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Evaluation of Compressive Strength with different W/C Ratio and Replacement of Recycled Aggregate in Concrete

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ABSTRACT

This research work presents the results of a laboratory investigation on the performance of natural and recycled aggregate concrete prepared with the incorporation of different water cement ratio. Find out compressive strength on 7Days and 28 Days with two different water cement ratios. The compressive strength and concrete workability by slump of the concrete mixtures were determined. The test results, in general, showed that the properties of the recycled aggregate concretes. The replacement 10%, 20% and 30% of recycled coarse aggregate in concrete we cannot achieve target mean strength but we achieve the characteristic strength in all mixes. Observed by results of compressive test by the compression testing machine of compressive strength is decreasing with increasing the replacement of recycled coarse aggregates in percentage variation at 10%, 20% and 30% are 11.54, 12.18 and18.63 respectively at 0.45 W/C ratio. Observed by results of compressive test with the compression of compressive strength is decreasing with increasing the replacement of recycled coarse aggregates in percentage variation at 10%, 20% and 30% are 11.54, 12.18 and18.63 respectively at 0.45 W/C ratio. In this this research work are using coarse aggregate from Construction and Demolition waste as partial replacement of coarse aggregate in concrete by the observation of workability and we find out that concrete is workable with replacement of coarse aggregate in concrete.

Keywords: Compressive Strength, Workability, Water Cement Ratio, Recycled Aggregate

INTRODUCTION

Recycling is the act of processing that used material for use in developed new materials. The usage of natural aggregate is getting much acute with the new era development in the field of infrastructure. To reduce the utilizing of natural aggregate by recycled aggregate can be used as the replacement materials for new concrete. Recycled aggregate are comprised of crushed, graded inorganic particles processed from the materials that have been used in the constructions and demolition waste. These materials are mostly from buildings, roads, bridge etc.

Recycled aggregate (RA) is a substitute to natural aggregate, which assist in the conservation of the environment. The properties of recycled aggregate are influenced by the quality of materials being used in building and its ages. The main purpose of the present research work is to

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investigate different properties of aggregate and their effects on new concrete. Aggregate strength, Water absorption, moisture content, specific gravity, shape, and size are the physical and mechanical characteristics that effect to the strength and durability of concrete. So it is necessary to investigate these properties before utilizing the aggregate. In this research paper, different properties of recycled aggregate which collected from Jodhpur in Rajasthan over a period of 30 Years from a demolished building were evaluated.

OBJECTIVE OF STUDY

To characterize the recycled aggregates in terms of physical property and also to study the properties of concrete made with recycled aggregates.
To analyze the structural behavior of concrete made with different percentages of recycled coarse aggregates.
To analyze the option for the use of recycled aggregate in concrete in main stream construction rather than using it as an infill material.
To ameliorate the reservations if any, for the use of recycled aggregates in concretes and make the industry aware of the option available on recycling and reuse.

CHARACTERISTICS OF INGREDIENTS IN RECYCLED AGGREGATE CONCRETE

The lists of the various components which are used in concrete:-
Cement
Fine Aggregate (Sand)
Coarse Aggregate
Recycled Aggregate (Course)
Water
These are above various components that were used in this experiment for the mix design of the concrete and for studying the behavior and various properties of the concrete.
Cement: - Cement is like a binder which sets hardens and adheres to the other materials and bind together. For this experiment work we had selected is the 43 Grade Ordinary Portland cement. The most important physical properties of cement are hydration of cement, setting of cement, fineness of cement and strength of cement. Ordinary Portland cement used in the present work has been tested and the results are as displayed below figure.

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Test Name	Result	Specific limits	Methods of testing
Standard consistency	28.5%	----------	IS:4031(PART IV)-1995
Initial Setting time	90 min	Min. 30 min	IS:4031(PART V)-2000
Final setting time	305 min	Max 600min	IS:4031(PART V)-2000
3 days compressive strength	38.83N/mm^2	Min 23N/mm^2	IS:4031(PART VI)-2005
28days compressive strength	67.43 N/mm^2	Min 43N/mm^2	IS:4031(PART VI)-2005
Specific gravity of Cement	3.15	…….	

