region was obtained from the petrol pumps.

Month-wise tollable traffic with different entry tickets was estimated based on frequency of travel made by vehicles passing through the survey locations which was obtained from O-D survey. Fixation of toll rate for different types of vehicles and entries was obtained from NHAI. Using the above rates, the annual toll collections for different sections of NHs have been estimated.

Average daily traffic volume passing through the toll plaza was found to be 9868 vehicles, most of them being cars/ vans/ jeeps. The annual toll collection potential is estimated at 3.91 crores **(Table 2).**

Table 2: Annual Toll Collection Potential

Sl. No.	Type of vehicle	Toll (Rs.)
1	Car, jeep, van or light motor vehicle	1,53,46,634
2	Light commercial vehicle, light goods vehicle or mini-bus	23,18,215
3	Truck or bus	1,29,23,416
4	Three axle commercial vehicle	43,11,883
5	Heavy construction machinery, earth moving equipment or multi axle vehicle	25,69,313
6	Oversized vehicles	16,70,676
	Total	**3,91,40,136**

10. Price Index for Stage Carriage Operations in Kerala

An efficient bus transport system is a major contribution to economic growth. It meets the travel needs of commuters in urban and semi-urban areas, for intra and inter-city mobility. In Kerala, both Kerala State Road Transport Corporation (KSRTC) and private operators provide bus transport services. The periodic computation of price index, PISCO brought out by NATPAC was helpful in quickly estimating the movement of prices of various components of stage carriage operations for various periods. This was also helpful for Government in taking decisions to revise the fares from time to time.

Findings

The price of diesel, lubricants, tyre and certain other spare parts have increased significantly since the last bus fare revision in November 2012. The diesel price alone increased from ₹ 49.61 per litre in September 2012 to ₹ 56.42 per litre with effect from October 2013. PISCO estimated a variation of 12.36 % in the variable cost and 15.10% in the fixed cost between September 2012 and October 2013 **(Table 3).** The overall price index for stage carriage operation showed a variation of 11% during the period. Since the PISCO showed an overall variation of 11% in the cost of operation of stage carriages between September 2012 and October 2013, an overall increase of fare by 11% is recommended.

Table 3
Computation of Price Index for Ordinary Private Stage Carriage as on October 2013 prices
(Base Year - September 2011)

Sl No.	ITEMS	Components	Quantity(Q)	Price as on Sept. 2011	Value/km (Sep. 2011)	Price as on Sept.2012	Value/km (Sept.2012)	*Price as on Oct.2013	* Value/km (Oct.2013)	% growth in price from Sept.2012 / Oct.2013
A	**Variable Cost**									
	Fuel	**Diesel**	0.285522	44.55	12.72	50.75	14.4902	56.42	16.1092	11.1724
1	Lubricants	Engine oil	0.002244	197.4	0.4	239.24	0.5369	249.39	0.5596	4.2438
2	Tyre	Average for MRF 900-20 & 1000-20	4.61E-05	14450	0.666	17881.87	0.8244	19362	0.8926	8.2771
3	Engine system	Piston set BS2 Henoi engine (Leyland)	1.84E-05	10505	0.1930	11302.07	0.2080	11863.3	0.2183	4.9655
4	Fuel injection	Fuel injector pipe kit	1.72E-05	1489	0.0260	1522.93	0.0262	1598.55	0.0275	4.9655
5	Exhaust	Hybrid silencer	3.63E-06	3331	0.0120	3361.93	0.0122	3528.87	0.0128	4.9655
6	Electrical	Battery cable unit	1.91E-05	5161	0.098	5103.06	0.0975	5356.45	0.1023	4.9655
7	Clutch	Clutch disc	2.77E-05	3166	0.0880	3248.91	0.0900	3410.24	0.0945	4.9655
8	Gear box	Pinion bearing	3.07E-05	1683	0.052	1748.14	0.0537	1834.94	0.0563	4.9655
9	Propeller shaft	Centre bearing housing	5.55E-05	3570	0.198	3755.78	0.2084	3942.27	0.2188	4.9655
10	Housing system	Crown & pinion set	9.96E-06	8839	0.0880	9298.97	0.0926	9760.71	0.0972	4.9655
11	Break system	Break lining 6'F1 Std (4 items)	2.64E-05	8408	0.2220	8431.51	0.2226	8850.18	0.2336	4.9655
12	Body & frames	Bumbers	0.00039	300	0.1170	322.76	0.1259	338.79	0.1321	4.9655
13	Steering system	Cartridge assembly	7.79E-06	3400	0.0270	3576.93	0.0279	3754.54	0.0292	4.9655
14	Suspension system	Tapper roller bearing	0.000187	2040	0.381	2117.20	0.3959	2222.33	0.4156	4.9655
	Sub Total (Material Cost - Sl No.1 - 14)	**Materials other than fuel**			**2.61**		**2.92**		**3.09**	
	Maintenance Labour	Labour Cost Aggregates	0.005142	250	1.2860	270.30	1.3899	322.23	1.6569	19.2118
	SUB TOTAL (VARIABLE COST)				**16.62**		**18.80**		**20.86**	
	PISCO Index (Variable Cost)				**100**		**113.16**		**125.52**	**10.93**
B	**Fixed Cost**									
	Crew	Crew cost per day	0.014545	500	7.273	540.60	7.863	644.46	9.3737	19.2118
	Depreciation	Annual depreciation	1.25E-05	106667	1.333	106667	1.333	106667	1.3333	0.0000
	Financing cost	Annual interest payment on capital	1.25E-05	69705	0.871	69705	0.871	69705	0.8713	0.0000
	Insurance	Insurance premium per annum	1.25E-05	25009	0.313	25009	0.313	25009	0.3126	0.0000
	Motor vehicle tax	Annual tax	1.25E-05	100800	1.26	100800	1.260	100800	1.2600	0.0000
	General overheads	Annual overhead cost	1.25E-05	39840	0.498	39840	0.498	39840	0.4980	0.0000
	Working capital interest	Interest on working capital	1.25E-05	2800	0.035	2800	0.035	2800	0.0350	0.0000
	Sub Total (Fixed)				**11.58**		**12.17**		**13.68**	
	GRAND TOTAL (Fixed + Variable)				**28.20**		**30.98**		**34.54**	
	PISCO INDEX				**100**		**109.85**		**122.49**	**11.51**

✻ ***Provisional***

11. Supply Demand Analysis of Railway Reservation Tickets

Indian Railways is one of the world's largest public sector organizations. Indian Railways generates 30% of the revenue through passenger services. Compared to other states in India, the railway in Kerala State was getting its maximum income from passenger traffic compared to freight traffic. It has been seen for the last few years that the railway was not able to meet the passenger demand. Transport Department, Government of Kerala entrusted National Transportation Planning and Research Centre (NATPAC) to assess the number of reserved tickets available for each train and the passenger demand.

The study was aimed at estimating passenger demand and supply of reserved tickets in the State of Kerala. The objectives of the study consisted of assessing the supply of existing reservation tickets, estimating the passenger demand for reserved tickets to major destinations and the number of tickets available and to suggest suitable remedial measures to balance the demand and supply.

Kerala State was divided into three segments viz., Thiruvananthapuram, Ernakulam and Kozhikode to alleviate the amount of data collected. A total of 17 stations/divisions outside the Kerala State were identified and are given in **Table 4**. Structured strategy method was adopted to collect a comprehensive database regarding the status of reservation tickets from the three origins in Kerala to the 17 destinations outside the state for the specified week (12.05.2013 – 18.05.2013) for each of the classes and for each of the trains.

Table 4: Indian Railway's Zone's and the Stations Identified for the Study outside Kerala

SL No.	Name of the Zones	Name of the Selected Stations
1	Central Railway	Mumbai
2	South Central Railway	Secunderabad
3	South East Central Railway	Bilaspur
4	Southern Railway	Chennai
5	East Coast Railway	Bhubaneswar
6	North Central railway	Allahabad
7	North Eastern Railway	Gorakhpur
8	North Western Railway	Jaipur
9	Northeast Frontier Railway	Guwahati
10	East Central Railway	Hajipur
11	Northern Railway	Jammu Tawi (Ferozpur Division)
12	South Western Railway	Bangalore
13	Northern Railway	New Delhi
14	Eastern Railway	Kolkatta
15	West Central Railway	Jabalpur
16	South Western Railway	Hubli
17	Western Railway	Ahmedabad

From the results drawn from the online queries it was found that the availability of reserved train tickets from Kerala is very much insufficient. Almost all the trains showed waiting list status irrespective of class and destinations. The status of reserved tickets remained as WL (Waiting List) for most of the trains running daily and weekly. The maximum demand was observed for the tickets to Mumbai, Chennai and Bangalore followed by Jabalpur, Ahmedabad, Kolkata, Bhubaneswar, Secundarabad and Delhi especially in sleeper class.

The availability of reserved tickets in Kerala is not meeting the demand. Certain proposals have been put forward for increasing the number of trains and also to increase the frequency of trains from Kerala.

- Significant improvement in ticket booking which can be done without making core changes ie. by increasing number of ticket counters/quota
- Capacity of existing online booking server should be increased
- Railways need to work a lot to manage its demand and capacity by proper utilization of their resources. The number of coaches for all trains running in Kerala may be increased considering the demand
- All passenger trains, express trains etc. which runs through Kerala should have minimum of 24 full capacity coaches.

12. Measurement of Air Quality and Noise Level at Proposed IISER Campus in 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; 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 at the time of 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 proposed IISER Campus as per CPCB guidelines with varying number of anthropogenic sources.

The measurement was done in four seasons - Season I (December - February), Season II (March-May), Season III (June-August) and Season IV (September-November). The Noise level at five locations during four 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, 5 stations were identified by NATPAC in and around the proposed IISER campus, Vithura **(Table 5).** Air Quality Monitoring and measurement of noise level were also carried out.

Table 5: 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

Findings

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 four seasons are given in **Table 6** and **Figures 15 to 17**.

Table 6
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	70.32	50.91	15.03	29.16	0.0088	65.39	605.79
STATION II	66.66	48.23	14.88	19.96	0.0058	55.63	493.69
STATION III	56.07	32.36	13.03	16.15	0.0040	50.89	319.15
STATION IV	47.14	27.92	11.44	14.22	0.0040	47.26	388.04
STATION V	82.93	53.50	20.94	28.98	0.0096	75.80	859.88

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.

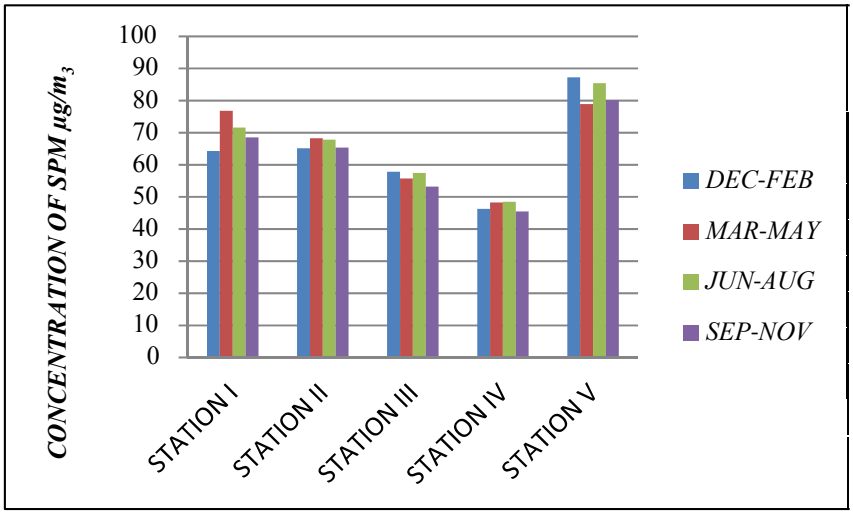

Figure 15: SPM concentration in IISER Campus

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

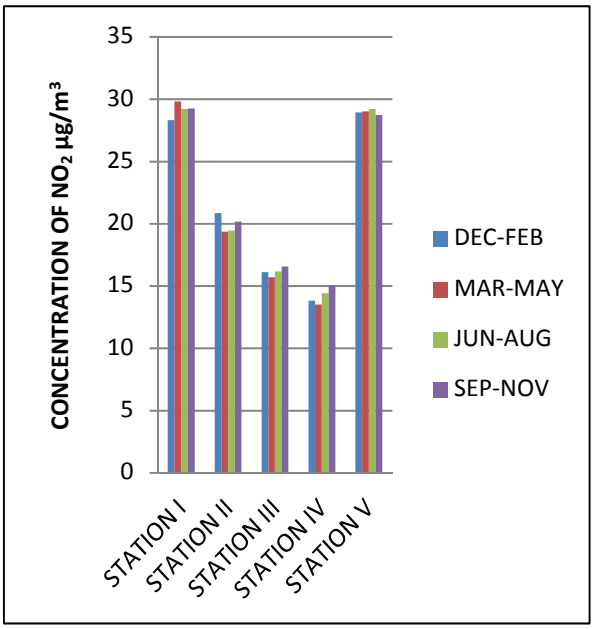

Figure 16: NO_2 Concentration in IISER Campus

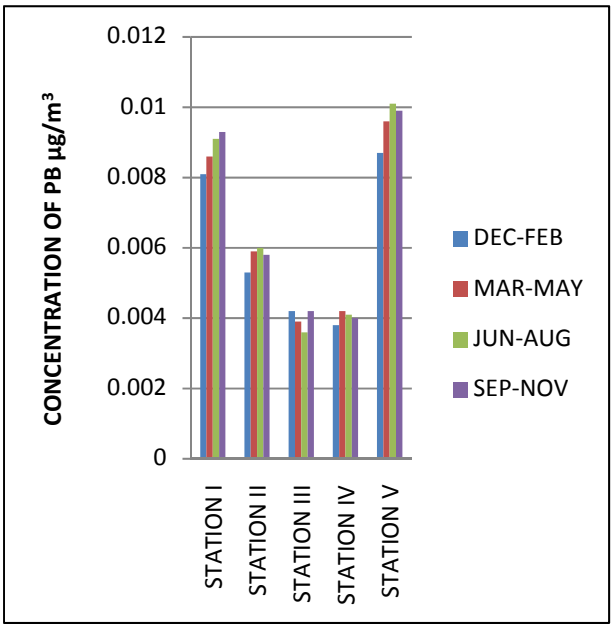

Figure 17: Pb Concentration in IISER Campus

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 lesser amounts of gaseous pollutants.

Noise Levels

The major sources of noise in the study area are 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 7**

Table 7
Summarized Result of Noise Level

Station/Season	Dec-Feb	Mar-May	Jun - Aug	Sept-Nov
STATION I	58.15	50.07	55.77	52.13
STATION II	57.78	53.84	55.47	54.57
STATION III	57.25	50.49	53.50	52.28
STATION IV	50.52	52.25	48.78	49.98
STATION V	63.00	53.78	58.59	60.02

The day time average at Station I to V are 54.03 dB (A), 55.42 dB (A), 53.38 dB (A), 50.38 dB (A) and 58.85 dB (A) respectively. The average maximum noise level was observed at Station V ie Main Plant. It was caused due to human made activities like construction activity, operation of mixture unit, vehicular movement, welding processes etc around the station. The noise levels at other stations are also closer to the standard value.

13. Impacts of Vehicular Emission on Human Health in Cities – a Case Study of Thiruvananthapuram

NATPAC analysed the impact of vehicular emission on people like traffic police, drivers and road side vendors who are subjected to continuous exposure to heavy traffic in Thiruvananthapuram urban centre. Thiruvananthapuram, the capital city of Kerala located in the south-western tip of India, situated between north latitudes 8° 17' to 8° 54' and east longitudes 76° 41' to77° 17' was selected as the study area. As per the Census report 2011, the district has a population of 16,87,406 of which 815,200 are males and 872,206 are females. The urban or metropolitan population is 752,490. There were 31,156 boys and 30,463 girls.

The methodology adopted for the study includes:

i. Assess the vehicle population of the study area
ii. Determine the vehicular emission
iii. Assessment of ambient air quality
iv. Study the effect of vehicular emission on the continuously exposed population
v. Suggest protective measures
vi. Propose further preventive and control measures to reduce the vehicular emission

The analysis of air quality data of the city shows that the principal component exceeding prescribed limit is suspended particulate matter (SPM). Average day time concentration of SPM in the study area is found as 75 µg /m^3. As per the Air Pollution Index (API) analysis, the air quality of Thiruvananthapuram falls in the border case of moderate air pollution i.e., highest in summer and lowest in monsoon owing to the contributions of variation in suspended particulate matter concentration.

The traffic volume study shows that most number of vehicles counted is two wheelers followed by cars, Auto rickshaws, Buses, MUV and LCV. Estimated percentage of emission by each category of vehicles is given in **Table 8**. Among the type of vehicles, two wheelers are the major contributors of carbon monoxide, methane, particulate matter and hydrocarbons. The major percentage of carbon dioxide is contributed by cars. The major percentage of nitrogen dioxide and sulphur dioxide are contributed by buses.

Table 8
Percentage of emission by each category of Vehicles

Pollutant	Two wheeler	Auto rickshaw	Pick up auto	Car	MUV	LCV	Bus	Truck/ Tractor	Others
CO_2%	14.6	10	0.5	42.4	6.9	4	21.3	0.3	0.2
CO%	44.3	31	1.5	13.8	2.2	1.4	5.5	0.1	0.1
NO_x%	11.8	23.9	1.2	4.3	0.7	1.1	56	0.4	0.2
CH_4%	57.5	17.4	0.9	19.9	3.2	0.4	1.9	0	0
SO_2%	7.5	5.2	0.3	9.9	1.6	11.3	60.6	0.9	0.9
PM%	28.8	34.7	1.7	6	1	1.6	26	0.2	0.1
HC%	86.6	2.6	0.1	5.3	0.9	0.1	4.1	0.1	0

The highest vehicle density was observed in East fort to Palayam road stretch. Peak hour traffic varies from 8.30 to 10.30 in each stretch. Total gaseous pollutant emission per day from each stretch is estimated and given in **Table 9.**

Table 9
Total emission of Pollutants from each road

Road Stretch	Vehicular Emission (g/day)
Sreekaryam - Ulloor	11772.5
Ulloor - Kesavadasapuram	4131.2
Kesavadasapuram - Pattom	9571
Pattom - Plamoodu	3448.9
Pattom - Cosmo	3485.5
Cosmo - Medical College	4845.1
Chakkai - General Hospital	11376.4
General Hospital - AKG Center	16267.3
Manacadu - East fort	25117.4
East fort - Palayam	44413.4
Over bridge MG Road- Killipalam	5390.5
Killipalam - Karamana	44090.8
Vellayambalam- Sasthamangalam	9743.3
Sasthamangalam - Vattiyoorkavu	18469.6
Vazhuthacadu - SreeMoolam Club - Vellayambalam	3883.5
Vellayambalam - Kowdiar	10150.3
Kowdiar - Peroorkada	14828.3

The population and average mortality data were collected from the Census Department. Ratio of asthmatic population, average mortality rate on respiratory diseases, cardiovascular diseases etc. are obtained from the Directorate of Health Services. Estimated health effects are given in **Tables 10** and **11.** The central estimate of number of cases per year is 379 Premature Mortality, 677 Respiratory Hospital Admission, 13263 Emergency room visit, 1914617 Restricted Adult Activity Days, 37023 Acute Bronchitis in Children, 18398 Asthma Exacerbation 227925 Respiratory Symptoms, 1796 Chronic Bronchitis, 161 Respiratory Mortality and 237 Cardiovascular Mortality. The economic costs of this impact is enormous.

