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Use of Recycled Concrete Aggregates

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Abstract: ***Use of RCA in concrete is beneficial for future use as well as environment can also be protected. The application of recycled aggregate has been started in a large number of construction projects of many European, American, Russian and Asian countries. According to past survey, countries are giving relaxation in the form of infrastructural law for use of recycled concrete aggregate. The amount of construction waste has been increased drastically from past few years, and environmental effect for recycling of the waste has consequently been increased. Recent technology has also improved the recycling process. In this fast developing world, recycling concrete aggregates plays a vital role to save the natural resources. The waste concrete is collected from demolished structure & crushed to obtain coarse aggregate; the different percentage (i.e. 0%, 25%, 50% & 75%) is used for preparing fresh concrete cubes & beams. The RCA has higher compressive strength compared to NA when used up to certain percentage. Even the slump obtained for RCA is more than NA. RCA has close proximity to NA in terms of compressive & flexural strength. At last we can conclude that use of RCA up to 50% can be done to obtain good quality concrete.***
Keywords: NA- natural aggregates, RCA- recycled concrete aggregates

I. INTRODUCTION

RCA is an aggregate obtained from crushing of demolished/waste concrete. Recycling is the method of producing the new materials from the existing waste products. The use of NA can be lessened by using RCA as a replacement for NA. Recycled aggregate are obtained from demolished wastes which are further crushed into required particle size used for construction. Demolished/waste materials are generally obtained from buildings, roads, bridges etc. However by the usage of RCA cost is being reduced, better quality products are obtained, energy saving & less hazardous to environment. The goal of this project is to analyze the characteristic strengths of RCA, for application in structural R.C.C, road pavements, which will give a better understanding on the properties of concrete with recycled coarse aggregate, as an alternative material to coarse aggregate in structural concrete. The aim of this experiment is to check for the various strengths of concrete by the use of various different percentage of RCA.
According to the previous research the total construction waste obtained per year is approximately 35million tons. Almost 98% of the concrete waste is being recycled; most of it is used for leveling of roadbed. Thus by recycling concrete waste we obtain the following benefits as follows,
Reduction in demand on new resources
Reduction in transport and production energy costs
Use of waste for land filling.

Recycling is a process to reuse the concrete waste in the form of aggregate which reduces energy usage, air pollution (from incineration) and water pollution and greenhouse gas emissions are decreased compared to plastic production. As per the waste hierarchy recycling is the main component of the "Reduce, Reuse and Recycle".

II. METHODOLOGY

A. *Properties of Natural & Recycled Aggregates*

1) *Procedure:* The main goal of this research project is to produce concrete by the use of RCA for various different proportions of concrete. It is of much importance to know that the replacement of RCA in concrete is inappropriate or acceptable. The aggregates used for this project included virgin coarse aggregate, river sand and RCA. Various physical properties were found for RCA such as specific gravity, water absorption, impact value etc. Then concrete cube and beams were prepared for 0%, 25%, 50% & 75% mix proportions and the same were been tested for 7, 14 and 28 days for determination of compressive strength and flexural strength test. The results after every respective day test were taken as an average. The properties of both RCA & NA were compared & analyzed.

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2) *Particle size distribution:*

IS Sieve	25 mm	20 mm	16 mm	12.5 mm	10 mm	4.75 mm	Pan
Percentage of passing (%)	88.20	60.46	33.76	14	1.6	00	00

3) *Physical properties of NA and RCA:*

Sr. No.	Physical property	NA	RCA
1	Water absorption (%)	1.53	6.38
2	Specific gravity	2.67	2.31
3	Bulk Density (kg/ m3)	1465.8	1330.93
4	Crushing value(%)	19.5	20.5
5	Impact value(%)	8.3	8.9

