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Study on Strength and Durability Studies of Concrete by Partial Replacement of Coarse Aggregates by Demolished Aggregates

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***Abstract*— The concrete should be properly disposed of when a structure is being taken down, whether it is an existing or a previously built one. After these kinds of demolitions, "Demolished Concrete" is the term used for the concrete waste that remains. Recycled aggregate is one of the products that have emerged in response to the calls for greener living and sustainable development practices. Solid debris from the demolition of buildings and the restoration of old structures have become the main sources of landfills in recent times. If the destroyed concrete is reused and recycled, the economy may benefit without harming the environment.**
Most of the previous studies based on literature have only considered strength characteristics of concrete as a function of different percentages of crushed aggregates. This study has also looked at durability along with strength characteristics. This research is centered on an investigation of the influence of utilizing crushed concrete as a substitution for coarse aggregates on concrete's workability, compressive strength, split tensile strength, flexural strength, and durability. The different percentages of the destroyed aggregate used for the replacement in this study are from 0% to 50%.

***Index Terms*— strength, durability, coarse aggregates, demolished aggregates, crushed aggregates.**

I. INTRODUCTION

The usage of construction materials has changed various times to what it was before, recently. Among these materials, those cheaper and more environmentally friendly than before have been mostly chosen from mounds of earth bricks, stones, woods, steels, aluminums, plastics, and fibers of all kinds. The weather, sanitariums, and the specific raw materials, which are the factors that, fruits of these materials, bring about the desired economic result, remake [1].
Although the term "C&D waste" commonly refers to the garbage that results from construction and demolition activities, the garbage that sources directly from these operations may be different from each other. The removal of old buildings through demolition is one reason, while the use of new manufacturing methods and materials is a significant part of the newly built projects. Another type of garbage may result from the older buildings due to the fact that the materials used in that are no longer in modern building practices [2].

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For example, asbestos, a widely used insulating material in the 1970s and 1980s that is now classified as a hazardous waste.
The character of the two works is another reason that separates construction debris from demolition debris besides the difference in the nature of the works. The amount of litter generated by demolition activities is twenty to thirty times more than that of construction works since demolition activities frequently entail the complete disassembly of the structure. Demolition waste can contain a significant amount of metal, which is almost never wasted during construction, thus, that can form a major part of demolition waste [3].

A. Uses of demolished aggregates

- Continue to fuel the building industry's heavy dependence on natural aggregates, which are limited.
- Construction debris generation
- Environmental protection
- Cost savings
- Can also be implemented in areas where natural aggregates are scarce, and the soil is weak.

B. Objectives of the study

Below, we have outlined the specific objectives of this investigation.

- By reusing and recycling building and demolition waste into new concrete, we not only help to reduce pollution levels but also provide the material with some economic value [4].
- The main aim of the research is to determine if demolition and construction waste can be used instead of traditional coarse aggregate.
- To conduct research experiments to investigate the mechanical and physical properties of the aggregate obtained from the demolition and building sites.
- The fourth point is to use the debris from the old concrete buildings as a raw material for fresh concrete. The concrete debris from the demolished neighboring building is removed.
- The primary goal is to support the search for new uses of this waste and other ways to make it valuable again, thus, with the hope of the construction industry becoming more sustainable [5]

II. Literature Survey

The first paper was authored by [1], 99 specimens were produced in order to figure out the principal attributes of hardened concrete. The authors of the paper state that the processing of recycled aggregate for concrete mixtures has a major impact on the concrete's workability. They also established that the workability of a concrete mixture with natural and recycled aggregates is almost the same provided that the surface of the dry recycled aggregate is saturated with water.
The research has replaced the use of fresh coarse aggregate with recycled coarse aggregate. The report states that the compressive strength of the concrete made with recycled coarse aggregate is almost similar to that of the natural one [2].
This part of the program investigated the workability and compressive strength of recycled concrete in a condition where the coarse aggregate was partially replaced with the demolition debris. Investigations for 7 and 28 days have been carried out [3]. Based on the findings of this study, recycled concrete aggregate is a viable source of material for the production of conventional concrete.

III. Materials and Mix Design

A. Cement

The 53-grade regular Portland cement, commonly called ACC cement, was used in this study which was shown in the below Figure 1.

Figure 1. OPC 53 Grade cement

B. Fine aggregates

Sands collected from either land or sea are the main materials of fine aggregate. Fine aggregates such as natural sand or crushed stone usually have particles that are small enough to pass through a 4.75 mm mesh filter [6]. River sand, bought from a local market, is used as the fine aggregate for the research which is shown in the below Figure 2.

Figure 2. Fine aggregates

C. Coarse aggregates

Particles with a diameter of more than 4.75 mm, but most of the time varying from 9.5 mm to 37.5 mm, are referred to as coarse aggregates. Besides that, they can be new, leftover, or even recycled materials. Here the coarse aggregate's nominal sizes are 20 mm and 12 mm which is shown in the below Figure 3 [7].

Figure 3. Coarse aggregates

D. Demolished aggregates

Construction and demolition debris originated from the area where the structure was taken down and replaced [8]. Aggregates that are kept on a 12.5 mm sieve after passing through a 20 mm IS sieve have been gathered shown in the Figure 4.

Figure 4. Demolished aggregates

E. Mix Design of Concrete

You can see the concrete mix proportions in the Table I below.