Table 10: Data for the Estimation of Health Effect of PM10

Population Ratio Above Age 18* (as fraction)	POPG18j	0.59
Population Ratio Above Age 25*(as fraction)	POPG25j	0.52
Ratio of Asthmatics in Total Population (as fraction)**	POPaj	0.01
Average Mortality Rate (number of deaths divided by 1,000,000)*	MR	0.007
Average Mortality Rate on Respiratory Diseases (number of deaths divided by 1,000,000)**	MRr	0.00084
Average Mortality Rate on Cardiovascular Diseases (Number of deaths divided by 1,000,000)**	MRc	0.003
Change in annual average PM10 in area jμg /m^3(Measured concentration is about 75 and WHO guideline standard is 30 μg / m^3) ***	PMj	45

Source: ** Census Data 2011 Thiruvananthapuram Corporation,*
*** Kerala Health Statistics Review 2013,*
**** Kerala State Pollution Control Board*

Table 11: Health Effects Estimated

Health effect	Low	Central	High
Premature Mortality	252	379	514
Respiratory Hospital Admissions	372	677	880
Emergency Room Visits	7,241	13263	19,330
Restricted Adult Activity Days	1,345,226	1,914,617	3,006,781
Acute Bronchitis in Children	18,511	37,023	55,071
Asthma Exacerbation	9,199	18,398	154,072
Respiratory Symptoms	135,744	2,27,925	5,63,670
Chronic Bronchitis	898	1,796	2,694
Respiratory Mortality	35	161	294

The air quality in Thiruvananthapuram city belongs to moderate polluted category. The pollutant, especially SPM shows high fluctuations according to the season. The average day time Suspended Particulate Matter in the city is estimated as 75 μg/ m^3. The correlation between the pollutants and meteorological factors are strong and positive for all parameters except with wind velocity. Wind velocity shows a strong negative correlation.

The health effects due to the exposure of PM10 using dose-response coefficients show that the effect is severe in terms of mortality and morbidity parameters. The authorities need to develop an action plan for progressively reducing the PM10 concentration level with in the specified limit.

14. Urban Travel and Traffic Flow Characteristics in Kerala – development of Quick Response Travel Demand Estimation Techniques

Kerala has experienced higher level of urbanization as against very low population growth rate. Increasing urbanization has resulted in development of vast areas as urban extensions in Kerala. Urban areas having similar geographic and demographic features tend to have same transport structure and travel pattern. So it is necessary to investigate the commonalities in travel pattern and thereby develop a quick response travel demand estimation techniques for applications in urban transport planning and impact assessment of major policy interventions.

Scope and Objectives of the Study

(i) Assess the traffic flow characteristics in selected urban areas of various sizes

(ii) Evaluate the travel pattern of people for different purposes in selected towns

(iii) Study the temporal variation of various travel indicators like per capita trip-rate, per capita vehicle ownership, changes in modal choice etc.

(iv) Correlate the above characteristics with size of the urban area, vehicle population,availability of transport infrastructures etc. and identify the commonalities

(v) Develop Quick Response Travel Demand Estimation Techniques for wider applications in Impact Assessment, Traffic Management and Transport Planning.

The scope of the study is confined to the towns and cities where traffic and transportation studies have been carried out by NATPAC during the last 10-15 years.

The methodology adopted for the study consisted of:

(i) Collection of base-line data from various traffic and transportation study reports

(ii) Classification of cities and towns based on demographic and geographic features

(iii) Collection of socio-economic and travel characteristics (Road network, vehicle ownership, modal split, existing traffic flow pattern, volume/capacity ratio, speed, parking and pedestrian flow characteristics) for selected towns

(iv) Collection of data on future/forecasted transport scenario discussed in study reports

(v) Analysis of data by appropriate statistical methods

(vi) Identification of commonalities, computation of indices that reflect urban traffic and travel characteristics for different urban centers and

(vii) Development of Quick Response Travel Demand Estimation techniques for towns.

The trip rates and various indices developed from the study will be useful for assessing the impact of policy interventions in traffic system, transport network, changes in transit operations, TSM applications, transport planning etc.

15. Goods Transportation and Freight Policy Intermodal Traffic Split: A Case Study-Phase I

Goods transport is one of the basic economic services and a prerequisite for enabling production, distribution and consumption of goods and services. A freight rate for transportation of commodities by various modes varies with regard to commodity type, size and capacity of vessel carried and the volume freight. The freight rates by trucks are normally fixed by mutual agreement between producer and supplier. Such impacts of freight rates on the profitability of goods transportation by trucks have not been assessed scientifically. NATPAC studied goods transport operation including the quantity and type of commodity transported. Cost of operation, service level offered, freight charged, safety condition of vehicles etc. will be studied in the next phase

Objectives of the Study

(i) Assess the quantum of goods transportation in the state and their modal split
(ii) Assess operational characteristics, fixed and variable cost of goods transport operation by heavy trucks, rail and waterways
(iii) Determine the freight rate for transportation of various goods by different modes; and
(iv) Recommend appropriate freight policy to the Government.

Around 10,48,576 goods vehicle passed through 53 check posts of Kerala in 2013 and Walayar check post transacted largest volume of the traffic. Around 2000 commercial vehicles enter the state through Walayar and an equal number exit the state through the same. Cost Modelling approach was adopted for arriving at the fixed and variable cost of transportation of various commodities.

16. Preparation of Traffic Improvement Plan for Pala

NATPAC has undertaken detailed traffic and transportation studies to reduce transportation problems of Pala Town and suggested implementable solutions on a long term perspective. The study aimed at preparing a Transport Infrastructure Development Plan for a horizon of 20 years, thereby solving present and future traffic problems faced by Pala town.

The study area is confined to Pala town and adjoining Panchayats, since the traffic from surrounding areas will have profound influence on the transportation system of the Town. Four adjoining Panchayats such as Karoor, Mutholy, Meenachal and Bharanganam were considered as the influence area for the study. The study was divided into two phases.

Phase I includes Traffic Operation Plan for Pala town and development of outer ring road, Parallel road from Kizhathodiyoor to Civil Station and river view extension road starting from R.V Park Junction to Kottaramattom Junction. Phase II of the study includes improvement proposals for important intersections in Pala Region.

NATPAC formulated implementable solutions to the traffic problem of the City. In order to improve the road network, several widening schemes and proposals for completing the missing links on the road network have been recommended. Junction improvement proposal have been prepared for those, which have been identified as functionally important thereby sustaining the current traffic flow and also expected traffic rise in the foreseeable future. Pedestrian facilities have also been incorporated in the junction improvement plans proposed for the city. Pedestrian subways are recommended at various locations in Pala Town.

Development of outer ring road for Pala Region

NATPAC proposed a ring road alignment which is divided into four homogeneous sections/reaches viz., Kadapattoor - 12th Mile Junction, 12th mile Junction - Kalariamakkal Kadavu, Kalarimakkal Kadavu – Karoor Junction, Karoor Junction - Kadapattoor Junction.

Alignment plan proposed for the outer ring road includes, Ist reach from Kadapattoor to 12th mile (2.4 km), 2nd reach from 12th Mile Junction to Kalariamakkal Kadavu Junction (2.120 km), 3rd reach from Kalariamakkal Bridge to Karoor Junction (3.17 km) and 4th reach from Karoor to Kadapattoor (4.33 km). A minimum width of 12 m in Municipal areas and 15 m in Panchayat areas were proposed for the two lane ring road. Land acquisition has been completed for 1st reach and in progress for other reaches. Tendering process is in progress for the implementation of 1st reach from Kadappattoor to 12th Mile Junction.

Development of River view extension Road

The River view extension road designed by NATPAC starts from from RV park Junction to Kottaramattom Junction (1.1 km) passing through the banks of Meenachil River and back of Bishop House in Pala Town. Land acquisition is in progress and the project is in the final stage of implementation.

Development of Parallel Road

The Parallel road in Pala consists of three homogeneous stretches which includes Keezhathodiyoor - Civil Station, Civil Station - RV Junction and RV Junction - Puliyannoor Junction. Total length of the proposed parallel road is about 4 km, which starts at Keezhathodiyoor on Pala- Thodupuzha road (SH-8) and ends at Puliyanoor Bypass Junction on Pala - Ettumanoor road (SH-32).

The proposed first reach alignment starts from Keezhathodiyoor and ends at Civil Station Junction (0.750 km), passes through new alignment crossing the Lalam Thodu. The second and third reach alignment passes through existing Kottavazhi road from Civil Station to Puliyanoor Bypass Junction. Kottavazhi road will be widened to 16 m by acquiring land equidistant from the centre line of existing road.

First reach of Parallel road was designed by NATPAC to four lane standards from Keezhathodiyoor to Civil Station. A minimum width of 19 m was proposed for this four lane road. This first reach has been completed and opened to traffic.

All major intersections in Pala region were surveyed and junction improvement plans were prepared to cater the smooth and safe movement of traffic. All major junctions in Pala Town were proposed for improvement and included in phase I of the study.

Other major junctions coming in the proposed ring road and Cherpunkal – Bharanghanam road widening project were proposed for improvement in Phase II of the study. Some of the junctions formed as part of the proposed Pala ring road and widening of Cherpunkal – Bharanghanam road and Kottavazhi road proposed for improvement in Phase II of the study are Kadapattoor Junction, Cable Factory (Mutholi Road crossing) Junction , 12th Mile Junction (Ist Junction),12th Mile Junction (II Junction), Kannadiurumbu Junction, Parapilly Junction, Chettimattom Junction, Njondimakkal Junction, Kannattupara Junction, Karur Junction, Match Box Junction,

Ashanilayam Junction, Pendanamvayal Junction, Neliyani Junction, Water Tank (Parallel Road) Junction, Murukkumpuzha (Ponkunnam road crossing) Junction, Bharanghanam Junction, Vilangupara Junction, Cherpunkal Junction, Forane Church Junction, Mutholi Kadavu Road Junction and Puthen Palli Kunnu Junction.

Plate 2
A view of newly upgraded Kizhathodiyoor Junction(designed by NATPAC) in Pala Town

Early implementation of traffic improvement schemes would reduce the traffic congestion and ensure safe and orderly movement of traffic on the existing road system. A phased implementation of medium and long-term development may be considered as per the priority fixed by the local people through public participation programme.

Plate 3
A view of newly designed parallel road (designed by NATPAC) in Pala Town

17. Performance of Highway Development Projects in Kerala

Large and ever – increasing investment demands in road infrastructure facilities emphasize the need for addressing road maintenance and rehabilitation problems. The accurate prediction of pavement performance is important for the efficient management of the transportation infrastructure. National Transportation Planning and Research Centre (NATPAC) carried out a study for the appraisal of highway developed under Kerala State Transport Project (KSTP).

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, traffic studies, structural and functional evaluation of the study road pavements, road safety audit by means of an Automated Road Safety Audit Technology, axle load studies and capacity analysis. The details of stretches on study roads are given in **Table 12.**

Table 12
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 Policodu Jn	HS V
6	Lower Karickam to Kottarakkara	HS VI

Findings

The traffic plying on the study roads vary from 754 commercial vehicles per day (cvpd) to 1675 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 exhibits a current functional performance of good to average rating based on the unevenness values indicated by the International Roughness Index (IRI) values of the study stretches. Signs of impending failures have initiated on the pavement surface of the study roads in the form of various distresses like fractures or cracks, distortion, disintegration etc. Ravelling and alligator cracks are the major distresses seen on the pavement surface. Initiation of potholes is also noticed at some of the locations. Road safety audit was conducted and the deficiency of the roads was identified. The major deficiencies observed from the road safety audit are in Kazhakkottam to Kottarakkara stretch of the MC road. They 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, poor pavement condition, inadequate delineation, no 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.

18. Use of Waste Plastic for Road Construction in Urban Centres in Kerala

NATPAC explored the possibility of usage of waste plastic in road construction, conducted laboratory studies and developed methodology for processing waste plastic. The Centre also constructed test stretches with mixes of plastic coated aggregates and conducted their periodic evaluation.

Laboratory Studies

Marshall studies were conducted to determine the strength characteristics of Bituminous Concrete (BC), Semi Dense Bituminous Concrete (SDBC) and Dense Bituminous Macadam (DBM) made using plastic coated aggregates and compared the results with that of ordinary mix. The

constituent materials like aggregates and bitumen used for the study were tested in the laboratory to ensure that they conform to the standard specifications. Stripping tests were also conducted on the bituminous mixes to evaluate their resistance to water soaking (**Table 13)**.

Table 13
Marshall Mix Design for Mixes Using Plastic Coated Aggregates and comparison with ordinary mixes

Bituminous mix type		Optimum Binder Content (%)	Optimum Waste Plastics (%)	Stability (kN)	Retained Stability (%)	Flow (mm)	Bulk Density (g/cc)	Volume of Voids, Vv (%)	Voids filled with bitumen, VFB (%)
BC	*Ordinary*	5.00	0	15.39	80.09	3.25	2.50	4.187	65.86
	with PCA	4.5	0.5	22.68	83.37	3.58	2.426	3.38	76.05
SDBC	*Ordinary*	5.00	0	14.17	82.8	3.70	2.445	4.187	74.11
	with PCA	4.60	0.4	19.45	83.84	3.80	2.437	3.066	78.19
DBM	*Ordinary*	4.6	0	18.94	83.96	2.50	2.380	2.241	82.73
	with PCA	4.0	0.6	22.75	86.52	3.48	2.463	3.48	73.52

Field Studies

Four test roads were resurfaced in collaboration with local bodies - Municipal Town Hall – Our College Road in Vadakara Municipality (400m length), Stadium to Puthiyara road at Kozhikode (600m length), Logans Road at Thalassery (650m length) and Kokkalai to KSRTC Junction (700m) in Thrissur district. A surface layer of 20mm Premix Chipping Carpet (PMC) with modified mix is laid on all these roads and a control stretch is maintained. Recently two roads were laid in collaboration with the Kerala Public Works Department in Ernakulam and Thiruvananthapuram districts. In the GIDA Road (in front of High court) in Ernakulam district having a length of 300m and a width of 10 m, two layers of PMC with modified mix was laid. In the Arattuvazhi - Menamkulam Road in Thiruvananthapuram District having a length of 500 m and a width of 7 m, plastic was added in Bituminous Macadam and PMC layers. Periodical pavement evaluation studies were conducted to investigate the functional performance of all these study roads (**Tables 14** and **15**).

Table 14
Study Stretches

Name of study road	Length	Width of carriageway	Year of resurfacing	Traffic
Municipal Town Hall Road, Vadakara Municipality	500m	3.75 to 5 m	March 2008	<150 CVPD
Stadium to Puthiyara road, Kozhikode	600 m	4.5 to 5.5 m	March 2009	2844 CVPD
Logans Road, Thalassery	650 m	5.5 to 7.5 m	December 2009	5280 CVPD
Kokkalai Road, Thrissur	700 m	7 m	December 2010	3136 CVPD

Table 15
New Study Stretches

Name of study road	Length	Width of carriageway	Year of resurfacing	Traffic
GIDA Road (infront of highcourt)	300m	10 m	February 2012	Heavy
Arattuvazhi - Menamkulam Road	500 m	7.5 m	March 2012	270 CVPD
Mutholi-Poovarani Road, Pala, Kottayam	1000 m	7 m	January 2013	Medium

Laboratory studies showed increase in Marshall Stability, reduction in optimum binder content and stripping. Field performance studies showed less damage in terms of potholes, ravelling and cracks on the stretches which have used plastic coated aggregates for surfacing than the control stretch. This will lead to the increased service life of roads and reduces consumption of petroleum products because smooth surface reduces the vehicle operating costs.

Social benefit is predominant by using waste plastic in road construction and this study provides input for evolving guidelines/specifications for the use of waste plastic materials in road construction and help in its effective usage thereby reducing a serious community menace.

19. Evaluation of Fibre Reinforced Asphalt Mixes and its suitability to Kerala Condition

Due to high traffic speed, density and heavy traffic load various types of distresses such as rutting, ravelling, undulations, cracking, bleeding and potholes occurred in conventional asphaltic pavements. Constant efforts were done to improve the performance of asphaltic concrete mixtures. Adding fibre materials into asphalt mixtures is one of the approaches, which act as reinforcing agents for the asphaltic mixes. NATPAC evaluated the feasibility of using natural and artificial fibres in bituminous mixes.

Objectives

- To find optimum fibre -reinforced asphalt mixtures using the laboratory tests
- To assess how the material properties for the modified fibre -reinforced mixture differs in stiffness, permanent deformation and cracking characteristics
- To identify and lay fibre reinforced asphalt mixes in suitable study stretches
- To evaluate the performance of the laid fibre reinforced asphalt mixes and compare with control road section using conventional/modified asphaltic mixes

The following types of fibres were studied in detail.

- Glass fibre
- Polypropylene fibre
- Steel fibre

Plate 4
Artificial Fibres selected for the study

Natural fibres such as coir, sisal and cellulose were not considered since they have shown less temperature resistance when added to the heated aggregates.

Laboratory Investigation

Dense grade bituminous concrete was selected as the control mix. 60/70 grade bitumen and bituminous concrete mix of 19mm normal aggregate gradation was used. Artificial fibres such as polypropylene, glass fibres and steel fibres were added with bituminous concrete mix. Length of the fibres was kept constant at 20mm and thickness of fibres varies from 0.5 -0.75mm. Optimum bitumen content for bituminous concrete was determined from Marshall stability test **Table**s **16** and **17**.

Table 16
Summary of Test on Aggregates

Sl.No.	Properties	Results
1	Aggregate crushing strength	20%
2	Aggregate Impact Value	23.6%
3	LOS Angeles Abrasion value	19.1%
4	Combined flakiness and elongation index	24.5%
5	Specific Gravity	2.76%
6	Water absorption	0.13%
7	Angularity number	8

Table 17
Summary of Test on Bitumen

Sl.No.	Properties	Results
1	Penetration Test	67
2	Softening Point test	46
3	Ductility of Bitumen	75
4	Specific Gravity	0.98
5	Flash and fire point	175-242

Conclusion

Polypropylene fibres increase the stability value of bituminous concrete by 14% to 25%. Stability value of bituminous concrete decreases with increase in the glass fibre content. Addition of glass fibres in the mix increases flow values and steel fibres added to bituminous concrete shows increase in stability value up to 0.8% of weight of total mix and then decreases.

