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Investigating the Viability of Using Recycled Coarse Aggregates from Construction & Demolition Waste

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Abstract - This paper takes a closer look at the potential of using recycled coarse aggregates (RCA) sourced from construction and demolition (C&D) waste as either partial or complete substitutes for natural coarse aggregates (NA) in both structural and non-structural concrete. It brings together insights from recent reviews and experimental studies, highlighting how RCA performs in three important mechanical tests: Aggregate Crushing Value (ACV), Aggregate Impact Value (AIV), and Los Angeles (LA) abrasion. The findings in the literature indicate that RCA typically shows higher ACV, higher AIV, and greater mass losses in LA abrasion (meaning it has poorer resistance to fragmentation and abrasion) compared to similar natural aggregates. This is largely due to the presence of adhered mortar, increased porosity, and angular shapes. However, when RCA is treated or processed—through improved crushing, removal or strengthening of the attached mortar, and proper grading—it can achieve properties that are suitable for a variety of concrete applications, often with suggested partial replacement rates and necessary pre-treatment.

Key Words: recycled coarse aggregates, Aggregate Crushing Value, light, Aggregate Impact Value Los, abrasion Value, journals

1.INTRODUCTION

Rapid urbanization and renovation are creating a significant amount of construction and demolition (C&D) waste. By transforming this waste into recycled concrete aggregate (RCA), we can cut down on landfill usage, save our natural aggregate resources, and reduce embodied carbon emissions—provided it's done responsibly. However, RCA has some key differences from natural aggregate (NA) that can impact its mechanical performance. First, there's an attached layer of mortar or encrustation that increases porosity and weakens the particle. Second, the mix of materials (like concrete, brick, tile, and mortar) can be quite varied, leading to inconsistent performance. To assess the suitability of RCA for different concrete applications, mechanical tests such as Aggregate Crushing Value (ACV), Aggregate Impact Value (AIV), and Los Angeles (LA) abrasion are commonly employed. Standards like IS 2386 (Part IV) and related ASTM methods outline the testing procedures and typical acceptance limits that engineers rely on. This paper delves into these tests, gathers typical RCA versus NA ranges found in existing literature, and discusses the implications for concrete design and practical use in the field.

2. Body of Paper

2.1. Aggregate Crushing Value (ACV) — Purpose & Procedure

Purpose: The ACV provides a relative measure of how well aggregates can withstand crushing when a compressive load is applied gradually. This is crucial for evaluating the strength of coarse aggregates and predicting how they will perform under static loads.

Standard procedure: According to IS:2386 (Part IV), a sample of aggregate that passes through a specific sieve is placed into a cylindrical measure, compacted, and then subjected to a compressive load using a standardized testing machine. The percentage of fines that pass through a 2.36 mm sieve after applying the specified load is recorded as the ACV. A lower ACV indicates a stronger aggregate. In practice, typical thresholds are: less than 30% is desirable for general concreting and pavements, while up to about 35–45% may be acceptable for lower-grade applications, depending on the standards.

2.2. Aggregate Impact Value (AIV) — Purpose & Procedure

Purpose: The AIV measures how well aggregates can resist sudden shocks or impacts, which is different from their ability to handle slow compressive loads. This is particularly important for aggregates used in pavements and surfaces that experience heavy wear.

Standard procedure: Following IS:2386 (Part IV), a specified mass of sized aggregates is placed in an impact testing machine and subjected to a series of standard blows. The fraction that passes through a 2.36 mm sieve afterward gives the AIV (%) value. A lower AIV indicates greater toughness.

2.3. Los Angeles (LA) Abrasion Test — Purpose & Procedure

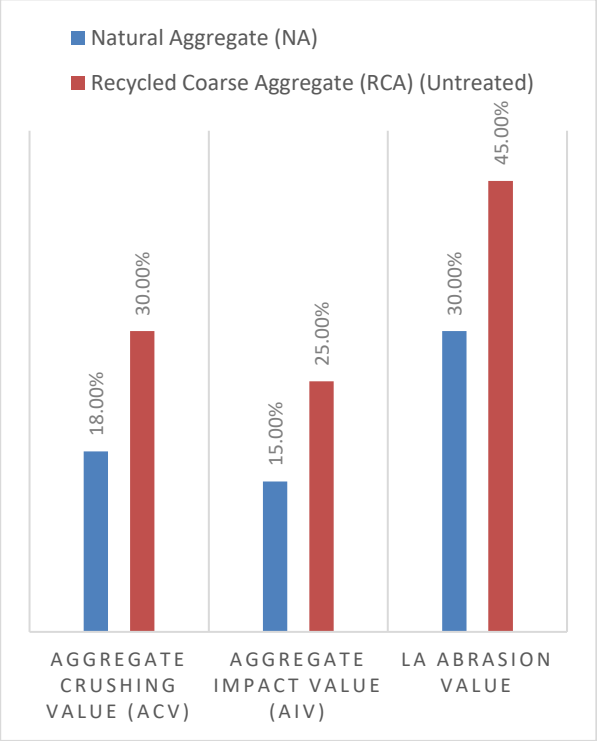
Purpose: The LA abrasion test assesses how well aggregates resist fragmentation and abrasion from repeated impacts and grinding actions. This test is often used as an indicator of long-term durability and resistance to mechanical degradation, which is vital for roads and exposed concrete.

Standard procedure: An aggregate sample is tumbled with steel balls in a rotating drum for a set number of revolutions. The mass loss, expressed as a percentage of the material passing through a sieve, is recorded as the LA abrasion value. A lower LA value signifies better abrasion resistance. Many highway agencies establish maximum allowable LA values, typically around 30–45%, depending on the application. (PMC)

Table -1: Experimental Analysis and Results

Property	Natural Aggregate (NA)	Recycled Coarse Aggregate (RCA) (Untreated)
Aggregate Crushing Value (ACV)	12.0% - 18.0%	30 %
Aggregate Impact Value (AIV)	10.0% - 15.0%	25 %
LA Abrasion Value	20.0% - 30.0%	45 %

Chart



3. CONCLUSIONS

Using untreated recycled concrete aggregate (RCA) in concrete mixes can work, but it's important to handle it with care. The higher values for Aggregate Crushing Value (ACV), Aggregate Impact Value (AIV), and Los Angeles (LA) Abrasion indicate that RCA tends to have lower mechanical strength and resistance to wear compared to natural aggregate (NA). When it comes to structural concrete, it's best to limit RCA replacement to 50% or less to ensure the strength and durability remain up to par. If considering a full 100% replacement, you'll need to pre-treat the RCA to get rid of any weak, adhered mortar and improve its mechanical properties to be more in line with NA standards.

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