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The Comparative Study of Natural Aggregates and Recycled Coarse Aggregate Used in Concrete

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Abstract: The increasing demand for concrete in the construction industry has resulted in extensive consumption of natural aggregates, leading to depletion of natural resources and environmental concerns. Recycled Coarse Aggregate (RCA), obtained from construction and demolition waste, has emerged as a sustainable alternative to natural aggregates. This study aims to comparatively evaluate the performance of Natural Aggregates (NA) and RCA when used in concrete. The investigation includes testing the physical properties of both aggregates such as specific gravity, water absorption. Concrete mixes were prepared using varying proportions of RCA (10%, 20%, 30%, 40%, and 50%) and tested for compressive strength. The results indicate that RCA has higher water absorption and lower density compared to natural aggregates due to the adhered mortar content. Concrete containing RCA shows a slight reduction in compressive strength as the percentage of RCA increases, but mixes with up to 50% RCA replacement achieve strength values comparable to conventional concrete, making it suitable for non-structural and selected structural applications. The study concludes that use of RCA not only helps conserve natural resources but also supports sustainable construction by reducing waste sent to landfills. Therefore, recycled aggregates can act as a viable alternative to natural aggregates in concrete production, especially where high strength is not a primary requirement.

Keywords: Natural Aggregates, compressive strength, conventional concrete

INTRODUCTION

Concrete is the most widely used construction material in the world due to its versatility, strength, durability, and economic advantages. It is a composite material consisting mainly of cement, water, fine aggregates, coarse aggregates, and, in some cases, chemical or mineral admixtures. Among these constituents, aggregates occupy nearly 70–75% of the total volume of concrete and significantly influence its strength and performance characteristics. The increasing demand for infrastructure development has resulted in extensive consumption of natural resources, particularly natural coarse aggregates obtained from quarries and riverbeds. Continuous extraction of these materials has led to depletion of natural resources and has created significant environmental concerns. At the same time, rapid urbanization and redevelopment activities generate a large amount of construction and demolition (C&D) waste. Traditionally, demolished concrete from old buildings, bridges, roads, and other structures has been treated as waste and disposed of in landfills, causing environmental and disposal-related problems.

One of the most effective solutions for managing construction and demolition waste is recycling the demolished concrete and reusing it as recycled coarse aggregate (RCA) in new concrete production. Recycled coarse aggregate is obtained by crushing and processing waste concrete collected from demolished structures. The concept of using recycled concrete aggregate gained importance after World War II when large quantities of demolished concrete were generated during reconstruction activities. Since then, researchers have investigated the feasibility of replacing natural coarse aggregates with recycled aggregates in concrete production. According to the Central Pollution Control Board (CPCB), India generates approximately 48 million tonnes of solid waste annually, of which more than 25% originates from construction activities. The quantity of construction and demolition waste is continuously increasing due to rapid urban growth and infrastructure development. Since concrete consists largely of aggregates, recycling concrete waste can significantly reduce the demand for natural aggregates and minimize environmental impacts associated with quarrying operations.

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The utilization of recycled coarse aggregate offers several benefits, including conservation of natural resources, reduction of landfill waste, lower environmental impact, and improved sustainability of construction activities. However, recycled aggregates generally contain adhered mortar from the original concrete, which results in higher water absorption and lower density compared to natural aggregates. Consequently, concrete produced with RCA may exhibit variations in strength and durability characteristics depending on the quality and percentage of recycled aggregate used. Therefore, a detailed comparative study between natural coarse aggregate (NCA) and recycled coarse aggregate (RCA) is essential to evaluate their engineering properties and suitability for concrete production. The present study focuses on comparing the performance of concrete prepared using natural and recycled coarse aggregates in terms of strength characteristics, durability, economic feasibility, and environmental benefits. The outcomes of this study will contribute to the promotion of sustainable construction practices and efficient utilization of construction and demolition waste.

LITERATURE REVIEW

Several researchers have investigated the use of recycled coarse aggregates in concrete and compared their performance with conventional concrete produced using natural aggregates. These studies provide valuable information regarding the mechanical properties, durability characteristics, and sustainability benefits of recycled aggregate concrete.

Limbachiya, Leelawat, and Dhir (2000) studied the use of recycled aggregates in high-grade concrete. Their investigation demonstrated that recycled aggregate concrete could achieve nearly 95% of the compressive strength of conventional concrete when high-quality recycled aggregates and low water–cement ratios were used. The study emphasized that the quality of recycled aggregate is one of the most important factors affecting concrete performance.

