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Experimental Analysis of Concrete by Recycled Aggregates for M30 and M40 Grades

Vasanabhi Naveen[1], Ch. Damodhar Naidu[2]
[1]M-Tech Student [2]Assistant Professor, Civil Engineering Department, Gokul Group of Institutions, Bobbili, Vizianagaram District, Andhra Pradesh., India-535 558

Abstract: Use of Recycled Aggregates in Concrete can be beneficial for environmental protection. Recycled aggregates are the materials for the future. The utility of recycled aggregate has been started out in many construction initiatives of European, American, Russian and Asian countries. Many countries are giving infrastructural legal guidelines rest for increasing the use of recycled aggregate. In general, existing fame of recycled combination in India alongside with its future-want and its successful utilization are briefly introduced. This paper additionally reviews the recycled mixture and recycled coarse aggregate combination & also compares these mixes with natural aggregates. Basic modifications in all mixture are determined and their outcomes on M30 & M40 Grade concrete are mentioned at length. Basic concrete properties like compressive strength, flexural strength, workability etc. are determined for distinctive combinations of recycled combination with natural combination. As per 28 days, 14Days and 7days compressive, split tensile and flexural test results of recycled aggregate concrete 50/20 is increased 4-10% than conventional aggregate concrete of bothM30&M40 mixed designs.
Keywords: Recycled Aggregates, Compressive Strength flexural strength, workability etc...

I. INTRODUCTION

Urbanization growth rate in India is very high due to industrialization. Growth rate of India is reaching 9% of GDP. Rapid infrastructure development requires a large quantity of construction materials, land requirements & the site. For large construction, concrete is preferred as it has longer life, low maintenance cost & better performance. For achieving GDP rate, smaller structures are demolished & new towers are constructed. Protection of environment is a basic factor which is directly connected with the survival of humans. Parameters like environmental consciousness, protection of natural resources, sustainable development, play an important role in modern requirements of construction works. Due to modernization, demolished materials are dumped on land & not used for any purpose. Such situations affect the fertility of land. As per report of Hindu online of March 2007, India generates 23.75 million tons demolition waste annually. As per report of Central Pollution Control Board (CPCB) Delhi, in India, 48million tons solid waste is produced out of which 14.5-million-ton waste is produced from the construction waste sector, out of which only 3% waste is used for embankment.

The use of recycled aggregate generally increases the drying shrinkage creep & porosity to water & decreases the compression strength of concrete compared to that of natural aggregate concrete. It is nearly 10- 30% as per replacement of aggregate. Recycling reduces the cost (LCC) by about 34-41% & CO2 emission (LCCO2) by about 23-28% for dumping at public / private disposal facilities.

II. MATERIALS FOR RECYCLED AGGREGATE CONCRETE

A. Cement

A high quality binder is necessary for High Strength concrete. Cement that yields high compressive strength at a later stage is obviously preferable. The use of fine cementitious material such as micro silica or fly ash is useful as the fine particles grading would be extended; which would result in good filler action and reduced porosity. Furthermore, the pozzolanic reaction with Portland cement would further strengthen the cement matrix and improve the bond strength between aggregates and the paste. Since the cement content of High Strength Concrete is unavoidably high, the heat of hydration resulting from the exothermic reaction of cement with water is high. Hence it would be advantageous to use an additional cement replacement material such as Silica fume or Fly ash etc. which is locally available in the market. Also, the use of such cement replacements would improve the impermeability of concrete to chlorides and sulphates; thus, the durability especially in relation to steel reinforcement, corrosion protection would be improved.

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Table-1 Properties of Cement

S.NO	PROPERTIES	TEST VALUES	STANDARD VALUES (IS 8112:1989)
1	Specific gravity	3.12	3.15
2	Standard consistency	29	28-32
3	Initial setting time(min)	215	>30
4	Final setting time(min)	360	<600
5	Fineness	4.75%	10

B. Coarse Aggregate

Since coarse aggregate forms the largest fraction of volume of concrete the characteristics of aggregates significantly influence the strength of concrete. The size of coarse aggregate plays an important role in determining the strength of concrete. In normal strength concrete, as the size of coarse aggregate increases, the water requirement reduces. So, the net effect is gain in strength. But in High Strength Concrete large size of coarse aggregate tends to reduce the strength. It may be attributed to smaller surface area available for bonding. Cement-Aggregate bond increases as aggregate shape changes from smooth and rounded to smooth and angular, and this must be considered for selecting the aggregate for HSC.

Table-2 Physical properties Of Conventional Aggregate& Recycled Aggregate

S.NO.	PROPERTY	CONVENTIONAL AGGREGATE	RECYCLED AGGREGATE
1	Max. Nominal size(mm)	20.00	20.00
2	Specific gravity	2.72	2.69
3	Bulk density in kg/m³	1710	1640
5	Impact value	18.30%	21.10%
6	Crushing value	21.10%	22.20%
7	Water absorption	0.50%	2.50%

C. Fine Aggregate

The shape and surface texture of fine aggregate has a greater influence on water demand of concrete because fine aggregates contain a much higher surface area for a given weight. Rounded and smooth fine aggregate particles are better from the view point workability than sharp and rough particles. This project involved use of locally available, moisture free fine aggregate. The following are the various tests that are carried out on the fine aggregate.

The locally available sand is used as fine aggregate in the present investigation. The sand is free from clayey matter, salt and organic impurities. The sand is tested for various properties like specific gravity, bulk density etc., in accordance with IS 2386-1963(28).

