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Rating and Condition Assessment of Urban Roads Based on Functional Distresses

Wadalkar Shruti S., Lad R. K., Jain R.K.

Abstract*: *The pavement management system deals with a pavement condition assessment. Rating of pavement can be done on the pavement condition assessment. Structural and functional distress is responsible for the failure of pavements. In this work, significant functional distresses which occur in flexible pavements are considered for the rating and assessment of road sections. The functional distress considered are Raveling, Potholes, Shoving, Patching, Depression, and Rutting as these are common and frequently occurred in the flexible pavements. The study of these distresses is done by authors. The measurement of distresses is done as per guideline given by the Indian Road Congress 1982 is used. For the condition, assessment guideline provided in Maintenance Management of Primary, Secondary, and Urban Roads, IRC, 2004, is used. Total five road section in the Pune region is considered for the study. All are flexible pavements. As Per assessment, it is observed that out of five segments, segment I and II are in fair to good condition, segment III is in very good condition. Segment IV and V are in very good and good condition, respectively.

Keywords* : *Pavement, Condition Assessment, Distress, Rating

I. INTRODUCTION

The pavement management system deals with a pavement condition assessment. Rating of pavement can be done on the pavement condition assessment. Flexible pavements are most commonly used. Indian states consist of around 90 % of roads constructed with flexible pavement [1]. Flexible pavement failure is defined by the formation of potholes, ruts, cracks, localized depressions, settlements, etc. [1]. Functional and materials failure is responsible for pavement failure [2]. Functional defects are mainly due to deformation and disintegration in the pavement surface. A pavement condition survey evaluates the functional properties of pavement. In the pavement condition survey, different types of distress like crack, potholes, etc. are identified and measured [3]. Deformation and deterioration are significant types of failure in flexible pavements. It may include rutting, shoving, depression, corrugation, and potholes [4, 5]. The researcher was identified weak spots of the pavement by observation for rutting, patchwork, potholes, and cracks [6]. Researchers have done visual inspection for rutting, potholes, cracks, and patchwork. They have identified defelection using Benkelman Beam, and visual observation correlates with each other as per IRC: 81-1997[7]. Some researchers have conducted a visual inspection for potholes, raveling, stripping, and cracks. They have conducted the Benkelman Beam test, and structural inadequacy was found [8]. Furthermore, some researchers were observed distresses such as cracking, patching, raveling, rutting, potholes, and roughness data was collected using fifth wheel BI (Bump Integrator) [9]. Pavement condition rating based on rutting, raveling, cracking, and International Roughness Index has been done [10].

In this study, functional distress is considered for the rating of pavements. The functional distress considered for the study is raveling, potholes, shoving, patching, depression, and rutting. Based on the functional distresses, rating of pavement as Very Poor, Poor, Fair, Good, Very Good is done. The evaluation is done as per the guidelines of the Indian Road Congress.

II. METHODOLOGY

The study is conducted on the five different sections of roads in the Pune region. The selected roads are flexible pavements. The identification and measurement of distress has been done in the selected section of roads. The selected distresses are Raveling, Potholes, Shoving, Patching, Depression, and Rutting.

Wearing of pavement surface in asphalt pavement is raveling. Raveling is caused by dislodging of aggregate particles and loss of asphalt binder. It is measured in the percentage of total surface area. Pothole is a Bowl-shaped hole of various sizes in the pavement surface. It is measured as total area in square meter. Shoving is a longitudinal displacement of a localized area of the pavement surface and measured as total area in square meter. Patching is a portion of the pavement surface, greater than 1 square foot that has been removed and replaced or additional material applied to the pavement surface after the original construction and measured as total area in square meter. Depression is the settlement of small, localized surface. Depth of depression is measured in meter. A rut is a longitudinal surface depression on the wheel path.

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* Correspondence Author
Shruti Wadalkar*, Civil Engineering Department,, DIT, Pimpri, Pune, Savitribai Phule Pune University ,Pune, India Email: wadalkarshruti@yahoo.in
Dr. R. K. Lad, Civil Engineering Department, JSPM Narhe Technical Campus, Pune, India, Savitribai Phule Pune University, Pune, India . Email: ranindraklad5@gmail.com
R. K. Jain, Civil Engineering Department, RSCOE, Pune, India, Savitribai Phule Pune University, Pune, India . Email: jainrb20@gmail.com

Rutting is measured as depth in mm Two Km section of road is considered from selected roads for distress measurement. Distresses are measured by using the procedure given in Indian Roads Congress (IRC) 2015 [11]. Figure 1 shows the images of detection and measurements of distress.