Tavakoli and Soroushian (1996) evaluated the strength characteristics of recycled aggregate concrete produced using field-demolished concrete. Their findings indicated that the reduction in strength ranged between 5% and 20%, depending upon the quality of the original concrete. The authors concluded that recycled aggregates could be successfully used in structural concrete provided that proper processing and grading procedures are followed.

Babu, Natesan, and co-researchers (2012) examined the physical and mechanical properties of recycled coarse aggregate concrete. The study reported that recycled aggregate concrete generally exhibits slightly lower compressive strength and higher water absorption than conventional concrete because of the presence of adhered mortar. However, appropriate mix design modifications and the use of supplementary cementitious materials can improve the overall performance of recycled aggregate concrete.

Reddy and Reddy (2018) conducted an experimental study on the strength characteristics of recycled aggregate concrete. They compared compressive strength, split tensile strength, and flexural strength of recycled aggregate concrete with those of conventional concrete. The results showed a slight reduction in mechanical properties; however, the incorporation of fly ash and silica fume significantly improved strength and durability performance.

Venu and Ramesh (2015) performed a comparative study between natural coarse aggregates and recycled coarse aggregates. Their investigation revealed that recycled aggregates possess lower specific gravity and higher water absorption than natural aggregates. The compressive strength of concrete decreased with increasing recycled aggregate content, but the reduction remained within acceptable limits for replacement levels up to 50%.

Rao, Jha, and Misra (2007) reviewed the use of recycled aggregates obtained from construction and demolition waste in concrete production. The study highlighted the environmental advantages of recycled aggregates, including reduced landfill disposal, conservation of natural resources, and promotion of sustainable construction practices. The authors recommended partial replacement of natural aggregates for structural applications and complete replacement for certain non-structural applications.

Vishnu Vijayan, Jaykesh, and Anand (2016) investigated the use of demolished concrete waste as recycled aggregate in concrete mixes. Silica fume and sisal fibers were incorporated to improve the mechanical properties of recycled aggregate concrete. Their results showed improvements in strength, durability, and fire resistance, demonstrating that supplementary materials can effectively enhance recycled aggregate concrete performance.

Chandni T. J. and Anand (2019) studied the influence of recycled materials in foam concrete. The researchers observed that recycled glass-filled foam concrete

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exhibited better compressive strength than plastic-filled foam concrete. Their findings highlighted the potential of recycled materials in producing sustainable construction materials with satisfactory engineering properties.

The literature reviewed clearly indicates that recycled coarse aggregates can be utilized as a partial replacement for natural coarse aggregates in concrete without significant loss of performance when proper processing and mix design procedures are adopted. Most researchers reported that the strength reduction associated with recycled aggregate concrete is within acceptable limits and can be minimized through the use of supplementary cementitious materials and appropriate quality control measures. Furthermore, the use of recycled aggregates contributes significantly to sustainable construction by reducing construction and demolition waste, conserving natural resources, lowering landfill requirements, and decreasing the environmental impact associated with aggregate extraction. Therefore, comparative studies between natural coarse aggregate and recycled coarse aggregate concrete are essential to determine the optimum replacement level that provides a balance between strength, durability, economy, and sustainability.

MATERIALS AND METHODOLOGY

The methodology adopted for this study involves a systematic approach to analyze and compare the performance of Natural Aggregates (NA) and Recycled Coarse Aggregates (RCA) in concrete production. The process includes collection, testing, and evaluation of aggregates and concrete samples to determine their physical and mechanical properties. The experimental work is carried out by preparing concrete mixes using both types of aggregates under similar mix proportions and testing conditions. The main purpose is to evaluate the strength, durability, and workability characteristics of concrete with RCA as a replacement for NA. The study also supports sustainable construction practices by promoting the reuse of construction and demolition waste materials.

