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Study of Pavement Performance Indicators: RII Approach

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Abstract

Objectives: In the present study, evaluation of Relative Importance Index (RII) of sixteen pavement performance indicators has been carried out. **Methods/Statistical Analysis**: For the study total sixteen indicators are considered which includes structural and functional indicators. Relative Importance Index is calculated by obtaining opinion of academician and professional experts from the field of transportation engineering. Questionnaire Survey methodology has been adopted for collection of experts opinion. Five linguistic terms are used for the same, which are, 'Very important', 'Important', 'Average', 'Less important' and 'Not important'. **Findings:** It has been observed from the values of RII, that, in case of flexible pavement deflection and potholes get maximum index followed by longitudinal cracking and Rutting. In case of rigid pavement Longitudinal cracking get maximum value followed by Transverse cracking. **Application/Improvements:** The values obtained from the study can be used for pavement condition evaluation incorporation with experimental evaluation of pavement surface condition for rating of pavements.

Keywords: Expert Opinion, Functional Indicators, Pavement Performance Indicators, Relative Importance Index, Structural Indicators

1. Introduction

Pavement condition evaluation (PCE) is a part of pavement management system. PCE is done by study of structural and functional indicators. The load carrying capability of the pavement structure decreases due to structural failure. Insufficient thickness, different types of cracks, distortion and disintegration leads to Structural deficiency. Rough driving surface and discomfort to user indicates functional deficiency. Less surface friction and bad texture, hydro planning and splash from wheel path, rutting and excess surface disintegration are the causes of functional deficiency. Potholes, corrugation, faulting, blow up, settlement; heaves etc. are the parameters of surface disintegration. The level of service provided by the road to the user is determined by functional condition. Vehicle Operating Costs is also affected by the level of service[1].

The study evaluated major structural and functional indicators for the pavement performance and their relative importance index is calculated by taking experts opinion. Structural capacity of road will be determined by deflection and cracking which includes fatigue cracking, longitudinal cracking, transverse cracking and block cracking, reflection cracking, micro cracking. Functional condition will be determined by using parameters like rutting, corrugation, shoving, potholes, patching, raveling, bleeding, pumping, drop-off, polished aggregates, depression.

1.1 Structural Indicators for Urban Pavement

Major Structural Indicators used in this study are explained here.

Deflection: Surface deflection is a function of traffic, pavement structural section, temperature and moisture

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affecting the pavement structure[2]; **Fatigue Cracking:** These cracks are characterized by interconnected**.** The cracking pattern resembles that of an alligator's skin,therefore, it is called as alligator cracking; **Longitudinal Cracking**: These Cracks are approximately parallel to centerline of pavement and are not in the path of the wheel. Longitudinal cracks are non-load associated cracks[3,4]; **Transverse Cracking:** Transverse Cracks are perpendicular to centerline of pavement. Thermal cracking is a type of transverse cracks[4]; **Block Cracking:** It resembles the pattern of rectangular blocks[4].

1.2 Functional Indicators for Urban Pavement

Some of the important Functional Indicators used for this study are explained here.

Rutting: It is a surface depression along the length of the path of the wheel of pavement under traffic[3,4]; **Corrugation:** Corrugations are the undulations appear transversely at regular interval[3,4.]; **Shoving:** It is the displacement of a localized area in the longitudinal direction[3,4]; **Potholes:** Bowl-shaped holes of various sizes in the pavement surface[3,4.]; **Patching:** It is the Portion of pavement surface which removed and replaced by additional material applied to the pavement after original construction[3,4]; **Raveling:** Raveling is the wearing away of the pavement surface which may be caused by the dislodging of aggregate particles and loss of asphalt binder[3,4.]; **Bleeding:** Excess bituminous binder occurring on the pavement surface is bleeding. A shiny, glass-like, reflective surface that may be tacky to the touch is occurred due to bleeding[4]; **Pumping:** It is ejection of water and fines through cracks of the pavement[4.]; **Drop-Off:** It is the difference in elevation between the traffic lane and the shoulder[4.]; **Polished Aggregates:** Coarse aggregates are exposed due to loosing of surface binder[4.]; **Depression:** depression is the settlement of surface due to rough ride of motorist[3,4].

2. Past Research Work

Pavement condition evaluation was done by previous workers considering five performance indicators which are roughness, deflection, surface deterioration, rutting, and skid resistance[5]. In an another work, pavement condition assessment was done by considering seventeen distresses[6].

