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Priority of Roads for Maintenance based on PCI Index: A Case Study of Radhanagari

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ABSTRACT: Road maintenance is a critical aspect of infrastructure management, significantly influencing the overall functionality and lifespan of road networks. This study focuses on prioritizing road maintenance in the Radhanagari region using the Pavement Condition Index (PCI) as a key evaluation metric. The PCI method evaluates pavement conditions based on surface distresses, providing a quantitative score that aids in the systematic categorization of maintenance needs. The research involves surveying selected road segments within Radhanagari, recording data on surface deterioration, and calculating the PCI values. These values are then analyzed to rank the roads according to their maintenance priority. The study identifies the critical thresholds for immediate intervention and categorizes roads into priority groups: urgent, medium, and low

KEYWORDS: Pavement Condition Index (PCI), Weightage rating value, flexible pavement.

I. INTRODUCTION

Road infrastructure plays a vital role in the economic development and social well-being of any region. Efficient road networks ensure the smooth movement of goods, services, and people, contributing to regional growth and connectivity. However, roads are subject to gradual deterioration due to factors such as traffic load, environmental conditions, and inadequate maintenance. This necessitates regular monitoring and timely interventions to preserve the quality and functionality of the road network. In the context of limited resources, prioritizing road maintenance becomes a critical task for local authorities. One of the most effective methods for assessing road conditions is the Pavement Condition Index (PCI). The PCI provides a standardized framework for evaluating road surface conditions by quantifying pavement distress into a numerical score. This score serves as a basis for determining maintenance priorities, ensuring that interventions are both timely and cost-effective. The Radhanagari region, with its growing transportation demands and diverse climatic conditions, faces significant challenges in maintaining its road network.

II. PROBLEM DEFINITION

The condition of road infrastructure plays a crucial role in ensuring safe and efficient transportation. In Radhanagari, deteriorating road conditions due to factors such as traffic load, environmental conditions, and inadequate maintenance have led to increased travel time, higher vehicle operating costs, and road safety concerns. However, due to budget constraints, it is essential to prioritize road maintenance based on an objective evaluation method. The Pavement Condition Index (PCI) is a widely used method for assessing road conditions and determining maintenance priorities. This study aims to evaluate the existing road network in Radhanagari, classify roads based on their PCI ratings, and propose a maintenance plan that optimizes resource allocation.

III. LITERATURE REVIEW

1. Zafar S. Muhammad et al. (2019) "worked to preserve and rehabilitate pavements for the serviceability necessary." The assessment of the present state of a pavement network and anticipation of potential conditions is a critical element of the pavement management system (PMS). The Lakhi larkana national highway was chosen for the analysis and the Pavement Condition Index (PCI) was calculated.

2. Karim M. A. Fareed et al. (2016) “examined the state of surface of roads, recognize repair and rehabilitation needs in Yemen. By using PAVER software (1982) condition rating procedure as defined in technical manual TM 5-623”, the author assessed pavement condition in terms of surface distress. First, they inspect the sample device, identify the type of distress, the degree of intensity, and then calculate the density.
3. Andrei Radu et al. (2015) “using basic pavement condition metrics, assessed the efficiency of flexible pavements.” The pavement serviceability index (PSI), pavement condition index (PCI), skid resistance (SR) and pavement damage were different parameters used in the analysis (consumed life). The PSI was assessed using the AASHTO road test. That ranges from 0-5.0 being the worst pavement condition and the best condition being 5.
4. Zumrawi M.E. Magdi (2015) “The analysis of traffic volume and data on riding quality were also considered.” Thanjavur (TM) pavements were found to have pavement condition index (PCI) values ranging from 45-60 in which 25% of cracks, 20% of patches, and 15% of potholes were found on both sections. It was concluded that the degree and quantity of cracking and patching values play a vital role in the pavement condition index (PCI) does not require any priority-based maintenance operation and pavements with lower pavement condition index requires maintenance on priority.