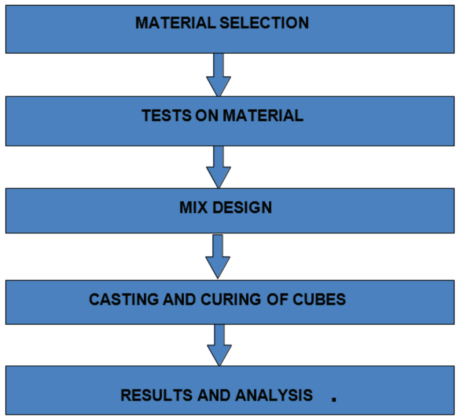

Figure 1 Research Methodology Flow Chart

Collection of Materials

The materials used for the preparation of concrete were collected from various sources and are listed below:

- **Natural Aggregate (NA):** Collected from a nearby construction site.
- **Fine Aggregate (Sand):** Collected from a nearby construction site.
- **Cement:** Ordinary Portland Cement (OPC) 53 Grade collected from a local supplier.
- **Water:** Potable water conforming to IS 456:2000 guidelines was used for mixing and curing of concrete.

3.2 Mix Design

M30 grade concrete mix was designed according to IS 10262 recommendations. The design parameters adopted for the study are as follows:

- Grade designation = M30
- Standard deviation = 5.00
- Type of cement = OPC 53 Grade (IS 8112)
- Workability (Slump) = 75 mm
- Exposure condition = Severe (for RCC)
- Degree of supervision = Good
- Maximum cement content = 450 kg/m^3
- Type of aggregate = Angular coarse aggregate (20 mm nominal size)
- Specific gravity of cement = 3.10
- Specific gravity of aggregates (CA & FA) = 2.75
- Water absorption of CA = 0.50%
- Water absorption of FA = 1.00%
- Free surface moisture (CA & FA) = Nil

Target Mean Strength

The target mean strength was calculated using:

Target Mean Strength = fck + 1.65 × s

= 30 + (1.65 × 5)

= 38.25 N/mm^2

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Selection of Water-Cement Ratio
For M30 grade concrete under severe exposure conditions, the maximum water-cement ratio recommended by IS standards is 0.45.
Therefore,
Water-Cement Ratio = 0.45

Selection of Water Content

According to IS 10262 reference tables, the recommended water content for 20 mm angular aggregates and 25–50 mm slump is approximately 186 kg/m³.
For a slump of 75 mm:
Water Content = 186 × (1 + 0.03)
= 191.58 kg/m³
≈ 191 kg/m³

Cement Content

Cement Content = Water Content / Water-Cement Ratio
= 191 / 0.45
= 425 kg/m³
Adopted Cement Content = 425 kg/m³

Aggregate Proportions

For 20 mm aggregate size and the selected workability condition:
• Volume fraction of coarse aggregate = 0.63
• Volume fraction of fine aggregate = 0.37
Absolute Volume Calculations

Volume of Cement

= 425 / (3.10 × 1000)
= 0.137 m³
Volume of Water
= 191 / 1000
= 0.191 m³

Volume Available for Aggregates

Vagg = 1 – (Vc + Vw)
= 1 – (0.137 + 0.191)
= 0.672 m³
Volume of Coarse Aggregate
VCA = 0.63 × 0.672
= 0.423 m³
Volume of Fine Aggregate
VFA = 0.37 × 0.672
= 0.248 m³
Mass of Coarse Aggregate
MCA = 0.423 × 2.75 × 1000
= 1165 kg
Mass of Fine Aggregate
MFA = 0.248 × 2.75 × 1000
= 684 kg
Final Mix Proportion (per m³)
• Water = 191 kg
• Cement = 425 kg
• Fine Aggregate = 684 kg
• Coarse Aggregate = 1165 kg

Mix Proportion = 1 : 1.53 : 2.50 : 0.45

RCA Replacement Levels

The recycled coarse aggregate was used as a replacement for natural coarse aggregate at three replacement levels, namely 10%, 30%, and 50%.
10% RCA Replacement
RCA = 0.10 × 1165
= 116.5 kg
NCA = 1165 – 116.5
= 1048.5 kg
30% RCA Replacement
RCA = 0.30 × 1165
= 349.5 kg
NCA = 1165 – 349.5
= 815.5 kg
50% RCA Replacement
RCA = 0.50 × 1165
= 582.5 kg
NCA = 1165 – 582.5
= 582.5 kg
3.4 Site Visit to Construction and Demolition Waste Management Plant
A site visit was conducted to the Construction and Demolition Waste Management Plant located at Moshi, Pune.
Name of Plant: Construction & Demolition Waste Management Plant, Moshi
Type of Technology: Collection – Segregation – Storage – Processing – Reuse
Capacity of Plant: 200 TPD
Operated By: SSN Innovative Infra LLP, Moshi
Purpose of Plant Visit
The purpose of visiting the Construction and Demolition Waste Recycling Plant was:

1. To understand the process of recycling construction and demolition waste into usable aggregates.
2. To study the methods of collection, segregation, crushing, and screening of demolished concrete materials.

