Crack Detection and Rating Analysis for Flexible Pavements

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ABSTRACT

Pavement condition assessment is one of the important components of pavement management system. Pavement maintenance strategy is decided on the basis of this assessment. There are various factors for pavement condition assessment like cracking, rutting, deflection, raveling, potholes etc. In this study, cracks are considered for rating of pavements as they are one of the important factors of pavement assessment. Longitudinal, transverse, fatigue and block cracking is considered for the study as they are frequently occurs in the flexible pavements. The said cracks are detected for selected road segments and measured as per Indian Road Congress guidelines. The measured cracks are analyzed for rating of pavement as very good, good, fair, poor, very poor. The rating is also done as per guidelines of Indian Road Congress.

Keywords: *Cracking, Flexible Pavement, Rating.*

I. INTRODUCTION

Evaluation of structural performance of flexible pavement is one of the important components of pavement management system. Major structural failure occurs because of cracking in the pavement. In this work detection and analysis of longitudinal cracks, Transverse cracks, Fatigue cracks and block cracks has been studied as these are frequently occurs in the pavement. Longitudinal and transverse cracking is because of poor drainage condition and temperature variation [10]. Thermal issues can lead to low-temperature transverse cracking if the asphalt cement is too hard [9].Fatigue cracking is caused by failure of the surface layer or base due to repeated traffic loading [9]. Block cracking is caused due to an inadequate pavement thickness and unstable condition of subgared and lower layers. They can also be due to lack of compaction during construction [9].

S. S. Jain et. al. (2005) [6] was developed HDM-4 pavement deterioration model in which cracking is considered as one of the parameters. Rushikesh P. Dangar et.al. (2011)[8] had analyzed the condition survey of NH8-B by considering severity of cracking. Umme Amina Mannan et. al. (2014) [7] was considered fatigue, longitudinal and transverse cracking as a distress parameter for evaluation of long term pavement performance on new Mexico SPS5 data. N.R. Avinash et.al.(2014) [1] has done condition rating of low volume flexible pavements by studying extents of cracking. Don Chen et.al. (2014) [2] had chosen transverse cracking, block cracking are part of the analysis to developed piecewise linear performance model. Dr. Pradeep Kumar Gupta et.al. (2015) [3] measured the distress by measuring crack area of pavements for developing optimum maintenance & rehabilitation strategy for urban bituminous concrete roads.

II. METHODOLOGY

1. Site Selection

For the study five different roads segments of Industrial area of Maharashtra Industrial Development Corporation (MIDC), Chakan are considered. All the roads are flexible pavements; asphalt roads. Details of roads are given in following Table 1. Two kilometer segment of each road is considered for experimentation work.

Table 1 Details of Road Project

Road	Land width (M)	Metal width (M)	Total length (Km)
I	20	5.5	2.15
II	60	16	4.925

III	45	7.5	5.3
IV	20	5.5	2.50
V	30	7.5	3.85

2. Methods for crack detection and measurement

Measurement of cracks is done by the following procedure of Bituminous Surface of Highways, Indian Roads Congress (IRC) 1982 [5].

- Longitudinal Cracks are predominantly parallel to the pavement centerline. The location within the lane (wheel path versus non-wheel path) is significant. Longitudinal cracks are measured in linear meter.
- Transverse Cracking is predominantly perpendicular to the pavement centerline and is not located over joints in underlying concrete pavements. Transverse cracks are measured in linear meter.
- Fatigue Cracking Occurs in areas subjected to repeated traffic loading (wheel paths). It can be a series of interconnected cracks in early stages of development. It develops into many-sided, sharp, angled pieces, usually less than 1 foot on the longest side, characteristically with a chicken wire alligator pattern in later stages. Fatigue cracks are measured in square meter.
- Block racking is a pattern of cracks that divides the pavement into approximately rectangular pieces. Rectangular blocks range in size from approximately 1 to 100 square feet. Measurement is done by selecting the typical size of the blocks and selects the appropriate standard block size and crack size.

For each 100 m length measurement of cracks has been done as per IRC 1982 [5]. Average values of cracks are shown in Table 2 to Table 4.

