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Mechanical Properties and Durability of Concrete Made with Recycled Concrete Aggregate an Experimental Investigation

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ABSTRACT

Recycle Aggregate Concrete (RCA) is the concrete product produced with recycled aggregate to replace part or whole of natural aggregate. The purpose of this study is to find the properties of RCA and compare the same with the concrete produced with natural aggregates with the development and modernization of societies, lot of construction activities are seen everywhere. There search work on analysis of different characteristics of concrete made with recycled aggregate recycled aggregate concrete is presented here and is one such attempt to establish the RAC as a structural grade concrete. This research work focuses on mainly four structural properties of concrete i.e., Compressive Strength, Split Tensile Strength, Acid resistance test and alkalinity resistance test. In this present study the experimental concrete making without fiber and with fiber. The natural coarse aggregates are replaced with Recycled coarse aggregate sat different replacement ratios. Four replacement ratios are considered in this present study 0%, 25%, 50% and100%. Based on their Results obtained it is found that on addition of steel fibers there is increase in almost all the structural properties of normal concrete and concrete made with recycled aggregates.

Keywords: ***RCA, NCA, Steel fiber, compressive strength, Tensile strength, durability***.

INTRODUCTION

Now-a-days concrete industry is consuming lot of natural resources. This causes lot of damage to environment and mother earth. So, the less cement and natural aggregates that are used in concrete production, the lower the impact on environment. The increase in cost of landfill, scarcity of natural resources for aggregate, encourages the use of construction waste as a source of aggregate. A manageable development has turned in to an awesome worry over development hone to the detriment without bounds of our planet. This is because of the way that the development business is an enormous purchaser of common assets and tremendous waste maker too. High estimation of crude material utilization in the development business ends up one of the principle factors that reason ecological harm and contamination to our mom earth and the exhaustion of regular and mineral assets. Consistently, in excess of165million tones of common totals are utilized as a part of various common and modern developments. In the interim, roughly 109 milliontones of development and pulverization buildups are created in the UK; around 60 million tons of this is gotten from concrete. The assets, for example, coarse totals, sands and bonds will beat a distraught position, as these assets are not ready to adapt to the appeal in the development business.

LITERATURE REVIEW

Abbas et al. (2009) concluded that recycled aggregate concrete shows less dense than conventional concrete. Furthermore, its concluded that by addition of silica fume to the recycled aggregate concrete and conventional concrete, reduces the density.Choi and Kang **(2008)** concluded that as cement mortar density of around 1.0 to 1.6mg/cum is less than that of natural aggregate particles at around 2.6 mg/cum, the lower the density of demolished concrete samples, the high earth element mortar content will be. The demolished concrete density ranges between 2269 kg/cum and2432kg/cum.**Thomas et al (2022)** In the recent past, substantial explorations have been accomplished to appreciate the distinct characteristics of concrete, employing recycled aggregates from construction and demolition waste. Geopolymer composite is a new cementitious material, and it appears to be a potential replacement for conventional cement concrete. This paper summarises the previous research concerning the utilisation of recycled aggregate as a partial or complete supplants for conventional aggregates in geopolymer concrete. The influence of recycled aggregate addition on the fresh and hardened properties of geopolymer concrete is comprehensively reviewed in this paper. The studies suggest significant improvement in the workability on addition of recycled aggregates to geopolymer concrete. However, the addition results in increased water absorption and sorptivity.

EXPERIMENTAL PROGRAMME

Cement Ordinary Portland cement of grade- 43 (Shree Ultratechcement) conforming to Indian standards IS: 8112-1989 has been used in the present study

Fine AggregateIS:383-1963 defines the fine aggregate as the aggregate most of which will pass 4.75mm IS sieve. The fine aggregate is usually termed as Sand. The sand is generally considered to have a lower size limit of 0.007 mm. usually natural sand is used as affine aggregate. The sand used for the experimental work is locally available and conformed to grading zone III. The Physical properties of fine aggregate are presentedinTable3.3.

Natural Coarse Aggregate The coarse aggregate is defined as an aggregate most of which is retained on 4.75 mm IS sieve. The broken stone is generally used as a coarse aggregate. Locally available coarse aggregate having the maximum size of 12.5 mm was used in the present work.

Recycled Coarse Aggregate A large amount of tested concrete specimens e.g. cubes, cylinders, beams etc. we relying in the concrete testing laboratory as shown in Fig 3.2(a). These specimens were used as a source of Recycled concrete aggregate. To obtain RCA, these specimens were broken down into small pieces manually using hammer as shown in Fig. 3.2(b).The broken pieces of concrete specimens were sieved, the larger fraction passing through 20mm IS sieve but retained on10 mm IS sieve. The fraction passing through 4.75 IS sieve was discarded.

