RESEARCH PAPER

Premature Settlement Of Village Roads In Waghodia Taluka: Causes And Remedies

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Abstract
Rural road infrastructure plays a crucial role in national development by ensuring connectivity between villages and economic centers. However, premature settlement and failure of rural roads have emerged as a significant concern in India despite substantial financial investments under programmes such as the Pradhan Mantri Gram Sadak Yojana. This study investigates premature settlement observed in village roads of Waghodia Taluka, Gujarat, where expansive black cotton soil dominates the subgrade. Field observations, laboratory testing, and engineering evaluation indicate that low bearing capacity, inadequate compaction, and poor drainage are primary causes of failure. The study proposes practical quality control and verification methods to improve pavement performance and reduce life-cycle costs.

Keywords: Rural roads, premature settlement, black cotton soil, drainage inadequacy, construction quality
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1 Introduction

Rural roads form the backbone of economic and social development by enabling mobility of goods, services, and people. In India, large-scale investments have been made to expand rural connectivity. However, the performance of many roads remains unsatisfactory due to premature structural failures.

In Waghodia Taluka, several village roads show early signs of settlement, rutting, and cracking within a few years of construction. The region is dominated by black cotton soil, which exhibits high plasticity and low strength characteristics. These soils undergo significant volume changes due to seasonal moisture variations, leading to instability of the pavement structure.

The present study focuses on identifying engineering causes of premature settlement and providing practical solutions that can be implemented within existing construction practices.

2 Literature Review

Previous studies have established that pavement performance is strongly influenced by subgrade strength, compaction quality, and drainage conditions. Black cotton soil has been widely recognized as problematic due to its swelling and shrinkage behavior. Research indicates that subgrade soils with CBR values less than five percent are unsuitable for supporting flexible pavements without stabilization. In addition, inadequate compaction during construction leads to increased void ratio, reduced stiffness, and higher susceptibility to deformation under traffic loads.

Drainage plays a vital role in maintaining pavement stability. Poor drainage leads to water accumulation, reducing soil strength and accelerating pavement deterioration. Despite these findings, many rural road projects fail to implement these principles effectively at the field level.

3 Research Gap

Despite significant financial investment in rural road development across India, premature failure remains a persistent issue. Existing research primarily focuses on design methodologies and theoretical performance models, while limited attention is given to construction-stage quality control and verification practices.

A major gap exists in ensuring proper assessment of soil properties before its use as embankment material. In many rural projects, locally available soil is used without adequate laboratory testing to verify parameters such as bearing capacity, plasticity, and compaction characteristics. Additionally, field-level practices often deviate from prescribed standards due to lack of supervision and testing.

The increasing traffic load due to population growth and rising vehicle usage further intensifies the problem. However, construction practices have not evolved to meet these demands. This gap between design specifications and actual execution results in premature settlement, increased maintenance cost, and inefficient utilization of public resources

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4 Contribution of Present Study

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The present study addresses the identified gap by focusing on practical engineering solutions rather than theoretical design alone. It integrates field observations, laboratory testing, and quality verification methods to evaluate pavement performance.

The study proposes a structured approach for soil selection, compaction control, and drainage improvement. It emphasizes mandatory laboratory testing of soil properties before use, ensuring compliance with required standards. Field density testing is recommended to verify compaction levels, while strict control over layer thickness is suggested to maintain structural integrity.

In addition, the study highlights the importance of drainage systems in preventing moisture ingress and maintaining subgrade strength. The proposed methodology is practical, cost-effective, and suitable for implementation in rural road projects.

By improving construction quality, the study demonstrates that pavement life can be significantly extended, thereby reducing maintenance costs and enhancing sustainability.

5 Methodology

The study is based on field investigation, laboratory testing, and comparative analysis with standard specifications.

Field observations were conducted along selected road stretches in Waghodia Taluka to assess settlement, rutting, and drainage conditions. Soil samples were collected and tested for key parameters including California Bearing Ratio, plasticity index, and compaction characteristics.

Core cutting was carried out to verify pavement layer thickness, while field density tests were performed to evaluate compaction levels. The collected data were compared with standards prescribed by Indian Roads Congress and Ministry of Road Transport and Highways.

6 Results and Discussion

The analysis revealed that subgrade soils have low bearing capacity with CBR values ranging from two percent to five percent. These values are below acceptable limits for flexible pavement construction.

Field density results indicate that compaction achieved at site is significantly lower than the required ninety-five percent of maximum dry density. This leads to increased settlement under traffic loading.

Drainage conditions were found to be inadequate, with absence of proper side drains and water stagnation observed in several locations. This results in reduction of soil strength and accelerates pavement deterioration.

The combined effect of weak soil, poor compaction, and inadequate drainage leads to premature settlement and failure of rural roads.

7 Quality Control and Verification Methods

Effective quality control is essential to ensure long-term pavement performance.

Soil testing should be carried out before construction to verify suitability of material. Compaction should be controlled through field density testing methods such as sand replacement test. Layer thickness should be maintained within specified limits to ensure uniform load distribution.

Drainage systems should be properly designed and maintained to prevent water accumulation. Regular inspection and monitoring should be conducted to identify and rectify defects at early stages.

Implementation of these measures can significantly improve pavement durability and reduce maintenance requirements.

8 Economic Considerations

Although implementation of quality control measures increases initial construction cost slightly, it results in significant savings in long-term maintenance. Studies indicate that a small increase in initial cost can extend pavement life considerably.

Proper construction practices reduce frequency of repairs, improve serviceability, and enhance overall performance. This leads to efficient utilization of public funds and contributes to sustainable infrastructure development.

9 Recommendations

- Conduct mandatory soil testing before construction
- Ensure proper compaction through field verification
- Provide adequate drainage system
- Maintain quality control during all stages of construction
- Implement regular inspection and maintenance

10 Conclusion

Premature settlement of rural roads in Waghodia Taluka is primarily caused by weak subgrade conditions, inadequate compaction, and poor drainage. The study highlights the importance of strict adherence to engineering standards and effective quality control measures.

By adopting proper construction practices, it is possible to significantly improve pavement performance, reduce maintenance costs, and ensure long-term sustainability of rural road infrastructure.

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