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“EVALUATION OF EXISTING FLEXIBLE PAVEMENT CONDITION USING MANUAL SURVEY

METHOD: A CASE STUDY OF RATIBAD–MUNGALIYA ROAD, BHOPAL ”

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ABSTRACT

This paper presents a survey of numerous papers and different procedures of Transmission line Protection over a previous decade. Electrical force transmission lines convey electrical power and thus, have been the significant component of intensity framework as the force progression is concerned. Force progression is a significant worried for any force framework, consequently brokenness anytime of intensity framework results into major efficient misfortune. Fake Neural Network is a delicate processing technique, which, when prepared, can substitute customary separation transfers or mathematical transfers with a bit of leeway that it changes itself with the changing organization designs. Because of attributes of Artificial Neural Networks, for example, design acknowledgment, speculation, adaptation to internal failure, rapid equal preparing, it can distinguish, arrange and find the shortcomings. The primary target of this venture is to build up an incorporated Artificial Neural Network based insurance plot, that can resolve the issues related with customary separation security methods. In this theory, back spread calculation based Artificial Neural Network will be created. For mistake minimization, Gradient Descent strategy will be utilized. The presentation of ANN, at that point can be contrasted and the written works accessible.

Key Words: Artificial Neural Networks, Power, Transmission line, economical.

I. INTRODUCTION

Flexible pavements are widely used in highway construction due to their cost-effectiveness and adaptability. However, these pavements are prone to deterioration under the combined effects of traffic loading, environmental conditions, and material degradation. The evaluation of pavement condition is essential to identify distress types, determine their causes, and recommend appropriate maintenance strategies.

Pavement deterioration manifests in the form of cracking, rutting, potholes, and surface disintegration, which adversely affect riding quality and safety. Early detection and systematic evaluation of these distresses can significantly reduce maintenance costs and extend pavement life.

This study focuses on the evaluation of an existing flexible pavement using a manual survey method. The selected road stretch between Ratibad and Mungaliya in Bhopal serves as a case study to analyze distress patterns and their underlying causes.

II. LITERATURE REVIEW

Previous studies have emphasized the importance of pavement condition evaluation in maintaining road performance. Adling and Gupta (2013) highlighted that pavement deterioration is influenced by traffic loading, environmental

factors, and construction quality. Adefemi and Ajibola (2015) conducted pavement assessment studies and concluded that inadequate maintenance leads to rapid deterioration of road surfaces.

Researchers have also explored various evaluation techniques such as visual inspection, Pavement Condition Index (PCI), and roughness measurements. ASTM D6433 provides a standardized method for PCI evaluation based on distress type, severity, and density.

The literature indicates that most pavement failures are caused by:

- Overloading and increased traffic volume
- Poor drainage and moisture ingress
- Inadequate pavement thickness
- Poor construction practices

However, limited studies focus on manual evaluation methods for rural roads, which this study addresses.

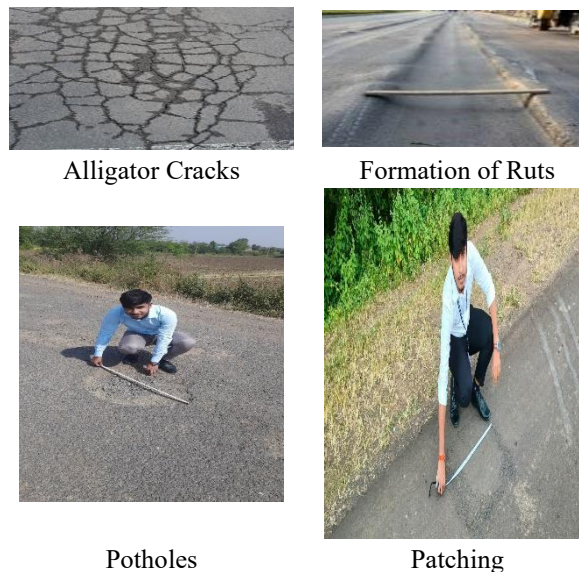


Figure 1: Type of Cracks and Patterns on Flexible Pavement

III. METHODOLOGY

The present study adopts a systematic and structured approach for evaluating the condition of an existing flexible pavement using manual survey techniques. The methodology integrates field data collection, distress identification, quantitative assessment, and analytical interpretation to determine pavement condition and underlying causes of deterioration.

