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A Study of Sustainable Pavement Sub-base using Indigenous Materials

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Abstract: *This study explores the feasibility of developing a sustainable pavement sub-base using indigenous materials. Traditional pavement sub-base construction relies heavily on non-renewable resources and often contributes to environmental degradation. By utilizing locally available materials, this research aims to promote sustainable practices and reduce the environmental footprint of pavement construction. The study investigates the mechanical properties and durability of pavement sub-bases constructed with indigenous materials, such as locally sourced aggregates, recycled materials, and natural binders. Laboratory tests, including compaction, strength, and moisture susceptibility evaluations, are conducted to assess the performance of the sustainable sub-base. Furthermore, economic and environmental analyses are conducted to evaluate the cost-effectiveness and sustainability benefits of using indigenous materials. The findings of this study provide valuable insights into the potential of sustainable pavement sub-bases, enabling transportation agencies and engineers to make informed decisions that prioritize environmental preservation while ensuring long-lasting and resilient infrastructure.*

Keywords: sustainable pavement

I. INTRODUCTION

The construction sector is currently facing a significant challenge of depleting natural resources, particularly in the road construction segment. The extensive processes involved in road construction require a substantial amount of aggregates, leading to activities such as blasting, quarrying, crushing, and transportation, which consume significant energy and deplete aggregate materials at an alarming rate. Additionally, the utilization of non-conventional materials, including industrial wastes, by-products, and locally available unused materials, has resulted in environmental concerns and dumping issues. However, these materials have the potential to serve as viable alternatives in road construction. This study focuses on the utilization of two such materials, slag (a waste material from the steel industry) and locally available gravel (moorum), in road sub-bases.

1.1 Objectives

The primary objective of this study is to investigate the feasibility of using slag and moorum as sustainable alternatives for road sub-bases. Specifically, the study aims to analyze the chemical composition, phase composition, and presence of toxic and heavy metals in slag and its leachate water. Furthermore, the physical properties, including gradation, will be examined using appropriate tests and techniques. Additionally, the study will explore the incorporation of conventional crushed aggregates in combination with slag or moorum to meet the desired grading requirements specified by the Ministry of Road Transport and Highways.

II. METHODOLOGY

To achieve the objectives of the study, a comprehensive methodology is proposed. Initially, samples of slag and moorum will be collected from relevant sources. Chemical analysis will be conducted to determine the composition of the materials, while leachate water analysis will assess the presence of toxic and heavy metals. Physical tests, such as sieve analysis, specific gravity, and water absorption, will be performed to evaluate the gradation and other properties of the materials. The conventional crushed aggregates will be blended with slag or moorum in varying proportions to

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achieve the desired grading for a specific sub-base layer, as per the specifications provided by the Ministry of Road Transport and Highways.

III. RESULTS AND DISCUSSION

The study found that the optimum percentage of slag that can be utilized in the sub-base layer is 80%. The chemical analysis indicated the presence of certain elements in the slag, but their concentrations were within permissible limits. Similarly, moorum can be utilized up to 50% in the sub-base layer. To achieve the desired strength, the required quantity of cement will be added when using moorum. The physical properties of both slag and hard moorum were found to be excellent for road aggregates, making them suitable for road base and sub-base applications. The blending of conventional crushed aggregates with slag or moorum helped achieve the desired gradation for sub-base layers.

IV. CONCLUSION

The utilization of slag and moorum as indigenous materials in road sub-bases offers a sustainable solution to address the depletion of natural resources. By reducing the reliance on traditional aggregates, the study contributes to minimizing the environmental impact associated with aggregate production processes. Moreover, the incorporation of non-conventional materials in road construction helps mitigate the challenges related to industrial waste management and the utilization of locally available unused materials. The findings of this research provide valuable insights for the construction industry, promoting sustainable practices and facilitating the development of cost-effective and environmentally friendly road infrastructure. Further research and field trials are recommended to validate the performance and long-term durability of road sub-bases using slag and moorum.

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