Table3: Physical properties of Fine Aggregate

S.NO.	PROPERTY	CONVENTIONAL AGGREGATE	RECYCLED AGGREGATE
1	Specific gravity	2.744	2.70
2	Bulk density in kg/m³	1670	1610
4	Water absorption	0.50%	3.0%

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D. Admixture

Admixture are widely Increased Workability and durability for High strength concrete. These materials include chemical admixture and mineral admixture.

1) *Chemical Admixture:* The super plasticizers (SP) are referred to as high range water reducing admixture by ASTMC494, which mainly disperses the water in concrete mix. Today super plasticizers are used in all important projects across the world in high raise buildings, pre-stressed concrete, slender components with congested and densely packed reinforcement, beams and slabs pre-cast elements and long slender columns. Conplast SP 430 A2(Sulphonated Naphthalene Formaldehyde Condense(SNF))super plasticizers from FOSROC chemicals was used asa water reducing agent to achieve required workability. Conplast SP 430 A2 is based on sulphonated naphthalene polymers and is a brown liquid instantly dispersible in water.

Table-4 Properties of Conplast Sp430 A2 Are Shown In Table.

S.no	Property	Value
1	Specific Gravity	1.20 to 1.21 at 30^o C
2	Chloride content	Nil
3	Air Entrainment	1%(additional)

III. MIX DESIGN

The main aim of the project was to achieve a mix proportion for M60 and M70 in the laboratory that we can propose for further use and can be used to calculate cost for the above grades of concrete. To get the control mix Entropy and Shack lock graphs were used during the first trials. It was designed for low workability.

Mix Design can be defined as the process of selecting ingredients of concrete and determine their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The object of any mix proportion method is to determine an economical combination of concrete constituents that can be used for a first trail batch to produce a concrete that is close to that which can achieve a good balance between the various desired properties of concrete at the lowest possible cost.

1) The mean design strength is obtained by applying suitable control factors to the specified minimum strength.
2) For a given type of cement and aggregates used, the reference number corresponding to the design strength at a particular age is interpolated from the graphs.
3) The water-cement ratio to achieve the required workability and corresponding to reference number is obtained from the aggregates with maximum sizes of 20 mm and 10 mm.
4) The aggregate-cement ratio to give the desired workability with the known water-cement ratio is obtained by absolute volume method.

Batch quantities are worked out after adjustments for moisture content in the aggregates

a) The concrete mix design adopted was in accordance to IS10262-2009. The mix is designed based on strength criteria, durability criteria for mild environment exposure and for good quality control. Design mixes of M30 & M40 grades of conventional aggregate with admixture forms the basic reference mix of the experimentation.
b) Concrete mix:
c) Types of concrete mixes:
d) Nominal mix (based on volume)
e) Standard mix (based on weight)
f) Designed mix (based on sp. wt.)
g) Designed mixes are recommended by “The Bureau of Indian Standards (BIS)(IS10262-1982)”.
h) IS-10262-2009
i) The Bureau of Indian Standards (BIS) has released the final code on concrete mix proportioning in December 2009. Before this, the draft code was circulated among practitioners. Significant changes have been made in the new code adapting from international codes on concrete mix design. The new code can now be used for designing a variety of concrete mixes using both mineral and chemical admixtures.

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IV. RESULTS

A. M30

4.3.1 Table - Compressive strength test result for **M30 CAC**

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
CAC	33.00	36.11	41.8

4.3.2 Table - Compressive strength test result for M30 RAC 25/10

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
RAC (25/10)	30.89	32.67	38.97

4.3.3 Table - Compressive strength test result for M30 RAC 50/20

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
RAC (50/20)	36.22	38.46	40.6

4.3.4 Table - Compressive strength test result for M30 RAC 75/30

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
RAC (75/30)	29.11	36.00	38.2

4.3.5 Table - Compressive strength test result for M30 RAC 100/40

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
RAC (100/40)	26.67	28.10	31.25

B. M40

4.3.6 Table - Compressive strength test result for **M40 CAC**

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
CAC	43.5	46.77	52.2

4.3.7 Table - Compressive strength test result for M40 RAC 25/10

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
RAC (25/10)	40.7	47.22	48.10

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4.3.8 Table - Compressive strength test result for M40 RAC 50/20

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
RAC (50/20)	44.67	49.11	50.8

4.3.9 Table - Compressive strength test result for M40 RAC 75/30

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
RAC (75/30)	36.00	39.00	40.21

4.3.10 Table - Compressive strength test result for M40 RAC 100/40

Designation	Average Compressive strength (MPa)		
	7days	14days	28days
RAC (100/40)	36.67	38.57	41.15

4.3.11 Table-Comparison of Compressive strength test result for M30

Designation	7days	14 days	28 days
CAC	33.00	36.11	41.8
RAC (25/10)	30.89	32.67	38.97
RAC (50/20)	36.22	38.46	40.6
RAC (75/30)	29.11	36.00	38.2
RAC (100/40)	26.67	28.10	31.25

4.3.12 Table - Comparison of Compressive strength test result for M40

Designation	7days	14 days	28 days
CAC	43.5	46.77	52.2
RAC (25/10)	40.7	47.22	48.10
RAC (50/20)	44.67	49.11	50.8
RAC (75/30)	36.00	39.00	40.21
RAC (100/40)	36.67	38.57	41.15