Steel Fibers

Steel fibers provide significant bridging effect on the cracking behavior of concrete and can control crack width and enhance shear capacity of RC members. Dramix Glued Hooked end type steel fibers Fig. 3.7, with diameter 0.5mm were used in the present investigation. The fibers were added in proportion of 1%byvolumeofconcrete. The aspect ratio of the fiber adopted was 65.

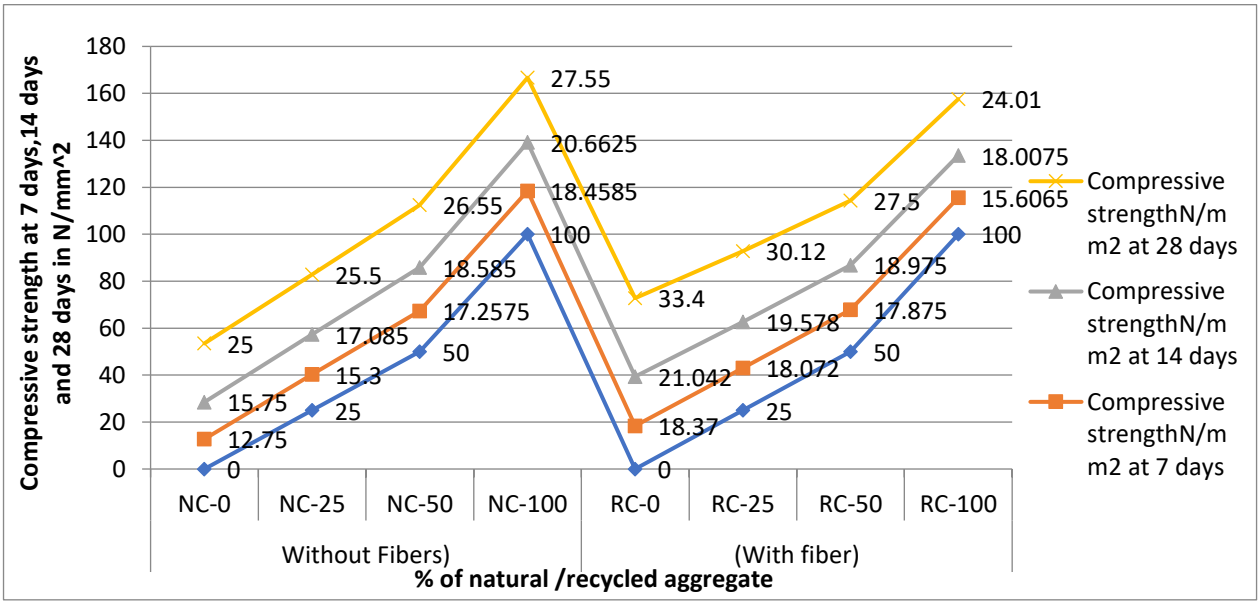
RESULTS AND DISCUSSIONS

COMPRESSIVE STRENGTH

Three cubes of 150 mm dimension are casted and cured for 28 days to evaluate the compressive strength of concrete made with RCA. The cubes are tested on 200Tcapacity compression testing machine as showninFig.4.1. The direct weight to weight replacement of natural coarse aggregate are carried out with the Recycled concrete aggregates at different replacement ratio of 0% (control specimens), 25%, 50% and 100%.

Mix.	Description	Percentage%	Compressive strength N/mm² at 7 days	Compressive strength N/mm² at 14 days	Compressive strength N/mm² at 28 days
Without Fibers)	NC-0	0	12.75	15.75	25
	NC-25	25	15.3	17.085	25.5
	NC-50	50	17.2575	18.585	26.55
	NC-100	100	18.4585	20.6625	27.55
(With fiber)	RC-0	0	18.37	21.042	33.4
	RC-25	25	18.072	19.578	30.12
	RC-50	50	17.875	18.975	27.5
	RC-100	100	15.6065	18.0075	24.01