The evaluation process primarily relied on visual inspection and manual measurement methods. Field surveys were conducted by walking along the pavement stretch and systematically recording various types of distresses, including cracking, potholes, ravelling, and rutting. The identification of distress types was carried out based on standard definitions and classification systems, ensuring consistency and reliability in observations.

For each segment, the extent and severity of distress were quantified. Cracking was measured in terms of percentage area affected within the segment, while potholes were counted based on their number and distribution. Ravelling was assessed as a percentage of surface area affected, indicating the degree of aggregate loss. Rutting depth was measured using scale-based observations, considering both left and right wheel paths, and the average rut depth was calculated for accuracy.

The methodology also incorporates principles of the Pavement Condition Index (PCI) approach as per ASTM standards, where distress density is calculated based on observed data. Although full PCI computation was not explicitly performed, the study follows similar concepts by evaluating distress type, extent, and severity. The distress density values can be correlated with deduct values to assess overall pavement condition.

Data collected from field surveys were tabulated and analyzed to identify trends and critical zones of deterioration. Chainage-wise variation of different distresses was examined to determine sections with maximum damage. Comparative analysis of different distress types was carried out to understand dominant failure mechanisms. In addition, qualitative assessment was performed to identify probable causes of pavement failure, including traffic loading, drainage conditions, material quality, and construction practices. The relationship between observed distresses and their causes was established based on engineering judgment and supporting literature. The overall methodology ensures a comprehensive evaluation of pavement condition using simple, cost-effective, and practical techniques. The approach is particularly suitable for rural and low-volume roads where advanced equipment-based evaluation methods may not be feasible.

IV STUDY AREA

The present study was conducted on a selected stretch of flexible pavement located between Ratibad and Mungaliya in Bhopal district, Madhya Pradesh, India. This road segment forms an important link connecting suburban and semi-rural areas to the main urban network of Bhopal, thereby facilitating the movement of passengers, agricultural produce, and commercial goods. Due to its strategic importance, the road experiences a mix of traffic, including light vehicles, two-wheelers, and a considerable proportion of heavy vehicles such as trucks and buses. The total length of the study stretch is approximately 10 km, consisting of a single-lane flexible pavement with shoulders in varying conditions. The road passes through semi-urban and rural surroundings, where traffic patterns are irregular and often exceed the designed capacity of the pavement. The increase in traffic volume over time, particularly heavy axle loads, has contributed significantly to the deterioration of the pavement. Geographically, the study area lies in a region characterized by moderate climatic conditions with distinct summer and monsoon seasons. The monsoon period plays a critical role in pavement performance, as water infiltration due to inadequate drainage systems weakens the subgrade and accelerates pavement distress. The soil in the region is generally of medium to low bearing capacity, which further influences pavement behavior under repeated loading. The pavement structure along the study stretch is typical of rural roads, consisting of bituminous layers over granular base and sub-base courses. However, variations in construction quality, material properties, and maintenance practices are evident along different segments of the road. The selected study area provides a representative case for evaluating flexible pavement performance under real field conditions, particularly in semi-urban and rural environments. The diversity in traffic loading, environmental exposure, and construction practices makes it suitable for analyzing various types of pavement distresses and their underlying causes.

V. RESULTS AND ANALYSIS

The evaluation of the selected flexible pavement stretch was carried out by analyzing key distress parameters, namely cracking, potholes, ravelling, and rutting. The results obtained from field observations were organized segment-wise and interpreted to assess the condition and performance of the pavement. Each parameter is discussed in detail to understand its severity, distribution, and impact on overall pavement performance.