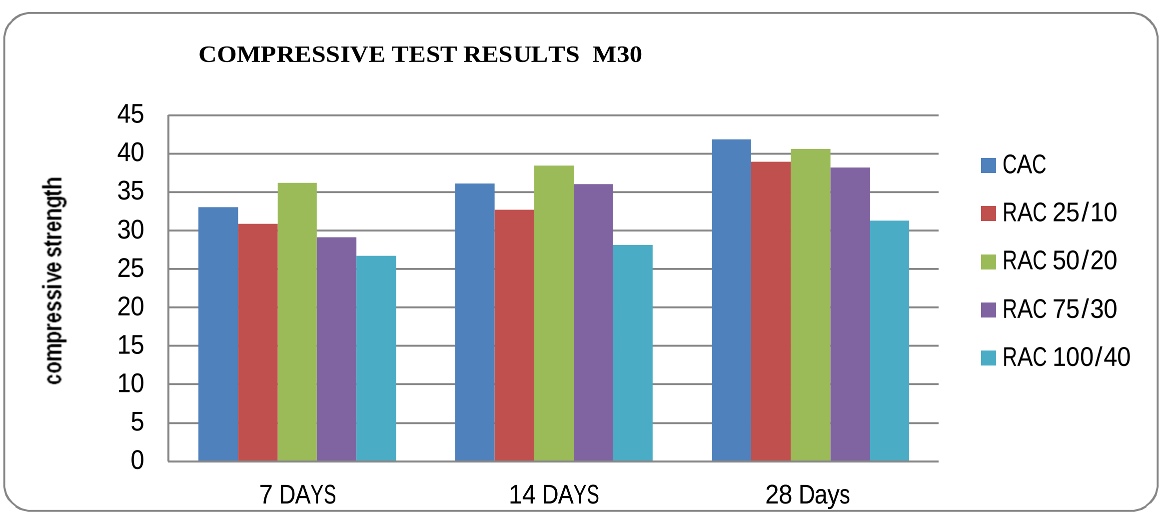

Fig.4.8Compressive strength Results comparison for M30

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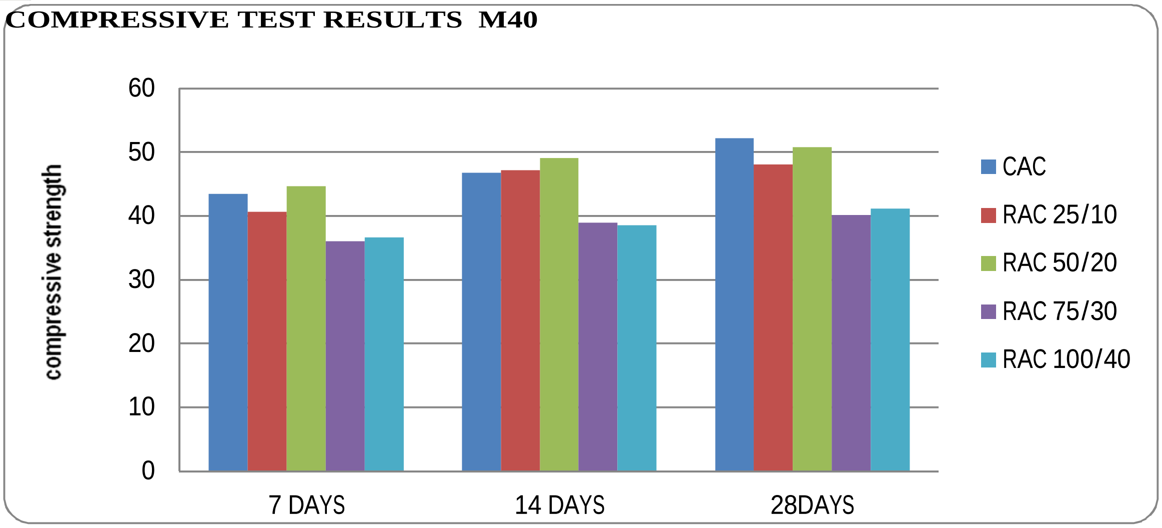

