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Virtual Revision on Compressive Srength of Conventional Concrete and Recycled Aggregate Concrete Consisting Treated Recycled Aggregate

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Abstract : ***Use of reused aggregate in concrete can be useful for the ecological protection and economical terms. The application of recycled has been started in many construction projects. Paper hear says the basic properties of recycled concrete aggregate. It similarly relates the properties with natural aggregate, similarly the properties of recycled aggregates concrete were also determined and explained here. For the concrete grades of M25 and M30, the recycled aggregate concrete is produced by changing the natural aggregate, by recycled aggregate in conventional concrete with 5%, 10% and 15% of weight of natural aggregates. Experimental studies were carried out on influence of recycled aggregate treatment and comparison of strength properties of conventional cement concrete and recycled aggregate concrete at the curing of 7days and 28 days. They are two types of treatments under the considerations for recycled aggregates are Abrasion of recycled aggregate and chemical immersion.***

Index Terms: coarse aggregate, fine aggregate, recycled coarse aggregate, compressive strength.

I. INTRODUCTION

Cement and aggregates which are the most important constituent used in concrete production, and these materials are needed for the construction industry. This certainly to a continuous and increasing demand of natural materials used for their production. Similar to the need for the utilization of the natural properties occurs a growing concern for defending the environmental and a need to reserve natural resources, such as aggregate, by using alternative materials that are either recycled or vacant as a waste. The key to local materials recovery and the recycling industry sector is to complete a balance between economic forces and ecologically sound practices.

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This stability is dangerous not only to ensure a workable future for the industry, but also to secure essential quality increases and development of markets for value-added products, which are required to make recycled materials more attractive and economical. Aggregate is cheaper than cement and it is then, economical to put into the mindmuch of the former and as little of the latter as possible. Never the less, economy is not the only reason for using aggregate. It discusses considerable technical advantages on concrete, which has a higher Volume stability and better durability than hydrated cement paste alone.

According to Kumara S.G.et. al, the goal of sustainability is that on the world can be continued for the foreseeable upcoming and there are three components of sustainability environment, low-priced and society. To meet its goal, workable development must confirm that these three components remain healthy and balanced.

For thousands of years, the improvement of the quality of life has been the indicator of any developed society. This indicator has always been associated to the presence of elements and infrastructures, which facilitate the development of daily activities without taking into account the impact that they could have. History has taught us that society has made the recovery and use of rejected basics a characteristic practice. Many societies have re used building materials of earlier people of their own smashed construction (either through war or natural causes) to construct new buildings. The remains of ruined Romanesque churches supplied the stone for various farmhouses.

Present day construction is derived from a money of quick and refined processes and use of materials started in the industrial revaluation. An indiscriminate use of primary resources threatens “the vision” in which society has occupied itself. The technical estimation bears upon its carries a more responsible use of materials, guiding “the sleep walkers” by hand towards a sustainable development. Construction and destruction waste is not unsafe from an environmental point of view; the control of this becomes necessary from the moment that statistics refer to the wastes volume approaching an un sustainable level.

According to information obtained from CPCB (Central Pollution Control Board), the annual quantity of construction and demolition wastes in India is approximately 120 lakhs tones. Management of such high important of waste puts huge pressure on solid waste management system.

II. OBJECTIVE

The current work is aimed to study and gives practical specifications on strength characteristics of Recycled Aggregate Concrete with and without treatments.

The key objective of the experimental investigations is to assess the utility of recycled coarse aggregates in the making of structural concrete. To fulfill the objective, the thesis work is aimed at the following:

- To carry out the mix design for the grade M25 for all Conventional Aggregate Concrete (CAC), Recycled Aggregate Concrete.
- To study the strength characteristics of concrete like compressive strength, for all Conventional Aggregate Concrete (CAC), Recycled Aggregate Concrete (RAC).
- To compare the strength characteristics of Recycled Aggregate concrete, with Conventional Aggregate Concrete.
- To arrive at the optimum percentage replacement of Conventional Coarse Aggregates with recycled coarse aggregates in the production of structural concrete.
- To study the durability performance and characteristics such as strength loss and mass loss of concrete made with different percentages of recycled coarse aggregates.

To compare the durability behavior of Recycled Aggregate Concrete, with Conventional Concrete.

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III. LITERATURE REVIEW

Ann K.Y, Moon H.Y, Kim Y.B, Ryou J studied on Recycled aggregates from deteriorated concrete. Pulverized fuel ash (PFA) and crushed blast furnace slag (GBFS) were used to compensate the strength loss and durability of concrete containing recycled aggregate. The study reported that 30% PFA and 65% GBFS concrete increased the compressive strength to the level of controlled specimen cast with natural granite gravel, but the tensile strength was still lowered at 28 days. Replacement with PFA and GBFS was effective in raising the resistance to chloride ion penetration into the concrete body. Corrosion time for 30% PFA and 65% GBFS concrete containing recycled aggregate mostly equates to the corrosion – free life of controlled specimen.