5.1 Cracking Analysis

Cracking was observed as one of the most prominent distresses along the study stretch. The cracks were primarily identified as longitudinal, transverse, and alligator cracks, indicating both functional and structural failures. The extent of cracking was quantified as a percentage of the affected area within each segment.

The results indicate that cracking severity increases significantly between chainages 3 km to 5 km, where up to 20–25% of the pavement surface was found to be affected. This level of cracking suggests fatigue failure due to repeated traffic loading and inadequate structural capacity of the pavement layers. In other sections, cracking was relatively moderate, ranging between 5% and 15%.

The presence of alligator cracking in certain segments indicates structural failure of the pavement, often caused by insufficient pavement thickness or weak subgrade support. Longitudinal and transverse cracks, on the other hand, are primarily associated with temperature variations and shrinkage effects.

5.2 Pothole Analysis

Potholes were observed in several segments, particularly in areas subjected to heavy traffic and poor drainage conditions. The number of potholes was recorded per segment and used as an indicator of pavement deterioration severity.

The analysis shows that the highest concentration of potholes was observed between chainages 6 km to 8 km, where the frequency exceeded 8–10 potholes per km in certain sections. These potholes are primarily formed due to the progressive disintegration of pavement layers following cracking and water infiltration.

The occurrence of potholes significantly affects ride quality and safety, and their presence indicates advanced stages of pavement failure. The results suggest that lack of timely maintenance and inadequate drainage are major contributing factors.

Table 1: Field Observations Cracks, Potholes and Ravelling

Chainage (km)		Cracks Area (%)	Potholes nos.	Ravelling Area (%)
From	To			
0	0.5	0	0	0
0.5	1	2	1	5
1	1.5	0	0	0
1.5	2	4	0	5
2	2.5	5	2	25
2.5	3	5	5	5
3	3.5	10	7	10
3.5	4	20	6	6
4	4.5	25	9	5
4.5	5	15	7	10
5	5.5	10	6	5
5.5	6	15	3	5
6	6.5	5	2	15
6.5	7	5	10	25
7	7.5	10	7	15
7.5	8	20	12	3
8	8.5	15	9	5
8.5	9	12	8	10
9	9.5	8	3	5
9.5	10	1	1	5

5.3 Ravelling Analysis

Ravelling, characterized by the progressive loss of aggregates from the pavement surface, was observed in multiple segments. The extent of ravelling was measured as a percentage of the affected surface area.

The results indicate moderate to severe ravelling in mid and later sections of the road, with affected areas ranging between 10% and 20%. This distress is primarily attributed to the aging of bituminous binder, poor bonding between aggregates, and environmental effects such as oxidation.

Ravelling reduces the skid resistance of the pavement surface and accelerates further deterioration by exposing underlying layers. It is often an early indicator of surface failure and requires preventive maintenance measures such as surface dressing or seal coats.

5.4 Rutting Analysis

Rutting was observed along the wheel paths of the pavement and measured in terms of rut depth. The recorded values ranged between 2 mm and 4 mm across different segments.

Although the rut depth is within moderate limits, it indicates the onset of permanent deformation due to repeated traffic loading, particularly heavy axle loads. Rutting is more prominent in sections with higher traffic intensity and weaker subgrade conditions.

Excessive rutting can lead to water accumulation in wheel paths, increasing the risk of hydroplaning and further structural damage. The observed rutting suggests the need for strengthening of pavement layers in critical sections.

