1. TRC12CETRP1_Critical Analysis of Road Safety Issues in Mixed Traffic Flow in Urban Streets

The study was aimed at collecting crash data and building a crash database for Thiruvananthapuram city. Crash data collection from police records was started. From the crash data collected, hotspots were identified using Accident Severity index method and public participation method. Crash locations were visited and remedial measures were suggested.

2. TRC12CETRP2_Analysis of Usage of Pedestrian Facilities and Its Impact on Capacity Reduction of Urban and Sub Urban Streets

Usage of pedestrian facility by users in Thiruvananthapuram City and capacity reduction of urban roads due to pedestrians using the carriageway was studied. 3 sites at Thiruvananthapuram, Kottayam and Ernakulam with similar geometric conditions and traffic conditions and the capacity reduction was estimated to quantitatively represent the impact of pedestrians on traffic How. It was examined that a capacity reduction of 32%, 24% and 21% was experienced at Thiruvananthapuram, Kottayam and Ernakulam stretches respectively and that the capacity reduction increases as the pedestrian volume increases. In the study it is found that width of footpath, conflict with vehicles and absence of shades of trees over footpath as the most discouraging factors of using footpaths.

3. TRC12CETRP3_Safety Audit of Highway Intersections

Five intersections were selected based on accident data. The selected intersections were Kazhakkuttam, CRPF Pallippuram, Kuzhivila, Chakkai and Plamoodu. After conducting RSA it is found that road markings and enhanced delineation markings are required and pedestrian/cyclists are greatly affected at night due to the lack of lane discipline by the motorist and poor visibility.

4. TRC12CETRP4_Utilization of plastic waste in bituminous mixes for road construction

Disposal of biomedical plastic wastes have always been a matter of concern because of the

various health hazards and pollution caused by them. Their use on the flexible pavements would open up a solution for the disposal issues regarding biomedical plasticwastes. The mechanical properties of matrix were studied in the lab and implementedfor a length of 30m in Arasumoodu- Thrippadapuram road (Fig.1 (a, b and c)). The functional evaluation is carried out and found to be satisfactory.

(a) (b) (c)

Fig.1 (a) Shredded plastic is mixed with aggregate, (b) Matrix is prepared, (c) Finished surface

5. TRC12CETRP5_Experimental Investigation on Effect of Coir Geotextiles on Reduction of Pavement Distress

One of the serious problems associated with flexible pavements are fatigue cracking and rutting. Fatigue and rutting are developing on the pavement due to many reasons like overloading, temp/climatic variations, utility cuts, poor quality materials and construction, aging etc. Hence this project aimed to study the efficiency of coir geotextiles to reduce the distress of flexible pavement. The scope of the project is limited to conduct lab test, FEM analysis and field implementation of coir geotextiles for future monitoring. The objectives include the Study of rutting potential in terms of deformation using wheel rut tester, field implementation of coir geotextiles and FEM analysis using coir geotextiles. Methodology involves preparation of samples of Specified size placing under and moving wheel loads to simulate vehicular traffic and finding rut deformation. Laying coir geotextiles in the field was done just above the existing layer or at the interface of overlay and existing layer. FEM analysis was used to simulate pavement responses to traffic loading.

Laboratory tests were conducted on overlay sample specimen with three types of coir geotextiles (800 GSM non-woven, 400 GSM woven and 740 GSM woven) obtained from different sources. Geotextiles introduced at three different positions on overlay i.e. bottom, middle and one-third from the bottom of the overlay. Wheel tracker test was conducted to simulate the effect of dynamic wheel load from the wheel tracker test, 400 GSM woven coir geotextile placed at bottom showed max decrease in rut depth compared to 740 GSM woven

400 GSM woven geotextile placed at bottom position of the overlay specimen showed maximum decrease in rut deformation compare to control specimen, implying it as the ideal placement position.

Analysis was carried out using ABAQUS finite element software to model the behaviour of overlay geotextile interaction. From analysis, coir geotextile placed in the models showed decrease in strain compared to control model. Outcome of the project was 400 GSM woven coir geotextile placed at bottom of the overlay specimen showed maximum decrease in rut deformation compared to 740 GSM woven and 800 GSM non-woven geotextile was placed at bottom of the overlay specimen. It is found that 400 GSM is useful for the road project and use of coir geotextiles reduced the vertical strain to a considerable amount. The feasibility of using the geotextile for further investigation in the field is thus established. Based on that result geotextile was laid on the road at the interface of the existing pavement and overlay for detailed pavement performance monitoring to ascertain the performance (Fig. 2). The road stretch selected was Kazhakkootom- Menamkulam (Vettu road). Control mix was laid along 800 m of the stretch and geotextile was laid along 200 m and performance analysis was carried out. When compared to the traditional overlay, the geotextile laid stretch shows a better performance (Fig.3).