Akash Rao, kumar N.Jha and Sudhir Mishra discussed different problems with recycled aggregate produced from construction and demolition waste (C&D) and their utilization in concrete. They also stated the effects of use of RAC on the properties of fresh and handed concrete and identified some of the major barriers in widespread use of RA in RAC for reusing these aggregate in new concrete.

Belen Gonzalez Fonteboa, Fernando Martinez Abella studied the shear behavior of concrete made with 50 % recycled concrete aggregate and conventional concrete. Study was carried on four reinforced beams with different amount of transverse reinforcement. The results showed that the deflections and ultimate loads were little effected by the different types of concrete but in recycled concrete, cracking was early.

Bodin and Zaharieva (2002) stated that decrease in strength of recycled concrete specimen was due to the increase of water/cement ratio that required for the preservation of workability.

IV. METHODOLOGY

The different methods used in this research include the following

- ✓ **Background study**

Literature survey was carried out to review previous studies related to the thesis.

- ✓ **Collection of raw Materials**

All the required materials such as Cement, Fine aggregate, Coarse aggregate were collected and delivered to the laboratory.

- ✓ **Material Tests**

Tests were conducted on the raw material to determine their properties and suitability for the experiment.

- ✓ **Mix Proportioning (Mix Design)**

Concrete mix design was prepared using the Indian standard recommended method.

- ✓ **Specimen Preparation**

The concrete cube specimens were prepared in the Civil Engineering Department Material Testing Laboratory.

- ✓ **Testing of Specimens**

Slump, compressive strength, unit weight are the laboratory tests conducted on prepared concrete specimens.

- ✓ **Data Collection**

The total data was collected from the tests conducted on the laboratory.

- ✓ **Data Analysis and Evaluation**

The tests results of the samples were compared with the particular control concrete properties and the results were presented in the format of tables and graphs. Conclusion and references were finally forwarded based on the findings and observations.

V.MATERIALS

- **Cement**

Priya brand OPC 53 grade cement was used in this investigation. Cement used was fresh, uniform color and free from any lumps and from the same batch. The properties of cement use

Table 1 Tests on cement properties

s.no	Property	Test values	Standard Values (IS8112:1989)
1.	Specific Gravity	2.78	3.125
2.	Standard Consistency	31%	30-33

3.	Initial Setting time (minutes)	81	>30
4.	Final Setting time	420	<600
5.	Fineness	1.77	<10%

- **Coarse Aggregates**

Conventional Coarse Aggregate from an established quarry was used. The coarse aggregates used were of size 20 mm and 10 mm.

Demolished concrete from an old concrete blocks (when we are tested) was the source for recycled coarse aggregate. The grade of source concrete was M20 & M30 and was with coarse aggregates of basalt origins with 20 mm down size. Demolished concrete was transported to strength of materials lab of civil engineering department where it was broken by ball miller. Broken aggregates were sieved through standard sieves to obtain the aggregates of 20 mm and 10 mm size. Utmost care has been taken to minimize the adhered mortar to the aggregates. No specimens from testing laboratory of S.M lab were used as concrete made with aggregates obtained from such specimens yield aggregates with high content of adhered mortar.

The percentage usage of coarse aggregate in the making of concrete was 60%, 40% for 20 mm and 10 mm respectively. The coarse aggregates (Conventional & recycled) were tested in accordance to IS 383-1970. The properties and test results of coarse conventional and recycled aggregates used

Table.2. Tests on properties of CAC and RAC

s.no	Property	Conventional aggregate	Recycled aggregate
1.	Max. Nominal size mm	2.00	20.00
2.	Specific gravity	2.70	2.36
3.	Bulk density (loose) m^3	1510	1480
4.	Abrasion value	27.8	18.4
5.	Fineness modulus	6.86	7.69
6.	Impact Value	27.27%	30%
7.	Crushing value	18.18%	27.27%
8.	Water absorption	0.98	1

Table 3 Tests results on treatment properties

Properties	Abrasion treated	HCL treated	H2SO4 Treated
Specific gravity	2.75	2.75	2.37
Water absorption	0.89%	1.50%	4.43%
Impact value	21.21%	29%	28%
Crushing value	15.03%	18%	20%
Abrasion value	20.20%	26.72%	24.30%

- **Fine Aggregate**

River sand conforming to Zone-II as per IS 383:1970 was used. The fine aggregate was clean, inert and free from organic matter,silt & clay. The Fine aggregate was dried before use. The properties of fine aggregate were presented.

