Int. J. Chem. Sci.: 14(S1), 2016, 275-781
ISSN 0972-768X
www.sadgurupublications.com

STUDY ON PRIORITIZING THE CRITICAL ROAD SECTION FOR THE SELECTED ROAD NETWORK IN CHENNAI USING PAVEMENT INDICES

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ABSTRACT

This paper is about the study on existing pavement condition and prioritizing the critical road network. The study road network selected is located at puzhuthivakkam, Chennai. Data have been collected namely pavement conditions, road geometry and volume count are practically to understand the pavement condition of the particular location from which we can find out the need for maintenance and prioritize the section for repair works. The analytical procedure for calculating present serviceability index (PSI), pavement serviceability rating (PSI) and International Roughness Index (IRI) were carried out and from the result, the critical sections are found out. The PSI value for critical section stretch from chainage 12-19 and 33-41 (i.e. GST road to veerangal via puzhuthivakkam) were found out to be 2.6 (very poor according to the PSR index) hence immediate maintenance has to be carried out.

Key words: Roughness index, Analytical analysis, Priority.

INTRODUCTION

A Pavement Management System (PMS) is a planning tool that collects and monitors information on current pavement conditions, evaluates and prioritizes alternative maintenance, rehabilitation and reconstruction (repair) strategies. According to the definition of the American Association of State Highway and Transportation Officials (AASHTO), a pavement management system is a set of tools or methods that assist decision-makers in finding optimum strategies for providing, evaluating and maintaining pavements in a serviceable condition over a period of time. It has been shown that, implementing properly designed and developed PMS depends mainly on three factors: reliable data, realistic models for processing the data and user-friendly software for organizing the inputs and presenting the outputs.

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Based on the roughness index and traffic volume count sources and heavily distressed regions can be identified, which helps in analytical analysis. Analytical analysis involves the calculation of value of PSI, PSR and IRI. The present serviceability index (PSI) is based on the original AASHO Road Test PSR. Basically, the PSR was a ride quality rating that required a panel of observers to actually ride in an automobile over the pavement in question. Since this type of rating is not practical for large-scale pavement networks, a transition to a non-panel based system was needed. The International Roughness Index (IRI) is the roughness index most commonly obtained from measured longitudinal road profiles. It is calculated using a quarter-car vehicle math model, whose response is accumulated to yield a roughness index with units of slope (in/mi, m/km, etc.). These values require rutting depth, patching thickness and slope variance in meter. So these values are calculated manually and substituted to the formulae for PSI, PSR and IRI, which was proposed by AASTHO (American association of state highways and transport officials).

The objectives of this study are manifold and they are as follows:

- To identify the source and cause of several distress in selected road network.
- To collect the existing pavement condition data in the selected road.
- To conduct survey for traffic volume count, geometric feature and visual rating.
- To identify the origin of failure and neglect them in initial stages.
- To carry out analytical analysis for calculating PSR, PSI and IRI values.
- To prioritize critical section for routine maintenance, resurfacing and rehabilitation.

Site details

The site chosen to carry out for this study is inner ring road near puzhuthivakkam located in Chennai city in Tamilnadu. The sole purpose of making our study here is to provide an effective solution for the repair and rehabilitation that are necessarily to be carried out from GST road to veerangal, which has a width of 13.4 m and stretch about 4.7 km. The site chosen to explore and examine in our paper is inner ring road from GST road to veerangal. The Directions chosen to carry out roughness measurement are as follows.

- From Guindy GST road to veerangal stretch about 4.7 km with 47 chainages each 100 m, respectively.
- From veerangal to GST road via puzhuthivakkam which also stretch about 4.7 km with 47 chainages each 100 m, respectively.

Methodology

The methodology adopted for this study is shown in Fig. 1.