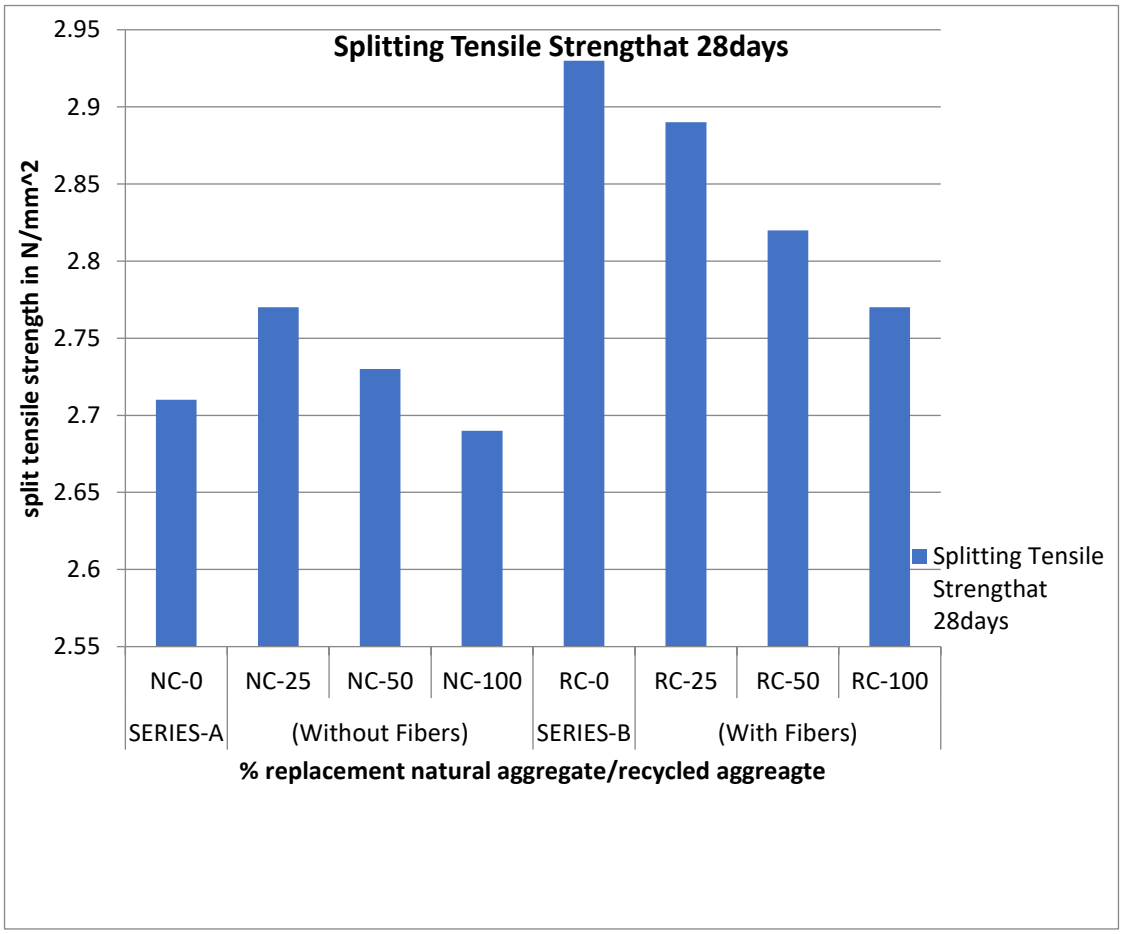
Graph 4.3 Show variation of compressive strength at 7 days, 14 days