- **Water**

Portable water from laboratory taps was used for concrete construction. Water from same source was used for curing.

- **Chemical Admixture**

With same water-cement ratio for both conventional aggregate concrete and recycled aggregate concrete, loss of workability was observed due to higher water absorption of water for recycled aggregates. In order to obtain medium workability as that of conventional aggregate concrete, HCL and H2SO4 Chemicals was used as water reducing agent to achieve required workability

VI.TEST RESULTS AND ANALYSIS:

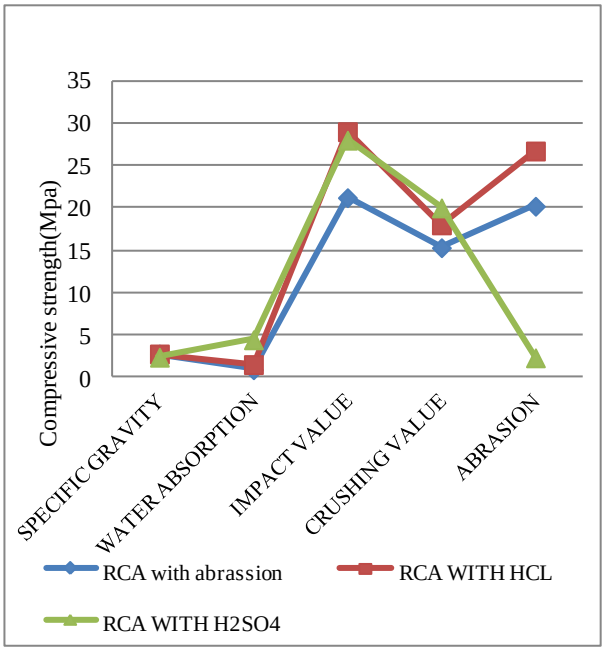

Fig.1. Comparison on tests of different treatments

- **Compressive Strength Test:**

Compressive strength test was conducted as per IS 516: 1959. Cubes of standard dimensions 150x150x150mm were cast and tested on compressive testing machine. Three cubes were tested for every percentage of replacement with recycled aggregate, and combination of recycled aggregate at the ages of 7 and 28 days to establish the average compressive strength. The cubes were well cured till the day of test.

Table.4. Compressive Strength M_{25}

w/c ratio	% of RAC	7 days			
		Without treatment	With treatment		
			Abrasion	HCL	H_2SO_4
0.46	0%	23.25			
0.46	5%	24.5	25.65	25.15	24.86

0.46	10%	25.32	26.84	26.38	25.96
0.46	15%	23.90	24.73	25.35	24.14

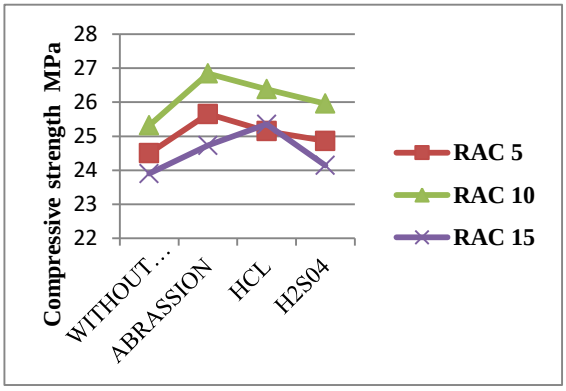

Fig.2.Comparison of M_{25} Compressive Strength of CAC and RAC for 7 days

From table.4 compressive strength with various replacement 5% 10% 15% for M25 grade, it is observed that The 7 days cube strength is about 25.65 to 26.84 MPa with replacement of coarse aggregates with recycled coarse aggregates in the range of 5% to 10%. The maximum strength, 26.84 MPa, is obtained for 10% replacement.

Table.5. Compressive Strength M_{25}

w/c ratio	% of RAC	28 days			
		Without treatment	With treatment		
			Abrasion	HCL	H_2SO_4
0.46	0%	34.48			
0.46	5%	35.20	34.64	34.94	35.45
0.46	10%	36.15	35.76	35.40	36.24
0.46	15%	35.65	34.38	34.86	35.86

From table 5 and it is experimental that The 28 days cube strength is about 36.24 to 35.86 MPa with replacement of conventional coarse aggregates with recycled coarse aggregates in the range of 10% to 15%. The maximum strength, 36.24 MPa, is obtained for 10% replacement.