20. Benkelman Beam Deflection Surveys in Technopark

At the instance of Technopark authorities, Thiruvanathapuram, NATPAC carried out Benkelman Beam Deflection surveys on the selected roads in Technopark area **(Table 18** and **Figure 18)**. NATPAC conducted pavement evaluation surveys using Benkelman beam in the inner roads of Technopark Campus in Thiruvanathapuram. The study aimed at designing the overlay required for these roads based on the deflection values and the design traffic

Table 18: List of Project Roads

Sl. No.	Corridor		Length (km)
	Code	Name	
1	PR 1	Karyavattom gate – Bypass Road	0.950
2	PR 2	Gayathri - Stadium Road	0.350
3	PR 3	Ring Road	0.400
4	PR 4	Nila Road	0.500
5	PR 5	STPI Road	0.350

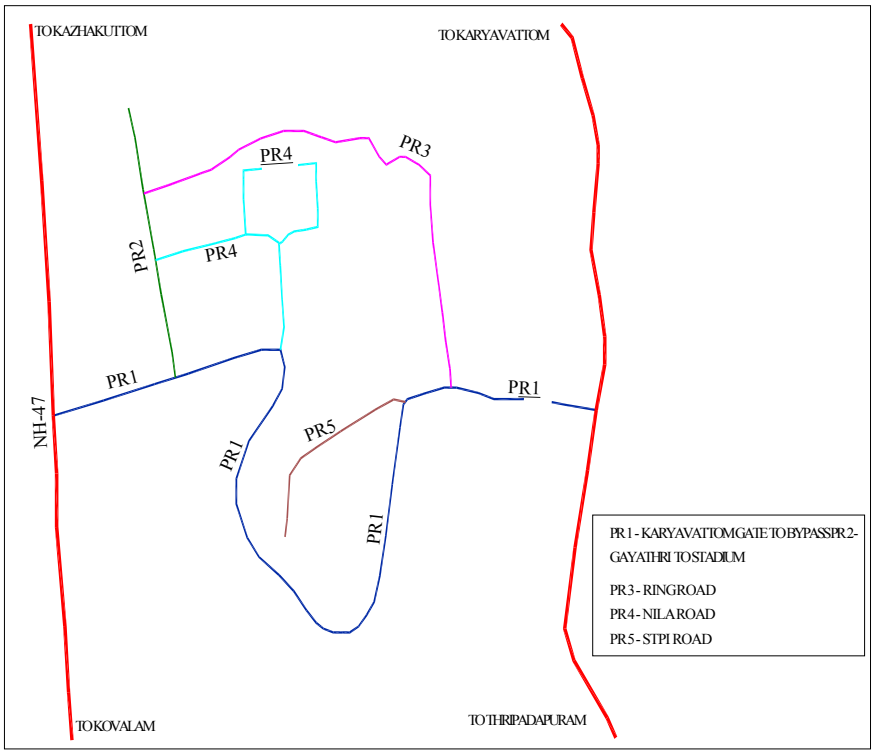

Figure 18
Layout Map of Project Roads

Findings

- Traffic volume counts were taken for a period of 8 hours to 24 hours in the project corridors. From the survey it was observed that the daily traffic through the corridors vary from 4,000 vehicles to 22,350 vehicles.
- For applying corrections during BBD calculations, laboratory tests on subgrade soil samples were carried out and it was found that the soil is of Sandy type and the moisture content values were in the range of ±13%.

- From BBD survey, it was found that the characteristic deflection values were in the range of 0.6 mm to 1.6 mm, indicating that the pavement is in a moderate condition.

Design of Overlay

- Buses, mini buses, trucks and mini trucks were considered for the design. Karyavattom gate - Bypass Road, Gayathri - Stadium Road, Ring Road, Nila Road and STPI Road were considered for the design **(Table 19)**.

- Corresponding to the design traffic and t he characteristic deflection obtained for the study stretches, total overlay thickness in terms of bituminous macadam construction is deduced from the graphs given in IRC: 81-1997. The equivalent overlay thickness to be provided for other pavement layer compositions are also determined based on the appropriate equivalency factors given in IRC guidelines.

Plate 5
Setting of the Beam for BBD Survey

Table 19: Overlay Design based on Benkelman Beam Deflection Study

Corridor Name	Characteristic Deflection (mm)	Design Traffic (msa)	Proposed Overlay (mm)		Total Overlay Thickness (mm)
			BM	BC	
Karyavattom gate - Bypass Road	0.7955	9.03	50	40	90
Gayathri - Stadium Road	1.5688	1.72	50	40	90
Ring Road	0.9809	0.79	50	40	90
Nila Road	1.1689	3.50	50	40	90
STPI Road	0.5856	2.82	50	40	90

It was seen that the design traffic and the characteristic deflection values warrant only minimum overlays viz. **50 mm thick Bituminous Macadam + 40 mm thick Bituminous Concrete** for all the project roads and the same has been proposed.

21. Benefit Monitoring of Tourist Oriented Directional Signs – a Case Study

Tourist Oriented Directional (TOD) signs helps in directing tourists to unknown tourist centres. For a tourist, sign boards would be quite useful for reaching their intending tourist centres without wasting time, effort and cost.

The Tourism Department, Government of Kerala has made substantial investment in installing tourism signages. It is useful to assess whether the investment made has the desired impact on the tourists. NATPAC carried out a qualitative and quantitative assessment of tourist oriented direction (TOD) boards in Kerala.

Objectives of the Study

(i) To assess the extent of availability of tourist signs and investment made on TOD

(ii) To study whether the TOD has any impact on the tourists

(iii) To quantify the total economic benefits (direct, indirect and induced effects), if any, arising from installation of tourist signs

(iv) To study the need for additional tourist signs, if any.

The methodology adopted for the study consisted of data collection from secondary sources, detailed inventory of sign boards, opinion survey of tourists and facility/service providers and assessment of economic impact of TOD signs on tourism using appropriate statistical methods. Ten major tourist locations were selected for the study and nearly 800 tourists (both foreign and domestic) have been interviewed.

The study quantified the benefits arising from the installation of tourist sign boards and evaluates the economic impact of investment on signage scheme for tourists. This will help in the increase of revenue earned by hotels and resorts, restaurants, local shops, ayurvedic centres and other commercial activities. Revenue earned by government in the form of taxes, entry tickets, pay park, government guest houses, etc. will also get increased.

22. Comprehensive Signage Scheme for Major Roads and Tourist Centres in Kerala

NATPAC provided various services for effective implementation of the comprehensive tourism signage scheme in Kerala State under the sponsorship of Department of Tourism, Government of Kerala.

Services Provided by NATPAC

i) Preparation of suitable design and specifications for the tourism sign boards;

ii) Preparation of tender documents for the fabrication, installation and maintenance of sign boards;

iii) Fixing of contractors for the signage scheme in consultation with Department of Tourism;

iv) Identification of tourist centres, in consultation with District Tourism Promotion Councils of all districts;

v) Identification of locations for installation of signboards and working out details of information to be provided on each board;

vi) Assessment of the total requirement of sign boards of different categories to cover the entire State;

vii) Preparation of the cost estimate for the signage scheme;

viii) Supervision and quality control of installation of signboards.

Single Information Sign Boards - Showing any Tourist Centre – in One Line/ Two Lines

These sign boards were placed on the approach roads to all major tourist centres at a gap of about 2-3 km. Each board contains the name of tourist centre, distance to the tourist centre, photo of the tourist centre and the direction of travel. Considering the length of tourist centre name and the size of sign board, two types of sign boards were proposed under this category, viz., (i) in one line or (ii) in two lines.

Single Information Sign Boards - Showing Major Tourist Centres

These sign boards were placed on the approach roads to all major tourist centres at a gap of about 2 to 3 km and contains the name of the tourist centre, distance to the tourist centre, photo of the tourist centre and the direction of travel.

Two Information Sign Boards – Two Line/ Three Lines

Two information sign boards were placed on all major Highways. These sign boards contain the names of two tourist centres, distance to the tourist centres, symbol depicting the nature of tourist spots and the direction of travel.

Plate 6
Single line single information

Plate 7
Three line two information

Three Information Sign Boards

Three information sign boards were placed at important junctions on all major Highways where roads to tourist centre deviates. These sign boards contain the names of three tourist centres, distance to the tourist centres, symbol depicting the nature of tourist spots and the direction of travel.

Welcome sign boards were installed at major tourist centre entry points and State entry points. These sign boards contain the message 'Welcome' along with a photo of the tourist centre and for State entry points, 'Welcome to Kerala' along with a symbol depicting the cultural/tourist importance of the State.

Layout map of major tourist areas were installed in all the major tourist centres. These maps will be prepared using GIS showing transport networks, major utilities, tourist attractions etc.

in the tourist area. The layout map of all the districts was installed in all the major tourist centres, railway stations, bus stations etc.

An open tendering process was adopted to fix the contractor for installing the sign boards in Kerala State.

Extensive primary surveys using GPS were carried out in all the districts in Kerala to locate the tourist centres, to measure the travel distance by road to these centres and also to identify the locations for installation of Sign boards. Based on the same, signage scheme for Kerala State has been prepared.

The tourist centres to be covered under the signage scheme for all the 14 districts in Kerala State were identified based on discussion with the respective District Tourism Promotion Councils and site visits.

Based on detailed analysis of survey data collected from the field using GPS, digitized road map of each district was prepared. The tourist centres covered in each district were located on these digitized road maps. Locations for installation of sign boards were also marked.

Plate 8
Welcome Sign Board

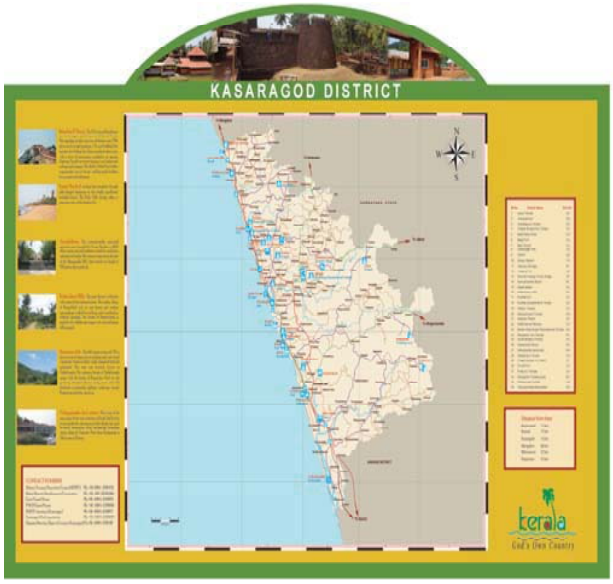

Plate 9
Map of Kasargod District

Implementation of signage scheme was carried out by NATPAC. Symbols representing various tourist centres were compiled from 'Tourism Signs and Symbols – A status report and guide book', published by the World Tourism Organisation.

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

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. The study area were confined to Cherthala in Alappuzha district, Chalakudy in Thrissur district and Kanhangad in Kasargode district i.e., three main cities 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 13 years using remote sensing technique
- Analyze the urban growth pattern of cities from 1995 to 2013 and develop a model to predict its expansion till 2030
- Suggest measures to effectively plan the cities for its future growth.

Satellite imageries at a time interval of five years starting from 1995 till 2013 for the study areas were procured from National Remote Sensing Centre (NRSC). Erdas Imagine software is used to classify (Supervised Classification) the satellite imageries of different time periods to analyse the urban growth of cities till date. GPS based field survey was conducted to verify the classified images and to collect data for the urban growth model. Future growth of the cities till 2030 will be predicted using Urban Growth Model.

Analysis for prediction of urban growth was done using ArcGIS 10.1 desktop software platform.

It is predicted that Chalakudy municipality urban area will increase by 19.18% by 2030 and population growth will increase by 8.54%. The lack of dependable infrastructure viz. resources, services, markets and job opportunities in rural areas will be the main cause of rural migration to the city. With the current rate of expansion tremendous pressure will be exerted on road transport. Congestions and accidents in road will be frequent.

Government should adopt conditions favorable to sustainable urban development by undertaking adequate measures. It should concentrate on strengthening local self-administration by applying the principle of decentralization of responsibility along with the related financial and personnel resources of local authorities. Greater participation of the people should also be assured. Government should encourage the national private sector to invest and become involved in solving problems such as the construction and improvement of housing and infrastructure, management of household and industrial waste, provision of adequate good-quality water, job creation, delivery of basic services, etc.

The government must ensure a healthy environment in and around large cities by thwarting activities harmful to the environment and increasing financial and technical resources for the preservation of the environment. It should allocate the budgetary resources needed for sustainable urban development and for the economic, social and cultural progress of rural areas which will help to narrow the gap between cities and villages and also balance the rural-urban migration by preventing the overpopulation of large cities.

Facilitating group discussions among citizens, local authorities and competent national bodies for finding solutions to the difficulties faced by urban communities should be done. Sustainable development in urban areas has to be promoted by encouraging sustainable patterns of production, consumption, transportation and settlement, pollution prevention, respect for the carrying capacity of ecosystems and the preservation of opportunities for future generations.

24. Revival of Inland Canals and Waterways in Kerala – A Case Study

Developing waterways for navigation with sufficient infrastructures such as fairway, terminals, navigational aids and fleet is necessary in the present scenario. It is important to extend the existing water transport facility from Vyttila mobility hub to Kakkanad further to Kadambrayar and Veegaland area. NATPAC carried out a study for the development of waterway connecting Chambakkara Canal with Kadambrayar River for tourism and passenger traffic.

The methodology adopted for the study consisted of survey of the canal, analysis of the existing facilities and demand, proposal for new facilities and cost estimation. The study region consisted of Kadambrayar River in Ernakulam district and Champakkara canal. Champakkara canal is a

tributary of Periyar river connecting industrial township of Ambalamugal and Kochi. It starts from Thevara and ends at Chitrapuzha railway bridge, Ambalamugal. Raw-materials for Fertilizers and Chemicals Travancore Ltd. (FACT), a Govt. of India undertaking is being transported through mechanized barges through this waterway from Kochi port. State Water Transport Department is running passenger boat service between Vyttila mobility hub and Kakkanad. Extending this through Kadambrayar river will give a boost in the existing passenger transport and tourism activities.

For the initial 3.7 km length of the river from its confluence with Champakkara canal the depth available is more than 3 m throughout the river stretch. Thereafter the depth decreases upto 2.3 m till Manakkakadavu Road Bridge. In the upstream stretch beyond Manakkakadavu Road Bridge till Kadambrayar tourism village the depth further decreases from 2.3 m to 1.0 m. Water hyacinth/ water weeds were observed on both sides near the banks. For the stretch downstream of Brahmapuram Road Bridge till its confluence with Champakkara canal, the entire waterway has been blocked by water hyacinth, water weeds and grass thereby causing obstruction for navigation in the present condition. This is primarily because of the erection of an earthen bund across the river at the confluence for preventing salt water intrusion in to the river during non-monsoon period (December to May). A small leading channel of approximate 7 to 10 m width with a sluice arrangement is provided at the left side of the confluence for ensuring flow. The colour of water was observed to be reddish-brown in the upstream regions of Brahmapuram road bridge whereas black in the downstream portion due to discharge of effluents from Kinfra park and Brahmapuram solid waste disposal plant. The total length of Kadambrayar stretch between Eco tourism project spot and its confluence with Champakkara canal is 6.9 km **(Table 20)**.

Table 20
Details of existing Bridges

Sl No	Name of Bridge	Chainage (in km)	Horizontal clearance between piers (in m)	Vertical clearance above HFL (in m)
1	Brahmapuram road bridge	2.100	18.5	2.8
2	Manakkakadavu road bridge	6.050	20.0	2.8

Plate 10
View of Kadambrayar Eco-tourism project spot

Plate 11
Manakkakadavu Road Bridge

In order to promote tourism activities and water sports in the river, it is proposed to develop a channel with bottom width of 20 m, depth of 2 m below lowest low water and side slope 1:3. As per this the estimated dredging quantity for development of Kadambrayar (confluence to Kadambrayar eco-tourism spot) is 31,104 cu.m and that of Wonderla channel is 34,080 cu.m. Bank protection work is required to be done for the entire length of the river (both banks) to prevent erosion of banks. The estimated quantity is 16,000 m. Water hyacinth/ water weeds are to be removed. Four floating jetties are to be constructed at Manakkakadavu bridge, Smart city, Brahmapuram bridge and Wonderla car parking spot for embarkation/ disembarkation of tourists/ passengers. One low level barrage - cum-lock is to be constructed at the confluence point with Champakkara canal to prevent salt intrusion during lean season (December to May) and also to facilitate through movement of tourist boats. The estimated cost of development worked out to Rs. 28 crores.

The river/ waterway can be developed for operation of boats having dimension of 15 m overall length x 4 m molded breadth x 1.8 m loaded draft for the entire stretch. Water sports may be introduced by using Speed boats and Water bikes in the stretch between Kadambrayar tourism village and Manakkakadavu bridge. Jetties may be constructed at Brahmapuram road bridge, Smart city, Manakkakadavu bridge and Wonderla car park for embarkation/ disembarkation of tourists/ passengers.Beautification of river banks may be done at least in the Water sports area proposed between Kadambrayar tourism village and Manakkakadavu bridge.

Methods to attract tourists in the form of "Evening package" (boat cruise with dinner) and "Weekend package" (boat cruise with lunch or dinner) may be introduced. Special boat ride packages may be introduced by making tie-up with Wonderla. "One day boating package" may be introduced between Menaka Jetty (Ernakulam) and Kadambrayar boat club through Ernakulam channel- Champakkara canal- Kadambrayar circuit.

25. Prospects of Cochin Port - Hinterland connectivity through Inland Waterways

The shipping sector contributes immensely to the Indian economy. The Cochin Port is located on the west coast. The maritime sector facilitates not only transportation of national and international cargos but also provides a variety of other services. The imports arriving at Cochin Port are transported to the hinterland predominately by road. The commodity consignments meant for exports are also transported by road to the port. This has adverse socio- economic consequences. The Inland Water Transport (IWT) mode still remains under utilised. A reasonable share needs to allocate to IWT through policy initiative of the Government.

The Cochin Port has emerged as a major hub for transshipment with the setting up of the International Container Transshipment Terminal at Vallarpadam. It handles an average annual volume 1.95 crore tonnes of cargo **(Table 21)**. Cochin Port has the benefit of the three modes of transport viz., waterways, roadways and rail.

The centers proposed to be served by the hinterland connectivity are Kochi local region, Alappuzha, Kottayam, Chengannur, Thiruvilla and Kollam. With the extension of the National Waterway III, the northern regions such as Kozhikode, Kannur, Kasargod etc. will fall under the geographical reach of the Cochin Port.

The constraints from the point of view of navigation across the IWs are the cross structures with in sufficient horizontal and vertical dimensions, inadequate draft, and a number of socio economic issues.

Table 21
Annual Volume of Imports (2011-'12) in MT

O/D	Cochin Port
Thiruvananthapuram	10,617
Kollam	240,504
Pathanamthitta	11,991
Alappuzha	8,323
Kottayam	49,742
Idukki	388
Ernakulam	777,346
Thrissur	20,125
Calicut	0
Kannur	0
Kassargod	0
Total	1,119,037

The economic benefits of the Cochin Port – Hinterland connectivity through Inland Waterways are, economy in fuel consumption, fuel savings due to decongestion of roads, accrual of carbon credit, fall in rate of road accidents, fall in annual road maintenance cost and boost to tourism. The annual economic benefits in monetary terms due to the implementation of the Port – Hinterland connectivity through Inland waterways are ₹442.00 crores.

The Inland Water Transport (IWT), Coastal shipping and International shipping lines needs to be integrated. Government of Kerala has granted a modal shift incentive scheme wherein an incentive of 1 ₹/tonne – Km for coastal shipping. This grant has to be extended to inland water transport also. The State Government needs to take urgent steps to solve the local community issues such as the problems posed by fishermen community, resistance to dredging, encroachment of the water etc. The state has a dense network of rivers, canals and backwaters. However transportation by waterways at present is confined to short trips between the Cochin Port and the International Container Transshipment through Inland waterways. Waterways need to be effectively utilised. Several tangible and intangible benefits will follow.