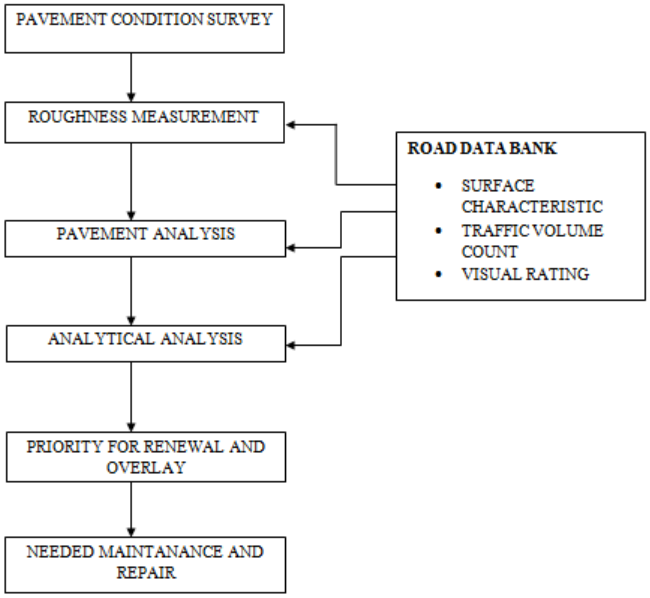

Fig. 1: Flowchart of the study

In order to identify the source of failure traffic volume count is carried out in the selected road stretch in accordance to IRC 106-1990. For the selected road network pavement condition survey for different types of distress is carried out using visual rating for every 100m chainage. The roughness measurement from visual rating was done and critical sections were identified. Volume count survey has been carried out to conclude the cause of failure.

Pavement indices were calculated using the manual method to prioritize out the most critical section among the total stretch. This analysis involves certain calculation such as PSR, PSI, and IRI whose equation is mentioned below.

$$PSR = 5 \text{ X } e^{(-0.0041 \text{ X IRI})}$$

Where, IRI = 0.593 + 0.0471D

D – Rut depth

$PSI = 5.03 – 1.91 \log (1 + Sv) – 1.38 (RD)^2 – 0.01 (c + p)^{1/2}$
Sv – slope variance ($Sv = 2.2704 \times IRI^2$)
C – Crack length in ft around 1000 Sqft region
P – Patching thickness in ft
RD – Rut depth in ft

RESULTS AND DISCUSSION

The volume count analysis shows that the stretches in the GST road and veerangal carry more volume of traffic during peak hours, which was shown in Figs. 2 and 3.

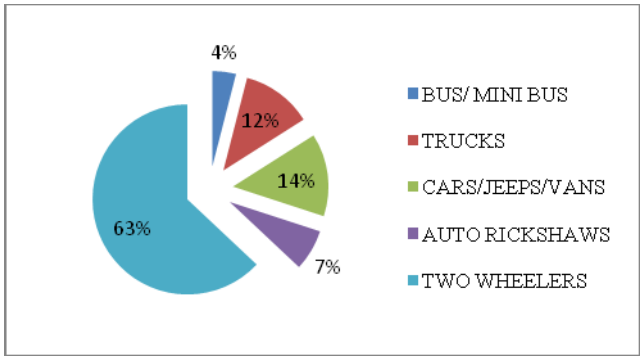

Fig. 2: Vehicle composition from veerangal to gst road

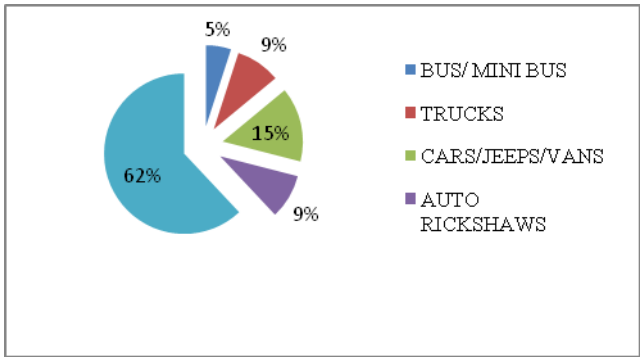

Fig. 3: Vehicle composition from GST road to veerangal

Traffic survey was conducted for selected road stretch during 3-6 pm. Totally 94 (47 + 47 for both lane) chain ages are made which has both distress and non distress road

surface. In roughness index measurement visual rating is carried out to identify the type and size of the distress, which then the distresses are categorized and the chain ages with maximum distress and severe priority are noted down for immediate maintenance and repair work. A graph is made between numbers of distress in the chain ages with total number of distressed chains. From the visual rating it shows the priority of chains, which has to be taken care immediately, the graph is shown below in figure 4. The chain ages 6, 12, 14, 60 stretches between GST road and veerangal are those with more than three distress and also posses severe condition of distress.