4) *Los Angeles Abrasion:* When concrete waste is crushed, some amount of cement particles are stuck to the aggregate. So, we used Los Angeles machine to remove the cement attached to the aggregates. This was done to obtain a better finished recycle aggregate. As number of revolutions increases; more and more fine recycled aggregates can be obtained. Hence, we rotated the aggregates for 200 & 500 revolutions. Reference: IS: 2386 (Part IV) – 1963, IS: 383- 1970

5) *Mix Design:* The mix design is done according to the IS 10262-1982 design method. The grade of concrete used for casting of cubes & beams for all the proportions was M25 grade. The cement used for preparing concrete was of 43 grade OPC cement. According to mix design the proportion obtained was 1:2.56:3.38 respectively. 'ALGISUPERPLAST N' was used to reduce water cement ratio. The concrete is prepared to find out the compressive strength and flexural strength. The cement used for a single mix proportion was 25kg. & sand used was 64kg.

Sr. No.	Proportion (%)	Aggregates (kg.)	
		Natural	Recycled
1.	0	84.5	Nil
2.	25	63.37	21.13
3.	50	42.25	42.25
4.	75	21.13	63.37

6) *Number of specimens prepared*: The total no. of specimens prepared for various different proportions for respected days is given below in the table.

Size of mould	Specimens prepared		
	7 days	14 days	28 days
150X150X150	30	30	30
700X150X150	-	30	30

7) *Slump test:* This test is taken to determine the consistency of concrete, which can be tested by either laboratory test or on site. The slump of RCA is more than the NA. The slump obtained for NA was 25cm RCA was incorporated while it was 29cm when 75% RCA are used.

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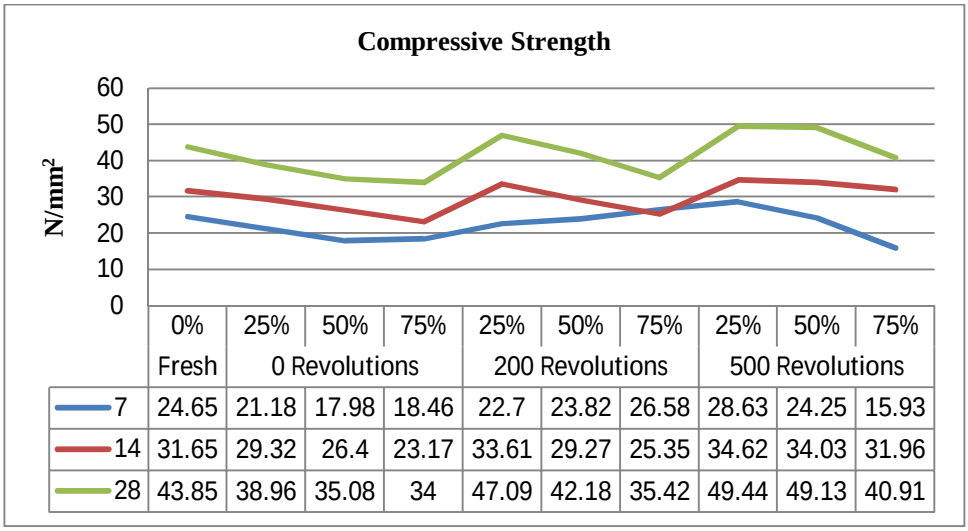
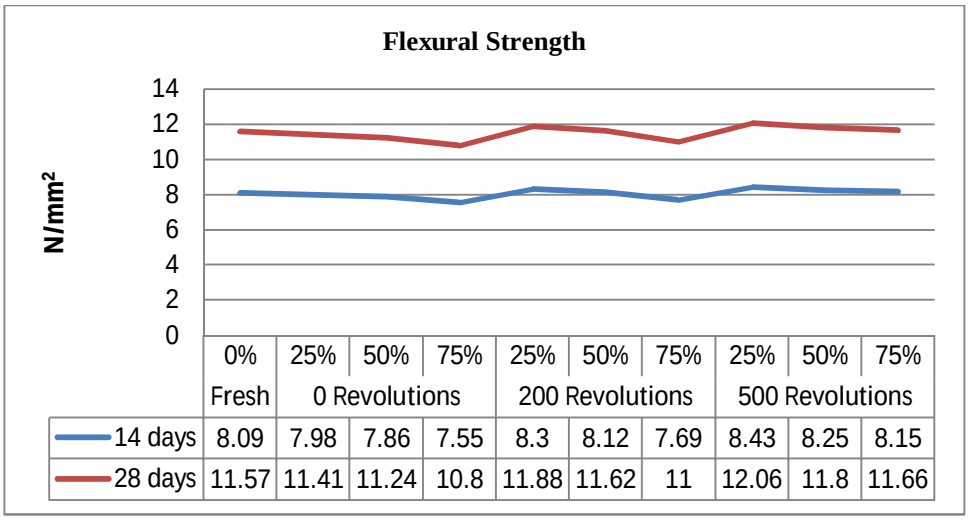
III. RESULTS

