

# Effect of Recycled Coarse Aggregate on Compressive Strength and Flexural Strength of Concrete a Review

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**Abstract** - This research is conducted with the use of recycled coarse aggregate as modification. In terms of the use of recycled coarse aggregate, the percentage of recycled coarse aggregate should be determined because the strength of concrete would not be obtained by the high percentage of recycled coarse aggregate. The scope of study is about comparison between recycled coarse aggregate and natural aggregate in terms of specific gravity, absorption, etc. Moreover, this research will also focus on the comparison between recycled aggregate for 0%, 20%, 40%, 60%, 80% and 100% replacement. Recycled coarse aggregate concrete construction technique can be called as 'green concrete', as it minimizes the environmental hazard of the concrete waste disposal. Indian standard recommends target mean compressive strength of the conventional concrete in terms of water cement ratio. The present work is an attempt to study the behavior of recycled coarse aggregate concrete to the compressive strength and flexural strength.

The necessity to produce recycled aggregate concrete with low-medium compressive strength was verified due to the requirement of the volume of cement. The influence of the order of materials used in concrete production (made with recycled aggregates) with respect to improving its tensile strength will analyze. The lower modulus of elasticity of recycled coarse aggregate concretes with respect to conventional concretes was measured verifying the numerical models proposed by several researchers.

**Key Words:** recycled aggregate; recycled aggregate concrete; mechanical properties; load test; structural concrete

## 1. INTRODUCTION

Today, there are critical shortages of natural resources in present scenario. Production of concrete and utilization of concrete has rapidly increased, which results in increased consumption of natural aggregate as the largest concrete component. A possible solution of these problems is to recycle demolished concrete and produce an alternative aggregate for structural concrete in this way. Recycled concrete aggregate is generally produced by two stage crushing of demolished concrete. However, there is totally the beneficial use of recycled coarse aggregate in concrete construction. Recycled aggregate is comprised of crushed, graded inorganic particles processed from the material that have been used in the construction and demolition debris. The aim of this project is to determine the strength characteristic such as compressive strength and flexural strength of recycled aggregate concrete, for application in structural concrete. Coarse aggregate is important material in concrete for compressive strength, so there are utilization of demolished concrete in replaced by natural coarse aggregate. Recycled coarse aggregate obtained from crushed concrete rubble, instead of being stored, can be reused in building industry. An attempt has been made to study the possibility of reusing the recycled concrete aggregate from demolished structures in the place of fresh aggregate. The basic properties of aggregates, such as water absorption and specific gravity, mechanical properties, such as abrasion resistance, effect, and crushing values were also calculated. Workability of fresh concrete and strength parameters of hardened concrete, such as compressive strength and flexural strength. The preceding properties will testing for three different periods of curing of 7, 14, and 28 days. All these mixes will design for M20 grade of concrete. In the present work, a comparison was made between the results of a laboratory investigation on various physical properties of concrete made with recycled aggregate concrete with fresh aggregate concrete and found that the results are encouraging to use concrete with recycled coarse aggregate by various researcher. Concrete is the most widely used construction material across the world. It is used in all types of civil engineering works like infrastructure, low and high-rise buildings, defense structure, and environment protection structure. Concrete is a man-made product, essentially consisting of cement, coarse & fine aggregates, water and/or admixture(s). Recycling of concrete is needed from the viewpoint of environmental preservation and effective utilization of resources.

### 1.1 OBJECTIVES:

The objectives of the study are:

- To investigate the effect of recycled coarse aggregate on the strength of concrete.

- To investigate the effect of recycled coarse aggregate on the workability of concrete.
- To determine the optimum percentage of recycled coarse aggregate in the concrete.

## 1.2 MATERIAL USE

### Materials:

- **Portland pozzolana cement**

The Portland Pozzolana Cement is a kind of Blended Cement which is produced by either inter-grinding of OPC clinker along with gypsum and pozzolanic materials in certain proportions or grinding the OPC clinker, gypsum and Pozzolanic materials separately and thoroughly blending them in certain proportions. Pozzolana such as fly ash is essentially a siliceous material which while in itself possessing little or no cementitious properties will, in finely divided form and in the presence of water, react with calcium hydroxide at ambient temperature to form compounds possessing cementitious properties.

Following tests will be conducted, on cement:

1. Consistency limit test:- Three samples were tested
2. Initial setting time and final setting time

- **Sand**

The sand used in the investigation will be ordinary river sand. The sand passing through 4.75 mm sieve will be used in the preparation of specimens. Sieve analysis for the sand will be carried out in the laboratory as per the procedure mentioned in IS2386 (part-I)-1963. The sizes of sand vary between 2 mm to 4.75 micron

- **Coarse aggregate**

- i) **Fresh crushed coarse aggregate**

The coarse aggregate used in the investigation will be 20 mm size crushed granite stone obtained from quarries. The physical properties will be determined as per IS: 3286-1963.

- ii) **Recycled coarse aggregate**

The recycled aggregate used in this project are taken from the demolished concrete members. These concrete wastes are crushed and Recycled coarse aggregates were produced. Recycled coarse aggregate used in the investigation will be 20 mm size

- **Water**

The water used in the mix design was potable water from the water supply and is free from suspended solids and organic materials, which might have affected the properties of the fresh and hardened concrete. The presence of tannic acid or iron compounds is objectionable. The general required of water for mixing and curing concrete shall be as per IS: 456-2000.