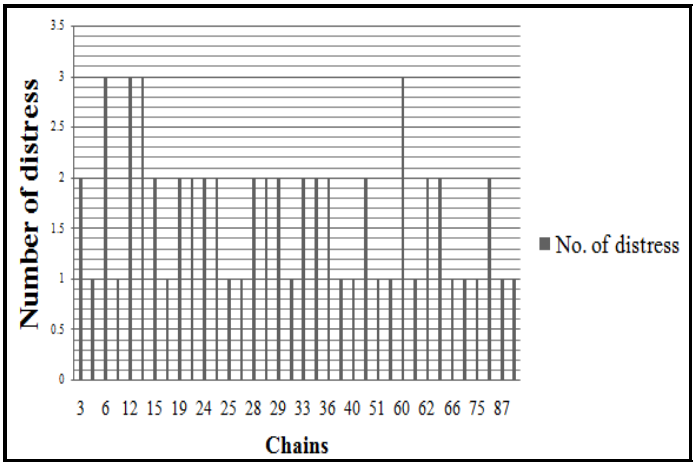

Fig. 4: Graph showing chains with more than two distresses

Analytical analysis is carried using the PSR and PSI values for which rut depth, slope variance and patching thickness is necessary. Those values are obtained by further site visit. The stretch with severe priority of distress which also posses rutting are selected for the calculation of these values. Once the PSR and PSI values have been calculated they are compared to show the difference between them. The PSR rating according to the standard is given below,

PSR Values
0 – 1 = Very poor
1 – 2 = Poor
2 – 3 =Fair
3 – 4 = Good

The PSR and PSI rating for critical section is shown in Table 1.

Table 1: PSI and PSR values of severity in chainages

Chainages	PSI	PSR	Severity
3 – 7 (Lane 1)	4.5	4.4	Very good
12 – 19 (Lane 1)	3.8	2.6	Fair
24 – 30 (Lane 1)	4.2	3.7	Good
33 – 41 (Lane 1)	4.1	2.6	Fair
13 – 15 (Lane 2)	3.5	4.5	Very good

A bar chart is made with PSR and PSI values to show the stretch that requires immediate maintenance or replacement. The graph is shown below. According to PSR scale the chainages from 12-19 & 33-41 from lane 1 has higher priority, which requires immediate maintenances. A comparative study of PSI and PSR was carried out and it is found out that the chain 12-19 critical for both the indices hence immediate maintenance is required for that several section.

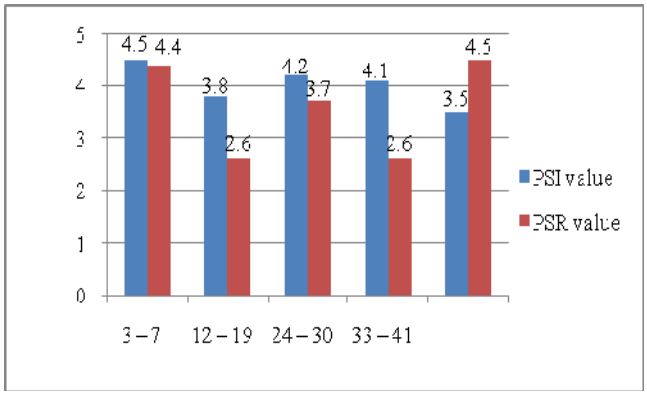

Fig. 5: PSR and PSI values on distressed chains

CONCLUSION

The present study helps to identify the critical road network where effective maintenances that should be required before the pavement fails completely. Different type of repair works to a specified distress can be matched. Source of distress can also be identified and failures may be neglected initially. According to PSR scale the chain ages from 12-19 & 33-41 from the stretch GST road to veerangal via puzhuthivakkam has higher priority, which require immediate maintenances. In the stretch 33-41 is in critical stage according to PSR values, which is good in PSI value. The difference in the values is due to the consideration

of variables namely rut depth, crack depth, patching thickness and slope variance. In case of PSR only rut depth value is used for the calculation of indices. Asphalt patching over the cracks and sealing over the rutting area are suggested. According to the PSR scale 2.6 is the value of fair priority that requires repairs and rehabilitation works only. If the values goes beyond 2 then resurfacing and replacement over the stretch is suggested. Based on the values of PSR & PSI obtained from selected stretch, origin of distress can be obtained for future use.

ACKNOWLEDGMENT

The authors would like to acknowledge the traffic police on the location to help us out to perform the entire study.

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Accepted : 04.05.2016