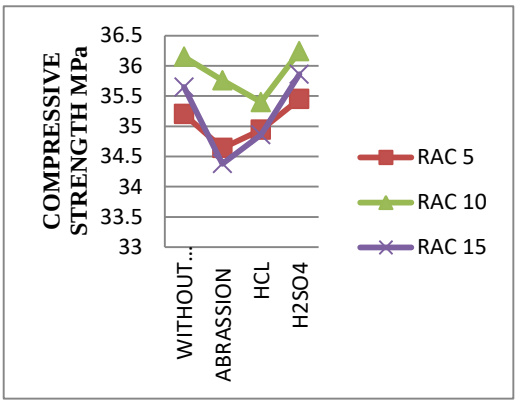

Fig.3 Comparison of M_{25} Compressive Strength of CAC and RAC for 28 days

Table.6. Compressive Strength of M_{30} in MPa

w/c ratio	% of RAC	7 days			
		Without treatment	With treatment		
			Abrasion	HCL	H_2SO_4
0.46	0 %	33.26			
0.46	5 %	34.87	35.65	35.25	33.18
0.46	10 %	35.32	36.84	36.38	35.96
0.46	15 %	33.90	34.73	35.35	34.14

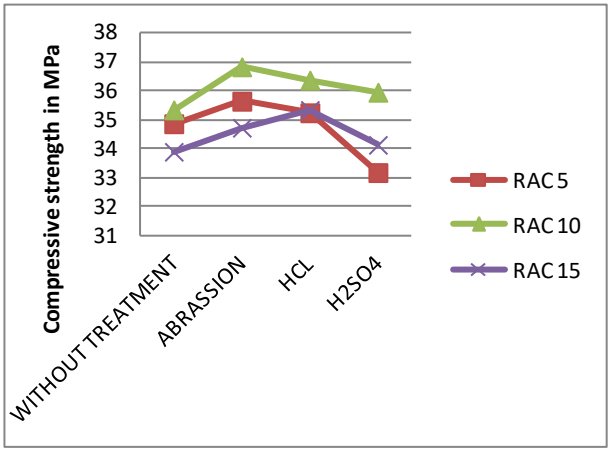

Fig.4. Comparison of M_{30} Compressive Strength of CAC and RAC for 7 days

From table.6 compressive strength with various replacement 5% 10% 15% for M30 grade, it is observed that The 7 days cube strength is about 36.84to 34.87 MPa with replacement of conventional coarse aggregates with recycled coarse aggregates in the range of 5% to 10%. The maximum strength, 26.84 MPa, is obtained for 10% replacement.

Table.7 Compressive Strength of M_{30} in MPa

w/c ratio	% of RAC	7 days			
		Without treatment	With treatment		
			Abrasion	HCL	H_2SO_4
0.46	0%	41.36			
0.46	5%	42.26	41.27	41.94	42.45
0.46	10%	44.15	46.76	42.40	43.25
0.46	15%	43.65	41.38	41.76	43.86

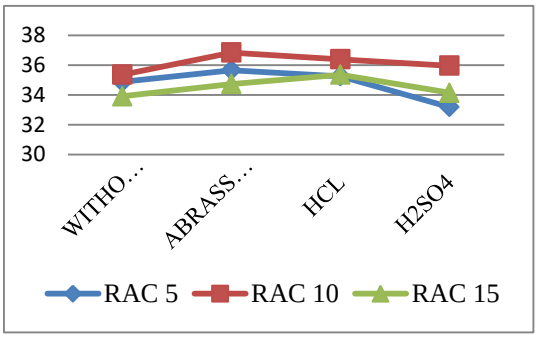

Fig.5. Comparison of M_{30} Compressive Strength of CAC and RAC for 28 days

From Table No. 7 it is observed that The 28 days cube strength is about 46.76 MPa to 43.86 MPa with replacement of conventional coarse aggregates with recycled coarse aggregates in the range of 10% to 15%. The maximum strength, 46.76 MPa, is obtained for 10% replacement.

VII.CONCLUSION

1. The reutilization of the aggregates will conserve both the natural aggregates and landfills from the excess construction demolished and waste materials like recycled coarse aggregate

4. Concrete finished with 15% replacement of conventional coarse aggregates with recycled coarse aggregate, compressive strength than conventional concrete at 28 days with same W/C ratio (is 0.46) and quantity of cement (364kg/m³).

5. Compressive strength results of RAC, show decrease in strength at 5%, 10% & 15% and it gives better results when the 10% replacement of conventional coarse aggregates with recycled coarse aggregate at the age of 28 days

6. Concrete is made with super plasticizer to achieve good workability and maximum strength gained at earlier stage of 7 days.

7. In RAC mixes by way of the percentage of recycled aggregate increases the strength. The maximum percentage decrease is 35.45 and 42.45 for M_{20} and M_{30} for 28 days which is obtained for 5% replacement with recycled aggregates. The highest Strength is obtained for 10% replacement with recycled aggregates. When compared to RAC mixes, the RAC mixes attained higher values. The reason for reduction in strength is due to inferior properties of recycled aggregates.

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