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

Inland Water Transport is a viable alternative to road and rail transport system. The main arterial waterway of Kerala is the West Coast Canal. The Kovalam – Akkulam stretch of the West Coast canal lies in Thiruvananthapuram city. Water in the canal is stagnant in most of the section and is infested with water hyacinths (African Payal). It is highly polluted due to sewage disposal and is unsuitable for navigation. A study was taken up by NATPAC to revive the Kovalam – Aakkulam stretch of T S Canal for Inland Navigation and Tourism Promotion and also to ensure sustainable development along the route.

The methodology adopted for the study consisted of assessing the existing conditions of the canal/ road cross structures through topographic/hydrographic survey, estimate the dredging quality to maintain uniform width and draft and suggesting appropriate improvements (**Table 22)**.

Major bottleneck is found near Panathura Subramaniya Swamy Temple.

Plate 12 (a)

Plate 12 (b)

Bottleneck found near Panathura Subramaniya Swamy Temple

Table 22

Dredging Quantity

Sl.No	Sec tion	Length (km)	Dredging Quantity (m)
1	Kovalam - Panathura	1.85	19891.57
2	Panathura - Edayar Island South	1.86	30771.51
3	Edayar Island South-Thiruvallom	1.90	26235.58
4	Thiruvallom - Moonattumukku	0.58	6047.13
5	Edayar Island South - Moonattumukku	2.25	13803.21
6	Moonattumukku-Ponnara bridge	3.34	69323.82
7	Ponnara bridge - Chakka Railway bridge	3.52	75218.16
8	Chakka Railway bridge- Vempalavattom bridge	2.32	34791.23
9	Vempalavattom bridge - Akkulam boat club	3.12	5879.69
Total		**20.74**	**281961.90**

Development proposals were identified to make the canal navigational which included desilting, widening,protection of banks,improvement of tunnels, provision of navigational aids, improvement of approach roads, reconstruction of cross-structures with inadequate clearance,canal protection and safety measures, etc. Proposals also include construction of sanitation facilities, rearranging sewage pipelines and installation of bio gas plant.

The overall cost for improving the canal between Kovalam and Akkulam section of Parvathyputhanar has been estimated to be ₹152.74 crores. The development of Kovalam - Akkulam section of Parvathyputhanaar in Thiruvananthapuram region was recommended for implementation at the earliest.

27. Impact of Surveillance Cameras installed in Cities

Advanced Transportation Management is an important application of Intelligent Transportation System (ITS) and can be done effectively by using the traffic monitoring and surveillance equipments. The primary goal of traffic surveillance is to supply information about conditions in the field to other system components so that appropriate response and control actions can be taken. Monitoring and traffic surveillance include the use of closed circuit television (CCTV) system detectors and communication networks. These tools can help improve incident management, inform control-decision making and determine the traffic conditions.

NATPAC carried out a study to assess the impact of surveillance cameras in reducing the road accidents, complaints of traffic regulations, speed control and operational efficiency of the identified intersections.

Scope and Objectives of the Study

(i) Identify the road stretches and junctions where surveillance cameras are installed.

(ii) Evaluate the impact of surveillance cameras in traffic congestion and crowd management during protests or processions on city roads.

(iii) Suggest appropriate guidelines to improve road user behaviour, lane discipline etc.

(iv) Identify the road stretches and junctions where the traffic surveillance cameras can be applied to improve road safety.

(v) Explore various applications of ITS for enforcing traffic discipline, traffic data collection, advanced traffic management system etc.

The methodology adopted for the study consisted of:

(i) Inventory of roads where surveillance cameras are installed.

(ii) Collection of past and present road accident data on selected stretches.

(iii) Opinion survey of road users and local people regarding the impacts.

(vi) Evaluation of the impacts of surveillance cameras on road safety and traffic accident control.

(iv) Evaluation of impacts of radar speed check cameras on road safety.

Plate 13

Traffic Control and Surveillance Devices

The study area consisted of 223 locations where surveillance cameras are installed in Thiruvananthapuram city. The study showed that 94% of the people were aware of the surveillance cameras installation, but they were not bothered about the radar speed check cameras because of improper enforcement measures as well as lack of sign boards and other informatory measures. There was considerable decrease in the traffic violations like jumping signals, over speed and also there was an increase in the helmet and seat belt usage. The installation of surveillance cameras helped in reducing crime rate in the city to a certain extent. For achieving 100% efficiency, proper awareness to the public should be given by the traffic control authorities and penalty measures should be taken against the violators.

28. Road Safety Funding and Role of Insurance Sector in Kerala

Insurance companies can play a major role in implementing various accident abatement measures. They can spend part of their premium income on road safety so that accident reduction occurs on one side benefiting the society as a whole and on the other hand reduce the claim on accident compensation benefiting the insurance companies, themselves. In Kerala, 12.27 persons per lakh population died in road accidents, which is higher than the national average of 11.4 persons. Thus, Kerala state needs to have an effective intervention to reduce this road accident fatality rate.

The major stake holders of road safety in Kerala are Public Works Department (PWD) (Highways), PWD (Roads and Bridges), Kerala Road Fund Board (KRFB), Traffic Police, Health Department, NATPAC, KELTRON and Kerala Road Safety Authority (KRSA). KRSA is the pivot authority for road safety in the state.

The expenditure for road safety improvement in Kerala state is assumed to come from the stake holders mentioned above. Based on the assumptions made on the share of engineering cost for Road Safety out of total investment on road infrastructure and on the share of funding from Medical Departments towards road accident trauma care, the total expenditures for road safety have been worked out. An expenditure of ₹ 274 crore had been made towards road safety in 2012-13, which was ₹ 122.4 Crore in 2007-08. A total of ₹ 1096.35 Crore had been invested towards road safety during the last six years. Average investment per one lakh population works out to ₹ 3.19 Crore.

Based on Smeed's formula for prediction of road accidents, relationship among the parameters namely, road accident fatalities, major injuries, minor injuries, number of registered motor vehicles and population were developed. Based on the same road accidents were predicted for various years **(Table 23)**.

Table 23: Projected Accident Scenario for Kerala

Year	No. of Vehicles (0000)	Major Injuries	Minor injuries	Persons Killed
2014	882	25270	13272	4901
2020	1600	23920	9524	6183
2025	2700	22064	6966	7521
2030	4700	19887	4968	9231
2034	7000	18362	3905	10704

In Kerala, accident cost comprising of cost of fatality, major injury and minor injury totals to ₹ 10.84 Billion for the year 2007, which further increased to ₹ 15.46 Billion in the year 2012. An annual inflation rate of 7.5% has also been considered, that is the average rate of inflation in India from the year 2003 to 2013. Combining the savings from reduction in fatality, major injury and minor injury, a total benefit of ₹ 2.98 Billion is obtained. This benefit is obtained against an investment of ₹ 10.24 Billion, leading to a poor B/C of 0.28.

Keeping a target to reduce 5% of fatality and grievous injury in Kerala, the total fund requirement is worked out as ₹ 1.23 billion.

In order to generate fund to achieve the target of 5% reduction in fatal and serious accidents, different mechanisms can be used. Here are a few mechanisms considered for fund generation. These mechanisms are mainly focusing on beneficiaries and users for fund generation.

- Insurance Levies or a share from insurance premium collected
- Increased one time Cess collected during vehicle registration
- Special Tax for road safety on fuel so that it is dependent on usage
- Grants from Central Government for the improvement of National Highways
- Increased traffic fines from offenders
- Part of Driving Licensing fee

It is recommended that substantial resources for road safety activities could be generated from sources like insurance, cess, tax on petroleum products and central government grants.

29. Pedestrian Safety: Improvement of Critical Locations in Thiruvananthapuram City, Kerala

Pedestrians are considered as the most vulnerable road users in the entire traffic stream. It has been estimated that pedestrians are involved in about 30 percent of accidents. At the instance of Kerala Road Safety Authority (KRSA), National Transportation Planning and Research Centre (NATPAC) addressed the needs of pedestrians and prepared improvement schemes for critical locations in Thiruvananthapuram city.

Scope and Objectives of the Study

(i) To identify the potential hazard locations and suggest suitable remedial measures to improve pedestrian safety in Thiruvananthapuram city.

(ii) To carry out safety audit of the existing pedestrian facilities in the study region.

(iii) To identify potential risk areas where pedestrian - vehicle conflicts are high.

(iv) To propose suitable pedestrian facilities such as footpath, cross-walk facilities, and grade separators (pedestrian subway, foot over-bridge, sky-walk etc) on major pedestrian movement corridors.

(v) To ensure effective integration of pedestrian facilities with transport terminals, major activity areas and important health and medical institutions in the region.

The methodology adopted for the study consisted of reconnaissance survey, literature review and data collection. Accident details for five years were taken and the pedestrian involved points/ locations were identified **(Table 24)**. Detailed survey was done for assessment of pedestrian facilities, pedestrian movement count (crossing & lateral) along with pedestrian opinion for walkability.

Table 24: Pedestrians Involved Injury (2008-2012)

Year	Dead	Grievous	Minor	Total
2008	25	294	105	424
2009	37	374	130	541
2010	36	340	150	526
2011	49	475	235	759
2012	46	414	146	606
Grand Total	193	1,897	766	2,856

Out of 36 roads selected for the study, it is observed that 90% of the roads have footpath. However, the quality and quantity of the footpaths are totally inadequate resulting in non-utilization of the same.

For rating the pedestrian facility, road inventory and pedestrian opinion survey was carried out. The pedestrian facility rating is given in **(Table 25)**. The average rating of footpath facility is 61% which is considered as not satisfactory. Almost 80% of footpath facility has rating below acceptable level and 10% of footpath has very bad rating.

Table 25: Rating of Pedestrian Facility

	Availability of walkway	Crossing facilities	Amenities	Overall Experience	Total Average
Facility Rating (%)	64.05	59.61	58.75	61.22	60. 91

For Thiruvananthapuram City, considering the scarcity of land availability, sidewalks with a width of 1.8 m to 4 m is proposed for all types of roads including arterial, sub-arterial, collector and local roads. Sidewalks or Footpath should have a clear walking zone of 2.2m. Guard rails need to be provided to segregate the moving vehicle and pedestrians and also to discourage the encroachments by street vendors. Cross walk markings are proposed at all the arms of intersections. Apart from these intersections, cross walk markings are proposed at major high pedestrian volume locations like educational institutions, hospitals and commercial centres. Zebra crossing of width ranging between 2-4 m should be provided at each major junction for each arm.

Pedestrian underpass/overpasses are proposed at selected locations in Thiruvananthapuram City which have high concentration of commercial establishments and pedestrian volume. The locations are given in **Table 26.**

Table 26: Proposed Pedestrian Underpass/Overpasses

1	St Mary's School, Pattom	7	Over Bridge
2	Kesavadasapuram	8	Thampanoor Railway Station & Bus terminals (skywalk connected)
3	Ulloor (skywalk connected)		
4	Medical College (skywalk connected)	9	Vazhuthacaud
5	Palayam	10	Pazhavangadi (skywalk connected)
6	VJT Hall (University College)	11	East Fort (skywalk connected)

Integrating pedestrian overpass with Light Rail Transit (LRT) stations along its route is advised for better access to the station from either sides of the road. Combined overpass with LRT stations are to be provided in the places given in **Table 27.**

Table 27: Proposed Pedestrian Overpass with Light Rail Transit (LRT) Stations

1	Kazhakkoottam (skywalk connected)	6	Assembly Hall
2	Ulloor	7	Statue (Secretariat)
3	Kesavadasapuram	8	Thampanoor (skywalk connected)
4	Pattom	9	Killippalam
5	Plamoodu	10	Karamana

Covered Skywalk will connect the pedestrians with different modes of public transport such as LRT stations, bus stations, railway stations and mobility hub. Thus covered skywalk provides intermodal connectivity between the transit terminals. Tentative locations identified for covered skywalks are:

- Thampanoor Railway to Bus terminal connecting LRT
- Thampanoor to East fort along Power House Road (above canal)
- East Fort to Attakulangara bus stand
- Ulloor LRT station to Medical College
- Kazhakkoottam Bus terminal to Techno Park and connecting LRT station at Kazhakkoottam

In Thiruvananthapuram city certain areas and streets are to be pedestrianized completely for better safety and for better walkability. On these areas only bicycles are allowed. The areas identified are:

- Chala Road (Killippalam to Gandhi Park)
- Temple Road 1 - Entrance from East Fort
- Temple Road 2 - RTO office to Ramachandra
- Temple Road 3 - By the northern side of Padmatheerthakulam

The implementation of these proposals will help in evolving the city into a pedestrian safe environment.

30. Accident Reconstruction Studies

The accident situation in Kerala is becoming more serious due to rapid growth of vehicles and irritative behavior of driver and road users. Various categories of roads in the state are exhibiting different pattern of accidents and thus warrant region specific accident control measures. NATPAC carried out site inspection of all major road accident spots in the state. Accident reconstruction models were used to work out real cause of accidents.

The aim of the study was to identify the fatal accidents taking place in different areas of the state and to reconstruct the entire sequence of the accident. Major causes of the accidents were identified and classified as road related, vehicle related, driver related etc., and suggested remedial measures to reduce such accidents.

This year NATPAC investigated five accident spots in the State.

i. Thelakkad at Perunthalmanna
ii. Thanoor
iii. Vamanapuram
iv. Alamcode and
v. Rajakkad

Accident at Rajakkad

Although there are some faults in the road infrastructure, the road accident at Rajakkad, in Idukki district, is caused mainly by human error. Human error is the most important cause of road accidents.

Losing control, the bus hit the safety barrier, telephone post & tree

After hitting the road edge, the bus overturned and landed upside down

Plate 14: Diagrammatic representation of the accident

Every vehicle operator should follow the defensive driving techniques to avoid minor errors that may end up in fatality. The lack of warning systems, pavement markings, street lighting for night drivers, poorly designed side protection and safety fencing system increases the chances of accidents and all these should be corrected judiciously at the earliest. The flaws on the road infrastructure design combined with human error resulted in the loss of eight innocent lives at Rajakkad.

31. Road Safety and Youth – Problems and Solutions

NATPAC studied the driving habits of the youth, their knowledge and awareness in road safety to identify specific areas for enhancing road safety education thereby reducing road accidents among youth. The driving and other traffic related habits of the youth in Kerala were studied. A detailed questionnaire was prepared and distributed among the young drivers. The age group of young drivers was classified as:

→ Less than 18 years

→ Between 19 – 25 years and

→ Between 26 – 35 years.

Out of 14 districts, seven districts were selected randomly for the study. The study identified road traffic injuries among youth as a serious public health problem. This problem is more serious among young men compared to young women. Road traffic injuries are a major strain on a country's health care system and on the national economy generally. The problem becomes even more acute in regions where young people constitute a major part of the population.

Effective methods that can put in place to tackle the risk factors among young road users are:

1. Identify and associate different agencies like police, health care etc. to give awareness among youth to attain zero level accidents
2. Prepare a road safety strategy and plan of action
3. Obtaining financial and human resources to address the problem
4. Implement specific actions to prevent road traffic crashes and minimizing injuries
5. Evaluate these actions and improve further if necessary.

32. Safe Road Corridor Pilot Project – Basesline Data for Kazhakkuttam –Adoor Stretch of MC Road (SH – 1)

Government of Kerala has been taking steps for improving the safety level and riding quality of roads under various programmes. In order to assess level of safety and riding quality achieved through one such project, NATPAC collected baseline data of Kazhakkuttam to Adoor stretch of MC Road (SH – 1), one of the stretch improved by Kerala State Transport Project (KSTP), with an aim to develop it as Safe Road Corridor.

The scope of the study is to compile the secondary data and collect the base line data on the study corridor. The specific objectives of the study included a comprehensive review of relevant road safety literature and collection of available secondary road accident data such as fatality, vehicle type and other related information and information on number of schools, NGOs active in Road Safety Campaign and conducting awareness programmes in the vicinity of project road etc.

Traffic volume count surveys, speed and delay surveys, vehicle checks and surveys to quantify the usage of helmets and seatbelts by the vehicle users were carried out as part of the project. The assessment of road accident trend in the project road, awareness levels of road users about traffic rules, speed limits and other road user legislation such as insurance, drunken driving etc., the quality and effectiveness of traffic enforcement and trauma care in the area, accident prone locations, deficiencies in road geometrics, road furniture and other bottleneck points were also studied. Spatial analysis of all the data collected in GIS platform was carried out.

Accident Scenario in the Project Area

As per the police records 1,159 accident cases happened during the last three years under the 80 km long study stretch, in which 229 persons died, 954 grievously injured and 384 persons got minor injuries. 21 % of these accidents occurred at junctions.

The trend of road accidents in the project area is given in **Figure 19**. The percentage shares of various age groups of accused drivers are shown in **Figure 20**. Majority of the accused drivers belong to the age group of 18-30 and 31-44.

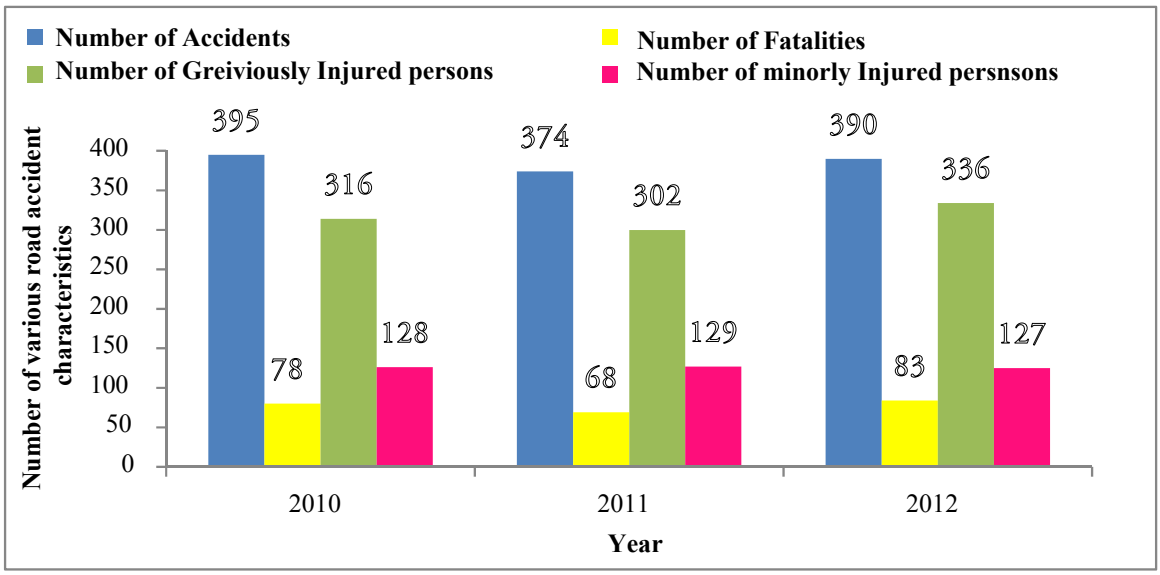

Figure 19
Trend of Road Accidents in the Project Area

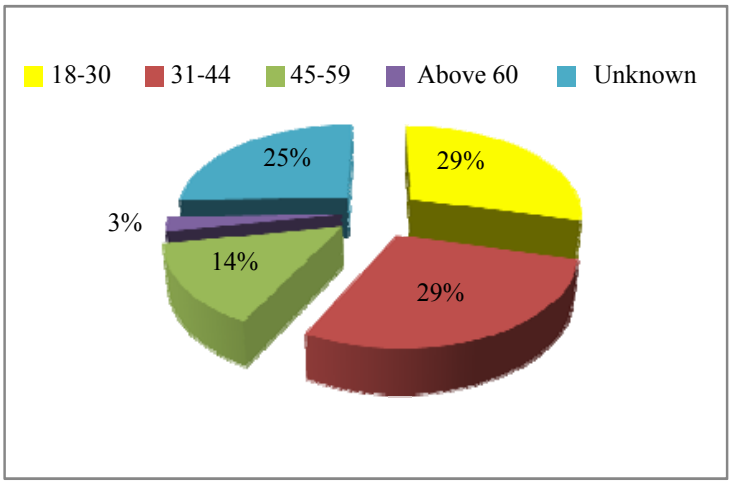

Figure 20
Distribution of Accused Drivers according to age group

Out of 917 accidents reported in eight police stations, 875 accidents were reported as the fault of drivers. Accidents due to other causes are negligibly small in number.

