EXPERIMENTAL INVESTIGATION ON PROPERTIES OF RECYCLED AGGREGATES, BAGASSE ASH AND STEEL FIBER ON PROPERTIES OF CONCRETE

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Abstract

The use of recycled aggregates in concrete opens wide range of opportunities in the reuse of materials in the building industry. The use of recycled aggregates is a good remedial to the problem of an excess of waste material. . In fact, none of the results revealed the unsuitability of the recycled aggregates in concrete. This Work focuses on the possibility of the use of recycled aggregate concrete as a structural material with replacement level of 25%, 50% and 75% by weight of normal aggregates along with the hook end steel fiber used in this study varied from 0.5% .1.0%, and 1.5 % by Volume of concrete. Bagasse ash is also used as a partial replacement of Portland cement with 5, 10 & 15 % by weight of binder in order to improve the properties of RAC. The use of bagasse ash replace cement in RA concrete could improve compressive strength to be higher than that of concrete without bagasse ash at the same W/B ratio. This Work focuses on the possibility of the use of recycled aggregate concrete with bagasse ash and steel fibers as a structural material. The properties of concrete evaluated include compressive strength, Split tensile strength, flexural strength.

***Keywords**: Recycled Aggregates, Recycled Aggregate Concrete, Bagasse Ash Hook End Steel Fiber*

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I. INTRODUCTION

The conservation of natural resources is a basic need, which is directly connected with the survival of the human life. Parameters like environmental consciousness, protection of natural recourses, sustainable development play an important role in modern requirements for construction works. Globally, the concrete industry consumes large quantities of natural resources, which are becoming scarce to meet increasing demands. At the same time, many old buildings have reached the end of their service life and are being dismanteled, resulting in wasted materialand can be used as backfill material, and much being sent to landfills. Recycling leads to conservation of natural resources.

Bagasse Ash (BA) - Bagasse is a by-product of sugar industry and important fuel source for that industry. It is a fibrous with low density material with a very wide range of particle size distribution.

The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicelluloses. Each ton of sugarcane generates approximately 25% of bagasse (at a moisture content of 50%) and 0.62% of residual ash. The present study used ash collected from Asia's first co-operative sugar factory Padmashri Dr. Vitthalrao Vikhe Patil Co-operative Sugar Factory, Pravaranagar with percentage replacement of 5%, 10%and 15%by weight of cement and mix design is done as per I.S.10262-2009.From many studies it is concluded that bagasse ash can be used as a cement replacing material because of its high silica content and fineness. It improves the workability of the fresh concrete.

Steel Fiber: Concrete is a brittle material as we know hence to improve ductility property and hence to introduce elasticity in concrete mass the steel fibers have been introduced in concrete.it improves many properties of concrete like long term strength,toughness and high sterss resistance. It has many applications in in structures such as flooring, housing, precast, tunneling, heavy duty pavement and mining.

Generally, aspect ratios of steel fibers used in concrete mix are varied between 50 to 100.The most suitable volume fraction values for concrete mixes are between 0.5% to 1.5% by volume of concrete.

II. EXPERIMENTAL PROGRAMME

The quantity of ingredient materials and mix proportions as per design for M20 grade of concrete is as follow.

Table 1. Identification Marks of in- gradient materials

Sr. No.	ID Mark	Percentage Variation of Ingradient Materials		
		RA%	BA%	SF%
1	RAC-A-1	25	5	0.5
2	RAC-A-2	25	10	1
3	RAC-A-3	25	15	1.5
4	RAC-B-1	50	5	0.5
5	RAC-B-2	50	10	1
6	RAC-B-3	50	15	1.5
7	RAC-C-1	75	5	0.5
8	RAC-C-2	75	10	1
9	RAC-C-3	75	15	1.5

Table 2. Physical Properties of Ingredient Material of concrete.

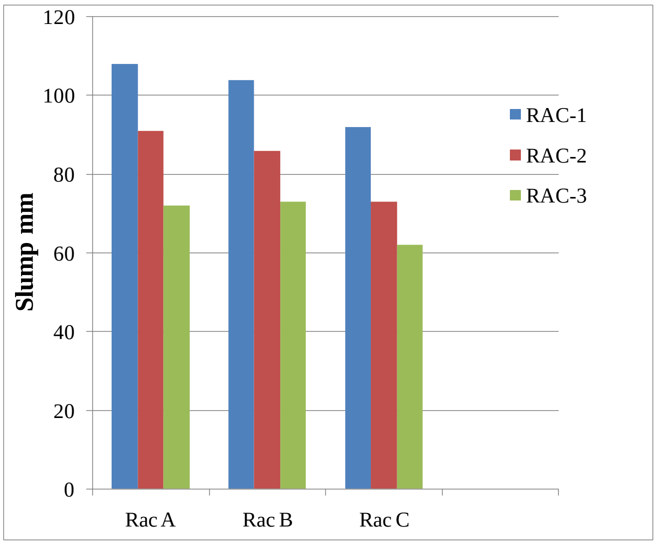
Sr No.	Ingredient	Physical Property		
1	Cement	Fineness		4%
		Setting Time(Min)	Initial	63
			Final	577
		Standard Consistency		35%
2	Fine Aggregates	Fineness Modulus		3.55
		Specific Gravity		2.64
3	Coarse Aggregates	Fineness Modulus		4.71
		Specific Gravity		2.70
4	Recycled Aggregates	Fineness Modulus		4.695
		Specific Gravity		2.747