Table 2; Measurement of Rutting

Chainage (km)		Rutting (mm)		
From	To	(Left Depth)	(RightDepth)	(Avg. Depth)
0.000	0.500	0.0	0.0	0.0
0.500	1.000	2.00	3.00	1.50
1.000	1.500	2.00	2.00	2.00
1.500	2.000	2.00	2.00	2.00
2.000	2.500	3.00	4.00	3.50
2.500	3.000	2.00	2.00	2.00
3.000	3.500	3.00	2.00	2.50
3.500	4.000	2.00	4.00	3.00
4.000	4.500	3.00	3.00	3.00
4.500	5.000	3.00	3.00	3.00
5.000	5.500	3.00	3.00	3.00
5.500	6.000	3.00	2.00	2.50
6.000	6.500	3.00	3.00	3.00
6.500	7.000	4.00	2.00	3.00
7.000	7.500	3.00	3.00	3.00
7.500	8.000	3.00	4.00	3.50
8.000	8.500	2.00	2.00	2.00
8.500	9.000	3.00	2.00	2.50
9.000	9.500	3.00	3.00	3.00
9.500	10.000	3.00	4.00	3.50

5.5 Comparative Analysis of Distress Parameters

A comparative evaluation of all distress parameters reveals that cracking and potholes are the dominant forms of pavement deterioration in the study area. Ravelling contributes to surface degradation, while rutting indicates structural deformation under load.

The spatial variation of distresses shows that different segments of the road are affected by different failure mechanisms. For example, mid-sections exhibit higher cracking and ravelling, while later sections show increased pothole formation.

5.6 Identification of Critical Sections

Based on the severity and combination of distresses, the most critical sections of the pavement were identified between:

- **Chainage 3–5 km** → High cracking (structural failure)
- **Chainage 6–8 km** → High pothole density (advanced deterioration)

These sections require immediate maintenance intervention to prevent further degradation.

5.7 Causes of Pavement Deterioration

The analysis of results indicates that pavement deterioration is influenced by multiple factors, including:

- Heavy traffic loading exceeding design capacity
- Poor drainage leading to water infiltration
- Inadequate pavement thickness and weak subgrade
- Aging and oxidation of bituminous materials
- Lack of timely maintenance

VI CONCLUSION

The present study focused on the evaluation of an existing flexible pavement along the Ratibad–Mungaliya road stretch using manual survey techniques. Based on detailed field investigations and analysis of key distress parameters such as cracking, potholes, ravelling, and rutting, the following conclusions are drawn:

The pavement condition varies significantly along the study stretch, indicating non-uniform performance influenced by traffic loading, environmental conditions, and construction quality. Among the observed distresses, cracking and potholes were identified as the most dominant forms of deterioration. The presence of alligator cracking in certain

segments clearly indicates structural failure of the pavement layers, primarily due to repeated traffic loading and inadequate pavement thickness.

The analysis revealed that critical sections between chainages 3–5 km and 6–8 km are severely deteriorated, with high cracking intensity and pothole density, respectively. These sections require immediate maintenance and rehabilitation to restore structural integrity and ensure safe traffic movement. Ravelling observed in several segments suggests aging and loss of binding strength of bituminous material, while rutting indicates the onset of permanent deformation under repeated axle loads.

The study highlights that inadequate drainage plays a significant role in accelerating pavement deterioration by allowing water infiltration into the subgrade, thereby reducing its load-bearing capacity. Additionally, the lack of timely maintenance interventions has contributed to the progression of minor surface defects into major structural failures.

The manual survey method adopted in this study proved to be a simple, cost-effective, and reliable approach for pavement condition assessment, particularly suitable for rural and low-volume roads where advanced equipment may not be available. The methodology enables effective identification of distress types, severity levels, and critical sections requiring attention.

Overall, the study emphasizes the importance of periodic pavement evaluation and preventive maintenance strategies to extend pavement life and reduce rehabilitation costs. Implementation of timely repair measures such as crack sealing, pothole patching, surface dressing, and improvement of drainage systems can significantly enhance pavement performance. The findings of this study provide valuable insights for highway engineers and policymakers in planning efficient maintenance and management of flexible pavements. These results confirm that the combination of coconut shell and sand filtration provides an effective treatment mechanism, where sand removes suspended particles and coconut shell enhances adsorption of dissolved contaminants.

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