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Analyzing Use of Recycled Concrete Aggregate as a Construction Material

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Abstract: The scarcity of the natural materials such as aggregates has hiked their cost, availability of good quality material, and also results in bulking volume by the contractors by mixing cheap quality materials with the good one affecting their performance. The main objective of this research was to investigate whether recycled concrete aggregate (RCA) can be in-corporated into the production of concrete without compromising the compressive strength of the concrete produced. In order to shed light on the strength of concrete produced with RCA, the thesis reviewed studies utilizing the RCA in the composition of concrete and presented the results of this synthesis and analysis.

Keywords: Aggregate, Compressive Strength, Performance, Recycled Aggregate, Recycled Concrete Aggregate.

I. INTRODUCTION

In this era of 21st century it's the need of the hour to develop sustainable solutions for the complexities. Since rehabitation of the mankind, there has been massive growth and construction industry since the past two decades. As Concrete is considered to be the most important material in the construction industry which tends to bear compressive stresses on the structural member. And aggregates play an important contribution in the compressive strength of the concrete, so it is a crucial element in it. As the need and importance of concrete is increasing the utilization of the aggregates is increasing and causing scarcity of natural aggregates. So need of the recycled concrete aggregate (RCA) in the production of concrete as a partial or full replacement to natural aggregate is need of the time.

It is thought that RCA has been used in concrete production since 1945, when World War II destroyed a large number of concrete structures and there was a strong demand for aggregate to repair them. Every year, many smaller buildings are demolished in order to achieve rapid urbanization, and newer, larger structures are built in their place. After these old roads and houses are demolished, the removed concrete is frequently considered worthless and discarded as demolition waste. This used/demolished concrete is gathered and broken according to grade forming RCA. It solves many issues at once like getting rid of waste material & minimizing the use of fresh materials.

1.1 Objectives

The thesis' main objective is to compare the compressive strength of concrete after replacing natural aggregate with RCA at different percentages in various grades of concrete using results published papers by renowned engineers in order to determine the viability of using RCAs in a structure.

1.2 Necessity

It is necessary to know the viability of the recycled concrete aggregate because aggregate is an important material in the production of concrete and as we are replacing the natural aggregate with the RCA it might or might not affect the compressive strength of the concrete.

Also, the use of RCA is the need of the time because it can solve the following issues all at a time,

- a. The lack of availability of natural or fresh aggregate.
- b. Hiking in the cost of the fresh material
- c. The landfill problems due to the dumping of the demolished materials.

II. LITERATURE REVIEW

It was discovered that RCA extracted from demolition waste can be used as a secondary aggregate in concrete. The use of recycled concrete aggregate in buildings saves a lot of energy and money on transportation and mining of natural resources. As a result, the environmental effect of waste material is reduced. Various studies on recycled aggregates have shown significant results as compared to natural aggregates. Recycling demolished concrete for use in value-added applications has a lot of potential for both economic and environmental benefits. Converting RCA into useful resources for the development of new concrete may result in significant cost savings.

The quality of recycled concrete aggregate determines the compressive strength of concrete. If a good quality recycled concrete aggregate is used for new concrete production, the result considering the compressive strength of the concrete shows improvement in the strength up to a certain limit of replacement with natural aggregates. Considering the load test on the concrete samples, the use of coarse aggregate type and quantity has no major impact on the pattern and width of cracks.

Concrete containing 50 percent RCA has a compressive strength that is equivalent to that of natural concrete. As a result, the strength of RCA in concrete mixtures is found to be close to that of natural aggregate. Also, the work for contractors interested in using demolished concrete would be streamlined, and a clear tested value for using recycled concrete would be given.

III. METHODOLOGY

The work begins with review of the problem regarding scarcity of natural aggregate for construction concrete, and finding the substitute to it. With an additional criteria that, the material must be a waste product whose use supports sustainable. The hunt of such product led toward the demolished waste which are been dumped on the landfill, impacting its fertility and utility of the land. Since used concrete was discovered of large quantities in demolition waste, the concept of crushing the concrete into granular particles and using it as aggregate arose, which has a lot of potential for solving problems. This approach leads towards the review of previous articles on these subjects. Research articles, case studies, publications, and PowerPoint presentations are gathered from reputable sources, and some results are chosen accordingly.

The obtained study report is compared based on the compressive strength of fresh concrete prepared with percentages of RCA replacing natural aggregates, thus taking into account the strength class of old concrete, which is the range of compressive strength of old concrete.

IV. RESULTS

The results mentioned below are compressive strength tests conducted on the cubes of the concrete using different percentages of RCA which are collected from 3 sources.

1. Recycled Concrete as Aggregate for Structural Concrete Production [6]

Strength class of old concrete: C30/37 & C40/50

% of RCA in Concrete	7 Days (MPa)	28 Days (MPa)
0	35.23	43.44
50	37.14	45.22
100	37.05	45.66

Table no. 1. Compressive strength of sample 1



Graph no. 1. Compressive strength of sample 1

2. Recycled Concrete Aggregates [1]

Strength class of old concrete: not mentioned

% of RCA in	7 Days	28 Days
Concrete	(MPa)	(MPa)
0	22.19	32.6
25	21.37	33.4
50	23.3	35.1
75	19.1	28.6
100	21.5	31.5

 Table no. 2. Compressive strength of sample 2



Graph no. 2. Compressive strength of sample 2

- Recycled Concrete Aggregates and Their Influences on Performances of Low and Normal Strength Concretes [7]
- a. Strength class of old concrete: C12/15

% of RCA in	7 Days	28 Days
Concrete	(MPa)	(MPa)
0	11.5	15
30	7.5	10
50	13	17
100	11	15.5

Table no. 3. Compressive strength of sample 3





Graph no. 3. Compressive strength of sample 3

b. Strength class of old concrete: C16/20

% of RCA in	7 Days	28 Days
Concrete	(MPa)	(MPa)
0	20	25.5
30	19.5	25
50	19	25.5
100	20.5	24.5

 Table no. 4 Compressive strength of sample 4



Graph no. 4. Compressive strength of sample 4

c. Strength class of old concrete: C25/30

% of RCA in	7 Days	28 Days
Concrete	(MPa)	(MPa)
0	24	31
30	24.5	32.5
50	26.5	0, 34
100	21	10,27

Table no. 5 Compressive strength of sample 5



Graph no. 5. Compressive strength of sample 5

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V. CONCLUSION

After observing the above results it can be concluded that the increase in the percentage of use of RCA in fresh concrete results in increasing the compressive strength of the concrete up to some extent. Also, excessive use of the RCA results in decreasing the compressive strength. From the above results, the optimum percent of using RCA is 50%.

Therefore it is feasible to use RCA as a construction material along with the fresh material without compromising the performance of the concrete.

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