Fig.2 Overlay of coir geotextiles

Fig.3 Performance Evaluation of the Test Sections

Deliverables:

- ✓ Laboratory Test Results
- ✓ Finite Element Method (FEM) Analysis
- ✓ Material Specifications and Evaluation
- ✓ Technical Reports and Publications
- ✓ Guidelines for Field Application

Societal Relevance:

- ✓ Reduced Maintenance and Repair Costs
- ✓ Improved Road Safety
- ✓ Sustainable Material Usage
- ✓ Waste Reduction
- ✓ Cost-Effective Solutions

6. TRC12CETRP7_ Study on Compatibility and Field Investigation of Inter Locking Concrete Blocks Over Periodically Distressed Road Sections in Kerala

Drainage provisions in roads are sometimes a luxury due to budget constrains but surface and subsurface drainage is the one which cannot be omitted from design. Due to these reasons many times the bituminous roads get distressed.

Vakkom is a village in Chirayinkeezhu Taluk,Thiruvananthapuram district. The road in the Vakkom market junction lying in a low level when compared with surroundings and when it comes to rainy season, water from the surrounding areas are directly flooded in to the Nilakkamukk- Kayikkara road section especially in market junction. Conventionally constructed bituminous pavement is in constant danger of deterioration and it also prevents the percolation of logged water. Providing drainage is not possible here, as it is low lying area, and if we increase the reducing level of existing road, it will not benefit anything except dumping water in other low-lying areas. Also, the buildings in the town are not in a state of affording an increase in the height of road as they are already lying in the road level.

In view of the above, the compatibility of Interlocking Concrete Block Pavements (ICBP pavements) in Vakkom was studied in this project. Objectives of the study were to reduce the water logging at Vakkom Market jn. by reconstructing a portion of road with interlocking concrete pavements and to study the effect of using 4mm aggregate and M. Sand as bed for interlocking concrete block pavement.

The road has been constructed as per the IRC guidelines. Interlocking Concrete pavements have proved to be a better choice, especially for rural roads because of good durability of structure, convenience of maintenance and simplicity in construction.The aim - prevention of water logging in the low lying areas of the town - has been fulfilled. As per the design criteria recommended by IRC and CRJRJ (Central Road Research Institute, New Delhi) the ICBP is laid by TRC in association with Kerala State PWD. New method of construction has been tried using 4mm aggregate instead of bedding sand as directed by IRC and CRR1 and this proved to be effective in terms of both stability and economic viability. The work is successfully completed and the road condition is well till the last visual evaluation (Fig. 4). PWD/LSGD is extensively replacing the damaged bituminous road sections (recurring) into Interlocking concrete block pavement sections in both urban and rural areas.

Deliverables:

- ✓ Detailed Project Plan
- ✓ Design Criteria and Specifications
- ✓ Construction Process Documentation
- ✓ Materials Used
- ✓ Implementation Guidelines
- ✓ Recommendations for Policy and Practice

Societal Relevance:

- ✓ Reduced Water Logging
- ✓ Durability and Longevity
- ✓ Cost-Effective Maintenance
- ✓ Promotion of Green Infrastructure
- ✓ Model for Other Regions
- ✓ Policy Influence
- ✓ Adaptation to Climate Variability

Condition of road after rain in Vakkom Market Jn

Condition after the construction using Interlocking concrete Blocks at Vakkom Market Jn.

Construction of ICBP at Channankara using Coir Geo Textile

Condition after the construction using Interlocking concrete Blocks at channankara

Fig.4 Field Investigation of ICBP Over Distressed Road Sections

7. TRC12CETRP8_Evaluation & Pavement Performance Analysis of Major Road Stretches in Trivandrum City

A database has been created for pavement maintenance management of road network of Trivandrum city (Fig.5). At different time periods (June 2012, March 2014, June 2016, December 2017) functional condition data were collected, for 2220 section (each sectionis of 100m) are entered in the GIS (Geomedia Professional), so that the data can be updated, stored and can be analysed.