The different tests were taken on the concrete prepared by various different proportions after 7, 14 & 28 days respectively. Even the density of concrete was also tested on the cubes during compression test. The flexural test on beams were taken after 14 & 28 days since the beam does not gains enough strength after days & fails during testing. There is no change seen in density, it ranges from 1.2 to 1.4.



	0%	25%	50%	75%	25%	50%	75%	25%	50%	75%
	Fresh	0 Revolutions			200 Revolutions			500 Revolutions		
7	24.65	21.18	17.98	18.46	22.7	23.82	26.58	28.63	24.25	15.93
14	31.65	29.32	26.4	23.17	33.61	29.27	25.35	34.62	34.03	31.96
28	43.85	38.96	35.08	34	47.09	42.18	35.42	49.44	49.13	40.91



	0%	25%	50%	75%	25%	50%	75%	25%	50%	75%
	Fresh	0 Revolutions			200 Revolutions			500 Revolutions		
14 days	8.09	7.98	7.86	7.55	8.3	8.12	7.69	8.43	8.25	8.15
28 days	11.57	11.41	11.24	10.8	11.88	11.62	11	12.06	11.8	11.66

IV. CONCLUSION

On the basis of our comparative analysis of test results of the basic properties of concrete with four different percentages of RCA content (0%, 25%, 50% and 75%), the following conclusions are made. The method of preparing RCA for concrete mixture enhances the concrete workability. Workability of concrete with NA and RCA is comparatively same only if dried water saturated aggregates are used. Use of RCA is directly proportional in cost reduction as the waste disposal is reduced & also virgin aggregates. The environmental benefit is obvious, reducing unlawful disposal problems and conserving limited landfill space. Use of recycled aggregate up to 50% does not affect the functional requirements of the structure as per the findings of the test results. Various tests are carried out on RCA and results compared with NA are satisfactory as per IS 2386. Due to use of RCA in construction, energy & cost of transportation of natural resources & excavation is significantly saved. It directly reduces the impact of waste material on environment.

As we go on increasing percentage of RCA the slump of concrete goes on decreasing which reduces its workability. According to

the results, the highest slump obtained was 29 cm and lowest slump obtained was 25 cm for M25 grade concrete. The workability was good and can be satisfactorily handled for 0% to 50% RCA. However, the strength of RCA specimens gradually increases up to 50% replacement of RCA & then it decreases. The result shows that the concrete specimens with 50% replacement of recycled aggregate get the highest strength when compared to the concrete specimens with different percentage of recycled aggregate. From the results obtained, use of RCA up to 50% is applicable for high strengths of concrete.

V. FUTURE SCOPE

Economy, strength & serviceability of concrete are maintained by varying the percentage replacement of mix combinations. Environmental effects are also reduced. Also, there is need to save land as lack of dumping sites, this process leads as the savior of environment. By various researches Percentage of CNC can be worked out with 100% replacement of NCA with RCA. To produce and secure a system of sale based packed precast concrete batches, in which CNC waste and recycled coarse aggregate concrete will be present.