IV. FUTURE SCOPE

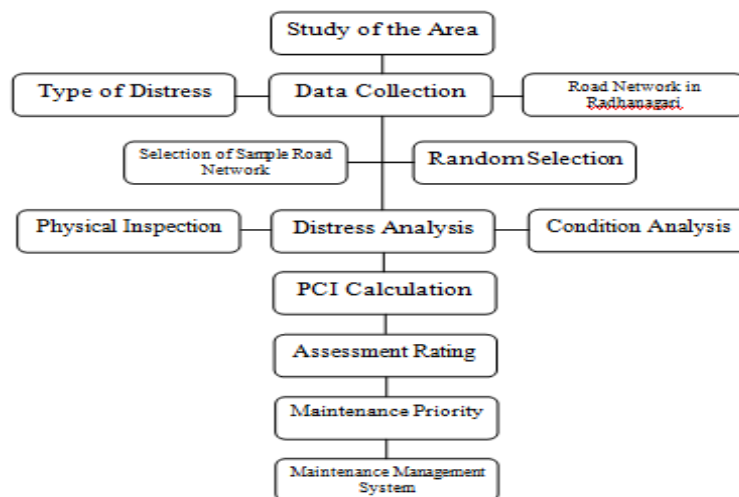
1. Integration with Advanced Technologies

The incorporation of advanced technologies such as Geographic Information Systems (GIS) and remote sensing can enhance the accuracy and efficiency of road condition assessments. Mapping the road network with geospatial data can provide detailed insights, enabling better visualization and planning of maintenance activities.

2. Automation of Data Collection

Implementing automated data collection methods, such as drones and vehicle-mounted sensors, can reduce manual efforts and improve the consistency of PCI evaluations. These technologies can capture real-time data on pavement conditions, allowing for dynamic updates to maintenance plans.

V. METHODOLOGY



VI. STUDY AREA INFORMATION

1. Introduction to the Study Area

Radhanagari is a town and taluka in the Kolhapur district of Maharashtra, India. It is well known for its Radhanagari Dam, built on the Bhogawati River, which plays a crucial role in irrigation and hydroelectric power generation. The region has a mix of rural and semi-urban settlements, with significant agricultural and tourism-based activities.

2. Geographic Location

- Latitude & Longitude: Approximately 16.397°N, 73.957°E
- Elevation: Around 600 meters above sea level
- Climate: Moderate to heavy rainfall due to proximity to the Western Ghats, with monsoon dominance from June to September.
- Topography: Hilly terrain with forests, farmlands, and a mix of asphalt and gravel roads.

3. Road Network in Radhanagari

- The road network in Radhanagari consists of:
- National & State Highways: Connecting Kolhapur, Gaganbawda, and nearby talukas.
- District Roads: Serving as arterial connections between villages.
- Rural & Village Roads: Providing last-mile connectivity.

VII. DATA ANALYSIS & RATING**Total Distress area in Radhanagari Tehsil:**

Below table shows the common distress found in Radhanagari tehsil in percentile area. Also it shows the contribution of all distress in percentile. Generally we found six distress in every road segment these are alligator cracking, Edge cutting, Longitudinal and transverse cracking, patching, Potholes, and raveling. In that potholes have large amount of distress area. The state highways are constructed recently so there is negligible distress are found

VIII. ADVANTAGES & DISADVANTAGES**ADVANTAGES**

- 1. Objective Assessment**
PCI provides a standardized, numerical value (0–100) that reflects pavement condition, making comparisons between roads easy and consistent.
- 2. Data-Driven Decision Making**
Maintenance can be prioritized based on actual pavement conditions rather than subjective judgment or political influence.
- 3. Efficient Resource Allocation**
Limited maintenance budgets can be allocated to roads in greatest need or with highest usage, improving cost-effectiveness.

DISADVANTAGES

- 1. Data Collection is Time-Consuming and Costly** Conducting PCI surveys requires trained personnel and can be resource-intensive, especially for large or rural areas.
- 2. May Not Capture All Road Priorities** Roads with lower PCI might be less critical than slightly better roads with higher traffic volume—PCI doesn't account for road usage or strategic importance.

IX. APPLICATIONS

- 1. Road Network Management** PCI helps local authorities in Radhanagari monitor the health of the entire road network, enabling systematic planning and timely intervention.
- 2. Maintenance Planning and Scheduling** Based on PCI ratings, roads can be categorized into maintenance types: preventive (good condition), corrective (fair), or rehabilitative (poor), allowing for effective scheduling.
- 3. Budget Optimization** By identifying roads in urgent need of repair, PCI supports optimal allocation of limited funds, reducing unnecessary spending on roads in good condition.

X. PHOTO VIEW



XI. CONCLUSION

The study on prioritizing roads for maintenance using the Pavement Condition Index (PCI) in the Radhanagari region provides a systematic and data-driven framework for efficient road management. By evaluating road conditions based on surface distress and assigning numerical PCI values, this method ensures an objective prioritization of maintenance activities.

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