Fig.4.9 Compressive strength Results comparison for M40

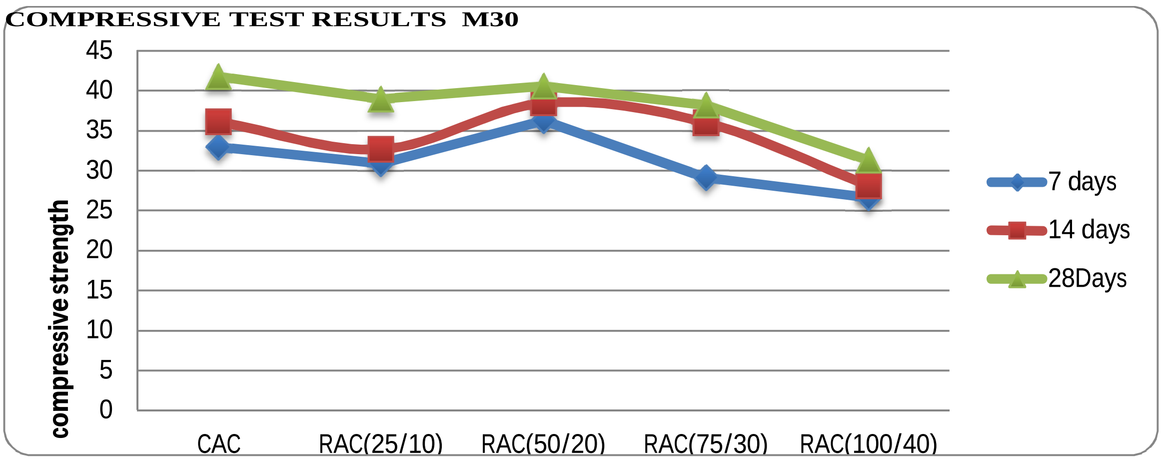

Fig.5.0 Compressive strength Results comparison for M30

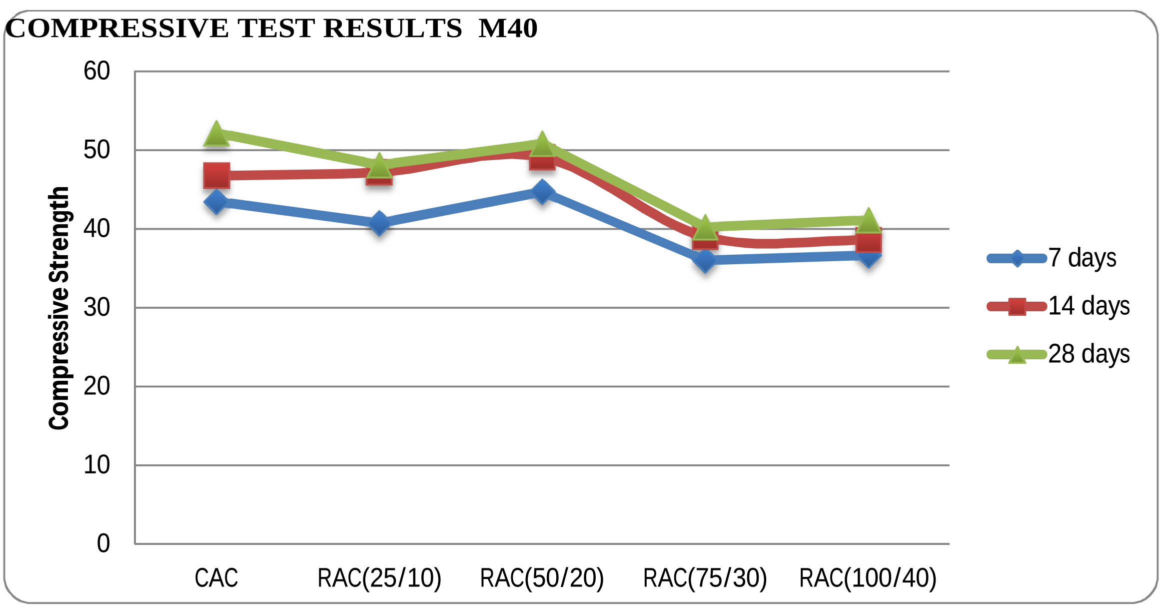

Fig.5.1 Compressive strength Results comparison for M40

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Table 4.3.13 Comparison of split tensile strength test result for M30

Designation	7days	14 days	28 days
CAC	4.12	4.21	4.49
RAC(25/10)	3.09	4.00	4.32
RAC(50/20)	4.19	4.34	4.34
RAC(75/30)	3.9	4.20	4.21
RAC(100/40)	3.7	3.71	3.85

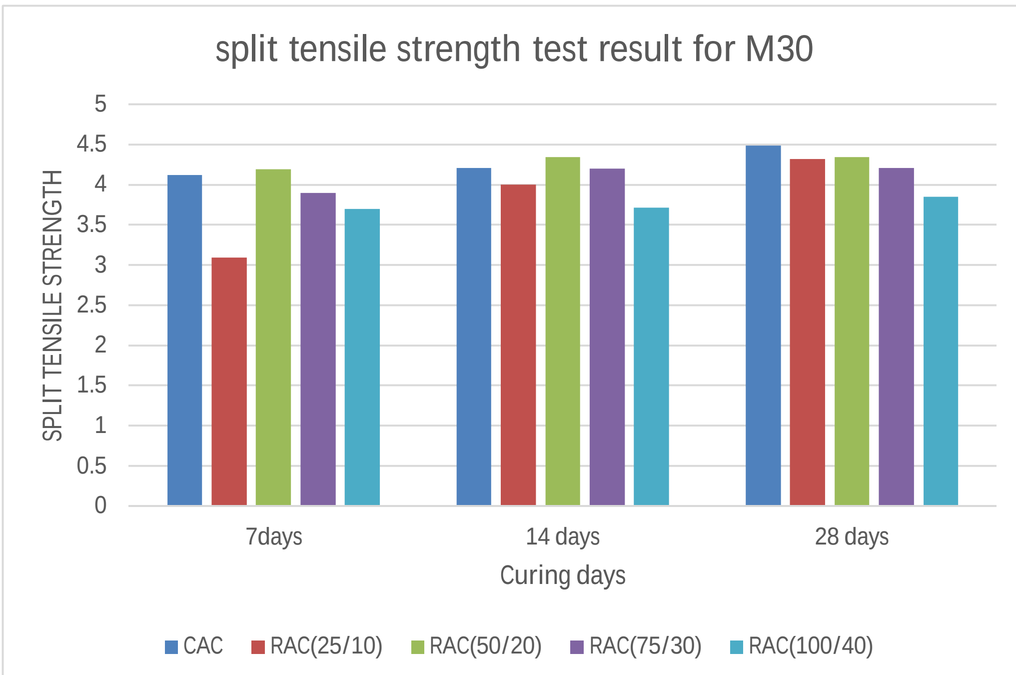

Fig.5.2 Results comparison for split tensile strength of M30

Table 4.3.14 Comparison of split tensile strength test result for M40

Designation	7days	14 days	28 days
CAC	4.59	4.74	5.01
RAC (25/10)	4.44	4.73	4.79
RAC (50/20)	4.63	4.89	4.89
RAC (75/30)	4.16	4.33	4.39
RAC (100/40)	4.21	4.33	4.41

