

Use of Recycle Concrete Aggregate in Rural Road

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Abstract - The rapid growth of construction activities has led to excessive consumption of natural aggregates and a significant increase in construction and demolition waste. Recycled Concrete Aggregate (RCA), obtained from demolished concrete structures, presents a sustainable alternative to natural aggregates, especially for rural road construction. This project investigates the feasibility, performance, and economic benefits of using RCA in rural road connectivity applications. The study evaluates the physical and mechanical properties of RCA through laboratory tests such as sieve analysis, aggregate crushing value test, aggregate impact value test, Los Angeles abrasion test, flakiness and elongation index tests, and specific gravity and water absorption tests.. The findings indicate that RCA exhibits acceptable strength and durability characteristics suitable for use in rural road construction, while also contributing to cost reduction and environmental sustainability. The study concludes that the use of Recycled Concrete Aggregate in rural roads is a practical, economical, and eco-friendly solution that helps in effective waste management, conservation of natural resources, and promotion of sustainable infrastructure development in India.

Key Words: Recycled Concrete Aggregate (RCA), Rural Road Connectivity, Sustainable Construction, Construction and Demolition Waste, Aggregate Strength Properties, Cost Analysis, Environmental Sustainability

1. INTRODUCTION

The rapid growth of infrastructure and urban development has resulted in an increasing demand for construction materials, particularly natural aggregates. At the same time, large quantities of construction and demolition waste are being generated due to the replacement of old and deteriorated structures. Disposal of this waste has become a major environmental challenge, especially in urban and semi-urban areas where landfill space

is limited. Therefore, the effective recycling and reuse of construction waste has become an important aspect of sustainable development in the construction industry. Recycled Concrete Aggregate (RCA) is produced by crushing demolished concrete elements such as slabs, beams, and columns. The use of RCA helps in reducing the consumption of natural aggregates, minimizing construction waste, and lowering environmental pollution. In recent years, RCA has gained attention as an alternative material in pavement construction due to its economic and environmental advantages. However, its engineering properties must be properly evaluated before it can be widely adopted for road construction. Rural road connectivity plays a vital role in the socio-economic development of a country like India. Many villages still lack durable and cost-effective road infrastructure due to limited resources and high construction costs. The use of recycled materials such as RCA in rural road construction can provide a sustainable and economical solution while maintaining acceptable performance and durability standards. This project focuses on evaluating the suitability of Recycled Concrete Aggregate for rural road construction by conducting various laboratory tests to assess its physical and mechanical properties. The performance of RCA is compared with that of natural aggregates in terms of strength, durability, and cost. The study also highlights the environmental benefits of using RCA, including waste reduction, conservation of natural resources, and reduction in carbon footprint. The findings of this project aim to support the adoption of sustainable construction practices and promote the effective utilization of recycled materials in rural infrastructure development.

2. Body of Paper

2.1 Material Collection and Preparation

Demolished concrete waste was collected from an old residential structure. The collected material was manually cleaned to remove impurities such as wood, plastic, and soil. The concrete debris was

then crushed and processed to obtain Recycled Concrete Aggregate (RCA) of required sizes suitable for laboratory testing and rural road construction.

2.2 Physical Property Evaluation of Aggregates

Basic physical properties of RCA such as particle size distribution, flakiness index, elongation index, specific gravity, and water absorption were determined. Sieve analysis was conducted to assess gradation, which plays a crucial role in pavement performance. These properties were compared with those of natural aggregates to understand the differences.

2.3 Mechanical Strength Tests Mechanical performance of RCA was evaluated using standard tests including Aggregate Crushing Value test, Aggregate Impact Value test, and Los Angeles Abrasion test. The results indicated that RCA possesses slightly lower strength compared to natural aggregates but remains within permissible limits for rural road applications as per Indian Standards.

2.4 Comparative Analysis with Natural Aggregates

A detailed comparison was carried out between RCA and natural aggregates based on strength parameters, durability characteristics, and physical properties. The analysis showed that RCA can effectively replace natural aggregates in low-traffic rural roads without compromising structural performance.

2.5 Economic Evaluation Cost analysis was performed considering demolition, recycling, transportation, and processing costs. The use of RCA resulted in overall cost savings due to reduced material procurement and transportation expenses. This makes RCA a cost-effective option for rural road construction projects.

2.6 Environmental and Sustainability Benefits

The utilization of RCA significantly reduces construction and demolition waste sent to landfills. It also conserves natural aggregate resources and lowers carbon emissions associated with quarrying and transportation. Thus, the use of RCA supports

sustainable construction and environmentally responsible infrastructure development.

2.7 Application in Rural Road Construction

The feasibility of using RCA was evaluated for a proposed 5 km rural road. Quantity estimation and material requirements were calculated, demonstrating that RCA can meet the demand for base and sub-base layers, making it suitable for improving rural road connectivity.



Fig 1 - Model

3. CONCLUSION

The present study evaluated the feasibility of using Recycled Concrete Aggregate (RCA) as an alternative to natural aggregates in rural road construction. Various physical and mechanical tests were conducted on RCA and the results were compared with those of conventional natural aggregates. The test outcomes indicate that although RCA exhibits slightly lower strength characteristics, it satisfies the permissible limits prescribed by Indian Standards for rural road applications. The comparative analysis confirms that RCA can be effectively used in low-traffic rural roads without compromising performance and durability. The economic evaluation demonstrates that the use of RCA leads to significant cost savings by reducing expenses related to raw material procurement, transportation, excavation, and waste disposal. Furthermore, the utilization of recycled concrete aggregate contributes to sustainable construction

practices by minimizing construction and demolition waste, conserving natural resources, and reducing environmental pollution and carbon footprint. The study also highlights the potential of RCA to improve rural road connectivity in a cost-effective and environmentally responsible manner. Overall, the findings of this project support the adoption of Recycled Concrete Aggregate as a viable, economical, and sustainable material for rural road construction, encouraging its wider implementation in future infrastructure development projects.

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