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3. To observe the production of recycled coarse aggregate used in concrete construction.
4. To collect RCA samples required for the experimental work.
5. To understand the quality control measures adopted during the recycling process.

Figure 2 Construction and Demolition Waste Management Plant, Moshi

Uses of CDE Urban Mining Machine

The CDE Urban Mining Machine is used for processing and recycling construction and demolition waste into reusable construction materials. The machine separates impurities, crushes concrete debris, and produces recycled coarse aggregates and recycled sand. It helps reduce landfill waste, conserve natural resources, and promote sustainable construction practices. The recycled aggregates produced by the machine can be used in concrete production, road construction, paving blocks, and various civil engineering applications.

Figure 3 CDE Urban Mining Machine

Cube Casting of Natural Coarse Aggregate Concrete

M30 grade concrete is a design mix concrete where the mix proportions are determined based on the required strength (30 MPa at 28 days), workability, durability, and exposure conditions. The casting and curing process plays a crucial role in achieving the desired strength and performance of concrete.

The casting and curing of all concrete specimens were carried out as per IS 516:1959 and IS 1199:1959 standards. In this study, a total of 18 cubes were cast using M30 grade concrete.

Quantity of Materials for One Cube

The quantity of materials required for casting one concrete cube was determined as per the mix design.

• Coarse Aggregate = 3.93 kg
• Fine Aggregate = 3.19 kg
• Cement = 1.43 kg

Figure 4 Quantity of Materials for Casting One Concrete Cube

Slump Cone Test

The slump cone test was conducted on fresh concrete to determine its workability.

Figure 5 Slump Cone Test on Fresh Concrete

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Mixing of Concrete

All ingredients were mixed thoroughly to obtain a homogeneous concrete mix.

Figure 6 Mixing of Concrete

Filling and Tamping of Cube Mould

Concrete was placed in the mould in three equal layers. Each layer was compacted by giving 25 blows using a tamping rod of 16 mm diameter. This process helps improve the density and strength of concrete.

Cube Casting of Recycled Coarse Aggregate Concrete

The same procedure adopted for natural aggregate concrete was followed for recycled aggregate concrete.

The concrete was mixed properly, slump tests were performed, and the moulds were filled and compacted in three layers.

A total of 27 cubes were cast using recycled coarse aggregate by replacing natural coarse aggregate at 10%, 30%, and 50% replacement levels.

Compressive Strength Test of Natural Aggregate Concrete

Concrete cubes of size 150 mm × 150 mm × 150 mm were prepared using natural coarse aggregate as the control mix. After 24 hours, the specimens were demoulded and cured in water for 7, 14, and 28 days.

The compressive strength was determined using a Compression Testing Machine (CTM) by applying load gradually until failure. The maximum load at failure was recorded and the compressive strength was calculated using:

Compressive Strength = Maximum Load / Area of Cube

Compressive Strength Test of Recycled Aggregate Concrete

Concrete cubes of size 150 mm × 150 mm × 150 mm were cast for different replacement levels of recycled coarse aggregate (10%, 30%, and 50%). After 24 hours, the specimens were demoulded and cured in water for 7, 14, and 28 days.

The compressive strength was determined using a Compression Testing Machine (CTM) by applying load until failure. The compressive strength was calculated using:

Compressive Strength = Maximum Load / Area of Cube

RESULTS AND DISCUSSION

Results

The compressive strength test was conducted on concrete cubes of size 150 mm × 150 mm × 150 mm at curing ages of 7, 14, and 28 days. Four different concrete mixes were prepared by replacing Natural Coarse Aggregate (NCA) with Recycled Coarse Aggregate (RCA) at replacement levels of 0%, 10%, 30%, and 50%. The average compressive strength values obtained from three specimens for each curing period are presented below.

Compressive Strength of M30 Concrete with 0% RCA Replacement (Control Mix)

Table 1 shows the compressive strength results of conventional M30 concrete prepared using 100% Natural Coarse Aggregate (NCA).