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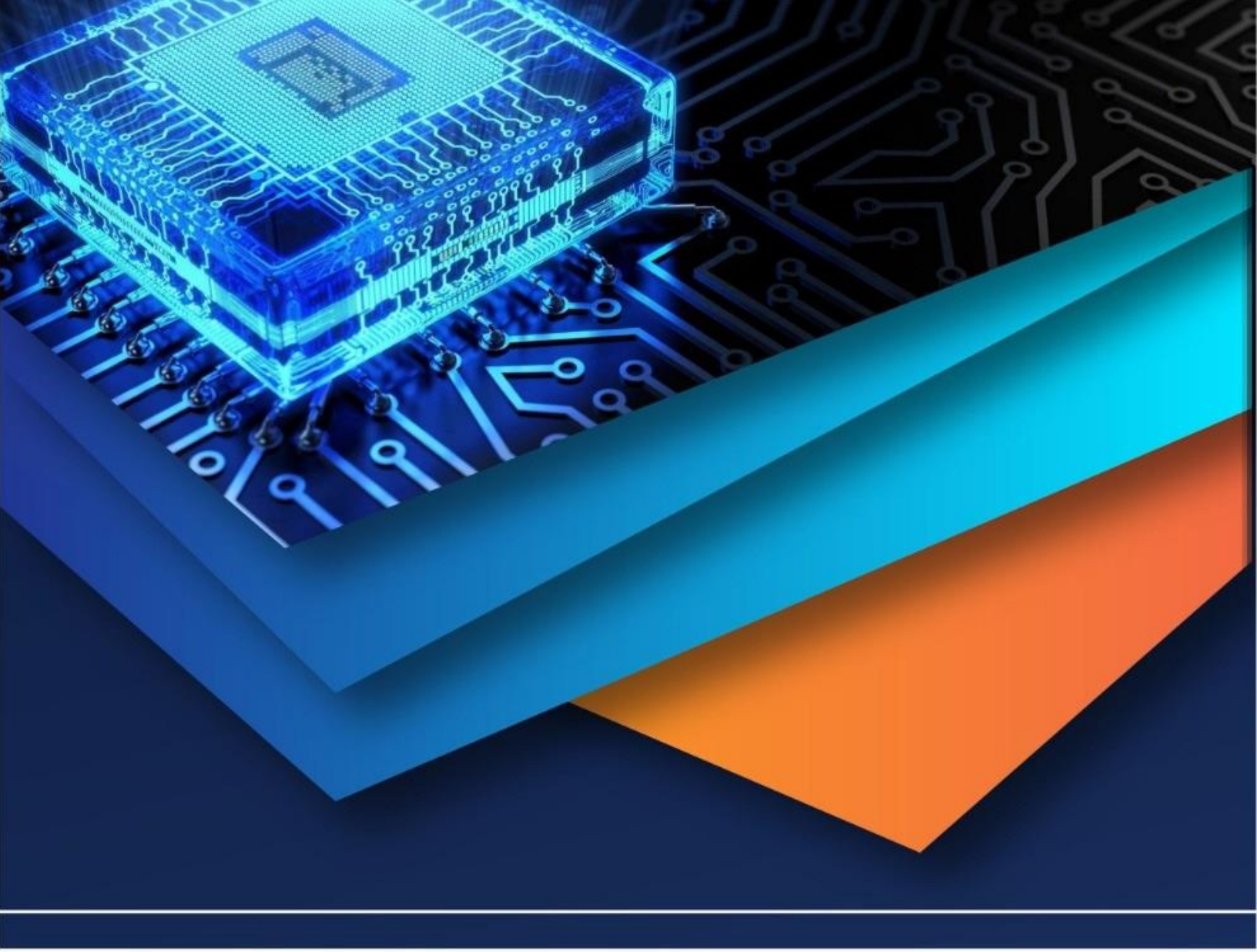

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