Figure1 : Images of detection and measurements of distress

The total values of distresses are shown in Table I.

Table – I : Total Values of Distresses

Types of Distresses	Road Section 1	Road Section 2	Road Section 3	Road Section 4	Road Section 5
Raveling	14.78	105.72	0	0	0
Potholes	16.61	8.72	11.66	0	26.99
Shoving	16.84	29.65	0	0	0
Patching	237.13	30.9	0	16.84	29.65
Depression	1.4	0.69	0.5	0	0
Rutting	159.98	104.71	0	0	57.37

In the Guidelines for Maintenance Management of Primary, Secondary and Urban Roads, IRC, 2004, pavement condition rating on different types of distresses is mentioned [11]. In this work rating of pavements is done by using these guidelines. The pavements are rated as very poor, poor, fair, good, and very good. As per IRC pavement condition rating is shown in Table II

Table – II: Guidelines for pavement condition rating for distresses

Defects in %	Range of Distresses in Percentage				
Raveling	>30	11 to30	6 to 10	1.0 to5	0
Potholes	>1	0.6 to 1.0	0.1 to 0.5	0.1	0
Shoving	>1	0.6 to 1.0	0.1 to 0.5	0.1	0
Patch	>30	16 to 30	6 to 15	2 to 5	<2
Depression	>5	3 to 5	Up to 2	Up to 1	0
Rutting	>50	21 to 50	11 to20	5 to10	<5
Rating	1	2	3	4	5
Condition	V. Poor	Poor	Fair	Good	V. Good

Source: Guidelines for Maintenance Management of Primary, and Urban Roads, IRC, 2004

The rating of roads is based on the percentage of each distress. The percentage of all the distresses are calculated and shown in Figure 2.

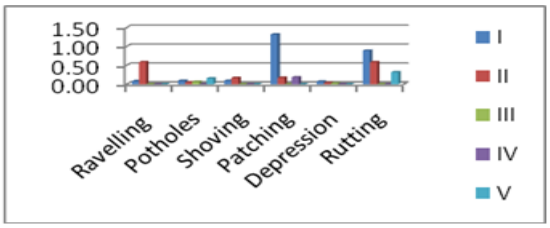

Figure 2: Percentage of Distresses

III. RESULT AND DISCUSSION

The rating of all the road section is done on the basis of distresses occurs in the respective road section. Rating is done considering the percentage of individual distress, and the average rating is calculated for each road section. Based on the average rating condition assessment of the road section is done. Table III indicates the rating and road condition based on the percentage of distress that occurred in the road sections.

As average rating of road section I is 3.83, which nearer to 4, condition of the road section is considered fair to good. Similarly, the condition of road sections II, III, IV, and V is fair to good, good to very good, very good, and good, respectively.

Table - III: Rating and condition of road section based on the distresses

Road Section	Rating on the basis of percentage of distress						Average Rating	Condition
	Raveling	Potholes	Shoving	Patching	Depression	Rutting		
I	5.00	4.00	4.00	5.00	4.00	1.00	3.83	Fair to Good
II	5.00	4.00	3.00	5.00	4.00	1.00	3.67	Fair to Good
III	5.00	4.00	5.00	5.00	4.00	5.00	4.67	Good to Very Good
IV	5.00	5.00	5.00	5.00	5.00	5.00	5	Very Good
V	5.00	3.00	5.00	5.00	5.00	1.00	4	Good

IV. CONCLUSION

In this work, major functional distresses are considered for the condition assessment of urban roads. Flexible pavements are considered for the study as the majority of urban roads are constructed as flexible pavements. Functional distresses Viz. Raveling, Potholes, Shoving, Patching, Depression, and Rutting are considered for the assessment as these are common and frequently occurred in the flexible pavements. Condition assessment of road is done based on the guideline for pavement condition rating given by Guidelines for Maintenance Management of Primary, Secondary, and Urban Roads, IRC, 2004.

As per the assessment, it is observed that out of five segments, segment I and II are in fair to good condition, segment III is in good to very good condition, segment IV and V are in Very good, and good condition respectively.

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AUTHORS PROFILE

Shruti Wadalkar, M.E., Research Scholar, DIT, Pimpri, Pune, India, Assistant Professor, DIT, Pimpri, Pune, Civil Engineering Department.

Dr. R. K. Lad, Ph.D., Professor, Research Guide, Civil Engineering Department, DIT, Pimpri, Pune, India, Director, JSPM Narhe Technical Campus, Pune, India.

Dr. R. K. Jain, Ph.D., Professor, Research Guide, Civil Engineering Department, DIT, Pimpri, Pune, India, Principal, RSCOE, Pune, India.

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