Table 3. Slump Test Result

Sr. No.	Id mark	Slump (mm)
1	RAC-A-1	108
2	RAC-A-2	91
3	RAC-A-3	72
4	RAC-B-1	104
5	RAC-B-2	86
6	RAC-B-3	68
7	RAC-C-1	92
8	RAC-C-2	73
9	RAC-C-3	62
10	Normal	120

Table 4. Slump Vs %Fiber Graph Details

ID Marks	RAC-A	RAC-B	RAC-C
RAC-1	108	104	92
RAC-2	91	86	73
RAC-3	72	68	62



Graph 1. Slump Test Graph

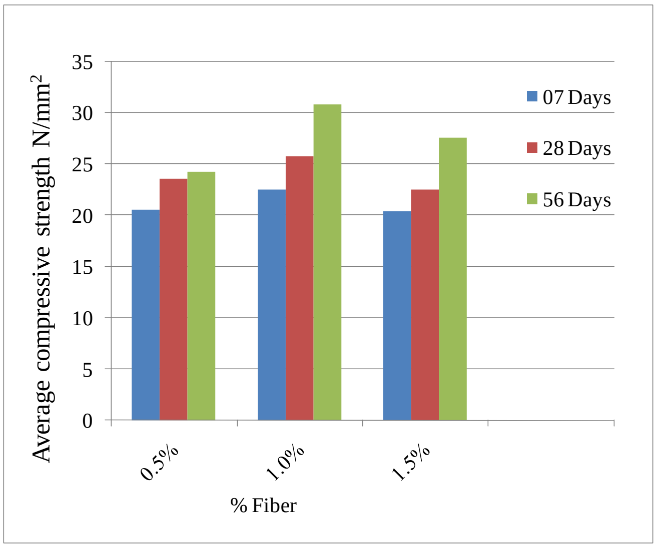
Table 5. Proportion of Material used for M20 grade of concrete

Table 6. Average Comp. Strength of NC

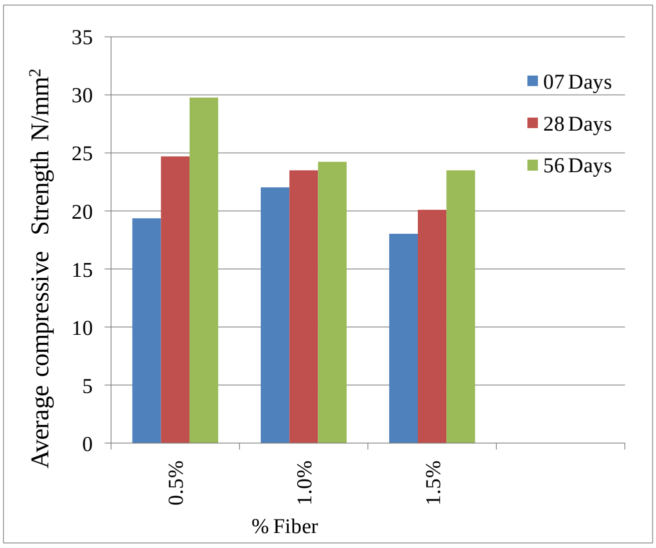
Sr no	Id mark	Average comp .strength (Mpa)		
		7 days	28 days	56 days
1	NC	18.81	26.72	29.92

Table 7. Averages Compressive Strength of RAC

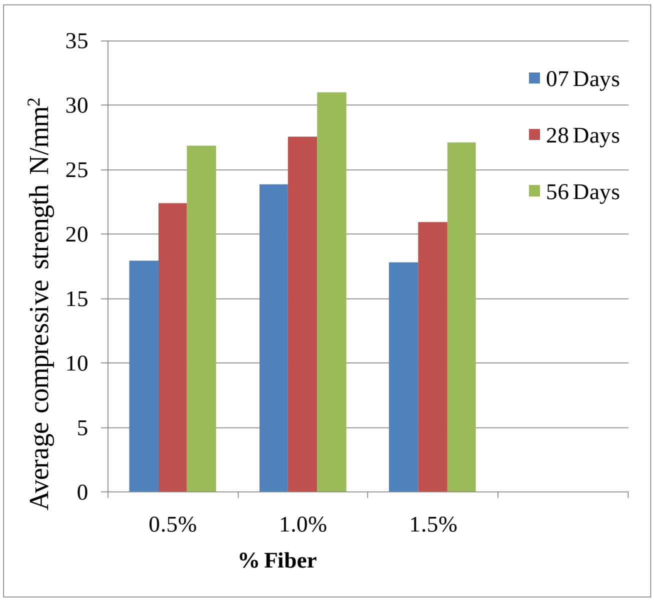
Sample ID	% of fiber No of days	0.5 %	1.0 %	1.5 %
RAC-A	7	20.59	22.52	20.44
	28	23.55	25.77	22.52
	56	24.29	30.81	27.56
RAC-B	7	19.41	22.07	18.08
	28	24.74	23.56	20.15
	56	29.78	24.29	23.56
RAC-C	7	17.93	23.85	17.78
	28	22.37	27.56	20.89
	56	26.82	30.96	27.11