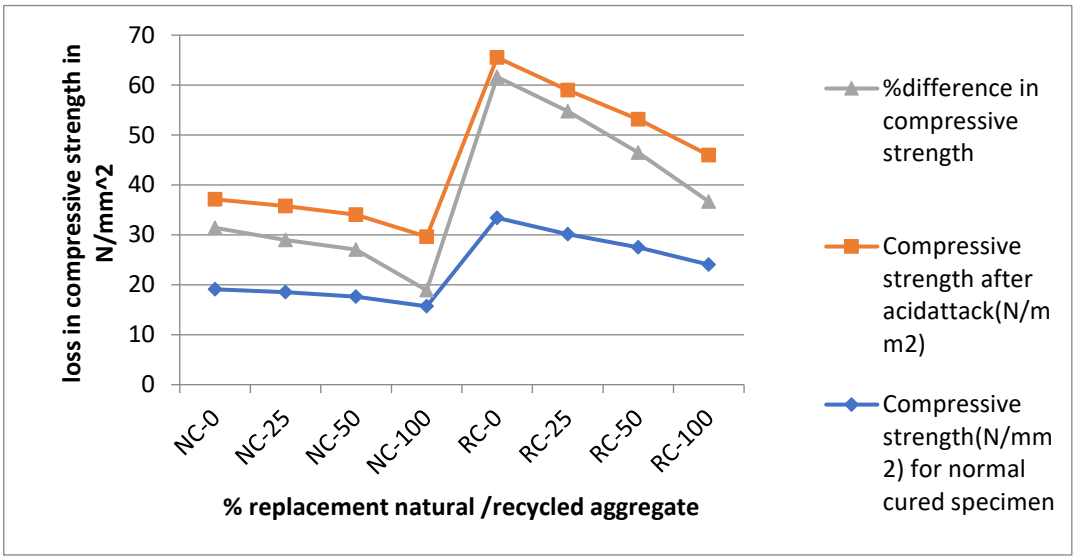
SPLITTING TENSILE STRENGTH

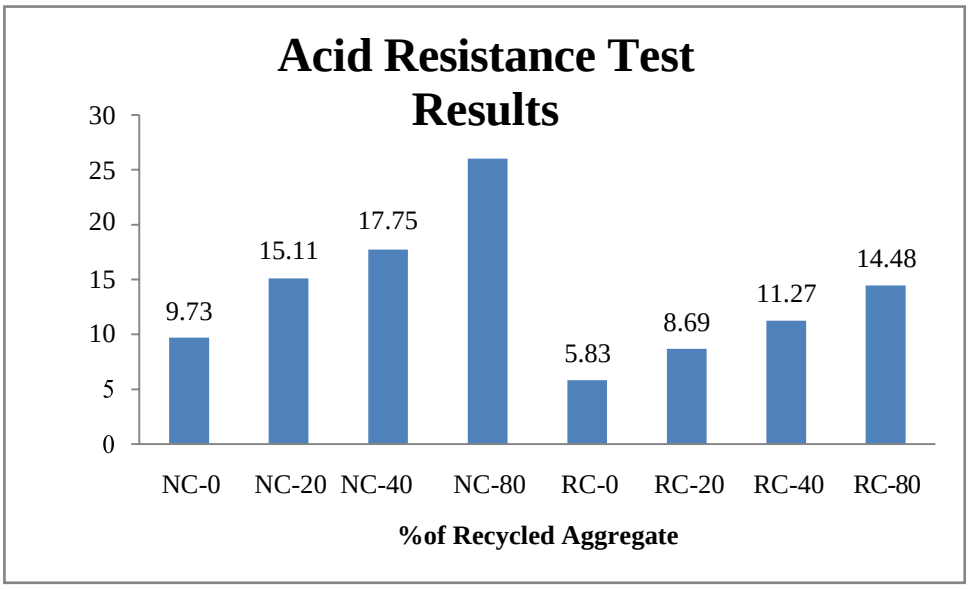
Two cylindrical specimens of 100 mm diameter and 200 mm height are casted and cured for 28 days to evaluate the split tensile strength of concrete made with RCA. The cylindrical specimens are tested on 200T capacity compression testingmachineasshowninFig.4.1.The direct weight to weight replacement of natural coarse aggregate are carried out with the Recycled concrete aggregates at different replacement ratio of 0% (control specimens), 25%, 50% and 100%.

Series	**Specification- Id**	**Replacement ratio**	**Splitting Tensile Strength at 28days**
SERIES-A (Without Fibers)	NC-0	0	2.71
	NC-25	25	2.77
	NC-50	50	2.73
	NC-100	100	2.69
SERIES-B (With Fibers)	RC-0	0	2.93
	RC-25	25	2.89
	RC-50	50	2.82
	RC-100	100	2.77



Graph 4.4 Show variation of Split tensile strength





CONCLUSION

Experimental works on the use of recycled aggregates have proven that good quality of concrete could be produced with recycled aggregates. Based on the experimental investigation reported in the present work, the following conclusions are drawn:

- The compressive strength of concrete increase with Out addition of steel fiber and maximum strength obtained is 15.3 Mpa ,17.08 Mpa and 25.5 Mpa whereas addition of steel fiber and maximum strength obtained is 18.07 Mpa ,19.578 Mpa and 30.12 Mpa at 7,14 and 28 days With 25% replacement of RCA
- The tensile strength of concrete increase without addition of steel fiber is 2.77 Mpa compares with fiber concrete as 2.89 N/mm^2. With 25% replacement of RCA.
- The Flexural strength of concrete increase without addition of steel fiber is 3.8 Mpa compares with fiber concrete as 4.2 $N/mm^{2.}$ with 25% replacement of RCA at 28 days.
- It was observed that concrete less effect due acid attack to addition of steel fiber with compare normal mix concrete
- It found that alkalinity solution attack is less to using of steel fiber compare with control mix. Concrete.

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