Study on the share of different type of road users involved in accidents showed that out of 1,208 road users involved in accidents, 37 % were passengers, 33 % were pedestrians and 30 % were drivers. Study revealed that 641 two wheelers and 578 four wheelers were involved in road accidents in the project area during 2010-12. It was found that light motor vehicles consisting of four wheelers & three wheelers were involved in 44% of accidents followed by two wheelers with 39%.

The accident data showed that the accidents spots were evenly distributed along the project road. The above spots are vulnerable and hazardous with respect to road engineering. This is further aggravated by over speeding of vehicles, negligent driving, wrong overtaking and lack of vision during night.

Accident prone areas in the project road were identified and is suggested that at least two trauma care centers should be setup up in the vicinity of these accident prone areas.

The improvements done were critically examined against various stipulations contained in Indian Safety Guidelines/ Manuals which are available at present. The major problems which were identified and addressed include multiple access points, lack of night-time visibility, inadequacy of signs, defects in signal phasing, location and arrangement, non provision of transition curve, vulnerable road user facilities and sight distance. Chainage specific road safety deficiencies have been addressed along with description of the potential hazardous situation and counter measures and the same were presented in GIS platform.

The study helped in providing a detailed presentation of all base line data such as traffic accidents, characteristics, enforcement, trauma care facilities, road safety audit etc. of the entire study corridor from Vetturoad to Adoor (80 kms) for developing the project road to a safe corridor and the entire baseline data collected for the study were presented in GIS platform for future references and implementation.

33. Characteristics of Hazardous Material Transportation within Kerala

Hazardous materials from industrial centers are transported to various regions of the country. Transportation of hazardous materials by road constitutes the weakest link in the supply chain. Accidents involving hazardous materials carriers are reported frequently. NATPAC aimed to study the mechanics of the operation of hazardous material carriers across the state.

The field studies were conducted at Amaravila in Thiruvanthapuram District,Walayar in Palakkad District, Manjeswaram in Kasargod District and Irumbanam in Ernakulum District.

On the basis of field studies NATPAC suggested the following measures for mitigating the negative consequences of hazardous material transportation by road:

- To divert a portion of the hazardous materials by waterways since water transport has a better record of safety. Even in the event of an accident which is very unlikely, the loss will be of a very low magnitude, as its operation is far away from human interaction. Hazardous substances belonging to Class 4.3 category i.e. which emit flammable gas when wet or react violently with water, for example Sodium, Calcium, Potassium etc. could be excluded from transportation through waterways.

- The basic precautions begin at the loading point, wherein the fitness of the vehicle is evaluated. License of the driver should be checked.
- Safety Audit of Hazardous Material Carriers has to be taken up periodically.
- The Chemical Emergency Response Centre (CHEMREC) at Kakkanad was established in 2010 for rescue of victims transporting hazardous materials. This centre lacks equipments and manpower and the same needs to be provided.
- Currently the TREMCARD is available in English and Malayalam. Since the truck tanker passes through several states, steps are to be taken to have them printed in 6 languages.
- Drivers/crew which transports hazardous materials should have in their possession a medical fitness certificate in order to ensure that he is physically fit to drive and also to take up the responsibility of emergency action when faced with an emergency.

- Qualitative shift of the system of transportation of hazardous materials is required. A new strain of professionals should take over the management of transportation. This will lead to efficiency of the system of transportation. In due course the minimum qualification for issuing driving license for transporting hazardous chemicals should be fixed as 10^{th} pass.
- The geometrics and the functional characteristics of the road through which the trucks/ tanker passes need to be kept in good condition.
- Special training to drivers carrying hazardous goods should be mandatory and the syllabus should be strictly followed as per Motor Vehicles Act.

EXTENSION SERVICES

1. Seminar on Road Safety Vision – Kerala

NATPAC organised a one day seminar on 'Road Safety Vision-Kerala' on 1st January 2014 at Thiruvananthapuram. The aim of the Seminar was to address all issues relating to road safety and to prepare the State Road Safety Vision document which envisages sustainable road safety policies. The Seminar was inaugurated by Shri.Oommen Chandy, Hon'ble Chief Minister of Kerala on 1st January 2014 at Government Guest House, Thiruvananthapuram.

The Seminar was attended by Shri.Aryadan Mohammed, Hon'ble Minister for Power; Shri.V.K.Ibrahim Kunju, Hon'ble Minister for Public Works; Shri.K.Muraleedharan, MLA; Decision-makers, Transportation Planners, Experts in logistics and transport sector, service providers and senior Government Officials.

The Hon'ble Chief Minister launched 'Safe Savari', an e-portal on road safety training for students which is an initiative of NATPAC and also released the 'Road Safety Vision Document'. The e-portal 'www.safesavari.com' aimed at creating awareness on road safety among school children, developing skills to combat accident risk and to help them grow as safe road users. The Hon'ble Chief Minister also declared Kerala as the first state in the country to claim the status of 'Zero Unmanned Level Crossings'.

Plate 15
Dr.B.G.Sreedevi, Director, NATPAC welcoming the participants at the inaugural session of 'Seminar on Road Safety Vision-Kerala'

Plate 16
Launching of e-portal by Hon'ble Chief Minister,GoK

Plate 17
Release of 'Road Safety Vision Document' by Hon'ble Chief Minister, Govt. of Kerala received by Shri.Aryadan Muhammed, Hon'ble Minister for Power, GoK in the presence of Shri.Muraleedharan MLA

Plate 18
Shri.Aryadan Muhammed, Hon'ble Minister for Power addressing the participants

In the technical sessions presentations in the areas of Road Safety and Level Crossing Safety were made. The discussions were moderated by Shri.N.T.Nair; Former Chairman, Institution of Engineers, Kerala State Centre and Chief Editor, Executive Knowledge Line and Shri.T.Elangovan; Scientist-G, NATPAC. Nearly 60 participants representing the Departments of PWD, KSRTC, C-DAC, Kerala State Planning board, Thiruvananthapuram Railway Division etc., participated.

Technical Presentations made during the Seminar

Sl.No.	Name	Designation	Topic
1	Dr.B.G.Sreedevi	Director, NATPAC	Road Accident Scenario in Kerala
2	Dr.M.V.L.R.Anjaneyulu	Professor, NIT, Calicut	Road Safety Research
3	Shri.P.K.Satheesan	Chief Engineer, Kerala PWD	Towards Safer Roads
4	Shri.K.G.Mohanlal IFS	CMD, KSRTC	Safety of Public Transport
5	Smt.T.M.Sudha	Chief Town Planner, (i/c)	Urban Planning for Better Safety
6	Shri.P.Ravikumar	Joint Director, ITND, C-DAC, Thiruvananthapuram	Role of Intelligent Transport System on Road Safety
7	Shri.T.Elangovan	Scientist-G, NATPAC	Pedestrian Safety
8	Shri.N.R.Joy	Chief, Industry & Infrastructure Division, Kerala State Planning Board	Infrastructure Development and Road Safety
9	Shri.Selvaraj	Railway Safety Officer, Southern Railway	Level Crossing Safety
10	Dr.Santhosh Kumar	Associate Professor, (Ortho), Medical College Hospital, Tvpm	Accidents and Trauma Care
11	Shri.George C Paul	Representative of NGO	Role of NGO's

2. Road Safety Week – 2014

NATPAC observed 'Road Safety Week – 2014' by organizing a series of activities from January 11-17, 2014. The theme of this year's Road Safety Week was "When on the road, always say *Pehle Aap"*. The programme was sponsored by Kerala Road Safety Authority. Activities during the road safety week included:

- Road Safety exhibition, road shows and training programmes for general public from 11th January 2014 to 17th January 2014 at different locations of Thiruvananthapuram district.
- Display of 18 Road Safety Slogans through banners around 150 major junctions in 5 districts of Kerala (Thiruvananthapuram, Kollam, Alappuzha, Kottayam and Ernakulam).
- "Road Safety Awareness Programme for School Children", at Mannam Memorial Residential Higher Secondary School, Thiruvananthapuram on 13th January 2014.

Plate 19
Class on 'Road Safety' at MMRHS

Plate 20
View of the participants

- "Road Safety Training Programme for Auto Taxi Drivers" as part of Janamithri Safe Community, at Priyadharshini Hall, Thiruvananthapuram in association with Fort Police Station on 13th January 2014.
- "Training on Road Safety for Rotary Club Members" at Kazhakuttam in association with Rotary Club, Thiruvananthapuram on 13th January 2014.
- Half day panel discussion on "Role of Residents' Associations in Road Safety" for Federation of Residents' Association Thiruvananthapuram (FRAT) Members, at Sasthra Bhavan, Pattom, Thiruvananthapuram, on 14th January 2014. The programme inaugurated by Smt. B.G.Sreedevi, Director, NATPAC. Dr.G.Ravikumar, Scientist –F, NATPAC presented the Road Safety Activities of NATPAC. About 20 members from different residents associations under FRAT actively participated and explained the practical problems faced by each residence association in the city areas.

Plate 21
Discussion with Residents' Association Members

Plate 22
Panel Discussion in progress

- " One day Training Programme for Driving School Instructors", at KPS Menon Hall, Kottayam on 15th January 2014.Shri.M.P.Dinesh IPS, Police Chief, Kottayam inaugurated the training programme. More than 250 driving school instructors underwent the training. Certificates were distributed to the participants by Shri.Thiruvanchoor Radhakrishnan, Hon'ble Minister for Transport and Forest, Govt. of Kerala at the valedictory function.

Plate 23
Shri.Thiruvanchoor Radhakrishnan, Hon'ble Minister for Transport and Forest, Govt. of Kerala, distributing the certificates to the participants

- Conducted State/District level Painting, Quiz and Elocution Competitions for school and college students at Sasthra Bhavan, Thiruvananthapuram on 16th January 2014. More than 150 students participated in the programme.

Plate 24
Painting Competition

Plate 25
Elocution Competition

Plate 26
Distribution of prizes by Dr.B.G.Sreedevi, Director, NATPAC

- "Road Safety Training Programme for School Children and Parents", at NSS Higher Secondary School, Palkulangara in connection with the Valedictory function, on 17th January 2014. Shri.P.K.Venugopal, Chairman, Trivandrum Development Authority (TRIDA) was the chief guest.

Plate 27
Introductory Speech by Dr.B.G.Sreedevi, Director, NATPAC

Plate 28
Presidential Address by Shri.Padmakumar, Councillor, Perunthanni,Thiruvananthapuram

Road shows were conducted from 11th to 17th January 2014 at different parts of Thiruvananthapuram District along with road safety exhibition and distribution of road safety materials for general public.

NATPAC Regional Office, Kozhikode organised the following programmes as part of Road Safety Week - 2014

i. Inauguration of Road Safety Activities in Thrissur District with the support of Accident Care and Transport Service (ACTS) Force on 11th January 2014.

ii. One day "Road Safety Training Programme for Private Bus drivers and School Bus drivers", at Architect & Engineers Association Hall, Thrissur on 12th January 2014.

iii. One day "Road Safety Training Programme for School Children and Teachers" and inauguration of NATPAC Traffic Club for students of Class VI & VII of 60 schools, at Kozhikkode, on 15th January 2014. More than 350 students participated in the programme.

Plate 29(a)

Plate 29(b)

View of participants at the Road Safety Training Programme for school children and Teachers, Kozhikode

iv. Poster exhibition and distribution of Road Safety education materials to schools and general public in Kozhikkode, Wayanad, Kasargod, Malappuram, Ernakulam and Thrissur Districts.

v. Road Safety Awareness Programme for Students at Thrissur on 16th January 2014.

- Good Shepherd Central School, Kunnamkulam
- TMVHS School, Perumpilavu, Kunnamkulam

Plate 30
Class on 'Road User Behaviour', at TMVHS School

Plate 31
Demonstration class by NATPAC Officials at TMVHS School

vi. "Road Safety Youth Leadership Programme" (RSYLP), at Mar Dionysius Arts and Science College, Pazhanji, Thrissur on 17th January 2014.

18 different types of Road Safety Slogans were displayed at 350 major locations in Kerala.

Plate 32(a)

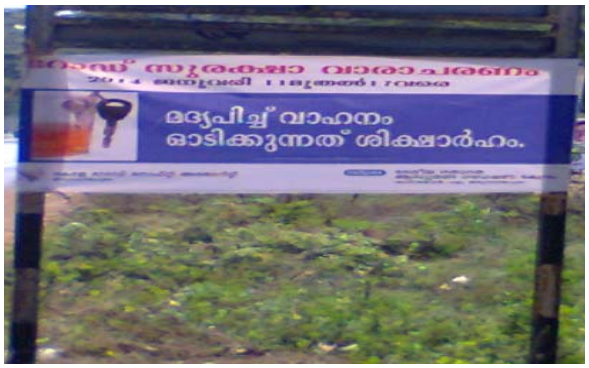

Plate 32(b)

Display of Road Safety Slogans

3. *Road Safety Education through Schools in Kerala*

NATPAC in association with Kerala Road Safety Authority launched a new programme - 'Road Safety Education through Schools in Kerala' which can be effectively utilized in reducing the accident rate among children and also in saving the life of other road users by introducing various road safety activities through school children. School teachers in the state will be trained for two days on the different facets of road safety modules. The programme is mainly aimed to have at least one teacher from each school in the State trained on Road Safety to become Master Trainer and in turn conduct Road Safety Awareness Programmes to the entire students and teachers in that school on a regular basis.

The State level launching of the programme was done by Shri.Abdu Rabb, Hon'ble Minister for Education, Govt. of Kerala at Loyola College, Thiruvananthapuram on 25th February 2014. The inaugural session was attended by Shri.Biju Prabhakar IAS, District Collector, Thiruvananthapuram; Shri.Alex Paul, Joint Transport Commissioner and Shri.Jacob Punnoose IPS, former DGP, Kerala and Chairman, National Games Committee.

Plate 33
Lighting the lamp during the inauguration of 'Road Safety Education through Schools in Kerala

Plate 34
Inaugural Address by Shri. P.K.Abdu Rabb, Hon'ble Minister for Education

Plate 35
Class by Dr.B.G.Sreedevi, Director NATPAC

Plate 36
Class by Dr. G. Ravi Kumar, Scientist F NATPAC

Plate 37
Felicitation by Shri.Biju Prabhakar, IAS, District Collector, Thiruvananthapuram

Plate 38
A view of the participants

On the whole 106 teachers from different schools in Thiruvananthapuram District participated in the training programme

The following districts were covered under this project during this year:

⇒ Kollam District - 24^{th} – 25^{th} March 2014

⇒ Alappuzha District - 27^{th} - 28^{th} March 2014

4. Safe Community Programme for Panchayats

To encourage local communities like Panchayats to initiate and proactively seek ways to reduce accident risk and increase road safety, NATPAC in association with Kerala Road Safety Authority organised 'Safe Community Programme for Panchayats'. NATPAC prioritized rural settlements at Panchayat level which have high exposure to traffic and accident risk. Panchayats which have high exposure to accident risk were selected and organised road safety initiatives. Panchayat Presidents, Secretaries and Circle Inspectors of Police participated. The programme is aimed at forming a Panchayat level Safety Cell.

The following Panchayats were covered during this year:

1. Kottarakkara, Pandalam, Aroor, Erattupetta, Koratti, Puthuserry, Angadipuram, Olavanna, Pallikkunnu and Kumbala Panchayats, at Sasthrabhavan, Pattom, Thiruvananthapuram (NATPAC Office) on 10^{th} October 2013. Dr.B.G.Sreedevi, Director, NATPAC delivered the welcome address. Ms.Mithra.T IAS, Director of Panchayats, GOK; Shri.Jacob Punnoose IPS,Former DGP and Shri.Sayed, Jt. Director of Panchayats graced the occasion.

Plate 39
Shri.Jacob Punnoose IPS, Former DGP, addressing the participants

Plate 40
View of the participants

2. Pandalam grama panchayat (Pathanamthitta District) on 20th January 2014, at Pandalam Panchayat Conference Hall.

Plate 41
Class on 'Safe Community Programme- formation and operation'

Plate 42
Class on 'Road engineering and Road Safety'

3. Puthusseri grama panchayat (Palakkad District) on 21st January 2014, at Puthusseri Panchayat Hall, Kanjikode.

4. Koratti grama panchayat (Thrissur District) on 24th January 2014, at Vyapara bhavan, Koratti.

5. Kumbala grama panchayat (Kasargod District) on 28th January 2014, at Panchayat Hall, Kumbala.

6. Pallikkunnu grama panchayat (Kannur District) on 30th January 2014, at Panchayat Hall, Kannur.

7. Olavanna grama panchayat (Kozhikode District) on 1st February 2014, at Panchayat Community Hall, Olavanna.

8. Aroor grama panchayat (Aleppey District) on 14th February 2014, at Panchayat Community Hall, Aroor.

9. Nallanad grama panchayat ,Venjaramoodu (Thiruvananthapuram District) on 7th March 2014, at Panchayat Conference Hall.
10. Erattupetta grama panchayat (Kottayam District) on 18th March 2014, at Vyapara Bhavan Auditorium, Erattupetta.

5. Road Safety Training Programme for Ambulance Drivers

NATPAC in association with Kerala Motor Vehicles Department organised 'Road Safety Training Programme for Emergency Drivers' at different parts of the State. Ambulance drivers and fire service drivers were trained on various aspects of road safety.

Selected faculties and experts of NATPAC took classes on various aspects of road safety. The training module includes:

i. Safe Driving Techniques and Road Signs
ii. Road Engineering and Safety
iii. Traffic rules, requirement and need of vehicle fitness for emergency services
iv. Defensive Driving Techniques

The training programme on 7th October 2013 conducted at Sastrabhavan, Pattom, Thiruvananthapuram (NATPAC office) was inaugurated by Shri.T.P.Senkumar IPS, ADGP, Intelligence, Government of Kerala followed by Special Address by Shri.Said Mohammed, Joint Transport Commissioner.

Plate 43
Dr.B.G.Sreedevi,Director,NATPAC welcoming the participants

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Plate 44
Inaugural Address by Shri.T.P.Senkumar IPS, ADGP, Intelligence, GOK

The second training programme for emergency drivers was conducted at K Karunakaran Transpark, Aakkulam on 13th November 2013.

6. *Road Safety Training Programme for Driving School Instructors*

NATPAC organised training programme for driving school instructors by considering the fact that driving instructors play a pivotal role in tutoring students. The programme was formally inaugurated by Shri.Rishiraj Singh IPS, Transport Commissioner, Govt. of Kerala on 11th December 2013 at Sasthrabhavan, Pattom.