Table 1 Compressive Strength of M30 Concrete with 0% RCA Replacement

Curing Age	Weight (kg)	Compressive Strength (N/mm²)	Average Strength (N/mm²)
7 Days	8.947	23.52	
	8.889	24.27	**23.56**
	8.776	22.89	
14 Days	8.894	28.60	
	8.974	29.10	**28.86**
	9.024	28.90	
28 Days	8.362	36.97	
	8.957	35.34	**35.89**
	8.245	35.58	

The results indicate that the compressive strength increased with curing age. The average compressive strengths obtained at 7, 14, and 28 days were 23.56 N/mm², 28.86 N/mm², and 35.89 N/mm² respectively.

4.1.2 Compressive Strength of M30 Concrete with 10% RCA Replacement

Table 4.2 presents the compressive strength results of M30 concrete containing 10% Recycled Coarse Aggregate.

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Vol. 15 Issue 06 , June - 2026

Table 2 Compressive Strength of M30 Concrete with 10% RCA Replacement

Curing Age	Weight (kg)	Compressive Strength (N/mm²)	Average Strength (N/mm²)
7 Days	8.707	24.99	
	8.817	26.92	**25.60**
	8.857	24.90	
14 Days	8.932	32.63	
	8.733	33.62	**33.14**
	8.805	33.17	
28 Days	8.872	37.10	
	8.694	36.19	**37.56**
	8.664	39.40	

The concrete containing 10% RCA showed better performance than the control mix. The average compressive strengths obtained at 7, 14, and 28 days were 25.60 N/mm², 33.14 N/mm², and 37.56 N/mm² respectively. The highest 28-day compressive strength was observed in this mix.

4.1.3 Compressive Strength of M30 Concrete with 30% RCA Replacement

Table 4.3 shows the compressive strength results of M30 concrete prepared with 30% RCA replacement.

Table 3 Compressive Strength of M30 Concrete with 30% RCA Replacement

Curing Age	Weight (kg)	Compressive Strength (N/mm²)	Average Strength (N/mm²)
7 Days	8.767	21.34	
	8.660	21.91	**21.16**
	8.627	20.24	
14 Days	8.692	28.86	
	8.772	29.94	**27.87**
	8.868	24.80	
28 Days	8.485	32.86	
	8.576	33.99	**34.66**
	8.612	37.14	

The average compressive strengths obtained for 30% RCA replacement were 21.16 N/mm², 27.87 N/mm², and 34.66 N/mm² at 7, 14, and 28 days respectively. Although the strength was lower than that of 10% RCA concrete, it remained close to the control mix.

4.1.4 Compressive Strength of M30 Concrete with 50% RCA Replacement

Table 4.4 presents the compressive strength results of M30 concrete prepared with 50% RCA replacement.

Table 4 Compressive Strength of M30 Concrete with 50% RCA Replacement

Curing Age	Weight (kg)	Compressive Strength (N/mm²)	Average Strength (N/mm²)
7 Days	8.859	17.10	
	8.715	17.84	**17.04**
	8.231	16.26	
14 Days	8.524	22.14	
	8.616	21.36	**21.99**
	8.596	22.47	
28 Days	8.726	29.99	
	8.825	30.89	**30.48**
	8.932	30.55	

The concrete containing 50% RCA exhibited the lowest compressive strength among all mixes. The average compressive strengths obtained at 7, 14, and 28 days were 17.04 N/mm², 21.99 N/mm², and 30.48 N/mm² respectively.

4.2 Discussion of Results

The experimental results indicate that the compressive strength of concrete is significantly influenced by the percentage replacement of Natural Coarse Aggregate (NCA) with Recycled Coarse Aggregate (RCA).

The control mix containing 0% RCA achieved a 28-day compressive strength of 35.89 N/mm². When 10% RCA was used, the compressive strength increased to 37.56 N/mm², indicating an improvement in strength performance. This improvement may be attributed to better particle packing and improved bonding characteristics between the recycled aggregate and cement paste.

For 30% RCA replacement, the 28-day compressive strength was 34.66 N/mm², which was slightly lower than the control mix but still satisfied the requirements of M30 grade concrete. This suggests that RCA can be used up to 30% replacement without causing significant reduction in strength.

However, when the replacement level was increased to 50%, the compressive strength reduced considerably to 30.48 N/mm². The reduction in strength can be attributed to the higher water absorption and porous nature of recycled aggregates due to the presence of adhered mortar on their surface.