Sand: - Sand is the most abundantly occurring natural fine aggregate. While contributing to the strength of concrete, the fine fraction also acts as fillers occupying the spaces between the coarse aggregates. Gradation and level of contaminants are the main parameters that are evaluated for the acceptance of fine aggregates in concrete which also helps in the strength gain. The other important function of the fine aggregates in the concrete mix is to assist in producing workable and uniform mixture. The fine aggregate also assists the cement paste to hold the coarse aggregate particles in suspension. On the basis of the grading criteria it is seen that sand belonged to the zone I and water content upto 4.36 percent.

Sieve sizes(mm)	Cumulative Wt. retained (kg)	Wt. passing (kg)	Wt. passing (%)	Wt. retained (%)
4.75	0.09	1.91	95.50	4.50
2.36	0.21	1.80	89.75	10.25
1.18	0.92	1.08	54.00	46.00
600	1.42	0.59	29.25	70.75
300	1.69	0.31	15.50	84.50
150	1.89	0.11	5.50	94.50
				310

Fineness Modulus

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Fineness modulus gives an idea of fineness of the material. It is an empirical factor obtained by adding the cumulative percentages of aggregate retained on each of the Standard Sieves ranging from 4.75 mm to 150 microns and dividing this by an arbitrary number 100. The sand used in the present work had a fineness modulus of 3.10

Specific Gravity of Sand

The specific gravity of sand was calculated using a pycnometer confirming to IS: 2386(Part IV) - 2002. The procedure consisted of measuring the weight pycnometer filled with only distilled water (A), and the weight of saturated surface dry sample (B), Weight of sample in pycnometer (C) and weight of oven dry sample (D) The specific gravity is calculated as follows

Specific Gravity = = =2.56
Specific gravity for the sand used in the present work has been obtained as 2.56

Recycled Aggregates

A recycled aggregate used in the present work was obtained from demolished structures from various places of Jodhpur. The demolished structures were around 10 to 30 years old. The demolished material was collected from composite waste (solid waste) with no significant data available on the strength composition of the original concrete. Disposal at common solid wastage sites being the usual method of disposal, the waste material could not be identified for its composition and compressive strength of the original concrete.

Fine aggregate Grading zone	Zone-II of IS 383:2016
Fine aggregate specific gravity	2.52
Water Absorption of fine aggregate	0.81 %
Specific Gravity of 20 mm coarse aggregate	2.53
Specific gravity of 10 mm coarse aggregate	2.52
Water absorption of 20 mm coarse aggregate	2.56 %
Water absorption of 10 mm coarse aggregate	2.83 %

Recycling Procedure

Various crushing equipment's have been used for extracting aggregates from construction and demolition waste namely jaw, impact, cone and hammer crushers. It was observed that the jaw crushers provide the best grain-size distribution of recycled aggregate to be used in making concrete. The material was segregated to remove all the impurities like brick, wood etc. and manually crushed to a size of 40 to 50 mm with the help of hammer of 50 kg capacity.

TEST RESULTS

% Replacement of RCA	Compressive Strength at 7 days	(%)	W/C Ratio

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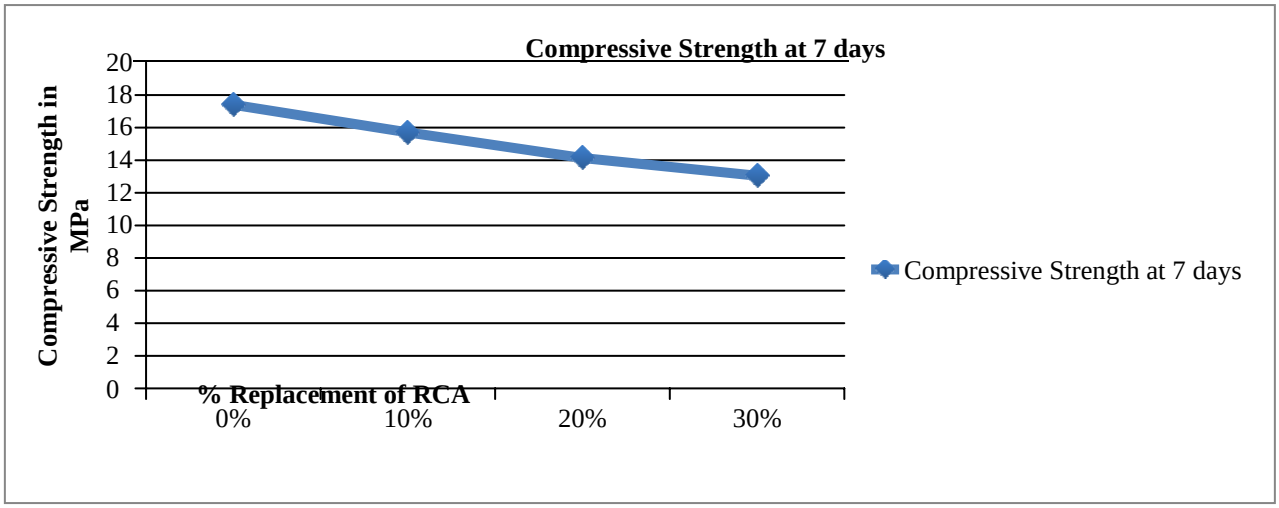
		Variation	
0%	17.4	0.00	0.45
10%	15.71	9.71	
20%	14.14	18.74	
30%	13.05	25.00	

