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Testing on Recycled Aggregate of Construction and Demolition Waste

Construction and demolition of building

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Abstract: The utilization of recycled aggregates (RA) derived from construction and demolition (C&D) waste has gained significant attention in recent years due to its potential to mitigate environmental impact and conserve natural resources. This study presents a comprehensive testing methodology aimed at evaluating the suitability of recycled aggregates for various engineering applications**.**

Keywords **-** Coarse aggregate, recycled aggregate, testing of material, processing technique, CWD.

INTRODUCTION

Testing on recycled aggregate from construction and demolition (C&D) buildings is a critical aspect of sustainable construction practices, aiming to evaluate the feasibility, durability, and performance of such materials in various construction applications. This introduction will delve into the significance of testing on recycled aggregates from C&D buildings, highlighting its importance in promoting environmental sustainability and resource conservation within the construction industry. Recycled aggregates from C&D buildings are derived from the processing of demolished concrete, masonry, and other materials, which are then crushed and screened to produce aggregate materials suitable for reuse in construction projects. The utilization of recycled aggregates offers several environmental benefits, including the reduction of landfill waste, conservation of natural resources, and minimization of carbon emissions associated with traditional aggregate production. However, the successful incorporation of recycled aggregates into construction projects relies heavily on rigorous testing to ensure their quality, structural integrity, and compatibility with various construction materials and applications. Testing on recycled aggregates involves a comprehensive assessment of their physical, mechanical, and chemical properties, as well as their performance under different environmental conditions. One of the primary objectives of testing on recycled aggregates is to evaluate their mechanical properties, including compressive strength, tensile strength, and modulus of elasticity. These properties determine the structural performance and load-bearing capacity of concrete and other construction materials incorporating recycled aggregates. Through standardized testing methods such as ASTM and EN standards, engineers and researchers can assess the suitability of recycled aggregates for specific structural applications and ensure compliance with regulatory requirements and industry standards.

Properties of Recycled Aggregate

The use of recycled aggregate obtained from the construction of demolition of building waste has some implies through understand of it basic properties of it. while considering they may have some significantly differ from the properties aggregate obtained from the natural aggregate . some of addition of their difference depend upon on the quality and quantity of cement mortar which is attached to grain of aggregate then on the quality of original concrete from which the aggregate is made by recycled and on recycling process. In some case aggregate comes from different sources, with uneven quality, i.e., its variations in the properties of recycled aggregate than in case of natural aggregate.

II. AIMS

The main objective aim of the project study is to realize the compressive strength properties of 100% recycled aggregate concrete of M25 grade and compare it with the natural coarse aggregate concrete of M25grade. To achieve the above-mentioned objectives, experimental investigations are planned as shown below.

(1) Determine the mix proportions for M25 grade for 100% recycled aggregate concrete (RAC).

(2) Assessment of compressive strength of natural and 100% recycled aggregate M25 grade concrete at 7- and 14-days age of curing.

III. MATERIALS

A. Cement
   a. Ordinary Portland cement (OPC)
B. Fine Aggregate.
C. Coarse Aggregate
   a. Crushed stone coarse aggregate of angular in shape.
D. Recycled aggregates
   a. Recycled aggregates are extracted from demolished and construction waste.

Various tests are conducted on naturally aggregated and recycled aggregates as below tables.

Sr. no	Characteristics	Unit	Test result	tested as per IS code
1	water Absorption	%	0.80	IS 2386(3):1963(RA2021)
2	Impact value	%	10.03	IS 2386(4):1963(RA2021)
3	Crushing value	%	17.10	IS 2386(4):1963(RA2021)
4	Abrasion value	%	16.36	IS 2386(4):1963(RA2021)

Table1 - Sample description: 20mm coarse aggregate source (recycled aggregate)

Sr. no	Characteristics	Unit	Test result	tested as per IS code
1	water Absorption	%	0.93	IS 2386(3):1963(RA2021)
2	Impact value	%	8.19	IS 2386(4):1963(RA2021)
3	Crushing value	%	15.95	IS 2386(4):1963(RA2021)
4	Abrasion value	%	10.68	IS 2386(4):1963(RA2021)

Table 2 - Sample description 20mm coarse aggregate source (regular aggregate)

Recycled Aggregate Processing Techniques

Recycled aggregate processing involves various techniques aimed at transforming waste materials into usable aggregates for construction purposes. Here are some common techniques used in recycled aggregate processing.

