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A Review Paper on Partially Replacement of Fine Aggregate by Construction and Demolition Waste In Plain Cement Concrete

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Abstract This paper presents the results of an experimental investigation on the use of construction and demolition (C&D) waste as a partial replacement for fine aggregate in plain cement concrete. The purpose of this study was to evaluate the effect of replacing fine aggregate with C&D waste on the compressive strength of plain cement concrete. The results showed that the replacement of fine aggregate with C&D waste had a significant effect on the strength properties of the concrete. The compressive strength decreased as the percentage of C&D waste increased. The study suggests that the use of C&D waste as a partial replacement for fine aggregate in plain cement concrete can be a viable option for sustainable construction practices.

Keywords: construction and demolition waste, concrete, fine aggregate, compression strength

1. INTRODUCTION

In construction, concrete is the primary material. When making mortar and concrete, fine aggregate is a key component and has a significant impact on mix design. River digging for sand is now prohibited in many places. So finding natural sand at a good price is becoming more and more difficult. The construction industry will be affected by a shortage of fine aggregate or a lack of availability. That is why various alternatives is being adopted to counter this problem, such as reuse and recycling of construction and demolition waste. Due to rapid urbanization, old structures are frequently demolished to make room for new and advanced ones in metropolitan areas. Concrete that has been demolished is rarely recycled. The study is a part of a comprehensive programme wherein experimental investigations have been carried out to assess the effect of partial replacement of fine aggregate by construction and demolished (C&D) waste on the compressive strength of recycled concrete for the study over a period of 7, 14, and 28 days. The concrete is prepared with 0, 5, 10, 15, and 20% C&D waste.

1.1 OBJECTIVES

- To collect the C&D waste.
- To collect the raw materials of the project like cement, coarse aggregate, and fine aggregate.
- To analyse the physical properties of recycled C&D aggregate, such as specific gravity tests and water absorption tests.
- To determine the strength parameters of C&D waste concrete, such as compression strength.

1.2 SCOPE OF THE STUDY

- Finding a substitute for fine aggregates in construction in order to reduce their overuse and properly conserve them.
- And as such, it must be essential to identify an alternative to natural sand.

2. LITREATURE REVIEW

Gamashta and Gumashta (2006) [1] used waste concrete and masonry to conduct experiments to test various properties, and provided some insightful feedback for future study and enhancement of structure life given the structure's low cost.

Sriharsha and Murthy (2014) [2] replaced the aggregate in a study on various samples with demolition debris from old buildings and blast furnace slag from iron ore industries. On the concrete's mechanical and physical characteristics, various tests were conducted. The strength of various replacements was measured and contrasted with various concrete mixtures.

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Lakshmi and Nivedhitha (2015) [3] compared the effects of using recycled fine and coarse aggregate in place of natural fine aggregate and natural coarse aggregate on compressive strength, flexural strength, and tensile strength through experiments. 10%, 20%, and 30% of natural coarse aggregate and fine aggregate were substituted with recycled fine and coarse aggregate, respectively. On the concrete, tests were conducted, and the outcomes were compared. When they replaced fine and coarse aggregate with recycled aggregate by 20%, they discovered that the compressive and tensile strengths increased. And as the percentage of natural coarse aggregate and fine aggregate replacement increased, the flexural strength decreased.

S Andavan (2018) [4] have investigated the use of 53 grade cement and partial replacement of fine aggregate in M-20 concrete. In this project, C&D waste makes up to 5%, 10%, 15%, 20%, 25%, 30%, and 35% of the coarse mixture. Then, by partially replacing the cement, 10%, 20%, or 30% of fly ash is also added to this mixture. The conclusion was that C&D waste was utilized. Additionally, it will interact amicably with the concrete, allowing it to be applied to up to a two-story building.