The following topics were discussed in the training programme:

i. Traffic control devices and code of conduct on roads
ii. Basics of defensive driving and factors affecting driver behavior
iii. Vehicle-Understanding basics inside & outside
iv. Requirement of a driving school and driving license
v. Handling of Emergency Incidents - Vehicle/Human

Plate 45
Shri.Rishiraj Singh IPS, Transport Commissioner, GoK inaugurating road safety training programme for driving school instructors

Plate 46
Class on 'Defensive Driving'

Second programme was conducted at AKSSIA Auditorium, Kollam on 12th March 2014.

7. *Road Safety Youth Leadership Programme*

Recognizing the role of youth in road safety, NATPAC launched a State-wide Programme to train Young Volunteers in Road Safety and related aspects. The Centre in association with Kerala Road Safety Authority organised one day 'Road Safety Youth Leadership Programme' at Sasthrabhavan,

Pattom, Thiruvananthapuram on 28th October 2013. Dr.B.G.Sreedevi, Director, NATPAC welcomed the participants. The programme was inaugurated by Shri.C.P.John, Member, Kerala State Planning Board. Shri.Rishi Raj Singh IPS, Transport Commissioner, GOK graced the occasion as Chief Guest and delivered the Key Note Address. Shri.M.Sadacharavel, Zonal Director (i/c), Nehru Yuva Kendra Sangathan extended felicitation.

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

Plate 48
Inaugural Address by Shri.C.P.John, Member, Kerala State Planning Board

Seven programmes on Road Safety Youth Leadership were completed this year.

i. Naipunnya Institute of Management & Information Technology, Koratti, (Thrissur District) - 22.01.2014

ii. Government Poly Technic Koratti, (Thrissur District) - 22.01.2014

iii. Kumbla Academy College, (Kasrgod District) - 27.01.2014

iv. Govt.Vocational Higher Secondary school, Chandiroor (Alappuzha District) - 13.02.2014

v. Sree Chitra Thirunal (SCT) College of Engineering, Pappanamcode (Thiruvananthapuram District) - 04.03.2014

vi. Jayasree Arts and Sports Club, Thottumukku, Nedumangadu (Thiruvananthapuram District) (in association with Visual Charitable Society) - 27.03.2014

8. Safe Road to School

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

1. Government Higher Secondary School, Venjaramoodu - 21.05.2013

2. Boss & Rajeev Parallel College, Kilimanoor - 31.05.2013

3. Kottarakkara - 05.06.2013

4. Puthoor - 18.06.2013

5. Adoor - 19.06.2013

6. Chadayamangalam - 21.06.2013

7. St.Mary's Higher Secondary School, Pattom - 22.07.2013

8. Government Girl's Higher Secondary School, Pattom - 24.07.2013

9. Govt. Medical College Higher Secondary School - 26.07.2013

10. Kendriya Vidyalaya, Aakkulam - 27.11.2013
(In association with Lion's Club, Thiruvananthapuram)

11. Aiswarya public school,
Kalacode, Poothenkulam (Kollam District) - 02.01.2014

Plate 49 (a) ***Plate 49 (b)***

Class on 'Road Safety'

12. NSS Boys high school, Pandalam
(Pathanamthitta District) - 10.01.2014

Plate 50(a) ***Plate 50(b)***

Demonstration Class for Students

13. Govt.Vocational Higher Secondary School, Puthusseri (Palakkad District) - 20.01.2014

14. Assissi Vocational Higher Secondary School, Kanjikode (Palakkad District) - 20.01.2014

15. Mar Augustine Memorial (MAM) High School, Koratti (Thrissur District) - 23.01.2014

16. Govt.High School, Sreekariyam, (Thiruvananthapuram District) - 23.01.2014

17. Govt. Higher Secondary School, Mangalpady, (Kasargode District) - 27.01.2014

18. Govt.VHSS, Mogral, (Kasargode District) - 29.01.2014

19. Govt.Vocational Higher Secondary School, Pallikkunnu, (Kannur District) - 31.01.2014

20. Sivagiri Higher Secondary School, Varkala, (Thiruvananthapuram District) - 31.01.2014

21. Govt.Vocational Higher Secondary school, Chandiroor (Alappuzha District) - 13.02.2014

22. Nadakkavu Vocational Girls HSS,(Kozhikode District) - 28.02.2014

23. Govt.UP school, Venjaramoodu (Thiruvananthapuram District) - 06.03.2014

24. Erattpeta Government School (Kottayam District) - 18.03.2014

25. Muslim Girls Higher Secondary School, Erattupetta (Kottayam District) - 19.03.2014

9. Training

a) In-house Training

i. Software Training on 'Vissim, Visum and Viswalk' for Scientists by Sunovatech India, Delhi on 24th May, 27th – 28th May 2013.

ii. Technical Presentation on "'Characterisation of Indian Road Traffic', by Dr.V.Thamizh Arasan, Retaired Professor, Transportation Engineering Division, Dept. of Civil Eng., IIT, Chennai on 24th January 2014.

iii. Hands-on training on VISSIM Software for Scientists on 4th February 2014.

b) Road Safety Training for various target groups

NATPAC organised and conducted the following training programmes during the year.

i. 'School Bus drivers Training Programme on Road Safety' at Ulloor, Thiruvananthapuram on 29th May 2013.

ii. 'School Bus drivers and cleaners Training Programme on Road Safety' at Thiruvananthapuram on 26th September 2013.

iii. 'Road Safety Education Programme' at St.Theresa's Convent, Shornur on 30th September 2013.

iv. 'Training on Road Safety' organised by Women's Association at Kowdiar, Thiruvananthapuram on 14th November 2013.

v. 'Training on Road Safety' for auto taxi drivers in association with Karamana Police, 26th January 2014.

vi. 'Road Safety and Traffic Management' at Kerala Police Academy, Thrissur on 13th February 2014.

vii. Training on Road Safety for the employees of Hindustan Latex, Peroorkada on 22nd February 2014.

10. Exhibitions

i. Road Safety Exhibition in connection with 'Scientists Interface Meet' organised by KSCSTE at Hotel Samudra (KTDC), Thiruvananthapuram, 5th – 8th September.

ii. Road Safety Exhibition and audio-visual programmes in the auto expo 'Auto Psych 2K13' organised by Department of Mechanical Engineering, College of Engineering, Perumon, 11th _ 13th October 2013.

iii. Road Safety Exhibition and audio-visual programmes in the exhibition conducted by New Jyothi Central School, Vattavila, Thiruvananthapuram, 22nd – 23rd November 2013.

iv. Road Safety Exhibition and audio-visual programmes in the exhibition conducted by Sree Narayana Central School, Kollam, 30th November 2013.

v. Road Safety Exhibition and audio-visual programmes in connection with 26th Kerala Science Congress at Kerala Veterinary and Animal Sciences University Campus, Pookode, Wayanad, 28th – 31st January 2014.

vi. Road Safety Exhibition and audio-visual programmes in the exhibition conducted at Sree Chitra Thirunal College of Engineering, Thiruvananthapuram, 15th February 2014.

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

Name of Programme	Organised by	Date	Venue	Participants
Workshops				
National Workshop on Sustainable Concrete Pavements – Practice, Challenges and Directions	The Indian Concrete Institute (ICI), Kochi Centre, Central Road Research Institute (CRRI) in association with Cement Manufactures Association (CMA) and Ready Mix Concrete Manufacturers Association (RMCMA)	01.06.2013	Hotel Dreams, Kochi	B.G.Sreedevi
Workshop on Translational Science and Engineering	Govt. Engineering College, Barton Hill	11.07.2013 & 26.07.2013		V S Sanjay Kumar
Workshop on Warm Mix Asphalt	Civil Engineering Department, IIT, Madras	08.08.2013-09.08.2013		V S Sanjay Kumar
National Workshop on Modern Techniques in Geotechnical and Construction Engineering	Cochin University of Science and Technology (CUSAT)	27.09.2013		S Shaheem
Workshop on Modern Bituminous Mix Technologies	Centre for Transportation Research, Civil Engineering Dept., NIT, Calicut	26.10.2013		S Shaheem V S Sanjay Kumar
Three day workshop on 'Innovations in Urban Transport Infrastructure'	Transportation Engineering Research Centre (TERC)	22.01.2014–24.01.2014	College of Engineering, Tvpm	Shaheem S P.Kalaiarasan

Seminars/Conferences				
'Service Tax'	Cosmopolitan Association of Professionals	08.05.2013		D.Shaju
Mapping as a tool for environmental management and planning	Centre for Earth Science Studies (CESS)	24.06.2013	CESS	P.Kalaiarasan
National Seminar on 'New Information Technology Interfaces in Libraries and Information Centres' (NITILIC)	Kerala Library Association	12.07.2013-13.07.2013	Kerala State Science & Technology Museum, Thiruvananthapuram	Veena K S
TRIMA-2013	Thiruvananthapuram Management Association	22.07.2013-23.07.2013	Mascot Hotel, Thiruvananthapuram	Sanjai R J
Council Meeting of Indian Roads Congress and Highway Research Board		11.08.2013-13.08.2013	New Delhi	T.Elangovan
Value Added Tax		21.08.2013	Thiruvananthapuram	Muhammed Naserudeen, Arya S K Maya Devi M
Scientists Interface Meeting	KSCSTE	05.09.2013-08.09.2013	Hotel Samudra (KTDC), Thiruvananthapuram	Director and Scientists
Role of Educational Institutions in Fostering Energy Efficiency	Energy Management Centre, Dept. of Power, GOK	04.09.2013	Govt. Guest House, Thycaud, Thiruvananthapuram	Veena K S Shyama C
9th Kerala Environment Congress	Centre for Environment and Development	08.10.2013 – 10.10.2013	Co-Bank Towers, Thiruvananthapuram	P.Kalaiarasan
Infrastructure Development of Thiruvananthapuram – Problems and Possibilities	Capital Development Council	15.11.2013	Press Club, Thiruvananthapuram	B G Sreedevi
12th C V Raman Memorial Inter School Science Exhibition – 2013		30.11.2013	Sree Narayana Central School, Kollam	B G Sreedevi
'Spatial Technologies for Watershed Planning'		08.01.2014– 10.01.2014	Trivandrum	P.Kalaiarasan
Highway Research Board Meeting	Indian Roads Congress	19.01.2014	Guwahati	T.Elangovan
Training Programmes				
Web Application Security	Kerala IT Mission	10.04.2013-12.04.2013	IIITMK, Technopark, Thiruvananthapuram	D.Sunder
Training on Trainers (ToT) Programme	Institute of Urban Transport (India), Ministry of Urban Transport	16.04.2013-18.04.2013	Delhi	P.Kalaiarasan (Awarded as 'Trainer' in the module of 'Environmental Issues')

12. *Guidance to Students' Project Work and Thesis*

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

Name of the Institution	Course	No.of Students	Topic
Director's Office			
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech	1	Development of Pavement Roughness Model an Maintenance Priority index for State Highway 1
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech	1	Evaluation of Elastic Properties of Bitumen with Modifiers
Sarabhai Institute of Technology, Vellanadu, Thiruvananthapuram	B.Tech (Civil)	5	Development of Thiruvallam Junction
Cochin University of Science & Technology, Cochin	B.Tech (Civil)	5	Strategic option studies for decongesting the NH 47 – Case study of Aroor – Edapally stretch of NH-bye-pass in Cochin
Traffic and Transportation Division			
National Institute of Technology, Surathkal, Karnataka	M.Tech (Tptn.)	1	Public Transport Demand Modeling for Thiruvananthapuram City
National Institute of Technology, Surathkal, Karnataka	M.Tech (Tptn.)	1	Estimation of passenger ridership for the proposed PRT system in Thiruvananthapuram City
National Institute of Technology, Surathkal, Karnataka	M.Tech (Tptn.)	1	Planning of Inter-modal transit terminal – a case study of Kalamassery town in Cochin
National Institute of Technology, Surathkal, Karnataka	M.Tech (Tptn.)	1	Application of congestion pricing as a tool for reducing traffic congestion in cities – a case study
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Tptn.)	1	Impact of speed restriction measures on road safety and level of service
College of Engineering, Thiruvananthapuram	M.Planning	1	Application of transit oriented development along Monorail corridors in Thiruvananthapuram city
Cochin University of Science & Technology, Cochin	B.Tech (Civil)	6	Comprehensive Mobility Plan for Kalamassery town in Cochin Region
Mar Ivanious College of Engineering, Thiruvananthapuram	B.Tech (Civil)	6	Improving pedestrian safety at Medical College Junction in Thiruvananthapuram City
Marian College of Engineering, Thiruvananthapuram	B.Tech (Civil)	6	Traffic forecasting and planning for the proposed international stadium at Kariyavattom, Thiruvananthapuram
CEPT University, Ahmedabad Gujarat	M.U.R.P (Urban&Regional Planning)	1	Accessibility – Transport – Income link: Case of Kerala
College of Engineering, Thiruvananthapuram	M.Tech (Tptn.)	4	Pedestrian safety: Improvement of critical locations in Thiruvananthapuram city
National Institute of Technology, Trichy	ME (Tptn.)	4	Effect of vehicular emission on the health of road users who are constantly exposed to traffic
Indian Institute of Technology Kharagpur	MCP (City Planning)	3	Pedestrian friendly urban transport system for CBD areas of Kochi

School of Planning & Architecture, New Delhi	M.T.P (Trpt. Planning)	1	Assessment of toll collection potentials Padanakkad on NH-17 in Kasargode Dist.
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Tptn.)	2	Impact of surveillance cameras installed in Thiruvananthapuram City
SCT College of Engineering, Pappanamcode,	B.Tech (Mech.)	1	Routing of 108 ambulance services Thiruvananthapuram city region
CochThiruvananthapuramin University of Science & Technology, Cochin	B.Tech (Civil)	6	Pedestrian friendly transport system for Thrissur Corporation area
Cochin University of Science & Technology, Cochin	B.Tech (Civil)	5	Effect of vehicular emission on the health of Police men and other road users in Ernakulam
Sarabhai Institute of Technology, Vellanadu, Thiruvananthapuram	B.Tech (Civil)	5	Traffic Management Plan for Nedumangad Town
National Institute of Technology, Trichirapally	M.Tech (T&T)	1	Pedestrian Safety – Identification of critical locations and improvement – a case study of Thiruvananthapuram City
College of Engineering, Thiruvananthapuram	M.Plan (Housing)	1	Mobility Planning for Streamlining Pedestrian flow in Urban area – a Case Study
College of Engineering, Thiruvananthapuram	M.Tech (T&T)	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
Infant Jesus College of Engg. & Technology, Tirunelveli	B.Tech (Civil)	4	Planning of Skywalk facility between Thampanoor & East Fort in Trivandrum City
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	Congestion Charging in CBD areas – A case study
Regional Transportation Division			
Rajiv Gandhi Institute of Technology, Kottayam	M.Tech (Tptn.)	1	Evaluation and treatment of Accident Black Spots using Geographic Information System
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 SLEUTH Model for major cities in Kerala
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

Rajiv Gandhi Institute of Technology, Kottayam	M.Tech	1	Transportation Modelling for an Urban Area - Scenario Analysis with the Proposed Mass Rapid Transit System : A Case Study of Thiruvananthapuram City
Rajiv Gandhi Institute of Technology,	M.Tech	1	Measurement of Variations in Accessibility to Public Transport Opportunities
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, 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
Highway Engineering Division			
Cochin University of Science and Technology	B.Tech (Civil)	5	Planning and design of outer ring road in Pala Town
St.Joseph College, Pala	B.Tech (Civil)	6	Traffic improvement plan for Pala Region
Yunis College, Kollam	B.Tech (Civil)	4	Design of alternatives for new fly over intersection near SN College, Kollam
College of Engineering, Thiruvananthapuram	B.Tech (Civil)	4	Feasibility study of Monorail system between Kottayam and Ettumanor in MC road
National Institute of Technology, Nagpur	M.Tech (Tptn.)	4	Detailed design and estimation of proposed outer ring road for Pala region
College of Engineering, Thiruvananthapuram	M.Plan	1	Feasibility study of Monorail system Thiruvananthapuram
St.Joseph College, Pala	B.Tech (Civil)	4	Preparation of TOP for Kochi Metro alignment
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
NSS College of Engineering,	B.Tech (Civil)	4	Preparation of Fibre reinforcement bituminous mixes
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

13. *Presentation of papers in Seminars/Workshops*

B G Sreedevi, *"Inland Waterway Development for Kerala".* Planning Board, 25th May 2015.

B G Sreedevi, *"Road Infrastructure Development for Kerala".* Technical Member of the Expert Committee on 'Infrastructure Development' at Planning Board, Thiruvananthapuram, 28th May 2013.

B G Sreedevi, "*Draft Annual Energy Savings Plan for Municipal and Industrial Sector for the State of Kerala".* Organised by Energy Management Centre at Mascot Hotel, Thiruvananthapuram, 27th June 2013.

B G Sreedevi, "*Infrastructure for Children Safety in Public Place".* State Level Consultation on Child Rights, organised by Kerala State Commission for Protection of Child Rights, Thiruvananthapuram at Institute of Management in Government, Thiruvananthapuram, 31st August 2013.

B G Sreedevi, *"Role of Women in Society and how can be an effective manager".* Women Industry Awareness Programme at Vallikkavu, Karunagappally, 10th September 2013.

B.G.Sreedevi, *" Role of Women in Society".* Conference on 'Women Empowerment and Education' at Rajdhani Institute of Engineering & Technology, Nagroor, 7th March 2014.

T Elangovan, *"Augmentation of Road Infrastructures".* Kerala Development Meet – 2013, organised by Kerala Sasthra Sahithya Parishath (KSSP), Thiruvananthapuram, 29th April – 1st May 2013

T Elangovan, *"Traffic Planning for Small and Medium size towns"* and *"Towards Safer Roads - Role of Civil Engineers".* Take off Programme of B.Tech (Civil) Students at Pankaja Kasthuri College of Engineering and Technology, 30th May 2013.

T Elangovan, *"Pedestrian Friendly Urban Transport for Cochin City".* Technical Seminar, organised by Institute of Town Planners (India), Kerala Regional Chapter and GCDA, Cochin, 9th October 2013

T.Elangovan, *"Road Safety – Role of Engineers".* National Conference on Recent Advances and Trends in Engineering – 2014 at Pankaja Kasturi College of Engineering & Technology, Thiruvananthapuram, 16th January 2014

T.Elangovan, *"Prioritising Non-motorised Transport for Urban Mobility".* National Seminar on Innovations in Urban Transport Infrastructures at College of Engineering, Thiruvananthapuram, 24th January 2014.

T.Elangovan, *"Personal Rapid Transit System for Thiruvananthapuram City".* 3 days Seminar organised by Transportation Engineering Research Centre, College of Engineering, Thiruvananthapuram, 24th January 2014.

T.Elangovan, "*Trend of Motor Vehicle Accidents and related casualties in the roads of Kerala*". National Conference on Advances in Actuarial Science, organised by Dept. of Demography,University of Kerala, 4th February 2014.

T.Elangovan, "*Road Engineering and Vehicle Safety*". National Seminar on Vehicle and Road Safety, organised by Sree Chitra Thirunal College of Engineering, Thiruvananthapuram, 21st March 2014.

Shaheem S, *"Performance evaluation of coir geo-textiles as earth reinforcement in soil structures".* RASE 2013 at CUSAT, 13th - 15th December 2013.

