

## **Advancement of Pavement strength to prevent frequent failure. Models of Rural Roads**

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### **Abstract**

Ethiopia has wasted billions of dollars on replacing its national highways that have prematurely deteriorated (Jovanovic, 2014). Big, expensive road systems have been poorly maintained while being more regularly used and damaged than originally anticipated. As old pavements collapse and as new ones last longer than expected, the degradation of maintained roadways will increase if this carelessness is allowed to continue. That's why the roads in Ethiopia are in such a sorry state. One-fourth of the annual infrastructure spending goes on roads. Fewer resources are allocated to preserving the nation's paved roads, which slows the progress of the industry as a whole. Document analysis, participant observation, and a questionnaire survey were all used to compile the data for this study. For this review, we obtained the Pavement Repair Road Annual Reports for the preceding three years from the ERA's Central District Region. In a similar vein, data was gathered from road repair contractors and consultants, as well as road users in a variety of settings. The visual inspection of five sites revealed that the maintained roads were being used by overloaded trucks, that the pavements were old, that severe weather had been observed, that the drainages were poor, that the construction quality was poor and that the construction materials were substandard, that the maintenance management system was poor, and that all of these problems had contributed to the deterioration of the pavements.

**Key Words;** Causes, Frequent Failures, Maintained Roads, Asphalt Pavement, Federal Roads and Road users

### **Introduction**

Seventy-five percent of India's roadways are classified as low volume roads (LVRs), which are defined as roads that may be travelled on in all types of weather with the exception of major river crossings. Many motorists choose the less-traveled roads that run parallel to the highways in order to avoid paying tolls. As a result of being used beyond their intended capacity, low-

traffic roads degrade quickly and cost a lot to fix. Even if the present design process in India takes into account the overcrowded state up to 20%, it is nevertheless shown that these low volume roads are significantly impacted. The design method needs updating to reflect the realities of today. Now more than ever, it's crucial to build a pavement section that can withstand the cumulative effects of things like nonrepetitive high loads, weather, and temperature fluctuations. Granular pavements with a black bituminous top are the standard construction for LVRs. Rising traffic volumes, larger vehicles, an increase in the use of LVRs by overweight truck drivers, shifting weather patterns, rising construction costs, and a growing emphasis on sustainability are only some of the modern obstacles to low-volume road design. It is difficult to construct and maintain these pavements in a cost-effective way, especially when doing so requires careful planning and careful attention to detail. Using the FEM's many functions, you may assess the interplay between the aforementioned variables, make predictions about the characteristics of low-traffic highways, and much more. The roads are deteriorating due to the rising number of commercial cars, the use of heavy cargo trucks, and the effects of climate change. In this study, we examine in depth the many adjustments that should be made to design techniques in light of the current situation. The sub-grade, sub-base, base, and surface layers make up the road's construction sequence. All of these different parts come together to form the pavement. Pavements constructed from high-quality materials distribute the weight of vehicles so that the roadbed is not stressed to the point of cracking or shifting. To accommodate varying volumes of foot and vehicle traffic, unique layouts are required. Paving materials might include gravel, stone, bitumen, concrete, or even repurposed or enhanced soils. The anticipated traffic volume informs both the pavement materials used and the thickness of its various layers. Key elements that must be carefully considered throughout the design stage include available funds, the location of the road, and the availability of acceptable local materials. The top coat prevents surface water from seeping into the pavement, which may otherwise degrade the sub- and base layers. Natural gravels are the prevalent choice for paving rural highways. The bituminous and concrete surfaces are more resistant to the abrasive impacts of weather and traffic, and they also offer more effective sealing.