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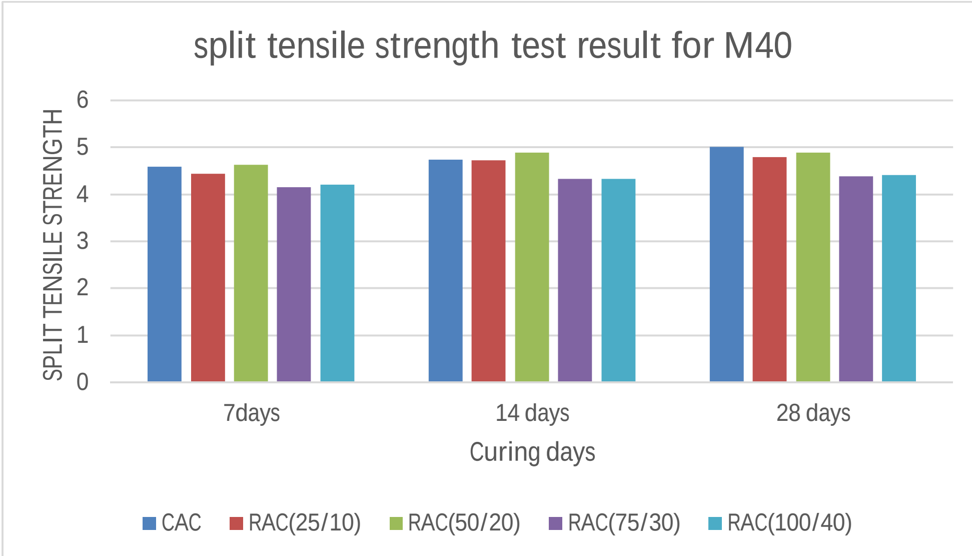

Fig.5.3 Results comparison for split tensile strength of M40

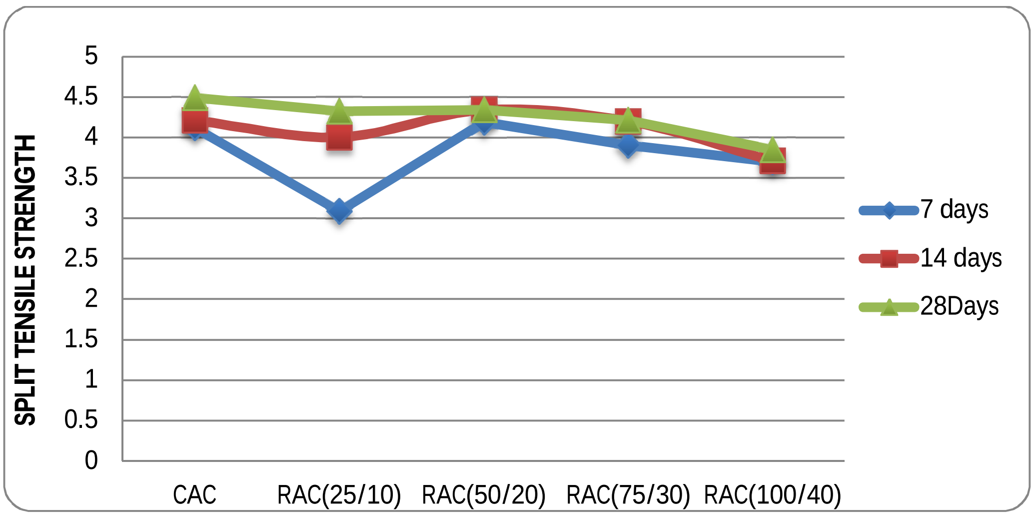

Fig.5.4 Results comparison for split tensile strength of M30

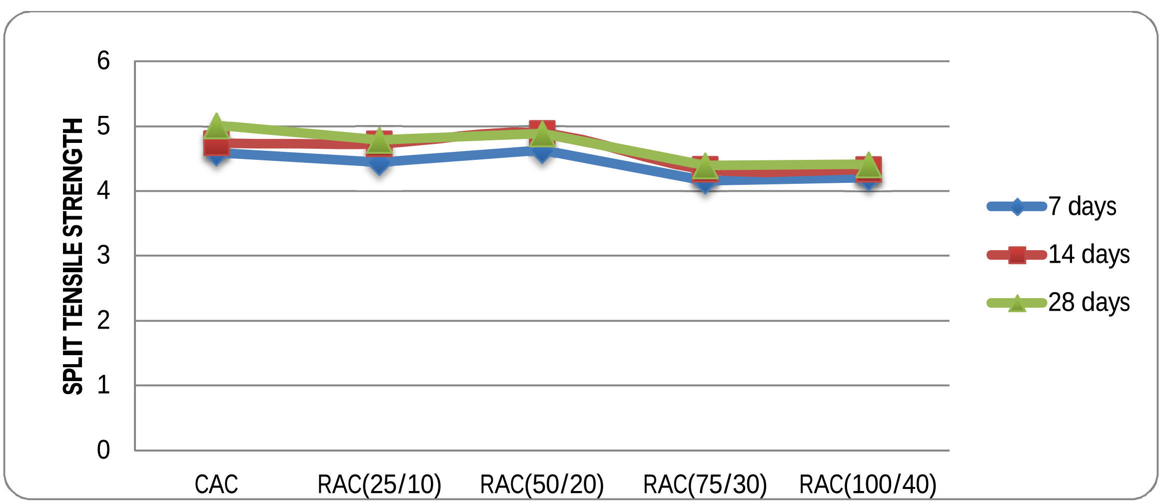

Fig.5.5 Results comparison for split tensile strength of M40

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Table 4.3.15: Flexure strength of M30 concrete with age