Sanjay Kumar V S, *"Trip Generation Model for the Core Area of Thiruvananthapuram City".* International Conference on Energy and Environment (ICEE 2013), organised by RIT, Kottayam.

Sanjay Kumar V S, *"Accessibility Analysis to Public Transport – a Case Study of Thiruvananthapuram City".* International Conference on Energy and Environment (ICEE 2013), organised by RIT, Kottayam.

Sanjay Kumar V S, *"Development of Multinomial Logit Mode Choice Model and Scenario Analysis of the Proposed Monorail System for Thiruvananthapuram City".* Proceedings of the 26th Kerala Science Congress, organised by KSCSTE at Kerala Veterinary and Animal Sciences University Campus, Pookode, Wayanad, 28th – 31st January 2014.

P.Kalaiarasan, *"Estimation of Carbon Footprint due to vehicular traffic at Government Secretariat Campus, Thiruvananthapuram". 23rd Swadesi Science Congress at M G University, Kottayam, 6th – 8th November 2013.*

P.Kalaiarasan, "*Environmental Impact of Revival of T.S Canal - Case Study of Kovalam Akkulam Stretch".* International Water Resources and Management (IWRM) Symposium.

M S Saran, *"Evaluation and treatment of accident black sopts in Ernakulam District using GIS".* Proceedings of 'International Conference on Modeling and Simulation in Civil Engineering', organised by TKM College of Engineering, December 2013.

M S Saran, *"Identification and analysis of accident black spots using GIS".* Proceedings of International Conference on Energy and Environment –ICEE 2013, organised by RIT, Kottayam, December 2013.

Papers Published in Referred Journals

Geethu Saji, Sreelatha, B G Sreedevi, A Study on Pavement Performance and Overlay Design using HDM- 4. International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), Vol.2 (8), August 2013.

M S Saranya, B G Sreedevi, Sreelatha T, Pavement Performance Modeling using SPSS – a Case Study. International Journal of Innovative Technology and Exploring Engineering (IJITEE), Vol.3 (3), August 2013.

B G Sreedevi, Pavement Performance Studies on Roads Surfaced Using Bituminous Mix with Plastic Coated Aggregates. International Journal of Engineering Research and Technology (IJERT), Vol.2 (9), September 2013.

Sanjay Kumar V S, Public Transport Accessibility Index for Thiruvananthapuram Urban Area. IOSR Journal of Mechanical and Civil Engineering (IOSR – JMCE), Vol.7 (4), July-August 2013, P.61-66.

Sanjay Kumar V S, Trip Generation Model for the Core Area of Thiruvananthapuram City. International Journal of Innovative Research in Science, Engineering and Technology, Vol.2 (1), Special issue, December 2013, P.99-106.

Sanjay Kumar V S, Accessibility Analysis to Public Transport – a Case Study of Thiruvananthapuram City. International Journal of Innovative Research in Science, Engineering and Technology, Vol.2 (1), Special issue, December 2013, P.99326-336.

M S Saran, Evaluation and treatment of accident black spots using Geographic Information System. International Journal of Innovative Research in Science, Engineering and Technology, Vol.2 (8), August 2013. (Impact Factor – 1.672).

Popular Articles

B G Sreedevi. "*Role of R&D Institutions in Kerala".* SPATO, Special Issue 2013.

B G Sreedevi. "*Road Safety – Remedial Measures (in Malayalam)".* ACTS 12th Issue 2013.

T Elangovan. "*Road accidents – causes and consequences".* Executive Knowledge Lines. Vol.9 (1), August 2013.

T Elangovan. *"Wear Helmet now or else hell-met forever".* Executive Knowledge Lines. Vol.9 (1), August 2013.

14. Invited Talks/Media Interactions

B G Sreedevi

Invited Talk

1. '*Road Engineering/Planning for Safety'.* Kollam Press Club as part of 'Road Safety Decade Action Plan for Kollam' on 14th June 2013.
2. Talk delivered at 'Kerala Road Conclave Innovation – 2013', organised by All Kerala Govt. Contractors Association, Ernakulam at Govt. Polytechnic Auditorium, Kalamasserry on 21st September 2013.
3. *Extended Felicitation* in the 'District Level Inauguration of 25th National Road Safety Week Observance' organised by Motor Vehicles Department at Kanakakunnu Palace, Thiruvananthapuram, 11th January 2014.
4. *'Introduction of General Awareness on Road Safety'.* Talk delivered at In-Service Training to PWD Engineers in Trivandrum & Kollam Divisions at Engineers Association Hall, Roads Campus, PMG, Thiruvananthapuram, 27th January 2014.

5. '*Road Safety Education through Schools'*. Two days Workshop on 'Road Safety Education through Schools in Kerala (Teachers Training Programme)', organised by NATPAC at Loyola Extension Centre, Loyola College, Sreekariyam, Thiruvananthapuram, 25th February 2014

Media Interactions

1. *'Brand Kerala'* – Discussion about NATPAC. Doordarshan on 10th May 2013.
2. *'Safety of School Children'*. All India Radio on 26th May 2013.
3. *'Road Development'*. India Vision on 7th August 2013.
4. *'Road Development'*. Mathrubhumi News Channel on 9th August 2013.
5. *'Road Safety'*. Manorama Channel on 6th September 2013.
6. *'KSRTC'*. Asianet News Channel on 18th September 2013.

T Elangovan

Invited Talk

1. Chaired Technical Session on 'Traffic and Transportation Engineering' at 14th National Conference on Technological Trends – 2013. College of Engineering, Thiruvananthapuram on 30th August 2013.
2. *'Urban Mobility'*. On the occasion of 'World Habitat Day', organised by Indian Institute of Architects and Architecture Department, College of Engineering, Thiruvananthapuram at Thiruvananthapuram on 7th October 2013.
3. *'Sustainable Urban Mobility'*. Talk delivered to visiting students of Kansas University, USA at Asian School of Business, Pallipuram, Thiruvananthapuram, 2nd January 2014.
4. *'Pedestrian friendly Urban Transport in Kerala'*. Talk delivered at Workshop on 'Prioritising Non-motorized Transport in Urban Transport Sector' organized by NATPAC and Evangelical Social Action Forum (ESAF) at Thrissur, 7th January 2014.
5. Co-Chairman of Technical Session on 'Presentation of Research Work by Central Govt./State Govt. Agencies' at IRC Annual Session, Guwahati, 21st January 2014.
6. *'Accident analysis and Counter Measures'*. Talk delivered at the In-Service Training to PWD Engineers in Trivandrum & Kollam Divisions at Trivandrum, 27th January 2014.
7. *'Traffic Calming Techniques'*. Talk delivered at the In-Service Training to PWD Engineers in Trivandrum & Kollam Divisions, 29th January 2014.
8. *'Road Accidents in Kerala and Traffic Calming Techniques'*. Talk delivered to Police Officers at Kerala Police Academy, Thrissur, 13th February 2014.

9. *'Personal Rapid Transit System and Sky Tran System in cities of Kerala'.* Talk delivered at Sree Chitra Thirunal College of Engineering, Thiruvananthapuram, 15th February 2014.

10. '*Pedestrian Safety'*. Two days Workshop on 'Road Safety Education through Schools in Kerala (Teachers Training Programme)', organised by NATPAC at Loyola Extension Centre, LoyolaCollege, Sreekariyam, Thiruvananthapuram, 25th February 2014, at Kristu Jyothis Animation Centre, Kollam, 25th March 2014 and at Karmadasan Convent Junction, Alappuzha, 26th March 2014.

Media Interactions

1. *'Traffic Enforcement and its impact on Road Safety'.* Panel Discussion. Mathrubhumi News Channel on 27th September 2013.

P Kalaiarasan

Invited Talk

1. Keynote address on '*Disaster Management'.* K.S.R.Engineering College, Tiruchencode, Erode, (for Faculty Development Programme (FDP) of AICTE), 23rd May 2013.

2. *'Environmental Issues Module'.* Training to Transport Department Officials of Government of Tamil Nadu as part of 'Capacity Development Programme' of Institute of Urban Transport (IUT), Delhi, sponsored by Ministry of Urban Transport (MoUD), Chennai on 27th – 28th June 2013

3. *'Environmental Issues Module'.* Training to Transport Department Officials of Government of Karnataka as part of 'Capacity Development Programme' of Institute of Urban Transport (IUT), Delhi, sponsored by Ministry of Urban Transport (MoUD), Bengaluru on 25th – 26th July 2013.

4. *'Environmental Issues Module'.* Training to various Department Officials of Government of Andhra Pradesh as part of 'Capacity Development Programme' of Institute of Urban Transport (IUT), Delhi, sponsored by Ministry of Urban Transport (MoUD), Hyderabad on 22nd – 24th August 2013.

5. *'Need for EIA Studies for Sustainable Process".* Talk delivered at College of Engineering, Trivandrum (CET) on 7th January 2014.

Arun Chandran

Invited Talk

1. *'Road Safety Engineering'.* Talk delivered at the Workshop on 'Towards Safer Roads-an Engineering Approach' at Thrissur on 25th January 2014.
2. *'Road Signs and Markings'.* Talk delivered at the In-Service Training to PWD Engineers in Trivandrum & Kollam Divisions at Trivandrum on 28th January 2014.

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

B G Sreedevi

- Official Member, Board of Directors of Kerala State Road Transport Corporation (KSRTC), Government of Kerala
- Official Member, Board of Directors of Kerala Urban Road Transport Corporation (KURTC),Government of Kerala
- Member, 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
- Corresponding Member of 'Bridge Maintenance and Rehabilitation Committee (B-8)', 2006-2009, Indian Roads Congress. (National Level)
- 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 (RGCB), 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, 'Expert Committee on Infrastructure Development Including Water supply and sanitation' of Kerala State Planning Board, Government of Kerala, 2013
- Member, Board of Studies in 'Environmental Studies' Cochin University of Science and Technology 2011-2015
- Member, 'Technical Committee for Roads and Road Safety', Kerala State Planning Board, Government of Kerala, 2011-'12
- Life Fellow, Institution of Engineers, India

- Life Member, Indian Roads Congress
- Life Member, Indian Geotechnical Society
- Life Member, Institute of Urban Transport
- Member, Trivandrum Management Association (TMA) and Management Committee Member
- Life Member, Swadeshi Science Movement and Chairperson, Trivandrum Chapter for 2014-'15
- Life Member, Energy Conservation Society, Office bearer several times, State President for 2015-'16
- Member, University Women's Association (UWA) (NGO)
- Life member and Executive committee member, TRUST(An NGO for road safety)
- Member, Sreevaraham Vanitha Samithi (NGO)
- Life Member, Environment and Development Initiatives for Trivandrum (EDIT)
- Former Member, Indian Institution of Bridge Engineers

T Elangovan

- Member of Curriculum Development Committee for formulation of Curriculum and Syllabus for M S Programme in 'Translational Science and Engineering', offered by Kerala University and DTE, Kerala.
- Expert Member, Consultative Committee of Transportation Engineering and Research Centre (representing NATPAC), functioning under CET, Thiruvananthapuram.

V S Sanjay Kumar

- Associate Member, Institution of Engineers, India
- Member, Indian Roads Congress, New Delhi
- Member, Accident Prevention and Trauma Care Association

P.Kalaiarasan

- Technical Expert in Differential Global Positioning System (DGPS) and Electronic Total Station (ETS) at LBS Centre for Science and Technology, Thiruvananthapuram.
- Scientific Member of International Society of Environmental Botanists (ISEB)

- Member of Indian Road Congress (IRC), New Delhi
- Member of Air Pollution Crops and Environment Network (APCEN)
- Member of Indian Water Works Association

16. *Road Safety Education Materials*

Films

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

Booklets

1. Safe Road to School (English & Malayalam)
2. Preventing Accidents
3. Two Wheeler Driving Manual
4. Road Safety Manual for Goods Vehicle
5. All about Lane Driving and Road Safety
6. Safe Cycling
7. Autorickshaw Driving Manual (English & Malayalam)
8. Defensive Driving
9. Teacher's Manual (English & Malayalam)
10. Safe Community Programme for Panchayats (English & Malayalam)
11. Helping Road Accident Victims (English & Malayalam)
12. Rules of Road Regulations,1989
13. On Car and Safe Driving
14. Defensive Bus Driving and Road Safety Guide
15. Road Safety Slogan
16. Vehicle Upkeep and Safety
17. Alphabets of Road Language
18. Road Safety Quiz
19. Safe and Responsible Parking
20. Road Safety and Youth Leadership Programmes
21. Safety Rules for Railway Level Crossing and Around Tracks
22. Safe and Secure Travel by Train
23. Driver's Guide (Malayalam)
24. Formation and Activities of Road Safety Cell in Schools (Malayalam)

Student Badges

1. Be Careful and Be Safe
2. Don't Be Safety Blinded Be Safety Minded
3. Follow Traffic Rules and Be Safe
4. You Can't Fix Your Brain at a Body Shop – Buckle Up!
5. While Driving Put off Mobile! Put on Seat Belt!
6. Better to Arrive Late Than Never
7. Courtesy and Common Sense Promote Road Safety
8. Road Safety is a Mission, Not an Intermission
9. Before Crossing Stop! Think! Then Act
10. Kindness is Giving the Right of Way
11. Look Carefully and Drive Safely
12. Be smart, think, then Start
13. Leave sooner, drive slower, live longer
14. Drive as if every child on the street were your own
15. Be careful and be safe
16. At work at play let safety lead the way
17. Safety is a simple ABC- Always Be Careful
18. Safety on road, Safe tea at home
19. The safe way is the best way
20. നിൽക്കൂ!ശ്രദ്ധിക്കൂ!റോഡ് മുറിച്ച് കടക്കൂ!
21. സൂക്ഷിച്ച് വാഹനമോടിക്കൂ, റോഡിലെ തിരക്കിൽ നിങ്ങളുടെ കുട്ടികളും ഉണ്ടായിരിക്കാം
22. വേഗതയിലല്ല സ്മാർട്ടാകേണ്ടത്, സുരക്ഷയിലാണ്
23. ശ്രദ്ധിച്ച് നോക്കൂ, സുരക്ഷിതമായി ഡ്രൈവ് ചെയ്യൂ
24. സുരക്ഷിതത്വം മഹത്വമാണ്
25. വീഥിയിലൂടെ വേഗത വേണ്ട
26. ശ്രദ്ധിക്കൂ സുരക്ഷിതരായിരിക്കൂ
27. അശ്രദ്ധ അപകടമാണ്
28. നേരത്തെ ഇറങ്ങൂ, നേരെ ഓടിക്കൂ, നേരായവിധം ജീവിക്കൂ
29. ശ്രദ്ധയുള്ളിടത്ത് സുരക്ഷ ഉണ്ട്
30. പാഞ്ഞു പോകരുത്, പ്രാണൻ എടുക്കരുത്
31. സുഗമമായ പാത നിങ്ങളുടെ മാത്രം സ്വന്തമല്ല

Calenders

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

Leaflets

1. Who is Walking on the Wrong Side
2. Police Hand signals
3. Safe and Correct Ways of Parking
4. Protect your Child from Injury
5. Spot the Hidden Dangers
6. Two Wheeler Driving

7. Follow this Simple Kerb Drill
8. School Safety – A Checklist for Parents
9. Understanding Traffic Rules and Regulations (English & Malayalam)
10. Don't Be Rash and End in Crash (English & Malayalam)
11. Helmets (English & Malayalam)
12. Golden Rules for Defensive Driving (English & Malayalam)
13. Untied Duppatta/Saree – Risks and Remedies (English & Malayalam)
14. Safe Travel by Bus
15. Safe Bus Driving
16. Safe Car Driving
17. Safety Precautions for Two-Wheeler Drivers
18. Safe and Responsible Parking
19. Traffic Control Devices
20. Don't find out the hard way…
21. Trains of thought- Use Extreme caution when crossing
22. Trains of thought- Safety Slogans - Just Think
23. Trains of thought- Safety Slogans - Just Think over these
24. Railway level Crossings- Safety Tips for Vehicle Drivers
25. Safe Crossing of Railway Tracks-Tips for Pedestrians and Cyclists
26. Railway Level Crossing- Safety Tips for School Buses
27. Railway Level Crossing- Safety Tips for Truck drivers

Display Boards

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

Road Safety Posters

1. ആട്ടോറിക്ഷയിൽ സഞ്ചരിക്കുമ്പോൾ ശ്രദ്ധിക്കേണ്ടവ
2. ബസ് യാത്രയിൽ
3. മദ്യപിച്ചു വാഹനം ഓടിക്കുന്നത് ശിഷാർഹമാണ്
4. ഹെൽമറ്റ് ധരിക്കൂ, ജീവൻ രക്ഷിക്കൂ
5. മൊബൈൽ ഫോൺ റോഡിൽ ജീവനെടുക്കുന്ന കാലൻ
6. കാൽനടയാത്രക്കാർ എങ്ങനെ റോഡ് സുരക്ഷിതമായി ഉപയോഗിക്കും
7. സീറ്റ് ഹെൽമറ്റ് ഒരു രക്ഷാകവചം
8. അമിത വേഗത ഒരു കാരണമാകരുത്
9. ഡ്രൈവർമാർ ശ്രദ്ധിക്കു അപകടം ഒഴിവാക്കൂ
10. സ്കൂട്ടർ/മോട്ടോർ സൈക്കിൾ യാത്ര ചെയ്യുമ്പോൾ

INFRASTRUCTURE

1. *Testing Facilities and Equipments*

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

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

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

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

58.	CO_2 Analyzer
59.	NO_2 Analyzer
60.	CH_4 Analyzer
61.	Cup Anemometer
62.	Wind vane
63.	Wind logger
64.	RH meter
65.	Thermo couple sensor
66.	Spectro photo meter
67.	Respirable Dust Sampler (APM 460)-2 Nos.
e) Water Transport Laboratory	
68.	Echo sounder
68.	Portable canti lever scale
70.	Distometer
f) General Accessories for Laboratory	
71.	Thermostatically controlled drying oven 0-150^{0}C
72.	Thermostatically controlled water bath
73.	Electronic balances – 200 g, 2 kg, 50 kg
74.	Soaking tank
75.	Heater
76.	Semiautomatic balance 10 kg – 2 nos.
77.	Traffic safety appurtenances
78.	Power generator- 2 nos.
79.	External car battery-3 nos.
80.	Digital Thermometer
g) Application Softwares	
81.	MX ROAD
82.	AUTO CAD
83.	ARC GIS
84.	3D MAX
85.	TALLY
86.	STAD PRO
87.	HDM IV
88.	SPSS
89.	ERDAS

2. *Library and Information Services*

The NATPAC Library is mandated with the responsibility of providing assistance to the scientists, researchers and students in their scientific and academic activities. The Library continued to cater to the information needs of the institute and students. The Library has a vast collection of books on Transportation, Traffic Engineering, Transport Economics, Urban and Regional Planning, Environment, Management, Operations Research, Geography and allied subjects. In addition to this the Technical Reports prepared by NATPAC are also available for reference purpose. The library has a good collection of the publications by Indian Roads Congress (IRC) and this collection is being updated regularly. A number of new journals, both National and International, have been added to the library during this year. An in-house database of books, periodicals, bound volumes of journals, reports, etc., is being updated. For computerization of the Library, NATPAC uses LIBSOFT. Bibliographic records of books available in the library can be accessed through Online Public Access Catalogue (OPAC). The Library also took up updating of Library Automation Software as a special initiative.