% Replacement of RCA	Compressive Strength at 28 days	(%) Variation	W/C Ratio
0%	24.96	0.00	0.45
10%	22.08	11.54	
20%	21.92	12.18	
30%	20.31	18.63	

% Replacement of RCA	Slump value in mm	W/C Ratio
0%	48	0.45
10%	45	
20%	44	
30%	42	



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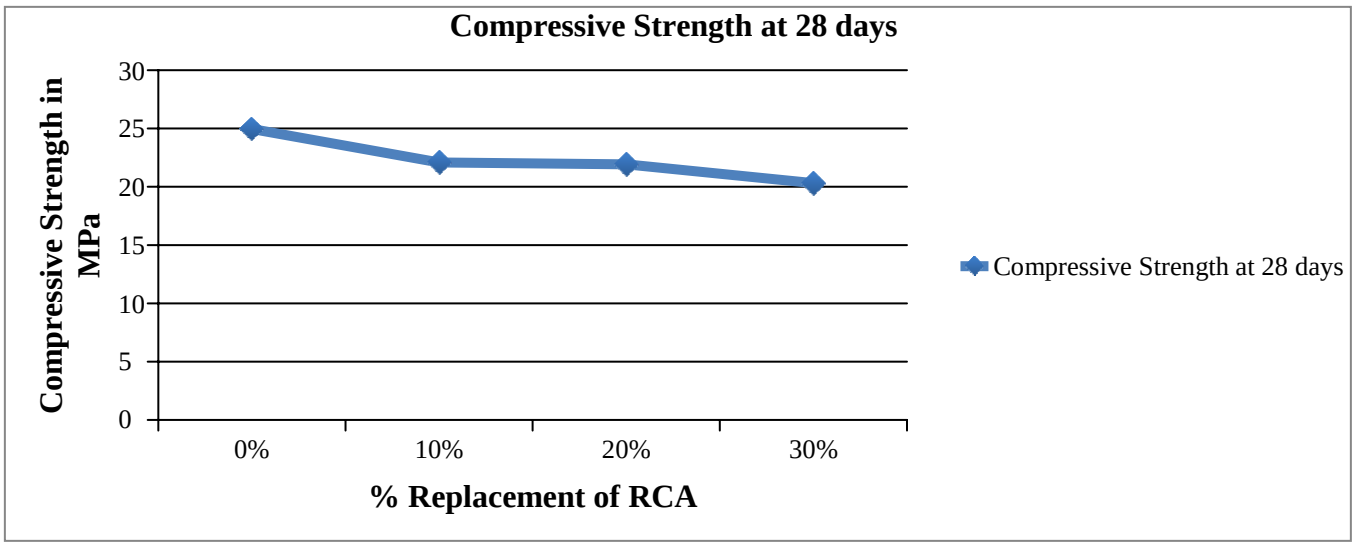

