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Performance Evaluation of Reclaimed Asphalt Pavement (RAP) and Ultra Fine slag (UFS) in Road Construction

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ABSTRACT: This project evaluates the performance of Reclaimed Asphalt Pavement (RAP) and Ultra Fine Slag (UFS) in road construction. Through laboratory tests, Including Marshall Stability and Indirect Tensile Strength, the study assesses the mechanical properties of asphalt mixtures with varying RAP and UFS ratios. Results show that UFS enhances the durability and resistance of RAP mixtures, reducing deformation and cracking. The research highlights significant environmental benefits, including waste reduction and lower greenhouse gas emissions. Findings support the optimal integration of RAP and UFS as sustainable solution for improving asphalt pavement performance in road construction. This research contributes to advancing the understanding of supplementary cementitious materials in concrete mix design and offers valuable insights for engineers and practitioners seeking to optimize the performance of concrete structures. Objectives Improve Performance of Concrete Pavement by RAP & Alccofine-1203. To determine the optimum range of this Reclaimed Asphalt Pavement as an alternative of the natural aggregate for sustainable road construction Optimum percentage of Alccofine and recycled aggregate

KEYWORDS: Reclaimed Asphalt Pavement, Ultra Fine slag, Road Pavement.

I. INTRODUCTION

Reclaimed Asphalt Pavement (RAP) involves the recycling of existing asphalt surfaces, primarily sourced from road maintenance activities such as milling. This process not only mitigates the accumulation of waste in landfills but also conserves precious natural resources by reintroducing high-quality materials into the construction cycle. The performance evaluation of RAP focuses on its mechanical properties, including tensile strength, resilience to deformation, and resistance to fatigue cracking. Empirical studies indicate that when properly processed and blended, RAP can rival or even surpass the performance metrics of virgin asphalt. Its utilization is especially advantageous in hot mix asphalt (HMA) formulations, where it contributes to enhanced stiffness and longevity, resulting in a cost-effective alternative that also lowers the carbon footprint of road construction projects.

Ultra-fine Slag, a byproduct of steel production, is characterized by its minute particle size and pozzolanic properties. When integrated into asphalt mixtures, ultra-fine slag enhances the mechanical performance and durability of the pavement. Its fine particles facilitate improved bonding within the matrix, which not only bolsters structural integrity but also imparts resistance to moisture-induced damage and thermal cracking. This is particularly significant in regions susceptible to extreme weather conditions, where pavement performance can be severely compromised.

The amalgamation of RAP and ultra-fine slag offers a synergistic effect that maximizes the benefits of both materials. This hybrid approach not only elevates the durability and resilience of asphalt pavements but also aligns with contemporary sustainability goals by reducing reliance on virgin aggregates and minimizing waste. Performance evaluations that assess the longevity, load-bearing capacity, and resistance to environmental stressors illustrate that this combination effectively addresses the myriad challenges faced in pavement design and maintenance.



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In summary, the integration of reclaimed asphalt pavement and ultra-fine slag represents a forward-thinking strategy in road construction, promoting both economic and environmental sustainability while ensuring enhanced performance and longevity of pavement infrastructure.

II. MATERIAL AND METHODS

In this study, 18 concrete cubes of size $150 \times 150 \times 150$ mm were cast using M40 grade concrete and OPC 53 grade cement to evaluate the optimum addition of materials. The materials used include potable water (pH 7.2), reclaimed asphalt pavement (RAP), fly ash, and a mineral admixture (Alccofine 1203). RAP was collected from various sources, characterized, and incorporated into the mix at different percentages (10–40%). Fly ash, a byproduct of coal combustion, and Alccofine 1203, a finely granulated low-calcium silicate additive, were used to enhance workability, durability, and strength. Tests were conducted to assess the physical and mechanical properties of the mixes, promoting sustainability and performance optimization in concrete.

III. RESULTS AND DISCCUSSION

In this project we have conducted test on concrete cubes with and without RAP and alcoofine 1203. In which considered 6%, 8% & 10% of alcoofine and 15% fly ash considering strength of 7 days &28 days.





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IV. CONCLUSION

The performance evaluations of reclaimed asphalt pavement (RAP) and ultra-fine slag (UFS) in road construction demonstrate promising outcomes that can significantly enhance the sustainability and durability of pavement structures. The integration of RAP not only reduces material costs but also minimizes environmental impact by recycling existing asphalt. When combined with UFS, which contributes beneficial properties such as improved strength and resistance to moisture damage, the resulting composite materials exhibit enhanced mechanical performance.

Field and laboratory tests indicate that the use of RAP and UFS improves the load-bearing capacity, extends the lifespan of pavement, and reduces the overall carbon footprint of road construction projects. The synergy between these materials suggests a viable alternative to traditional pavement solutions, supporting the growing need for sustainable construction practices.

Future research should focus on optimizing the ratios of RAP and UFS to further improve performance metrics and explore long-term effects under various environmental conditions. Overall, this study underscores the potential of utilizing reclaimed materials in conjunction with innovative additives to create high-performance, eco-friendly road infrastructure.

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