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 institutions like Rajiv Gandhi Institute of Technology, Kottayam; National Institute of Technology; Saintgits College of Engineering, Kottayam; Neharu Yuva Kendra, Kollam; School of Planning and Architecture, Bhopal; College of Engineering, Trivandrum; ITS Planners and Engineers, Hyderabad; Baselios Mathews College of Engineering, Sasthamcotta; Mar 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, Trivandrum; Marian Engineering College, Trivandrum etc.

ORGANISATION

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

I. KERALA STATE COUNCIL FOR SCIENCE, TECHNOLOGY AND ENVIRONMENT

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

1.	Chief Minister of Kerala	-	President
2.	Minister for Industries, Govt. of Kerala	-	Vice President
3.	Minister for Finance, Govt. of Kerala	-	Vice President
4.	Minister for Agriculture, Govt. of Kerala	-	Vice President
5.	Minister for Health, 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	-	Executive Vice President
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	-	Secretary

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
   304/28, 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
   Thiruvananthapuram
   - Member Convener

iv. Management Committee of NATPAC

1. Director, NATPAC
   - Chairperson

2. Director, KSCSTE

3. Director, JNTBGRI
   - Member

4. Dr.G.Ravikumar, Scientist –F
   NATPAC
   - Member

   - Member

5. Smt.L Geetha
   Additional Secretary to Govt., GoK
   - Member

6. Registrar, NATPAC
   -Member

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

Public Information Officers	:	Shri. D.Robinson Scientist - F *(Scientific and Technical Matters)* Shri. K Mohanakumar Deputy Registrar (Finance) *(Administrative Matters)*
Asst. Public Information Officer	:	Smt.T.S.Sangeetha Assistant Grade - 1
Appellate Authority, RTI Act	:	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. ***Capital 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	Member
Representative of Admn. & Accounts – Shri.P.C.Sivadas	Member
Representative of Technical Cadre - Shri.T.Ramakrishnan	Member
Representative of Women employees – Smt.Veena K S	Member
A Subordinate Officer dealing with establishment and personnel matters – Smt.T S Sangeetha	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***

Adoption of Malayalam Language

The Staff of NATPAC administered the official language pledge on 1st November 2013 (Kerala Piravi Day)

Research Council Meeting

The 15th meeting of the Research Council was held on 28th June 2013 at NATPAC under the chairmanship of Prof. (Dr.) Veeraraghavan

Research Council Meeting in progress

Management Committee Meeting

The Management Committee met on 24th December 2013 and 25th February 2014 at NATPAC under the chairmanship of Director, NATPAC.

NATPAC Staff –as on 01.04.2014

Dr.B.G.Sreedevi	Scientist G & Director

Scientific Staff

1	T. Elangovan	Scientist-G (Head, Traffic & Transportation Dn.)
2	Dr. G. Ravikumar	Scientist-F (Head, Extension Services Dn.)
3	Tomy Cyriac	Scientist-E2(Head, Highway Engineering Dn.)
4	D. Robinson	Scientist-E2(Head, Regional Transportation & Central Support Systems Dn.)
5	Satheish B. Nair	Scientist-E2(Head, Water Transportation Dn.)
6	D. Sunder	Scientist-E1
7	S.Shaheem	Scientist-E1
8	V.S. Sanjay Kumar	Scientist-C
9	P.Kalaiarasan	Scientist-B
10	B.Subin	Scientist-B
11	P N Salini	Scientist-B

12	M S Saran	Scientist-B
13	N.M.Sabitha	Scientist-B
14	K.C.Wilson	Scientist-B
15	Arun Chandran	Scientist-B
16	Veena.K.S	Scientist-B

Technical Staff

17	K. M. Syed Mohammed	Principal Technical Officer
18	C. Anbalagan	Technical Officer Grade -5
19	S. Ramachandran	Technical Officer Grade -5
20	T. Ramakrishnan	Technical Officer Grade -5
21	V. Ajith Kumar	Technical Officer Grade -5
22	C. Muraleedharan Pillai	Technical Officer Grade -4
23	V. Jayawardhanan	Technical Officer Grade -4
24	K. Satheesan	Technical Officer Grade -3
25	V.G. Sasi	Technical Officer Grade -2
26	M.S. Radhakrishnan	Technical Officer Grade -2
27	K. Devadethan Nair	Technical Officer Grade -2
28	E. P. Surendran Pillai	Technical Officer Grade -2
29	R J Sanjai	Technical Officer Grade -1
30	T. Mohan	Technical Assistant Grade-2
31	S. Geetha	Technical Assistant Grade-2
32	R. Radhakrishnan Thampi	Technical Assistant Grade-2
33	Shyama.C	Jr.Library Assistant Grade-1

Administrative Staff

34	K.George Koshy	Registrar Grade - 2
35	P.C. Sivadas	Dy. Registrar (Admn.)
36	K. Mohanakumar	Dy. Registrar (Finance)
37	J.Krishnamoorthy	P.A. to Director Grade-4
38	T. Vijayan	P.A. to Registrar Grade-1
39	Abey George	P.A. to Director Grade-1
40	D. Shaju	Section Officer Grade-1
41	R. Lekha	Typist cum Stenographer Grade-4
42	Arya.S.K	Office Assistant Grade – 1
43	Maya Devi.M	Office Assistant Grade – 1
44	Veena.S	Office Assistant Grade – 1

OTHER NEWS

- The Centre organised Onam celebration on 10th September 2013 at K Karunakaran Transpark. The celebration was inaugurated by Shri.Perumbavoor G. Raveendranath.

- A team of Officials from Odisha visited NATPAC on 3rd January 2014. The delegation included:

1. Mr. G. Mathivathanan, IAS, Commissioner-cum-Secretary, Transport Department

2. Mr. Lalit Das, Special Secretary, Home Department
3. Mr. B. C. Pradhan, Chief Engineer (Roads)
4. Mr. R. R. Bohidar, Superintending Engineer (ISAP Cell), OWD
5. Mr. Kailash Sahoo, Joint Secretary, Transport Department
6. Mr. M. R. Mishra, Deputy Transport Commissioner, Transport Department
7. Mr. Krushna Samal, Addl. Superintendent of Police (Rural), Cuttack
8. Dr. N. C. Pal, Executive Engineer, PMU, OWD
9. Mr. Manoranjan Mishra, Executive Engineer, PMU, OWD
10. Mr. Sameer Hota, Assistant Engineer, PMU, OWD
11. Tony Mathew, Chief General Manager (Traffic & Transportation)

Odisha Officials interacting with NATPAC Scientists

Plan Studies Undertaken During 2013-'14

Sl.No.	Code	Project
1	154/2013-14	Performance of Highway Development Projects in Kerala
2	155/2013-14	Use of Waste Plastic for Road Construction in Urban Centres in Kerala
3	156/2013-14	Revival of Inland Canals and Waterways of Kerala - Phase II - Champakkara - Kadambrayar Canal
4	157/2013-14	Road Safety and Youth - Problems and Solutions
5	158/2013-14	Forecasting Urban Growth based on GIS, Remote Sensing and Urban Growth Model for Major Cities in Kerala
6	159/2013-14	Urban Travel and Traffic flow characteristics in Kerala
7	160/2013-14	Impact of Surveillance Cameras installed in Cities - a case study
8	161/2013-14	Impacts of Vehicular Emission on human health in cities - a case study of Thiruvananthapuram
9	162/2013-14	Evaluation of Fibre Reinforced Asphalt Mixes and its suitability to Kerala Condition
10	164/2013-14	Prospects of Port - Hinterland connectivity through Inland Waterways
11	165/2013-14	Study on Goods Transportation and Freight Policy Intermodal Traffic Split-a case study
12	166/2013-14	Investigation of major accident spots and accident causative analysis
13	167/2013-14	Accessibility and mobility indicators for Thiruvananthapuram Urban Area
14	168/2013-14	Benefit Monitoring of Tourist Oriented Directional Signs
15	169/2013-14(1)	Periodic Updation of Price Indices for different Operations
16	169/2013-14(2)	Improvement of Kovalam Akkulam Stretch in Thiruvananthapuram Region for Inland Navigation, Tourism and Recreational Purposes
17	169/2013-14(3)	Traffic Improvement Plan for Seematty Junction area

Consultancy/Sponsored Projects in 2013 – '14

Sl.No.	Code	Project	Sponsored by
1	C 00312	Pre-feasibility studies for development of Ropeways in Kerala	Tourist Resorts (Kerala) Ltd. (TRKL)
2	C 00611	Techno Economic Feasibility Study for extension of NW- 3 towards North of Kottappuram and South of Kollam	Inland Waterways Authority of India (IWAI)
3	RP 00110	Study of ambient air quality and its impacts on climate change in Kerala	Directorate of Environment & Climate change, Kerala (EMAK)
4	C 01312	Comprehensive scheme for Tourism Signage on major roads and tourist centres in Kerala	Department of Tourism
5	C 02512	Preparation of Traffic Improvement Plan for Pala region	Public Works Department, GoK
6	C 02412	Measurement of Air Quality and Noise Level at proposed IISER Campus, Vithura in Thiruvananthapuram District - Phase II	Centre for Water Resources Development and Management (CWRDM)
7	C 00213	Traffic and Transportation Study for Pandalam Grama Panchayath	Town & Country Planning, GoK
8	C 00311	Environment Study at IISER Campus, Vithura	Centre for Water Resources Development and Management (CWRDM)
9	C 00813	Preparation of Improvement Plan for Chalai Junction, Kannur	Public Works Department,GoK
10	C 01013	Development of Piolet Safe Road Corridor - Base line data collection	Kerala State Transport Project (KSTP)
11	C 01113	BBD test in Techno Park - Phase I	Technopark
12	C 01513	Assessment of annual toll collection potentials at Padanakkad on NH-17 in Kasargode District	National Highways Authority of India, Kozhikkode
13	C 01213	Preparation of DPR for Bus Procurement under extended phase of JnNURM	Kerala State Road Transport Corporation (KSRTC)
14	C 01713	Preparation of Transit Oriented Development Plan for Kochi Metro Alignment	Kochi Metro Rail Limited
15	C 01313	Traffic improvement Proposal for Bolgatty Junction in Kochi	Lulu Convention Centre
16	C 01413	Traffic and Transportation Study for Attingal Town	Department of Town Planning, GoK
17	C 00113	Pedestrian Friendly Transport System for Cochin City	Town & Country Planning, GoK
18	C 02613	Pedestrian and bicycle friendly urban transport for the cities of Thiruvananthapuram, Kollam, Thrissur and Kozhikkode	Department of Town Planning, GoK
19	C 02013	Improvement of Kovalam - Aakkulam Canal	Inland Navigation Directorate
20	C 02913	Preparation of DPR for Hill Highway Package 1- Kasargode and Kannur	Kerala Road Fund Board
21	C 02813	Improvements to Kallettunkara Over Bridge Junction (Irinjalakkuda ROB)	Public Works Department,GoK

22	C 03213	Strengthening and Modernisation of selected Tourist Information Offices in Kerala State	Department of Tourism
23	C 03313	Total Station Survey and base map preparation for DTP Schemes - Attingal Bus Stand area	Department of Town Planning, GoK
24	C 03413	Total Station Survey and base map preparation for DTP Schemes - Central area Nedumangad	Department of Town Planning, GoK
25	C 03513	Total Station Survey and base map preparation for DTP Schemes - Neyyattinkara Bus Stand area	Department of Town Planning, GoK
26	C 03613	Fixing of GPS Bench Mark along Kuppam - Valapattanam river	Centre for Water Resources Development and Management
27	**Projects Sponsored by Kerala Road Safety Authority (KRSA)**		
i	RP 00113	Safe Community Programme at Panchayath Level	
ii		Safe Road to School	
iii		Accident Surveys, Database and Analysis	
iv		Characteristics of Hazardous Material Transportation within Kerala	
v		Pedestrian Safety: Improvement of critical locations in Thiruvananthapuram City	
vi		Study on Road Safety Funding and Role of Insurance Sector in Kerala	
vii		Parking Management System for major roads in Thiruvananthapuram City	
viii		Evaluation of Post Road Accident Victims' Status	
ix		Accident Reconstruction Studies of Selected Fatal Accidents	
x		Road Safety Workshop, Seminars and Training Programmes for Drivers, Public, Traffic Police, Driver Training Colleges etc.	
xi		Production and free distribution of road safety education/ awareness materials	
xii	RP 00213	Road Safety Education through schools	
28	Traffic and Transportation Studies for selected Towns		Department of Town Planning, GoK
1	C 01813	Irinjalakuda	
2	C 01913	Chavakkad	
3	C 02113	Kuthuparamba	
4	C 02213	Nedumangadu	
5	C 02313	Varkala	
6	C 02413	Mavelikkara	
7	C 02513	Chengannoor	

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 2014

Liabilities	Sch No	*As at 31.03.2014*	*As at 31.03.2013*	Assets	Sch No	As at 31.03.2014	As at 31.03.2013
Reserves & Surplus	4	1,50,77,437	1,05,51,125	Fixed Assets	1	1,50,77,437	1,05,51,125
Current Liablities	5	1,61,98,911	1,43,89,493	Current Assets	2	6,86,27,993	2,70,56,879
Unspent balance	6	4,71,90,061	1,69,31,322	Loans & Advances	3	8,37,50,979	7,49,53,936
Building Fund Account	4	8,89,90,000	7,06,90,000				
Total		**16,74,56,409**	**11,25,61,940**	**Total**		**16,74,56,409**	**11,25,61,940**

For Mohan & Mohan Associates
Chartered Accountants

MOHAN & MOHAN ASSOCIATES * CHARTERED ACCOUNTANTS * Reg.No.002928

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

Place : Thiruvananthapuram
Dated :

For National Transportation Planning and Research Centre
Trivandrum

(Dy. Registrar)

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

(Registrar) **(Director)**

Dr. B. G. SREEDEVI
DIRECTOR
National Transportation Planning
and Research Centre (NATPAC)
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 31/03/2014

Expenditure	Sch No	Year ended 31.03.2014	Year ended 31.03.2013	Income	Sch No	Year ended 31.03.2014	Year ended 31.03.2013
		`	`			`	`
To Infrastructure Strengtheni ng (Plan)	10	2,51,56,738	2,34,22,802	By Grant from Government of Kerala	7	7,74,14,969	8,09,28,006
To Infrastructure Strengtheni ng (Non Plan)	11	40,28,216	12,54,801	By Other Receipts	8	77,345	1,64,476
To Salaries and Allowances (Plan)	12	-	6,48,293	By Depreciation written back	1	42,51,112	38,68,171
To Salaries and Allowances (Non Plan)	13	4,83,07,359	5,57,66,586	By Income from Consultancy Project	9	1,38,23,678	31,89,668
To Depreciation	1	42,51,112	38,68,171	Other Project Expenses			
To Consultancy Project Expenses		1,38,23,678	31,89,668	Excess of Expenditure over Income			
To Refund to Govt of Kerala							
Total		**9,55,67,104**	**8,81,50,321**	**Total**		**9,55,67,104**	**8,81,50,321**

For Mohan & Mohan Associates
Chartered Accountants

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

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For National Transportation Planning and Research Centre
Trivandrum

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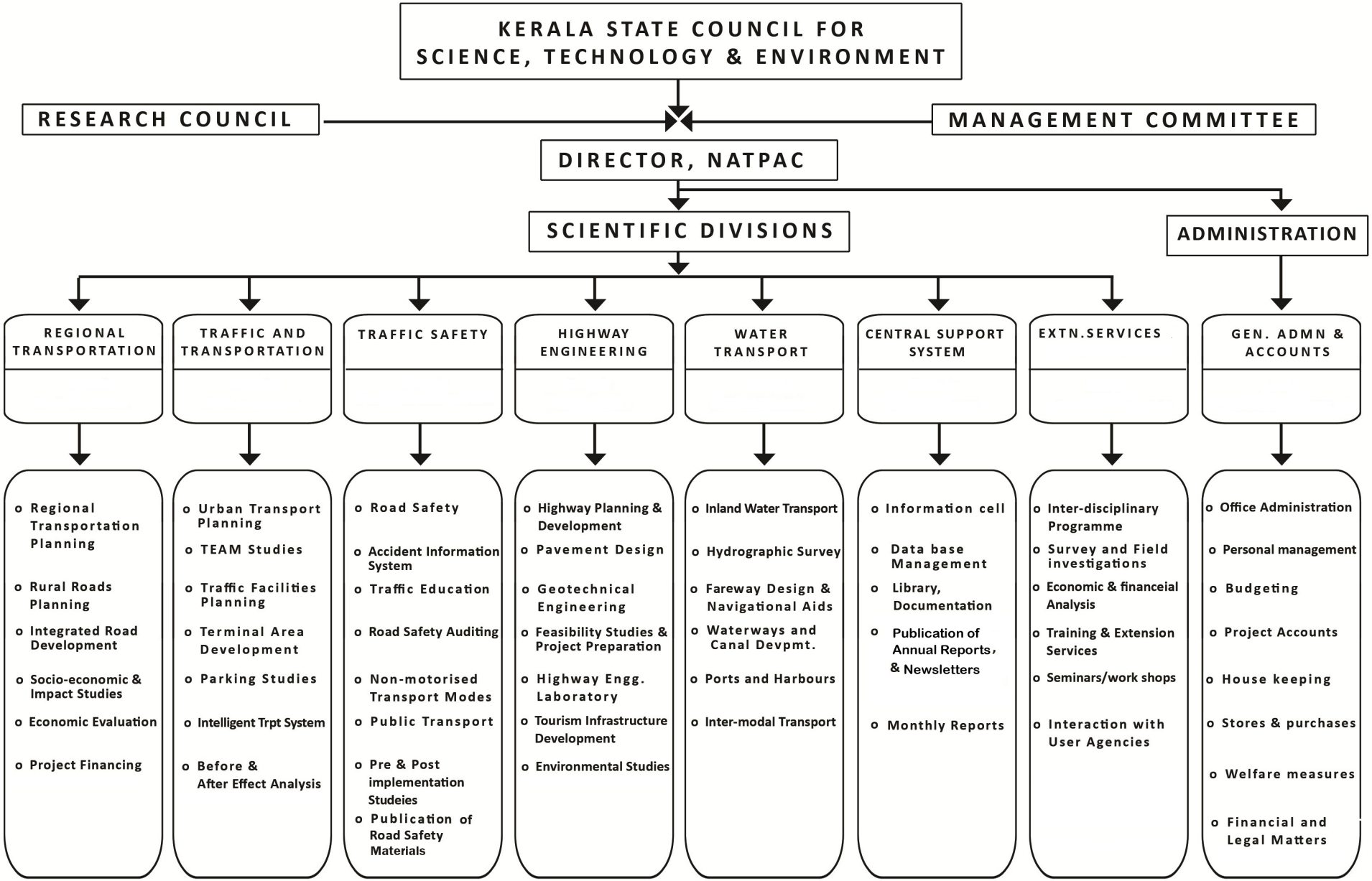
Thiruvananthapuram-695 004

(Registrar)

(Director)

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

Place : Thiruvananthapuram
Dated:


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

National Transportation Planning and Research Centre
(An Institution of Kerala State Council for Science, Technology and Environment)
Sasthra Bhavan, Pattom Palace P.O, Thiruvananthapuram-695 004

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REGIONAL OFFICE

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National Transportation Planning and Research Centre

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