Table 2 Average values of cracking

Type of Cracking	Unit of Measurement	Road 1	Road 2	Road 3	Road 4	Road 5
Longitudinal Cracking	Meter	12.230	8.760	11.86	3.830	1.630
Transverse Cracking	Meter	02.992	00.000	2.000	0.000	5.220
Fatigue Cracking	Square Meter	12.700	10.563	0.000	0.000	0.000
Block Cracking	Square Meter	08.103	03.580	2.167	0.000	0.000

Average cracks in all the roads are shown in figure 2

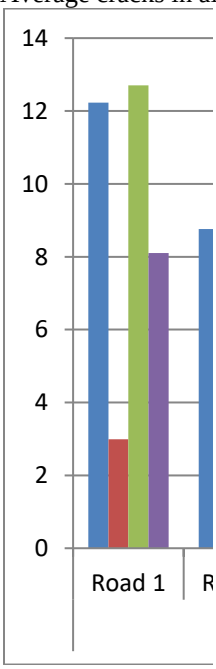

Fig. 1 : Images of onsite detection of cracks

Figure 2: Average cracking of all roads

Rating of roads is done on the basis of crack analysis. By using Guidelines for Maintenance Management of Primary, Secondary and Urban Roads, IRC, 2004 [4] pavements are rated as very poor, poor, fair, good and very good. As per IRC pavement condition rating for cracking is shown in Table 3 [4]

Table 3 Guide lines for pavement condition rating for cracking

Types of distress	**Range of Distress**				
Cracking (%) (Longitudinal, Transverse, Fatigue, Block)	>30	21-30	11-20	5-10	<5
Condition	Very Poor	Poor	Fair	Good	Very Good

For condition rating of roads on the basis of cracking total percentage cracking is calculated which is shown in figure 3

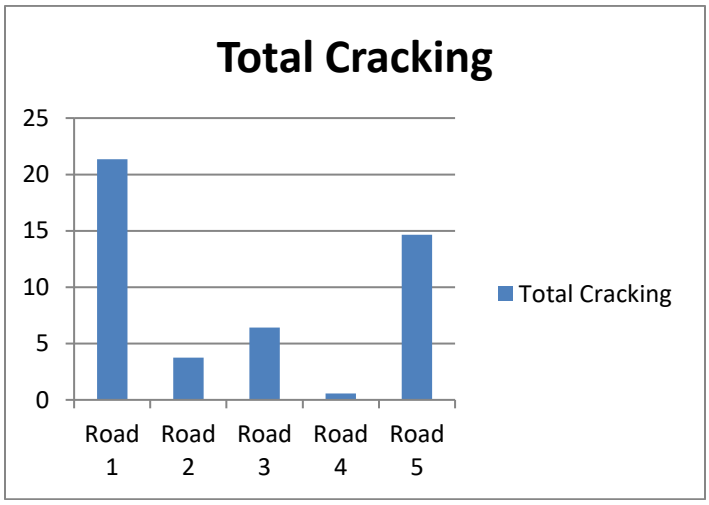

Figure 3: Total percentage cracking

III. RESULT & DISCUSSION

The range of longitudinal crack is 0.00 m to 16.00 m. Transverse cracks are found in the range of 0.00 m to 7.45 m. Fatigue cracking area is in the range of 0.00 Sq. Mt. to 13.75 Sq. Mt. Block cracking area is in the range of 0.00 Sq. Mt. to 24.45 Sq. Mt. Figure 3 shows that total percentage cracking is less than 5% in road 2 and 4 which indicates that these roads are in very good conditions. Percentage cracking in road 3 is in between 5 to 10 indicates the road is in good condition. Road five shows cracking in between 11 to 20 % which indicates road is in fair condition. And road 1 cracking is in between 21 % to 30 % which indicates road is in poor condition.

IV. CONCLUSION

In this paper study of cracks has been done. Longitudinal, transverse, fatigue and block cracks are considered for study as these cracks are frequently occurs in flexible pavements. Measurement of cracks is done as per IRC 82 and results are discussed. By considering guidelines for Maintenance Management of Primary, Secondary and Urban Roads, IRC, 2004, condition assessment of roads is done as very poor, poor, fair, good and very good.

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