



iJRASET

International Journal For Research in
Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4

Issue: I

Month of publication: January 2016

DOI:

www.ijraset.com

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Experimental Study of Recycled Aggregate Concrete

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Abstract--*In this paper work we are discussing about the use of recycled concrete aggregate in the concrete and the effects on its compressive strength by progressively replacing the natural concrete aggregate (NCA) with recycled aggregate. It is the experimental study of recycled concrete aggregate (RCA) when it is compared with the natural concrete aggregate on account of its properties. Cubes having dimension 150 X 150 X 150 mm³ were casted using recycled aggregate by replacing the natural aggregate by 0%, 25%, 50% and 75% and corresponding results of compressive strengths were noted. The compressive strengths were noted by crushing the cube at 7, 14 and 28 days and it was found that performance of concretes with 0% and 25% replacement of natural aggregate by recycled aggregate were quite similar to concrete without replacement but with 50% and 75% replacement, the strength of concrete was decreased.*

Keywords--*Recycled Aggregate, Concrete, Compressive Strength, Natural Concrete and Slump Value.*

I. INTRODUCTION

Concrete is man-made construction material which is widely used across the world for construction of the structure. It consists of coarse aggregate, fine aggregate, water, cement and suitable admixtures binding materials. According to IS: 456-2000, three grades of concrete are considered:

Ordinary concrete (M10-M20)

Standard concrete (M25-M65)

High strength concrete (M60-M80).

M20: M20 means mix is designed in such a way that compressive strength of standard cube of size 150mm after 28 days is 20 mpa. Now a day's recycled aggregate are utilized mainly as sub-base of roads and back-fill works. It may also be used in many applications such as retaining walls, sewage, structures of passing block and construction of low rise building.

II. LITERATURE REVIEW

Many researchers had invented new cheap and locally available material in concrete to make it cost effective. The material chosen in this report is recycled aggregate. Even there is lots of research in the same topic but no one had used more than 50% of replacement with natural aggregate. In this report I have used recycled aggregate in concrete as replacement of natural aggregate with proportion upto 75%.

III. MATERIAL AND METHODOLOGY

Recycled coarse aggregate (RCAs) are obtained by using of concrete obtained from demolition of structure such as old building concrete, pavements, bridges, and the structures that are turned into debris from disasters such as flood, earthquakes etc. Recycled concrete aggregate are also obtained from the abandoned structure which are not serving the need of present scenario and has to be brought down for new construction

A. Behavior Of Recycled Concrete With Respect To Natural Concrete

- 1) **Specific Gravity:** It is the ratio of the mass of a solid and mass of equal volume of water at same temperature. It is dimension less quantity. Specific gravity of recycled concrete aggregate is always less than natural concrete.
- 2) **Elongation Index:** It is the percentage of the weight of largest particle with respect to weight of sample. Particles greater than 180% of their average size are considered large particles.
- 3) **Flakiness Index:** It is the percentage of weight of small particle or flaky particle with respect to weight of sample. Particles less than 0.6 times of their average size are considered flaky particles. For recycled concrete aggregate elongation index and flakiness index is less when compare to natural concrete aggregate.

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- 4) *Density*: It is the ratio of weight and volume of the sample. It is measured in kg/m^3 . The density of recycled concrete aggregate is less than the natural concrete aggregate.
- 5) *Strength*: It is the most important property of cement and is a measure of load bearing capacity of any structure. The strength of recycled concrete aggregate is lower than the natural concrete aggregate.

Natural aggregate is replaced by recycled aggregate with various percentage i.e 0%, 25%, 50% and 75% and corresponding . Results of compressive strengths were noted. The compressive strengths were noted by crushing the cube at 7, 14 and 28 days of curing.

Table 1: Properties of aggregate

Properties of aggregate	CA 20 MM	Recycled concrete 20 MM
Sp. Gravity	2.86	2.50
Elongation index	34.82%	26.8%
Flakiness index	14.7%	6.2%
Specific density	2.4-2.9	2.1-2.4
Water absorption	1.99%	5.61%
Impact value	16.22%	32.19%
Crushing value	21.67%	29.8%



Fig1. (i)Recycled Concrete

(ii) Natural Concrete

IV. RESULTS AND ANALYSIS

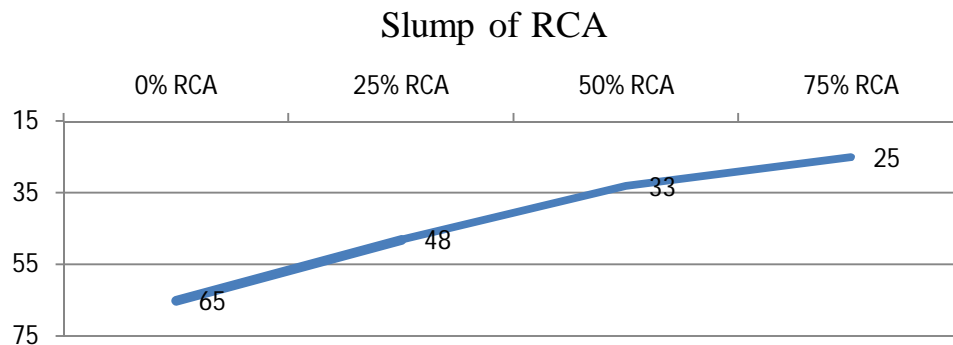
A. Analysis Of Workability Of Recycled Concrete Aggregate

Workability is the amount of work to produce full compaction. If more water is added to achieve the required degree of workmanship it results into the concrete of low strength and poor durability. Workability is mainly affected by the larger size of coarse aggregate, water content, water-cement ratio and aggregate-cement ratio. Slump cone test is the most commonly used method to determine the workability of the concrete. The slump test result is a measurement of the behavior of a compacted inverted cone of concrete under the action of gravity. It measure of the wetness of concrete.

