A Comparative Analysis of Resilient Surface Materials in Urban Pavement Design: Evaluating Performance Under Diverse Load Conditions

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Abstract. This study investigates the efficacy of various resilient surface materials in urban pavement design, focusing on load-bearing capacities and durability across different environmental conditions. Employing advanced tensile testing and field simulations, we assess the performance of asphalt, concrete, and composite materials under dynamic loading scenarios representative of modern urban traffic. Results reveal significant differences in performance, particularly in regards to thermal expansion, moisture resistance, and maintenance requirements. The findings highlight the potential for optimizing material selection to enhance the longevity and sustainability of urban pavements. This research underscores the importance of material resilience in coping with future urban transportation demands while mitigating maintenance costs.

Keywords: Resilient pavement, Urban infrastructure, Material performance, Transportation engineering, Load-bearing capacity, Sustainable materials

Introduction

As urban areas continue to expand rapidly, the need for durable and resilient pavement solutions has never been more critical. The global challenge of maintaining road infrastructure under increasing traffic loads and adverse environmental conditions is

paramount, particularly as cities grapple with the dual pressures of climate change and urbanization. In recent years, traditional pavement materials have come under scrutiny for their long-term performance and environmental impact, prompting researchers and engineers to explore innovative alternatives that promise enhanced durability and lower lifecycle costs. This paper aims to delve into the comparative analysis of various resilient surface materials, focusing on asphalt, concrete, and composite options. We will assess their performance metrics under diverse load conditions, providing insights into their load-bearing capacities, thermal expansion behaviors, and moisture resistance. Additionally, the implications of material selection on future maintenance requirements will be evaluated to inform best practices in transportation engineering. The structure of the paper is organized as follows: Section 1 reviews the literature on pavement material resilience, Section 2 details the methodology employed in the experimental analysis, Section 3 presents the comparative results of the material performance tests, Section 4 discusses the implications of the findings for urban infrastructure, and Section 5 concludes with recommendations for future research and practical applications.

References

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