Several departments of the Indian government are working together to build roads across the country. The Public Works or Rural Development agencies of each state are responsible for maintaining rural roads, such as Village Roads (VRs) and Other District Roads (ODRs). Many different types of organisations, including agricultural marketing boards, are responsible for

building and maintaining rural roads. The Panchayati Raj Institutions are a kind of local government that has authority over some stretches of the rural road network. Since December 2000, the Government of India has been working on a statewide programme called the PMGSY to increase connectivity to the country's rural road network. The programme aimed to construct all-weather roads linking all communities with populations of at least 500 people in the lowlands and all communities with populations of at least 250 people in the hill states, desert areas, and tribal territories. There is still a focus on expanding transportation options in rural communities, and similar initiatives are under progress in other states to better connect scattered communities. In 2013, the Prime Minister's Office launched the second phase of the Accelerated Rural Growth and Services for the Young (PMGSY-II) programme with the aim of consolidating and upgrading the existing rural road network, with a focus on roads that provide connectivity to rural growth centres and other critical rural business hubs. These roadways will have area-specific maintenance agreements put in place. Considering the astounding results of these projects, it is clear that this concerted effort to improve access in rural regions has been quite beneficial. The success of the programme can be traced in large part to the meticulous preparation and execution of the rollout. There must be enough money at every level of government, from the highest to the lowest, as well as the establishment of capable client organisations, the standardisation of technological designs, the execution of rigorous monitoring and quality assurance checks, and so on. As a result, a set of standards and guidelines for the administration of large-scale infrastructure projects have arisen. The importance of rural development has grown as people have become more concerned about issues like social equality, national cohesion, economic advancement, and inclusive growth. Building a network of roads in rural regions is crucial to improving life there because it connects people to metropolitan centres where they can access services like healthcare, education, and commerce. Given that lack of access is commonly acknowledged as a major contributor to the perpetuation of poverty, improvements to rural roads might be seen as a starting point for combating this issue. When India entered her era of planned expansion in 1951, she already had a somewhat developed railway system, a few ports, and around 400 thousand kilometres of passable roads. Only around one-fifth of the communities had access to roads all through the year. By providing financial support for infrastructure projects in irrigation, energy, heavy industry, and transportation, the government set the stage for a more rapid growth. Social infrastructure provision (such as schools and hospitals) and rural development (which includes farming) were prioritised. It is through the promotion of holistic

and inclusive rural development that poverty can be reduced more rapidly, the MDGs can be achieved, national integration can be strengthened, and the isolation of village communities can be broken. Rural roads play a crucial role in promoting and sustaining agricultural growth, improving basic health, providing access to schools and economic opportunities. It wasn't until the start of the Fifth Five Year Plan in 1974 that rural road construction received a serious boost from the Minimum Needs Programme. Since 1996, when it was merged with the Basic Minimum Services (BMS) programmes, the construction of village tracks has been prioritised by the Central and State governments as part of a variety of employment creation and poverty alleviation measures.

### **Review of literature**

(Temesgen, 2018) studied “investigating the causes of frequent failures on maintained asphalt pavement federal roads in ethiopia” revealed that Ethiopia's national highways have wasted billions of dollars in infrastructure and have deteriorated needlessly (Jovanovic, 2014). Big, expensive road systems have been poorly maintained while being more regularly used and damaged than originally anticipated. As old pavements collapse and as new ones last longer than expected, the degradation of maintained roadways will increase if this carelessness is allowed to continue. That's why the roads in Ethiopia are in such a sorry state. One-fourth of highways get the bulk of the yearly infrastructure budget. The decline in funding for road maintenance throughout the country has a chilling effect on the economy as a whole. Document analysis, participant observation, and a questionnaire survey were all used to compile the data for this study. For this review, we obtained the Pavement Repair Road Annual Reports for the preceding three years from the ERA's Central District Region. In a similar vein, data was gathered from road repair contractors and consultants, as well as road users in a variety of settings. The visual inspection of five sites revealed that the maintained roads were being used by overloaded trucks, that the pavements were old, that severe weather had been observed, that the drainages were poor, that the construction quality was poor and that the construction materials were substandard, that the maintenance management system was poor, and that all of these problems had contributed to the deterioration of the pavements.