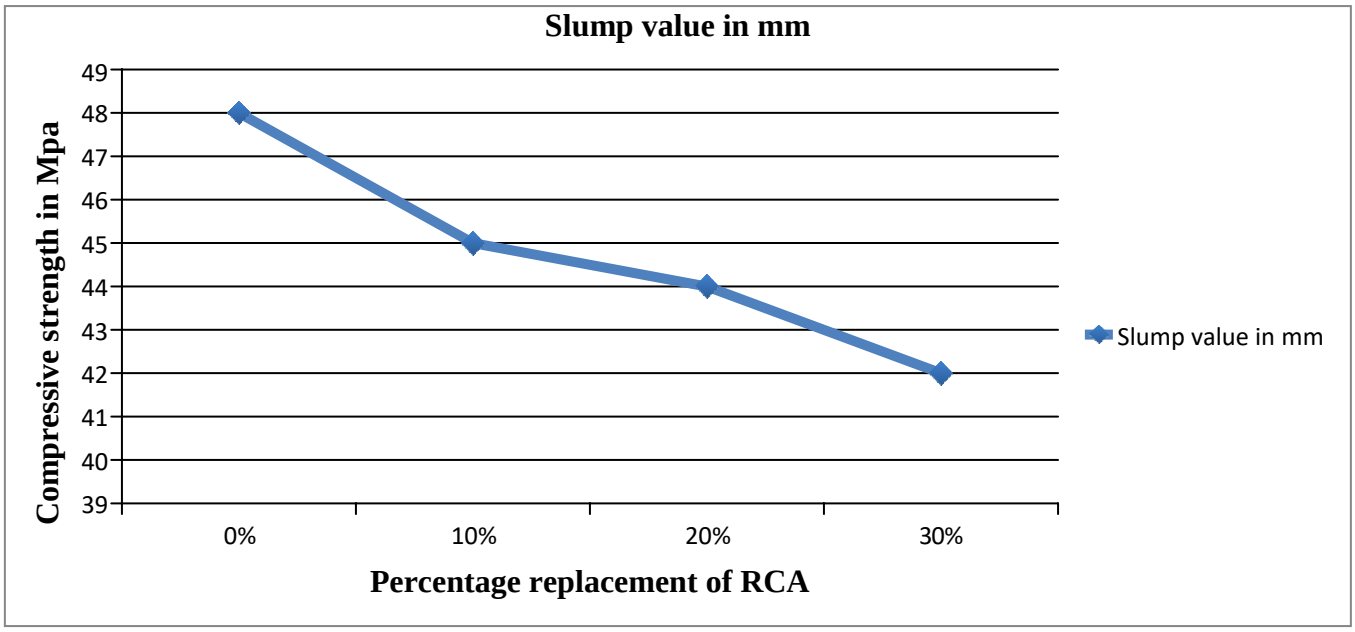

% Replacement of RCA	Compressive Strength at 7 days	(%) Variation	W/C Ratio
0%	18.06	0.00	0.43
10%	17.23	4.60	
20%	16.19	10.35	
30%	16.05	11.13	