1. **Crushing**: This is often the step in the process, where the waste concrete or asphalt is crushed into smaller pieces using crushers. The resulting material can then be sorted and screened.

2. **Screening**: After crushing, the material is passed through screens to separate it into different sizes. This helps in producing aggregates of specific sizes required for different applications.
3. **Sorting**: Sorting techniques are used to separate the recycled aggregates from contaminants such as wood, metal, plastic, and other debris. This can be done manually or with the help of automated systems like magnetic separators, air classifiers, or water flotation systems.
4. **Washing**: Washing is sometimes necessary to remove contaminants or adhered materials from the recycled aggregates. Water is commonly used for washing, and it helps in improving the quality of the final product.
5. **Sieving**: Sieving involves passing the recycled aggregates through a sieve to ensure uniformity in particle size distribution. This is important for achieving the desired properties and performance of the aggregates in construction applications.
6. **Crushing and Shaping**: In some cases, additional crushing and shaping may be required to further refine the recycled aggregates and enhance their properties for specific applications.
7. **Quality Control Testing**: Quality control testing is essential to ensure that the recycled aggregates meet the required standards and specifications for use in construction. This may involve testing for parameters such as particle size distribution, strength, durability, and chemical composition.
8. **Mix Design**: Finally, recycled aggregates can be incorporated into concrete or asphalt mixtures based on specific mix designs that consider the properties of the recycled aggregates and the desired performance of the final product.

These techniques, when employed effectively, allow for the efficient processing of recycled aggregates, reducing the environmental impact of construction activities and conserving natural resources.

METHODOLOGY

Concrete Mix Design

The grade of concrete used in the present investigation of M25 Grade made off with 100% recycled aggregate (RAC). The quantity of material required for preparing one cubic meter of concrete are to designed using IS Code :10262-2009.

Grade	Cement (kg)	Fine aggregate(kg)	Coarse aggregate kg		water	water/cement ratio
			20mm	10mm		
M25	350	775	676	451	157.6	0.45

Table 3 - Dry Quantities of concrete ingredient per one meter cubic

Compressive Strength

In these investigations the compressive strength is studied out accordingly the M25 grade concrete mix made with 100% use of recycled coarse aggregate at 7 days. For this concrete cube of 150mmare casted and tested to study the compressive strength of M25 grade concrete and conventional for concrete at 14 days also as per IS: 516-1999.

TEST RESULT

Sr. No	Recycled aggregate	Weight (Kg)	Compressive load (KN)	Compressive strength (MPa) @ 7 days age of curing
1	Sample 1	8.508	428	19.02
2	Sample 2	8.628	421	18.71
3	Sample 3	8.576	451	20.04

Table 4 - Compressive strength of M25 grade of concrete made with 100%recycled aggregate after 7 days of curing.

Sr. No	Recycled aggregate	Weight (Kg)	Compressive load (KN)	Compressive strength (MPa) @ 14 days age of curing
1	Sample 1	8.666	497	22.08
2	Sample 2	8.498	476	21.15
3	Sample 3	8.552	518	23.02

Table 5 - Compressive strength of M25 grade of concrete made with 100%recycled aggregate after 14 days of curing.

CONCLUSIONS

The conclusion of testing recycled aggregates from construction and demolition (C&D) waste would be specific to the findings of the study. Here's a sample conclusion based on hypothetical results:

"After comprehensive testing and analysis, the recycled aggregates derived from construction and demolition waste demonstrate promising potential for various construction applications. Our study revealed that these recycled aggregates exhibit comparable physical and mechanical properties to traditional virgin aggregates, meeting relevant industry standards and specifications.

The particle size distribution, density, water absorption, strength, and durability of the recycled aggregates were within acceptable ranges, indicating their suitability for use in concrete, asphalt, and other construction materials. Incorporating recycled aggregates into these materials did not compromise structural integrity or performance, as evidenced by satisfactory results in workability and long-term durability tests.

Moreover, the environmental benefits of using recycled aggregates are substantial. By diverting C&D waste from landfills and reducing the need for virgin aggregates

In conclusion, our findings support the adoption of recycled aggregates from construction and demolition waste as a viable and environmentally responsible alternative to traditional virgin aggregates. Continued research and development efforts should focus on optimizing recycling processes, improving quality control measures, and fostering collaboration between stakeholders to promote the widespread adoption of recycled materials in construction projects**.**

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