Fifty-nine factors contributing to the quality of pavement performance in Saudi Arabia have been explained and are ranked accordingly to their effective index[7]. Researchers were developed Pavement maintenance plan by considering the data of pavement condition like road surface roughness, deflection & traffic volume etc[8]. A model between roughness index and distresses were developed. Five distress parameters i.e. Rut depth, Total area of cracks, Area of potholes, Area of patchwork and Reveling were considered[9]. Researchers in their work categorize the distresses like Rutting and cracking (Transverse; Longitudinal Cracking; and Reflecting) by using used fuzzy logic[10]. Pavement performance assessment has been carried out by some researchers in which they considered five distress parameters including International Roughness Index, rutting and cracking (fatigue, longitudinal and transverse)[11]. Pavement condition assessment was made by considering pavement distress types. Structural Cracks like block, crocodile, etc.

Deformation like rutting & undulations, disintegration i.e. aggregate loss, potholes, patches, edge break and functional deficiency like riding quality, bleeding, surface drainage, shoulder condition were considered for the assessment[12]. Researchers have developed pavement maintenance management system by using visual inspection technique for evaluating the Asphalt Concrete pavement surface condition. Common types of asphalt concrete distress like bleeding, patching, and cracking like block; edge; longitudinal and transverse, rutting, potholes, longitudinal and transverse deformation were considered[13].

From past research work it is observed that pavement performance assessment has been done by considering mainly structural or functional indicators or by considering both. So in this study an attempt is made to find out relative importance of structural and functional indicators in the pavement performance assessment.

3. Methodology

In this work experts' opinion is taken for the identified performance indicators. A compressive questionnaire has prepared for taking expert opinion. Questionnaire survey has been done in which five linguistic terms are used i.e. very important, important, average, less important and not important. Separate questionnaire has prepared for

flexible pavement and rigid pavement. For the survey Academician and professional experts from transportation field as respondents are considered. Total sixty questionnaires are send out of which response is given by fifty respondents.

3.1 Relative Importance Index (RII)

The RII for each indicator is computed to identify the most significant indicator for pavement performance. RII is computed by using equation no. (1) For computing RII, five point Likert scale is used which indicates 1 for Not important, 2 for Less Important, 3 for Average, 4 for Important and 5 for very important. These weightage are transferred to RII for each indicators as follow[13]:

RII = ∑ W/ (A*N) (1)

Where, W - Weighting given to each factor by the respondents (1 -5)

A - Highest Weight (5)

N - Total number of respondents

Higher the value of RII more important is the indicators. Separate values are found out for flexible and rigid pavements.

4. Results and Discussion

Figure 1 shows the graphical representation of RII values for flexible and rigid pavements. For flexible pavement maximum RII is obtained for deflection 0.87 followed by potholes 0.86 and minimum is for polished aggregates that are 0.49. For rigid pavement maximum RII is obtained for longitudinal cracking 0.94 followed by transverse cracking 0.87 and minimum is for polished aggregates that are 0.48.

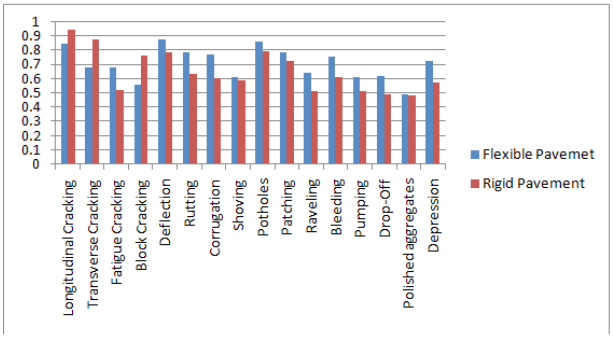

Figure 1: Comparison of RII for Flexible Pavement and Rigid Pavement

Figure 1. Comparison of RII for Flexible Pavement and Rigid Pavement.

5. Conclusion

In this study, an evaluation of pavement performance is done by using Structural and functional Indicators. Deflection, fatigue cracking, longitudinal cracking, transverse cracking, block cracking, reflection cracking and microcracking are the important structural indicators.

The important functional indicators are rutting, corrugation, shoving, potholes, patching, raveling, bleeding, pumping, drop-off, polished aggregates, depression.

From RII value it is observed that, in the flexible pavement deflection and potholes get maximum index followed by longitudinal cracking and Rutting. In the rigid pavement Longitudinal cracking get maximum value followed by Transverse cracking.

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