Objectives satisfied include:

- Database was developed for the identified road network in GeoMedia professional environment
- Pavement condition assessed by visual rating, finding free flow speedand riding comfort
- Roughness was measured using Fifth-wheel Bump integratorand later by Roughometer-III.
- The effect of drainage on pavement condition is studied.
- A Composite pavement condition index is developed.

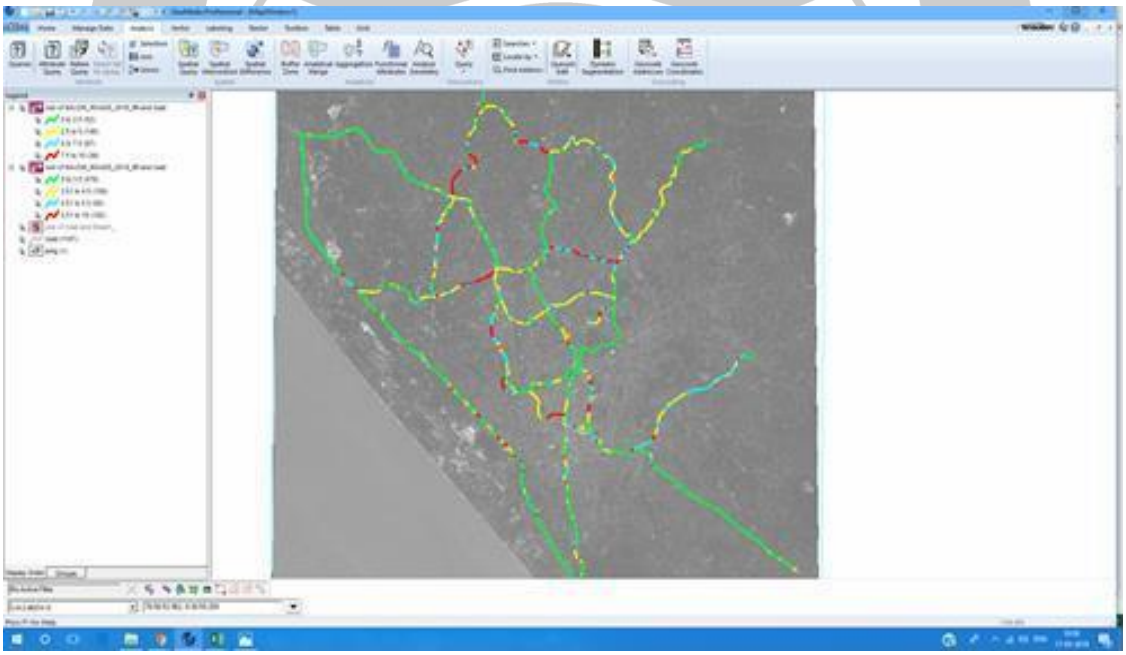

Fig. 5 Digitised roads

Table 1 Predicted pavement conditions for M&R (Do nothing)

YEAR	EXCELLENT	GOOD	FAIR	POOR
2014	0%	16%	37%	47%
2016	0%	2%	16%	82%
2017	0%	0%	13%	88%

Network level optimization was carried out and the optimum fraction of the roads in each condition states under steady state condition was found and shown below (Fig. 6). The steady state is obtained after 5 years.

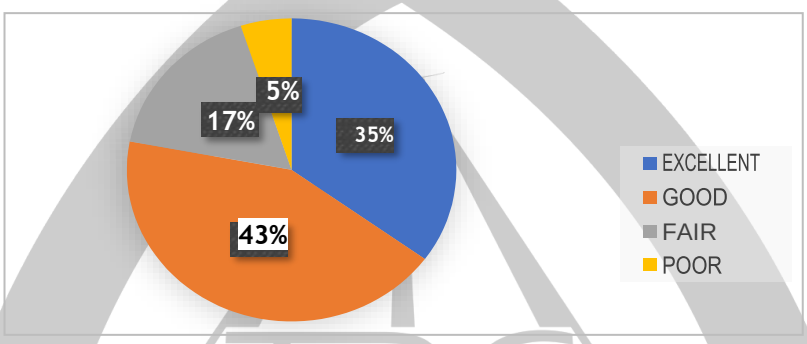

Fig. 6 Optimum fraction of the roads in each condition under steady state condition

To achieve the steady state condition the proportion of roads in each condition state and the respective maintenance proportions for the 5 years are shown below (Fig.7).