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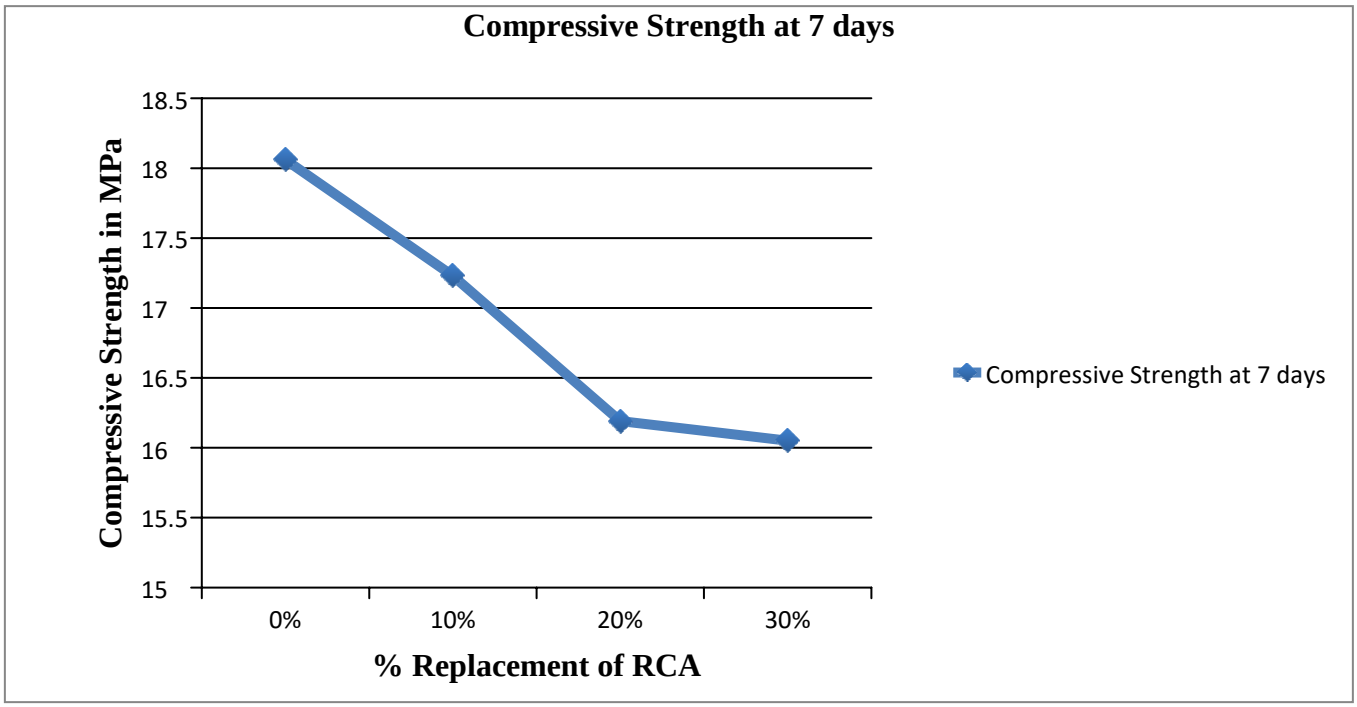
% Replacement of RCA	Compressive Strength at 28 days	(%) Variation	W/C Ratio
0%	24.51	0.00	0.43
10%	23.14	5.59	