TABLE I: MIX PROPORTIONS USED IN THE STUDY

Material	Cement	Fine Aggregates	Coarse Aggregates	Water
Density	438 kg/m3	717.12 kg/m3	1115 kg/m3	197 kg/m3
Proportions	1	1.63	2.54	0.45

The authors can conclude on the topic discussed and proposed. Future enhancement can also be briefed here.

IV. RESULTS AND ANALYSIS

A. Slump cone test

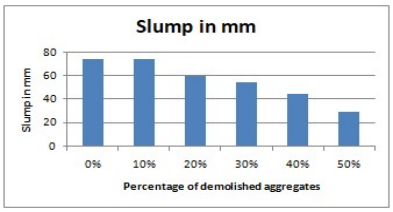

Figure 5. Comparison of slump cone test values

The variation of slump cone test values by using demolished aggregates as replacement for M40 grade concrete are shown in the above Figure 5 [9]. From these results it was observed that the values of slump decreases with increase in the percentage of demolished aggregates from 0%to 50%

B. Compaction factor test

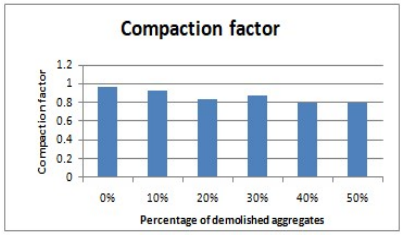

Figure 6. Comparison of compaction factor test values

The variation of compaction factor test values are shown in the above Figure 6 from this observation it was concluded that the value of compaction factor decreases with increase in the percentage of demolished aggregates from 0% to 50% [10].

C. Compressive strength of concrete

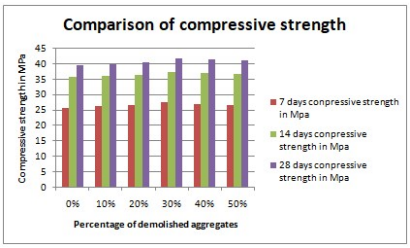

Figure 7. Comparison of compressive strength test values

The comparison of compressive strength values are shown in the above Figure 7. At 30% demolished aggregates the strength was seen maximum values for 7days, 14days and 28days curing.

D. Split tensile strength of concrete

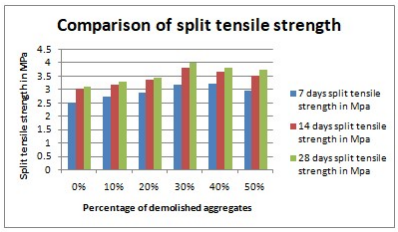

Figure 8. Comparison of split tensile strength test values

The comparison of split tensile strength values are shown in the above Figure 8. At 30% demolished aggregates the strength was seen maximum values for 7days, 14days and 28days curing.

E. Durability of concrete

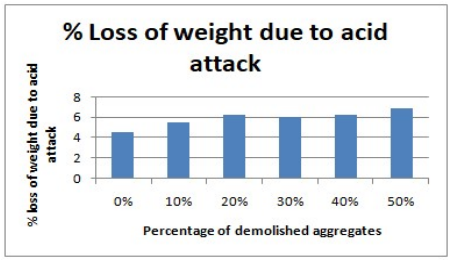

Figure 9. Percentage loss of weight due to acid attack

The comparison of percentage loss of weight is shown in above Figure 9, from this observation it was concluded that the value of percentage loss weight increases with increase in the percentage of demolished aggregates from 0% to 50% in M40 grade concrete.

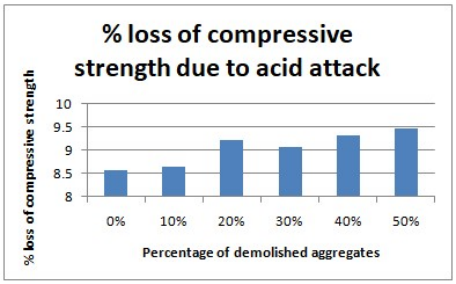

Figure 10. Percentage loss of compressive strength

The comparison of percentage loss of strength is shown in above Figure 10, from this observation it was concluded that the value of percentage loss strength increases with increase in the percentage of demolished aggregates from 0% to 50% in M40 grade concrete.

V. CONCLUSION

The following findings are derived from the aforementioned research:

- It is a wise decision to employ the demolition concrete as a coarse aggregate because it supplies us with a new material and at the same time, it encourages us to recycle waste.
- The use of demolition waste as a source of coarse aggregate can reduce the burden on landfills and environmental degradation [6].
- The demolished concrete is of lower density than the normal one, therefore it is lighter in weight and the cost of the material is reduced.
- In areas where there are no natural sources of coarse aggregate and the soil is weak, demolished concrete is used generally.
- The value of slump decreases as the percentage of destroyed waste changes from 0% to 50%.
- The value of the compaction factor also reduces as the amount of the destroyed waste changes from 0% to 50%.
- With an increase in the amount of destroyed material from 0% to 30%, the concrete's compressive strength, split tensile strength, and flexural strength also increase. The strength values start to decrease when aggregates are 30% destroyed.
- The proportion of weight lost due to acid and alkali attacks increases with the proportion of aggregates destroyed.
- Another finding is the relationship between the proportion of aggregates destroyed and the percentage of compressive capacity loss caused by acid and alkali assaults.

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