Evaluation on Properties of Structural Grade Concrete using RCA

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ABSTRACT

In this Rapid construction industrial world, Recycling construction material plays an major role to preserve natural resources. In this research Recycled aggregates (RCA) from demolished old concrete specimens are used from local body renovation project by demolishing the major portion of the building up to foundation & Gone by new method of foundation.

This old concrete structure samples are crushed to suitable size by manual method and Re used as a RCA by proposition of mix with natural aggregates to attain the strength for structural members of permanent structures without using any admixtures.

In this Research however shows that the recycled aggregate that are obtained from old make good quality of concrete. The compressive strength of RCA is found equal the normal concrete up to least proposition.

RCA aggregate concrete is close proximity to normal concrete in 20%, 30%, 40% of RCA with mixing of natural aggregate.

Keywords— RCA, Material, Concrete

I. INTRODUCTION

For the urban growth of construction industry produces the huge amount of waste and demolished material of old building which creates the environmental pollution and disorder along with this it will need huge space as per report on news paper. India generates 23.75 million tones demolition waste annually. 30% of total obtained solid waste is obtained from construction sector. Over all this the construction waste, 40% of waste is concrete, 30% ceramics and 15% is plastic and wood and 15% metal and other materials. Over all in the production of concrete we need around 80% of aggregates, out of this 70% is coarse aggregate and 40% is fine aggregate.

In this 70% of coarse aggregate we can use the RCA with proportion of 100% of natural aggregate with 20%, 30%, and 40% in RCA. so that to attain equal strength and workability.

The only way to solve this serious problem is to use the RCA in construction industry in major percentage with the no compromise of quality in strength of building. This can be done by using RCA in concrete in different proposition 20%, 30% and 40% by the partially replacement of Coarse Aggregate. The test has conducted to determine the compressive strength of cubes for M35 concretes for 7 days and 28 days.

ADVANTAGES AND DISADVANTAGES OF RECYCLING OF CONSTRUCTION MATERIALS

Cost saving: - There are no detrimental effects on concrete & it is expected that the increase in the cost of cement could be offset by the lower cost of Recycled Concrete Aggregate (RCA).

Save environment: - There is no excavation of natural resources & less transportation. Also less land is required.

Save time: - There is no waiting for material availability. Less emission of carbon due to less crushing. Up to 20% ,30% & 40% replacement of natural aggregate with RCA without a need for additional testing for all concrete up to a characteristic strength as per IS 456-2000

Less quality (e.g. compressive strength reduces by 10-30%).

Duration of procurement of materials may affect life cycle of project.

Land, special equipment’s machineries are required (more cost).

Very high water absorption (up to 6%). It has higher drying shrinkage & creep.

OBJECTIVES OF THE STUDY

To find out the strength of concrete using Recycled Coarse Aggregate (RCA) 20%, 30% and 40% by the partially replacement of Coarse Aggregate. The test has
conducted to determine the compressive strength of cubes for M35 concretes for 7 days and 28 days.

II. EXPERIMENTAL INVESTIGATION

**Cement:**
Ordinary Portland cement of 43 grade was used, which has the fineness modulus 1.5, Specific gravity 3.15, Consistency 37%

**Fine Aggregates:**
River sand conforming to zone III of IS: 383 – 1970 was used. Locally available sand having bulk density of 1860 kg/m³ is used.

**Coarse Aggregates (CA):**
Crushed aggregate confirming to IS: 383-1987 has been used. Aggregates of size 20 mm and 10 mm of specific gravity 2.86 and fineness modulus 7.28 for 20 mm and 6.30 for 10 mm were used.

**Recycle Coarse Aggregates (RCA):**
Crushed and used demolished concrete has been used. Aggregates of size 20 mm and 12.5 mm were used.

**Water:**
Potable water is used for mixing and curing of the concrete mixes.

**Mix Proportion:**
Concrete mix design is a process by which the proportions of the various raw materials of concrete are determined with an aim to achieve a certain minimum strength and durability, as economically as possible. Based on the simplified mix design procedure, a concrete mix of proportions with characteristic target mean compressive strength of 35 MPa was designed without any mineral admixtures.

The concrete mix was designed as per IS 10262:1982 for M35 grade of concrete. The mix adopted for the study are given in Table 1

**Table 1 Concrete Mix Proportion**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Water Kg/m³</th>
<th>Cement 430</th>
<th>Fine aggregate 620</th>
<th>Coarse aggregate 1140</th>
</tr>
</thead>
<tbody>
<tr>
<td>ratio</td>
<td>0.45</td>
<td>1</td>
<td>1.44</td>
<td>2.89</td>
</tr>
</tbody>
</table>

![Fig.1 Methodology](image-url)
The compression test is carried out according to BS1881-116 to determine the characteristic strength of the concrete. In this test, 150 mm standard cube mould is used for concrete mix. The apparatus should be clean and free from hardened concrete and superfluous water before testing.

![Fig.2 Concrete Cube Specimen](image)

**Curing:**
After preparation of concrete cubes the curing of all cubes are done with portable water for the period of 7 & 28 days.

III. **COMPRESSIVE STRENGTH**
Compression test on concrete cubes has been carried out confirming to IS 516-1999. The crushing strength of concrete cube is determined by applying compressive load at the rate of 140 kgf/cm²/min or 140 KN/min till the specimen fail. After 7 & 28 days of curing.

![Fig.3 Compression Test on Concrete Cube](image)
The mix design is first done according to the IS standards 456-2000, 10262-1982 mix design methods and numerous trial mixes were conducted to obtain the optimum mix. Once the optimum mix is determined it is used to produce the concrete with 20%, 30% & 40% by the replacement of RCA.

The slump is taken for each mixing of concrete with 20%, 30% and 40% replacement of RCA. The results show that slump of concrete made with natural aggregates is higher while the concrete with low slump in RAC is caused by the high absorption of RCA which absorbs water during the mixing process. It is recommended to use saturated surface for the results obtained, concrete made with RCA has competitive slump compared to the concrete made with natural aggregate.

The results of the experimental investigation on cubes are presented in this chapter. Failure mode and ultimate loads observed during the test is presented and discussed.

IV. CONCLUSION

Based on the experimental works from this research, the following conclusions are drawn:

Conclusion has made from this experiment is that we can use only 20% of RCA for permanent structure of building in design in foundation work. More than the 30% & 40% of RCA, it can be used as sub coarse or filling the materials of PCC

Hence We No Proper Machineries For Crushing And Cleaning We Attain This Strength. By Using Proper Machineries We Can Also Use Higher Proportion For Normal Concrete To Acheive Same Strength. The w/c used in all mixes is 0.41. The proportion of cement: sand: RCA1:1.44:2.89. The workability of fresh concrete is not satisfied since the slump of recycled concrete made with 30% & 40% RCA is 0mm. It is recommended to saturate the RCA to saturated surface dry condition before casting. RAC can achieve high compressive strength. RAC has higher 28-day compressive strength to control concrete. Recycled aggregates obtained from site tested concrete cubes (RCA) shows good potential as coarse aggregate for the production of new concrete.

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