Reema, (2020) [5] made an M-25 blend using replacement rates for coarse aggregates of 0%, 10%, 15%, and 20%. The used aggregate was nominally 20mm in size. RCA had a 2.45 specific gravity and a 5.62% water absorption rate. The findings indicated that the slump increases but the strength only slightly decreases as the percentage of RCA rises. The greatest decreases in split tensile strength and compressive strength, respectively, were 8.825% and 13.22%. The ideal percentage replacement was 20% because it had no effect on the structure's functional requirements.

3. MATERIALS

3.1 Cement

In order to bond with other materials and create a compact mass, cement must have extremely high adhesive and cohesive properties. A substance with high cementitious properties is cement.

3.2 Fine Aggregate

The fine aggregates used were locally accessible, and after testing, the findings complied with Indian Standard IS 383:1970. Concrete's compressive strength is increased through the use of fine aggregate. When fine aggregates are used, both fine and coarse aggregates bond or interlock more effectively. Three tests are carried out on fine aggregate: sieve analysis, specific gravity, and water absorption.

3.3 Coarse Aggregate

The aggregates used had a nominal maximum size of 20 mm, and when they were tested in accordance with Indian standards, the results were acceptable (IS: 10262, IS: 383). Specific gravity, water absorption, flakiness index, elongation index, impact test, and abrasion test are the tests done on coarse aggregate.

3.4 C&D waste

The building, remodeling, repair, and demolition of homes, large building structures, roads, bridges, piers, and dams results in the production of construction and demolition (C&D) waste. Wood, steel, concrete, gypsum, masonry, plaster, metal, and asphalt are the main components of C&D waste. Because it may contain dangerous substances like lead and asbestos, C&D waste is noteworthy. Although estimates vary, it is generally agreed that between 15% and 20% of municipal solid waste is generated by construction and demolition activities.

3.5 Water

In the lab, trial mixes were made using portable water. It is generally accepted that water that is pure enough to be drunk can also be used to mix concrete. For mixing and curing, portable water from the area was used.

4. METHODOLOGY

In this study, C&D waste was collected from a local construction site and was processed to obtain fine aggregate of size less than 4.75 mm. The fine aggregate was then used as a partial replacement for natural fine aggregate in plain cement concrete at various percentages (0%, 5%, 10%, 15%, and 20%). The concrete specimens were cast and tested for compressive strength, at 7, 14, and 28 days. The results were compared to those of plain cement concrete without any replacement.

5. TESTS

5.1 Compressive Strength

The ability to support loads on the surface of a material or structure without cracking or deforming is known as compressive strength. An object's size will decrease when it is compressed, while it will lengthen when it is under tension. We learn more about overall strength and the aforementioned factors from the compressive strength test. This test makes it

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simple to determine the concrete's psi strength and the level of quality being produced. With time, concrete becomes more durable. It can be seen that maximum strengths of 58.73 MPa, 61.45 MPa, 65.86 MPa, and 69.23 MPa for M30 grade.

Table 5.1: Stipulation for Proportioning of Concrete

Grade of Concrete	M30
Maximum nominal size of aggregate	20mm
Workability	75-100mm (slump)
Exposure condition	Moderate
Types of aggregates	Crushed angular
Maximum cement content	450 kg/m3
Minimum cement content	300 kg/m3
Maximum water cement ratio	0.40
Chemical admixture	Super plasticizer

6. RESULT

The results of the study showed that the replacement of fine aggregate with C&D waste had a significant effect on the strength properties of the concrete. The compressive strength decreased as the percentage of C&D waste increased, at 20% replacement, the compressive strength decreased by 26% at 28 days. These findings suggest that the use of C&D waste can reduce the compressive strength of concrete up to a certain level of replacement.

7. CONCLUSION

As a fine aggregate in the concrete, recycled construction and demolition waste can be optimally replaced. When compared to conventional concrete, strength characteristics linearly declined at replacement rates of 0%, 5%, 10%, 15%, and 20%. Construction and demolition waste generated during the demolition of construction sites has the potential to partially replace fine aggregate.

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