## 1.3 Review of Related Literature:

A large number of researchers have extensively studied the effect of **Recycled aggregate** on the compressive strength & workability of concrete..

1. **SRINIVAS ANGADI, S SELVAPRAKASH, J S R PRASAD** have studied effectiveness of using recycled coarse aggregates in making high strength concrete in this he analysed only a compressive strength of concrete From Compressive strength test results, it is observed that 40% replacement of 10 mm aggregates in recycled coarse aggregate mixing attains more than the conventional concrete and also 40% replacement of 20 mm aggregates in RCA mixing attains more strength when compared to conventional mix at 28 days. It is also found that, Compressive strength of 20% Replacement of 10 mm, 20 mm and combination of 10 mm and 20 mm in RCA mix cubes were attain strength closer to

the compressive strength results of conventional concrete at 12 hours, 3 days, 7 days, 28 days. Compressive strength is decreased while replacing recycled coarse aggregates of 30% in mix at 28 days. But the earlier strength is same as like conventional concrete mix. Finally, overall results are equal to the conventional concrete results at all ages.

- 2. Goudappa Biradar An Experimental Study on Recycled Coarse Aggregates.** The studies showed that the compressive strength of the recycled aggregate concrete is found to be lower than the natural aggregate. The strength of recycled aggregate concrete can be improved by the water and acid treatments. Recycled aggregate treated with nitric acid displayed the decent result compared to the hydrochloric and sulphuric acid and from economical point of view; water and acid treated recycled aggregates can be used in place of natural aggregates for temporary structures.
- 3. Mirjana Malesev, Vlastimir Radonjani and Snezana Marinkovic** A comparative analysis of the experimental results of the properties of fresh and hardened concrete with different replacement ratios of natural with recycled coarse aggregate is presented in the paper. Recycled aggregate was made by crushing the waste concrete of laboratory test cubes and precast concrete columns. Three types of concrete mixtures were tested: concrete made entirely with natural aggregate as a control concrete and two types of concrete made with natural fine and recycled coarse aggregate (50% and 100% replacement of coarse recycled aggregate). Ninety-nine specimens were made for the testing of the basic properties of hardened concrete. Load testing of reinforced concrete beams made of the investigated concrete types is also presented in the paper. Regardless of the replacement ratio, recycled aggregate concrete (RAC) had a satisfactory performance, which did not differ significantly from the performance of control concrete in this experimental research. However, for this to be fulfilled, it is necessary to use quality recycled concrete coarse aggregate and to follow the specific rules for design and production of this new concrete type
- 4. N.Sivakumar1 , S.Muthukumar2 , V.Sivakumar2 D.Gowtham2 , V.Muthuraj2** Experimental Studies on High Strength Concrete by using Recycled Coarse Aggregate When the percentage of RCA replacement was increased, compressive strength gets reduced. However when water/cement ratio of mix was decreased, the compressive strength increases. 2) The target compressive strength (40MPa) can be achieved for 30 to 40 % of RCA replacement by decreasing the water cement ratio and adjusting the admixture content of mix. This is classified as high strength concrete and can be applied in infrastructures, which need compressive strength up to 40MPa. 3) Another result found in this research is that when reducing the water cement ratio used in recycled aggregate mixes, tensile strength and modulus of elasticity are also improved. This will give an improvement in general strength characteristics of structural building. 4) The percentage loss in weight of concrete cubes after the conduct of acid resistance test is negligible for 30 to 40% RCA replacements. Moreover reduction in the strength is also nominal, which shows that these mixes were less attacked by acid. 5) The water absorption and porosity of RCA replaced mixes are higher than normal mix but within the permissible limits. These properties can be modified by reducing the w/c ratio and by incorporating admixtures.
- 5. Prafulla Kumar Tiwari1 , Dr. Raman Nateriya2** Replacement of recycled coarse aggregates with natural coarse aggregates in concrete in this studies the strength of cubes decrease from 0% to 50% and then to 100% . The cubes of 50% replaced RCA could not achieve the targeted mean strength. The optimum value should lie in between 0% and 50% RCA used 4. For this we he perform more replacement like 10%, 20%, 30% and 40% replacement of natural coarse aggregates with recycled coarse aggregates. Although all replacement percentages of recycled coarse aggregate satisfied for impact and los angels abrasions test.

## 1.4 PROPOSED METHODOLOGY

The experimental work was divided into two phases. In first phase, preliminary tests were conducted on materials. In second phase, Concrete cubes and beams will caste for compressive strength and flexural strength. The concrete is prepared by recycled coarse aggregate percentage from 20%, 40%, 60%,80, and 100% with water cement ratios of 0.5. Fresh concrete test for slump test and Hardened concrete test for compressive strength and flexural strength. After 7 and 28 days of curing.

## 1.5 EXPECTED OUTCOMES

It expected that flaky aggregates beyond certain limit decreases strength and workability and hence the strength of concrete greatly depends on shape and size aggregates. It also expected that the compressive strength of concrete decreases with increases in percentage of recycled coarsed aggregate because of increases in voids.

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