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Among all the mixes tested, the concrete containing 10% RCA exhibited the highest compressive strength at all curing ages. Therefore, 10% RCA replacement can be considered the optimum replacement level for achieving maximum strength while promoting sustainable utilization of construction and demolition waste.

CONCLUSION

The present study was carried out to evaluate the effect of replacing Natural Coarse Aggregate (NCA) with Recycled Coarse Aggregate (RCA) in M30 grade concrete. Experimental investigations were conducted by replacing NCA with RCA at different replacement levels of 10%, 30%, and 50%, and the compressive strength of concrete was determined at 7, 14, and 28 days of curing.

The test results indicate that the compressive strength of concrete is influenced by the percentage of RCA replacement. Among all the mixes tested, concrete containing 10% RCA achieved the highest 28-day compressive strength of 37.56 N/mm², which was slightly higher than that of conventional concrete (0% RCA), having a compressive strength of 35.89 N/mm². This result indicates that a small percentage of recycled coarse aggregate can be effectively incorporated into concrete without adversely affecting its strength.

For the concrete mix containing 30% RCA, the 28-day compressive strength was found to be 34.66 N/mm², which is close to that of the control mix and satisfies the strength requirements of M30 grade concrete. This demonstrates that recycled coarse aggregate can be utilized up to 30% replacement without significant reduction in compressive strength.

However, when the replacement level was increased to 50%, the 28-day compressive strength decreased to 30.48 N/mm². The reduction in strength may be attributed to the higher water absorption capacity, lower density, and porous nature of recycled aggregates due to the presence of adhered mortar on their surface.

Based on the experimental results, it can be concluded that recycled coarse aggregate can be successfully used in concrete up to 30% replacement without significant loss of strength. Among the replacement levels investigated, 10% RCA replacement exhibited the optimum performance in terms of compressive strength. Furthermore, the utilization of recycled coarse aggregate contributes to the effective management of construction and demolition waste, conservation of natural aggregate resources, and promotion of sustainable and environmentally friendly construction practices.

REFERENCES

[1] Abdelfatah, A. S., and Tabsh, S. W., "Review of Research on and Implementation of Recycled Concrete Aggregate in the GCC," Advances in Civil Engineering, Vol. 2011, Article ID 567924, 2011.

[2] Tempest, B., Cavalline, T., Gergely, J., and Weggel, D., "Construction and Demolition Waste Used as Recycled Aggregates in Concrete: Solutions for Increasing the Marketability of Recycled Aggregate Concrete," 2010 Concrete Sustainability Conference, National Ready Mixed Concrete Association, 2010.

[3] Mirza, F. A., and Saif, M. A., "Mechanical Properties of Recycled Aggregate Concrete Incorporating Silica Fume," Proceedings of the 2nd International Conference on Sustainable Construction Materials and Technologies, Ancona, Italy, June 2010.

[4] Safiuddin, M., Alengaram, U. J., Rahman, M. M., Salam, M. A., and Jumaat, M. Z., "Use of Recycled Concrete Aggregate in Concrete: A Review," Construction and Building Materials, 2013.

[5] Shaban, W. M., Yang, J., Su, H., Mo, K. H., Li, L., and Xie, J., "Treatment Methods for Improving the Quality of Recycled Aggregates: A Review," Journal of Advanced Concrete Technology, Vol. 19, No. 1, 2021.

[6] Godihal, J., "A Study on Properties of Recycled Coarse Aggregate (RCA) Using Modified Treatment Method," 2023.

[7] Gupta, Y. P., "Use of Recycled Aggregate in Concrete Construction: A Need for Sustainable Environment," 34th Conference on Our World in Concrete and Structures, Singapore, 16–18 August 2009.

[8] Limbachiya, M. C., Leelawat, T., and Dhir, R. K., "Use of Recycled Concrete Aggregate in High-Strength Concrete," Materials and Structures, Vol. 33, No. 9, pp. 574–580, 2000.

[9] Tavakoli, M., and Soroushian, P., "Strengths of Recycled Aggregate Concrete Made Using Field-Demolished Concrete as Aggregate," ACI Materials Journal, Vol. 93, No. 2, pp. 182–190, 1996.

[10] Rao, A., Jha, K. N., and Misra, S., "Use of Aggregates from Recycled Construction and Demolition Waste in Concrete," Resources, Conservation and Recycling, Vol. 50, No. 1, pp. 71–81, 2007.

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