Identification	Flexure strength of concrete at 7 days	Flexure strength of concrete at 14days	Flexure strength of concrete at 28days
CAC	2.98	3.55	4.12
RAC (25/10)	2.82	3.35	3.81
RAC (50/20)	2.85	3.32	3.95
RAC (75/30)	2.91	3.51	4.01
RAC (100/40)	2.85	3.40	4.05

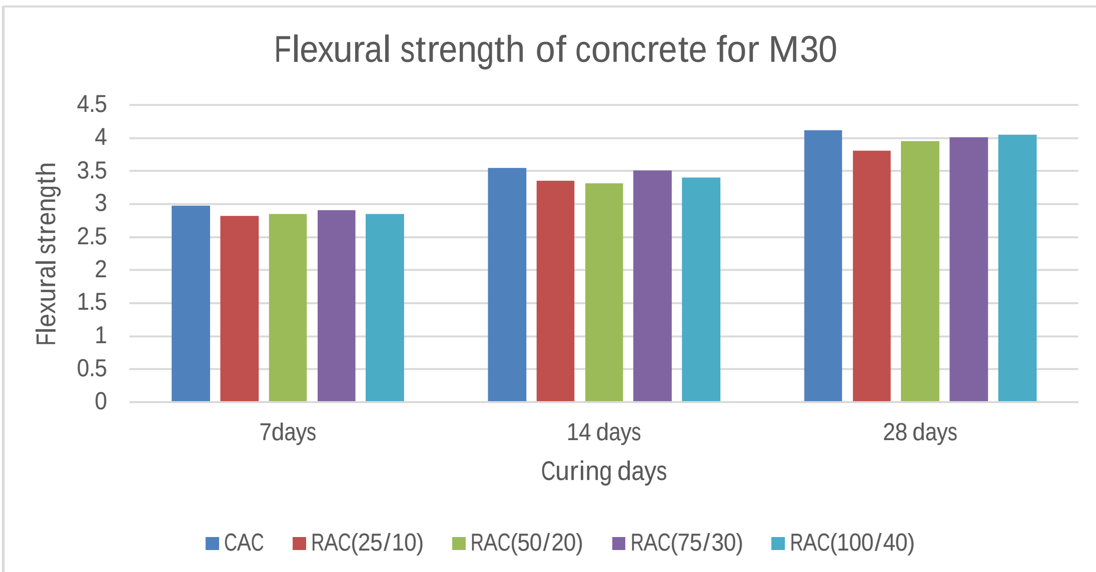

Fig.5.6 Results comparison for Flexural strength of M30

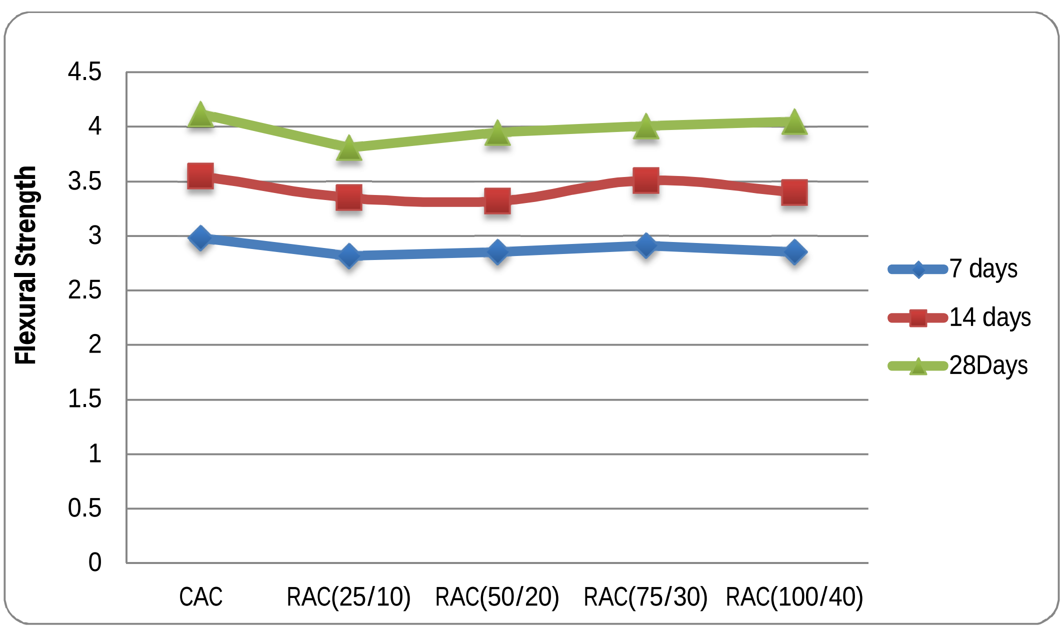

Fig.5.7 Results comparison for Flexural strength of M40

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Table 4.3.16: Flexure strength of M40 concrete with age

Identification	Flexure strength of concrete at 7 days	Flexure strength of concrete at 14days	Flexure strength of concrete at 28days
CAC	3.15	3.96	4.56
RAC (25/10)	2.96	3.89	4.10
RAC (50/20)	3.02	3.56	4.23
RAC (75/30)	3.12	3.63	4.36
RAC (100/40)	3.01	3.69	4.19