20%	22.16	9.59	
30%	21.58	11.95	

% Replacement of RCA	Slump value in mm	W/C Ratio
0%	43	0.43
10%	41	
20%	36	
30%	35	



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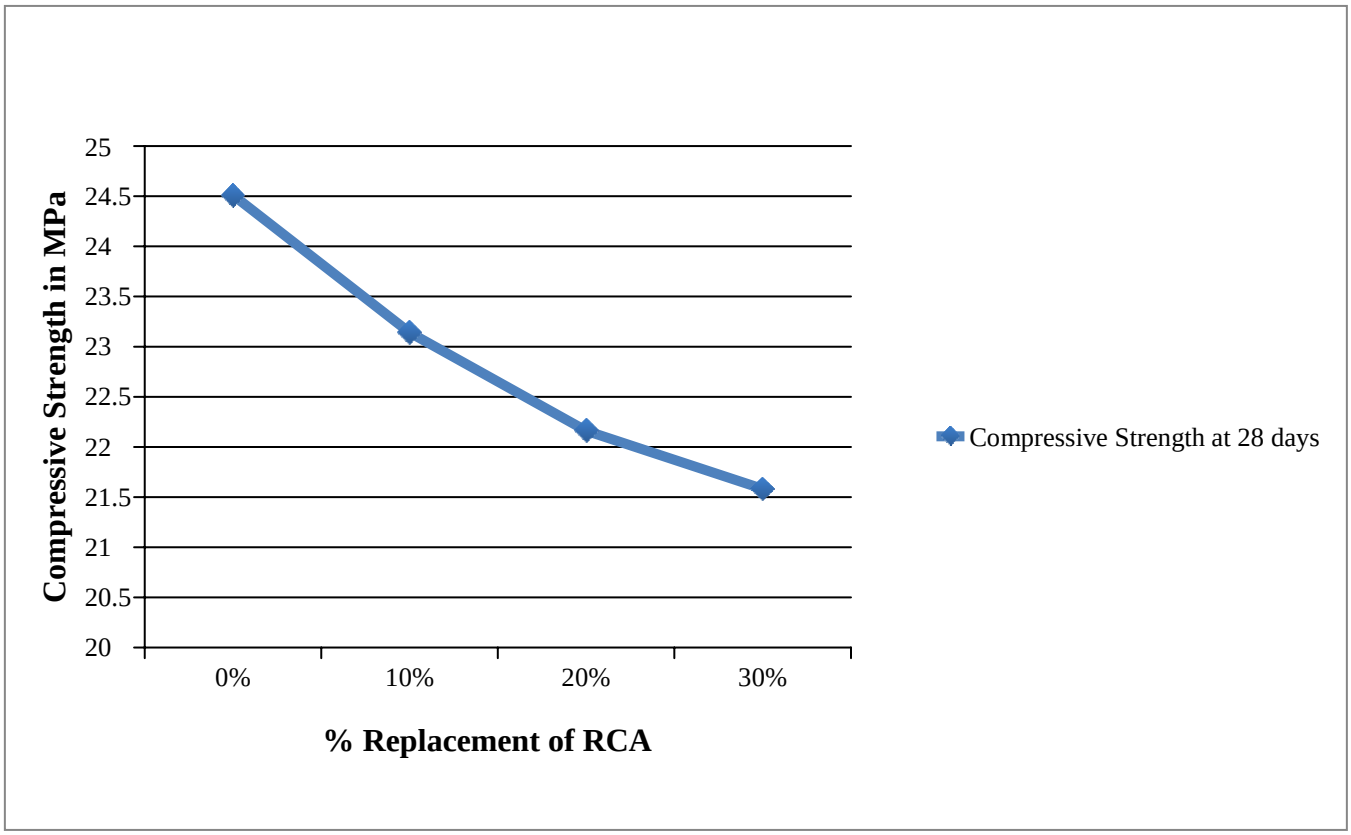