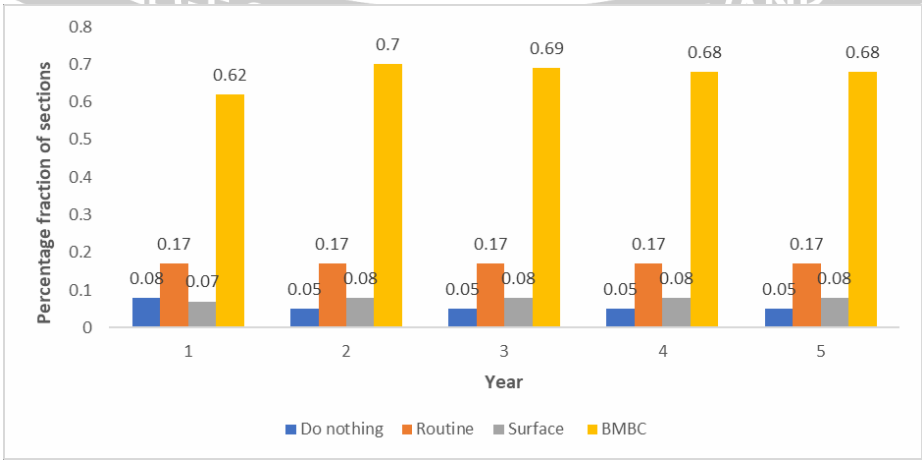

Fig.7 Percentage fraction of the roads receiving each maintenance action in 5 years Multi period model

8. TRC12CETRP9_Development of a Methodology for Rapid Routine Maintenance of Roads of Kerala

Potholes are a common type of distress that is noticed on roads in Kerala and negligence towards immediate repair of these potholes lead to the total deterioration of the pavements in the long run. Hence the development of a pothole patching pre-mix suitable for the climatic condition of Kerala which will facilitate the immediate repair of potholes can be a milestone in the pavement maintenance sector. Mixes were prepared with varying gradation and bitumen content so as to arrive at an optimum patching mix. Trial drilling of potholes on Kariavattorn - Thrippadapuram road as suggested by concerned PWD section was done and evaluation of the performance of these patching done were evaluated for a period of three months. An attempt has also been done to fabricate equipment for easy and quick patching of potholes on the roads.Trial filling of potholes on Kariavattom – Thrippadapuram road as suggested by concerned PWD section was done and evaluation of the performance of these patching done were done for a period of three months. Various stages of patching potholes and the condition of patched potholes after one week to one month are shown in the following figures (Fig.8).

Fig.8 Trial filling of potholes on Kariavattom – Thrippadapuram road

Deliverables:

- ✓ Pothole Patching Pre-Mix
- ✓ Performance Evaluation Report

Societal Relevance:

- ✓ Reduction in accidents
- ✓ Enhanced driver comfort
- ✓ Extended pavement life
- ✓ Cost savings
- ✓ Reduced vehicle maintenance costs
- ✓ Sustainable practices
- ✓ Reduced carbon footprint
- ✓ Weather-resilient roads
- ✓ Model for other regions

9. TRC12CETRP10_ Stabilization of Soil Subgrade using RBI Grade 81

This study investigated the use of RBI Grade 81, a new additive, for stabilizing weak subgrade soils in road construction. The primary objective was to determine the optimal quantity of RBI Grade 81 required to enhance soil stability and to design a pavement that could withstand projected traffic volumes. Implemented in 2016 at Nedumangad (Fig. 9), the technology involved applying the determined optimal amount of RBI Grade 81 to the subgrade before constructing the pavement. The pavement was monitored over a three-year period, during which it demonstrated promising performance. The results showed that the pavement, stabilized with RBI Grade 81, remained durable and effective in handling traffic loads and environmental conditions, even after three years. This successful application underscores RBI Grade 81's potential to improve road infrastructure by providing long-term stability and reducing maintenance costs. The findings suggest that RBI Grade 81 is a viable solution for addressing subgrade stabilization challenges and enhancing the overall quality and longevity of road pavements.

Fig.9 Soil Stabilisation using RBI Grade 81

Deliverables:

- ✓ Determination of Optimum RBI Grade 81 Quantity
- ✓ Pavement Design Based on Forecasted Traffic Volume
- ✓ Field Implementation Report

Societal Relevance:

- ✓ Improved Road Durability
- ✓ Reduced Maintenance Costs
- ✓ Enhanced Safety and Comfort
- ✓ Sustainable Resource Use
- ✓ Long-Term Economic Benefits