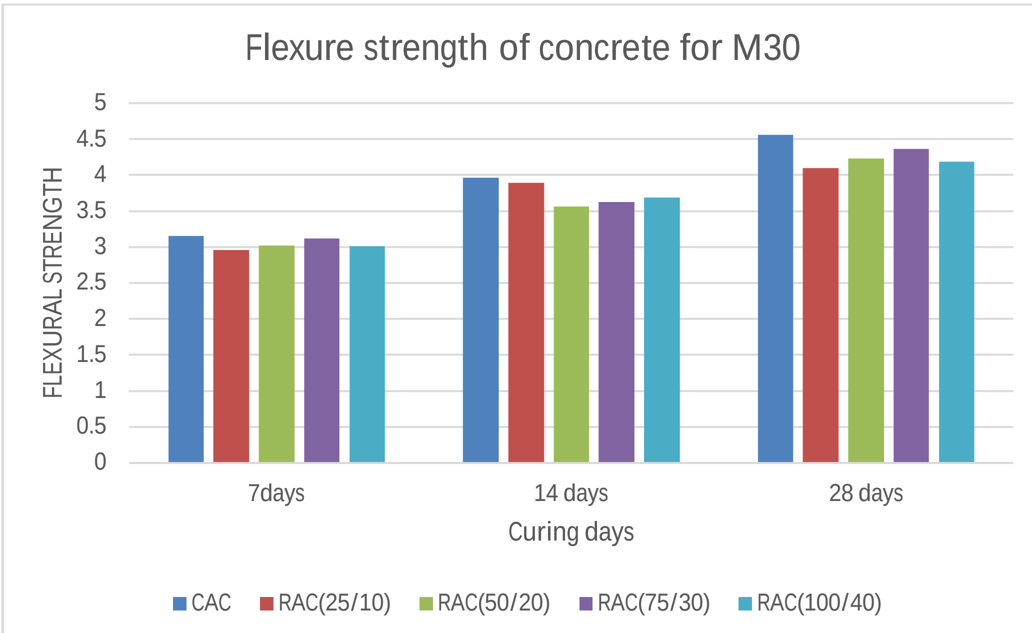

Fig.5.8 Results comparison for Flexural strength of M40

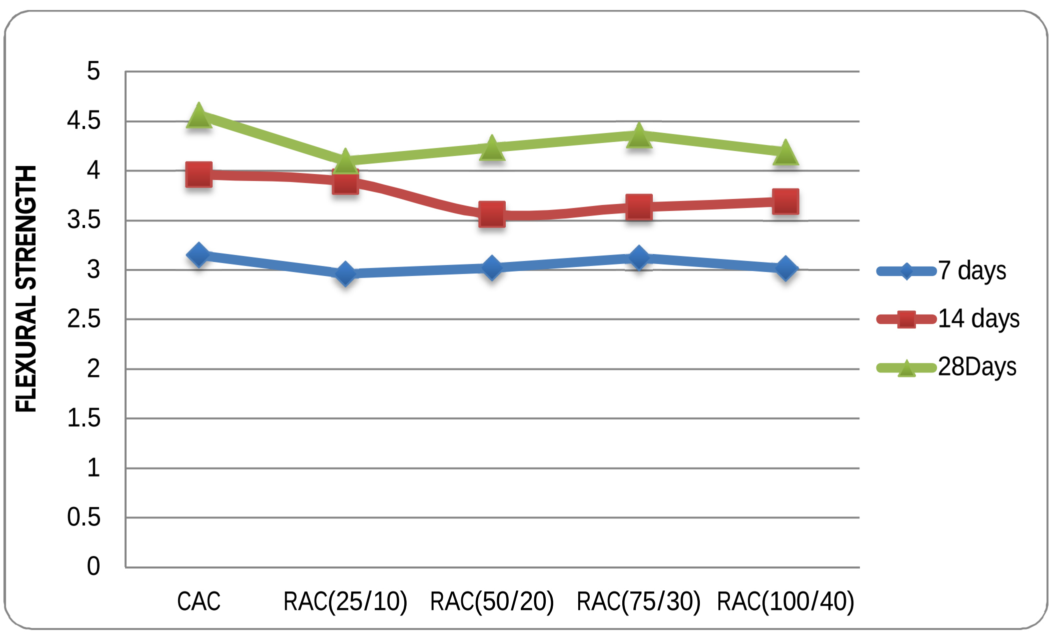

Fig.5.9 Results comparison for Flexural strength of M40

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V. CONCLUSIONS

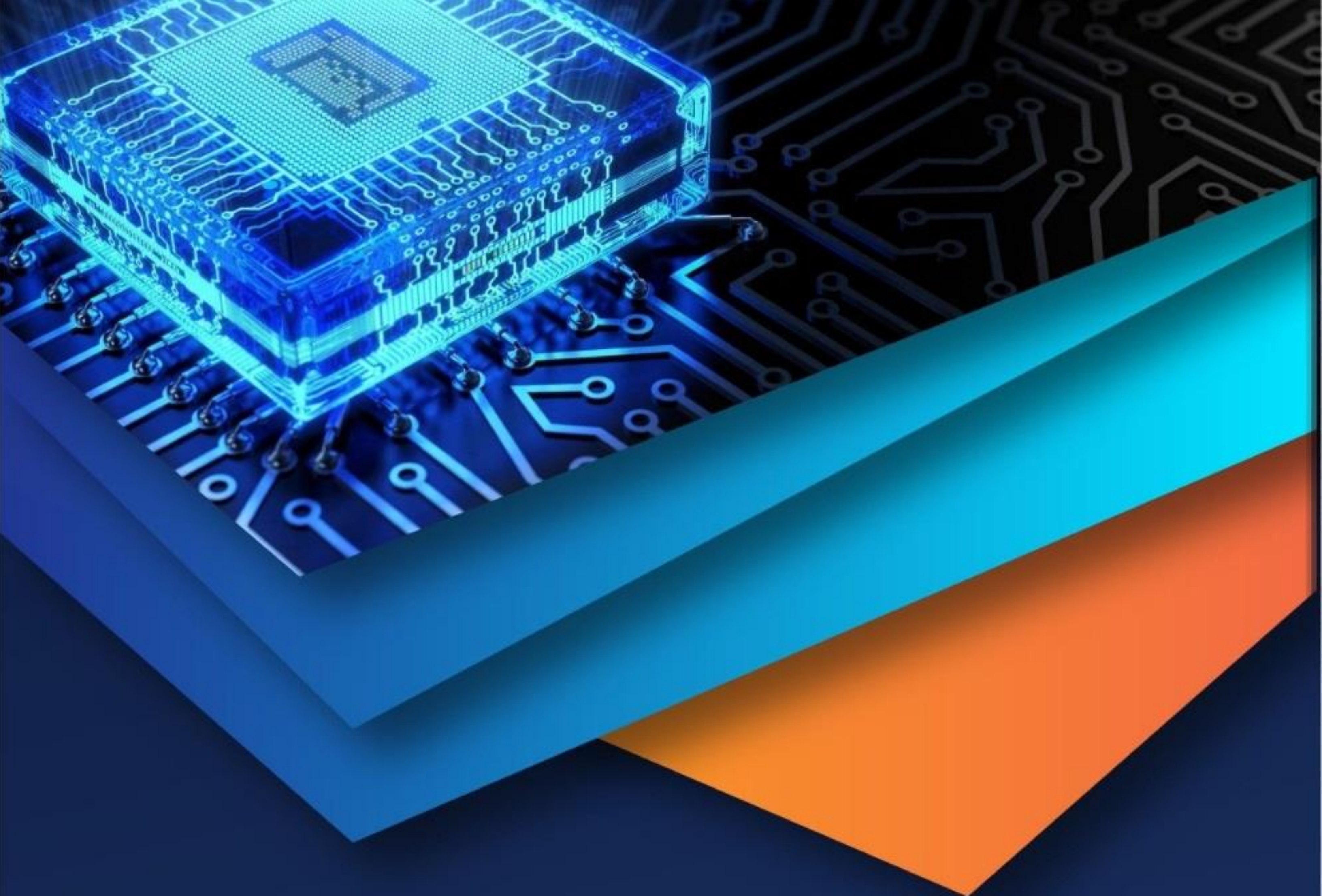
Recycling and Reuse of building wastes have been found to be an appropriate solution to the problems of dumping million tons of debris accompanied with shortage of natural aggregates. The use of recycled aggregates in concrete proves to be a valuable building material in technical, environment and economical respect.

In accordance with the experimental phase carried out in this study, the following conclusions are drawn:

1) All the mixes attained the target strength.
2) As per 28 days and 14Days compressive, split tensile and flexural test results of recycled aggregate concrete 50/20 is increased 4-10% than conventional aggregate concrete of both mixed designs.
3) The water absorption is relatively higher for recycled aggregates. The recycled aggregates had 2.5% to 3% water absorption.
4) Concrete made with 100/40% replacement of conventional aggregate concrete with recycled aggregate concrete had 24% less compressive strength than conventional concrete at 28 days with same water cement ratio and quantity of cement in both concrete grades (M30 & M40).
5) Concrete is made with super plasticizer to achieve good workability, and maximum strength gained at earlier stage of 7 days.
6) Compressive strength results of RAC show decrease in strength at 25/10%;75/20% & 100/40% and increased at 50/20%.
7) RAC had strength loss of 6-15% and strength gain of 2-7% when compared to conventional aggregate concrete.

REFERENCES