Table 2: Slump of RCA

Grade of concrete	RCA (%)	Slump (in mm)
M-20	0%	65 mm
M-20	25%	48 mm
M-20	50%	33 mm
M-20	75%	25 mm

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B. Compressive Strength Analysis of Recycled Concrete Aggregate

In this paper we have studied compressive strength of concrete by replacing natural aggregate with recycled aggregate by 25%, 50% and 75%. This mixture formed in the sample of cubes of dimension $150 \times 150 \times 150 \text{ mm}^3$. The strength of well compacted concrete with good workability depends on its water-cement ratio. Water-cement ratio within certain limits results in the increased strength. The load test on cubes was performed on 7th days, 14th days and 28th days. The load to be applied by UTM machine to the opposite side of the cube placed centrally between the plates. The load to be applied without shock increased continuously at the rate of approximately $140 \text{ kg/cm}^2/\text{min}$. when the maximum load was applied cube got cracked in inclined direction.

C. The Result Of The Load Test Was As Below

Mix	RCA %	7 Days	14 Days	28 Days
M20	0%	16.1	23.3	28.0
M20	25%	15.8	22.8	25.9
M20	50%	13.4	15.7	18.6
M20	75%	10.5	12.6	13.5

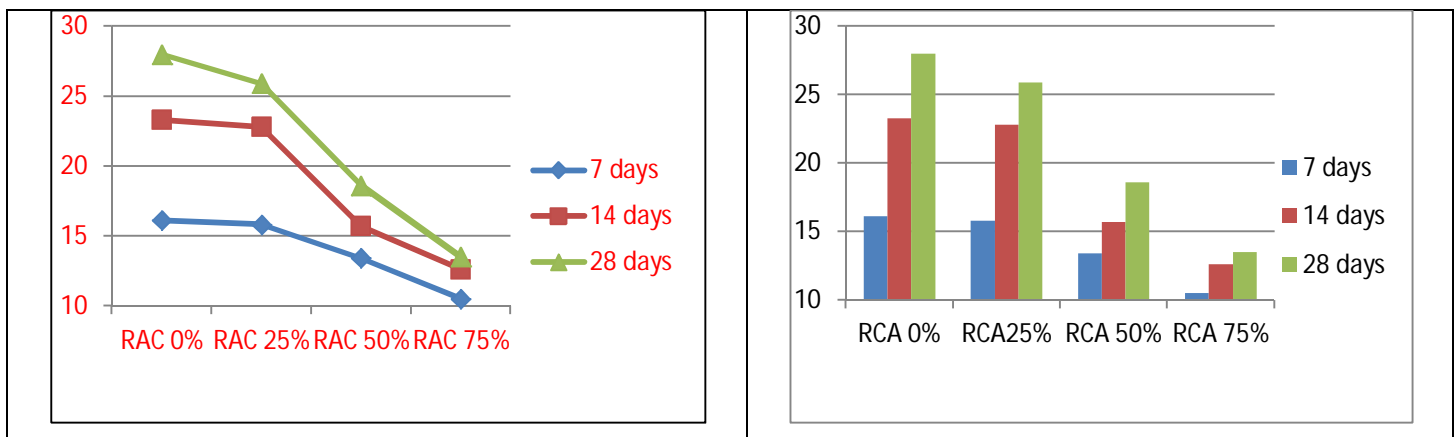


Fig: Compressive strength of cubes for M20

V. CONCLUSION

Based on above result it is concluded that use of Recycle concrete aggregate up to 33% in concrete does not affect the compressive strength of the concrete. Addition of the more than 33% of recycled concrete aggregate reduces the compressive strength of the concrete. Moreover the workability of the concrete with RCA is of same order up to 25% addition of RCA. So it is advisable to use 25-30% recycled concrete aggregate in low rise structure, pavement design, drainage structure, road construction etc. This fill also resolve environmental issues raised due to dumping of demolition debris and construction waste.

A. Economy

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The cost of using natural aggregates includes crushing cost, grading cost, transportation cost, disposal cost of demolished waste, if any. Thus use of purely natural aggregate concrete in any construction also reduces the profit margin of the business. In this project work it has been substantially observed that the recycled aggregates can be used along with natural aggregate in the concrete mix. Under tested proportion, recycled aggregate concrete gives good results and in turn produces a sustainable structure.

B. Applications

In general recycle aggregate are used in the following ways:

Construction of low rise building.

Road construction.

In sewerage structures and sub-base course pavement.

Fill embankment.

Beside drainage layer in highways and retaining walls.

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