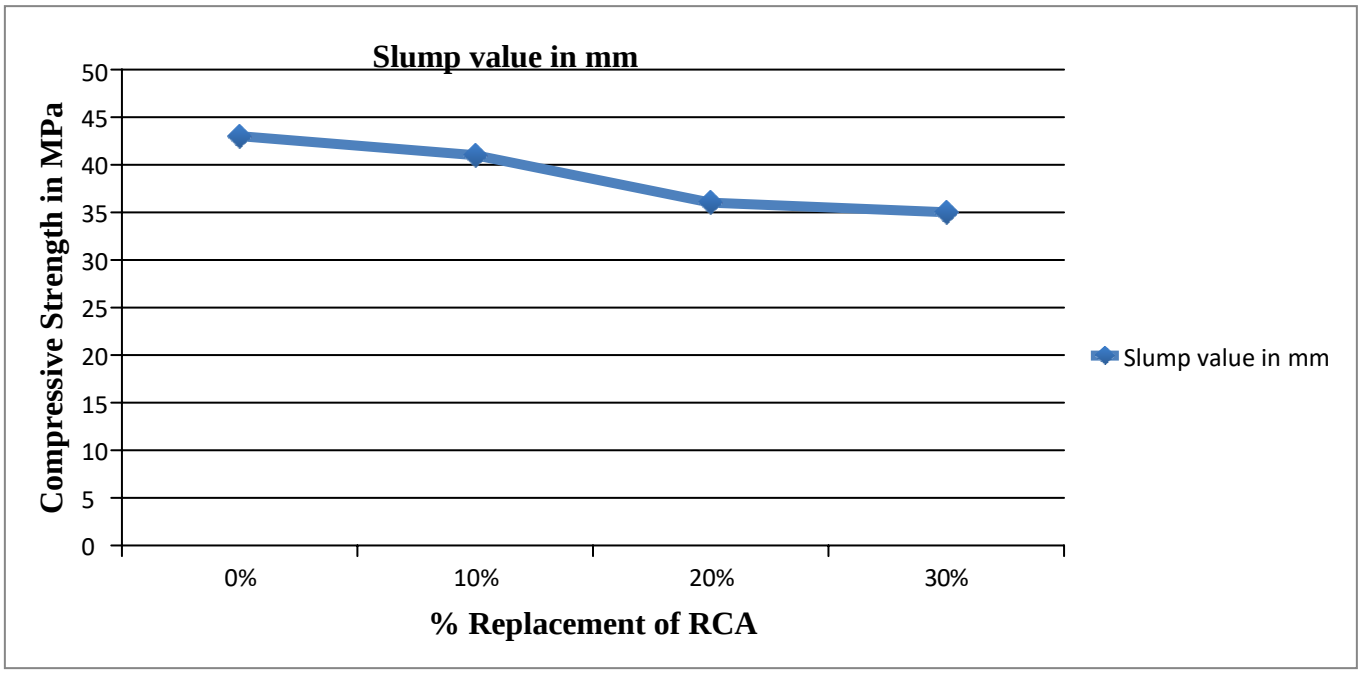

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CONCLUSION

- From the mid-seventies onwards the properties of recycled aggregates and their applications have been studied throughout the world. The conclusions obtained from the research and invest. In this this study we are using coarse aggregate from Construction and Demolition waste as partial replacement of coarse aggregate in concrete by the observation of workability we found that concrete is workable with replacement of coarse aggregate in concrete.

- By the observation of compression test we found that the structural properties in concrete with partial replacement of coarse aggregate in concrete.

- By the observation of compression test we found the maximum compressive strength at 10% replacement of coarse aggregate in concrete of 22.08 MPa and minimum at 30% replacement of coarse aggregate 20.31MPa with at 0.45 W/C ratios which shows that the strength decrease with increase the replacement of coarse aggregates in concrete

- By the observation of compression test we found the maximum compressive strength at 10% replacement of coarse aggregate in concrete of 23.14 MPa and minimum at 30% replacement of coarse aggregate 21.58 MPa with at 0.43 W/C ratios. Which shows that the strength decrease with increase the replacement of coarse aggregates in concrete.

- We observed by results of compressive test with the compression of compressive strength is decreasing with increasing the replacement of recycled coarse aggregates in percentage variation at 10%, 20% and 30% are 11.54, 12.18 and18.63 respectively at 0.45 W/C ratio.

- We observed by results of compressive test with the compression of compressive strength is decreasing with increasing the replacement of recycled coarse aggregates with base concrete in percentage variation at 10%, 20% and 30% are 5.59, 9.59 and11.95 respectively at 0.43 W/C ratio.

- By the observed results we found that the percentage variation in compressive strength is decreasing with decreasing the W/C ratio.

- With the replacement 10%, 20% and 30% of recycled coarse aggregate in concrete we cannot achieve target mean strength but we achieve the characteristic strength in all mixes.

- Various tests conducted on recycled aggregates and results compared with natural aggregates are satisfactory as per IS 2386.

- The specific gravity decreases from 4.5 to7.6% when compared with specific gravity of natural aggregate. The specific gravity of recycle coarse aggregates (RCA) was lower than normal crushed aggregates.

REFERENCES

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1. IS 10262:2009
2. IS 456:2000
3. IS 383:2016
4. European Journal of Scientific Research ISSN 1450-216X Vol.88 No-1 October, 2012, pp.155163@Euro journals Publishing, Inc. 2012 http://www.europeanjournalof scientific research.com.
5. Venu Malagavelliet.al./International Journal of Engineering Science and Technology Vol. 2(10), 2010, 5107-511.
6. ASTM C 989-940, Standard specification for ground granulated blast furnace slag for use in concrete and mortars.
7. AvelineDarquennes, Stephanie Staquet, and Bernard Espion. (2011). “Behavior of Slag Cement Concrete under Restraint Conditions”. European Journal of Environmental and Civil Engineering, 15 (5), 787-798.
8. Santosh Kumar Karri, G. V. Rama Rao, P. MarkandeyaRaju "Strength and Durability Studies on GGBS Concrete", SSRG International Journal of Civil Engineering (SSRG - IJCE), V2 (10), 34-41 October 2015. ISSN: 2348 – 8352. www.internationaljournalssrg.org/IJCE/index.html. Published by: Seventh Sense Research Group.
9. MojtabaValinejadShoubi, AzinShakiba Borough, and OmidrezaAmirsoleimani. (2013). "Assessment of the Roles of Various Cement Replacements in Achieving Sustainable and High-Performance Concrete". International Journal of Advances in Engineering and Technology, 6 (1): 68-77.
10. Reginald B. Kogbara, and Abir Al-Tabbaa. (2011). "Mechanical and Leaching Behavior of Slag-Cement and Limeactivated Slag Stabilized/Solidified Contaminated Soil".
11. M.S. Shetty (1982), “Concrete Technology”, ISBN: 81-219-0003-4.”