[1] IS 456-2000, “Plain cement reinforced concrete-code of practice” (fourth version), Bureau of Indian standards, New Delhi, India.
[2] IS 10262-2009, “Recommended guidelines for concrete mix design”, Bureau of Indian standards, New Delhi, India.
[3] IS 383-1970, “Specifications for coarse and fine aggregate from natural source for concrete, (second version)”, Bureau of Indian standards, New Delhi, India.
[4] IS 2386-PART 3, “Methods of test for concrete aggregates for concrete part 3 specific gravity, density, absorption and bulking”.
[5] IS 516-1959, “Method of test for compressive strength of concrete”.
[6] IS 8112-1989, “Specifications for ordinary Portland cement”.
[7] SOLID WASTES GENERATION IN INDIA AND THEIR RECYCLING POTENTIAL IN BUILDING MATERIALS By Asokan Pappua; Mohini Saxena and Shyam R. Asolekar.
[8] CONSTRUCTION AND DEMOLITION WASTE RECYCLING FOR SUSTAINABLE GROWTH AND DEVELOPMENT By Hemalatha B. R; Nagendra Prasad; B.V.Venkata Subramanya.
[9] CONCRETE USE OF RECYCLED CONCRETE AGGREGATE IN MAKING By S R Yadav, National Institute of Construction, Management and Research, India
[10] Use of Recycled Aggregate in Concrete By Mr. Tushar R Sonawane RESEARCH GRADUATE MAEER‟S MIT PUNE,
[11] An Innovative Method of Replacing River Sand by Quarry Dust Waste in Concrete for Sustainability By Dr. P.B.Sakthivel, C.Ramya, M.Raja
[12] EXPERIMENTAL STUDY ON RECYCLED AGGREGATE CONCRETE G. Murali1 and C.M. Vivek Vardhan
[13] Effectiveness of using Coarse Recycled Concrete Aggregate in Concrete By Neela Deshpande, S. S. KulkarniNikhil Patil
[14] Concrete Mix proportions By Dr. M. C. Nataraja
[15] Aggregates from Natural and Recycled Sources-By David R. Wilburn and Thomas G. Goonan.



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