(Peterson, 1981) studied “evaluation of pavement maintenance strategies” discovered, and The quality, timeliness, and nature of a pavement's upkeep have a significant impact on the pavement's ability to perform. When pavements are regularly maintained, the deterioration caused by traffic loads and weather conditions is mitigated. Overall, maintenance budgets have not been enough to keep up with the demands, thus pavements are degrading at a quicker rate

than they are being repaired. In most cases, the severity of faults and the cost to maintain a pavement surface both rise when repairs are delayed. Delaying maintenance and rehabilitation may raise the total cost of delivering a desired level of pavement performance throughout the course of its useful life, perhaps requiring a full reconstruction of the pavement several years down the road. In the context of this synthesis, maintenance refers to any work done to the pavement after its initial construction but before its total replacement. This definition does not include shoulders or bridges. Therefore, rehabilitating and restoring pavement is a part of pavement maintenance. Strategies for pavement maintenance are plans of action that embody the consistent use of pavement maintenance procedures with the goal of enhancing or maintaining the condition of a pavement segment beyond a specified minimum requirement. The plan includes the maintenance type, implementation timeline, expected lifespan, and other limitations. The optimal plan is the one that, given a set of limitations, generates the greatest net gain while incurring the fewest expenses.

(Chandak et al., 2019) studied “Performance Evaluation of Low Volume Rural Roads- A State-of-the-Art Review: Proceedings of the 5th GeoChina International Conference 2018 – Civil Infrastructures Confronting Sever.” Noticed this, and This article offers a comprehensive summary of the current research on performance evaluation of rural roads carrying low traffic volumes. The design of low-traffic roadways is informed by experience and empirical analysis. Tire pressure and loading intensities, surface and sub- surface temperature, ambient circumstances, thickness combinations of different layers, material qualities, seepage, etc. are the key elements which determine the behaviour of a road. As a result, the accepted practises and analytical methods currently used for pavement design are analysed and challenged. Roads in rural areas with lower traffic volumes are particularly vulnerable to the premature degradation caused by the excessive use of large vehicles. Second, there is a rising incidence of road deaths because maintenance is not being performed on time and enough funding is not being allocated for upkeep. There is a need for in-depth research on how many real-world factors impact the performance of low-volume rural roads. In an effort to better understand how high traffic and environmental variables affect the performance of rural roads, this research aims to compare and contrast many different approaches. The value of the finite element approach in estimating the performance of rural roads is also highlighted. Thus, the importance of analytical tools like the finite element technique, which may increase the potential of strengthening the road via the use of various material and thickness combinations for low volume roads, is examined in depth.

(National Rural Roads Development Agency (NRRDA), 2015) studied “Managing Maintenance of Rural Roads in India” discovered that State governments often assign responsibility for rural roads to the Public Works or Rural Development agencies. This includes both Village Roads (VRs) and Other District Roads (ODRs). In addition, rural road construction and maintenance is under the purview of a number of agricultural marketing boards and other similar organisations. Some sections of the rural road network are also under the jurisdiction of the Panchayati Raj Institutions at the local government level.

Through the PMGSY, the Government of India has been working on a nationwide initiative to improve access to the country's rural road network since December 2000. The initiative planned to build all-weather roads between all settlements with populations of over 500 people in the plains, and between all settlements with populations of over 250 people in the hill states, desert regions, and tribal territories. There is still a strong emphasis on improving access to transportation in rural areas, and comparable programmes are now underway in several states to better link smaller settlements.

### **Conclusions**

This study analysed the Central District of the ERA's annual project report, maintenance manual, maintenance specification, and selected sections of road to evaluate if the current maintenance pavement was outstanding or not based on serviceability. Good road maintenance is crucial to the prosperity of any road system and the satisfaction of its users. Users' outward appearance betrayed the mental and physical toll that a poorly maintained asphalt surface had on them. Drivers and other road users must always come first while maintenance is being performed. Uneven price increases/fluctuations; a lack of material, manpower, and an efficient/competent contractor; a lack of responsibility for risks that occur prior to and after maintenance works; and a lack of responsibility for worker skill, maintenance culture, quality materials, and soil condition were identified as the most common reasons for the failure of a maintained paved road in the survey. Lack of evaluation methodologies for the pavement's structural, functional, and safety state, and a lack of maintenance treatment selection tactics, contribute to longer commute times and higher fuel expenditures while driving on a badly maintained paved road.

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