Graph 2- Average Compressive strength of RAC-A Vs Steel Fiber



Graph 3- Average Compressive Strength of RAC-B Vs Steel Fiber



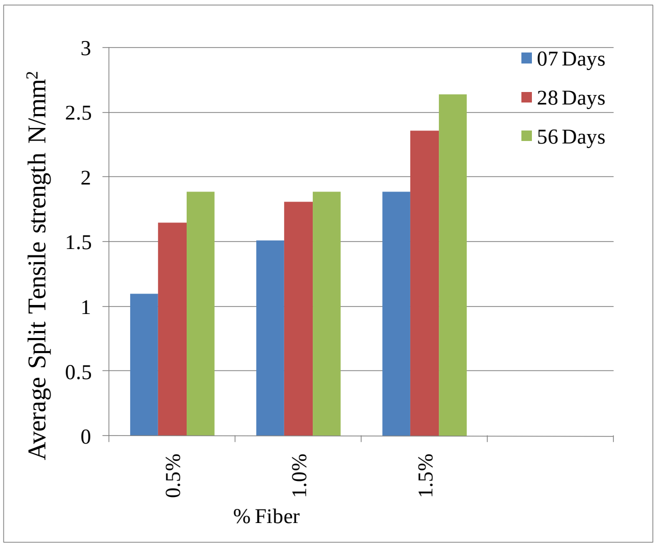
Graph 4- Average Compressive Strength of RAC-C Vs Steel Fiber

Table 8. Average Split Strength of NC

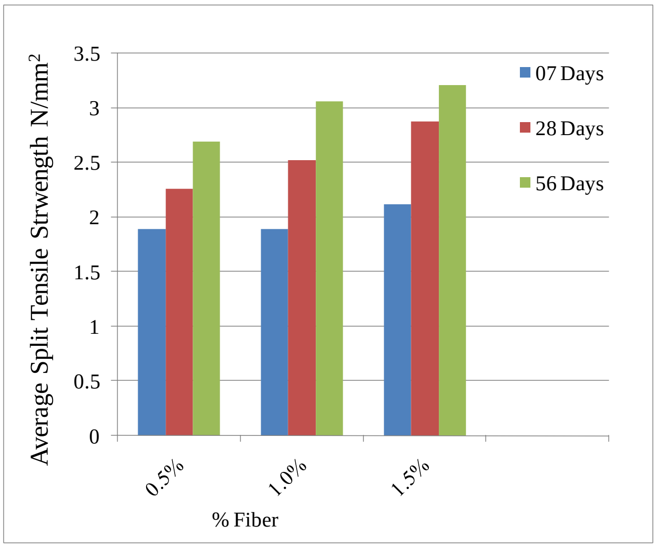
Sr no	Id mark	Split Tensile strength (Mpa)		
		7 days	28 days	56 days
1	NC	1.50	3.11	3.06

Table 9. Average Split Strength of RAC

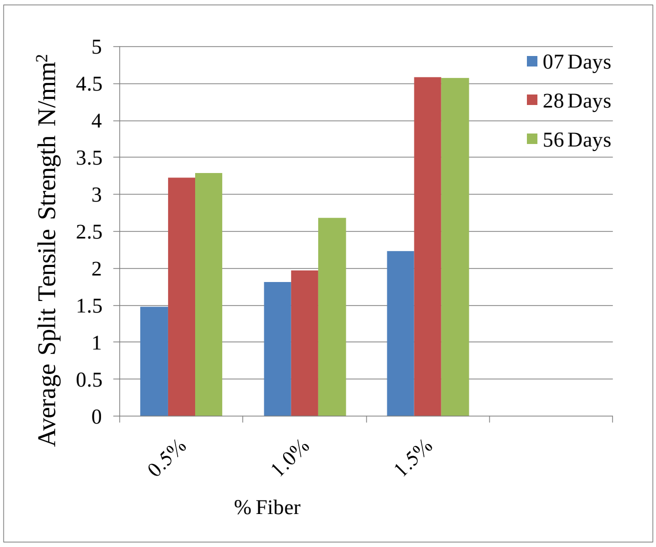
Sample ID	% of fiber No of days	0.5 %	1.0 %	1.5 %
RAC-A	7	1.10	1.51	1.89
	28	1.65	1.81	2.36
	56	1.89	1.89	2.64
RAC-B	7	1.89	1.89	2.12
	28	2.26	2.52	2.88
	56	2.69	3.06	3.21
RAC-C	7	1.49	1.82	2.24
	28	3.23	1.98	4.59
	56	3.30	2.69	4.58



Graph 5 -Split Tensile Strength of RAC-A Vs Steel Fiber



Graph 6- Split Tensile Strength of RAC-B Vs Steel Fiber



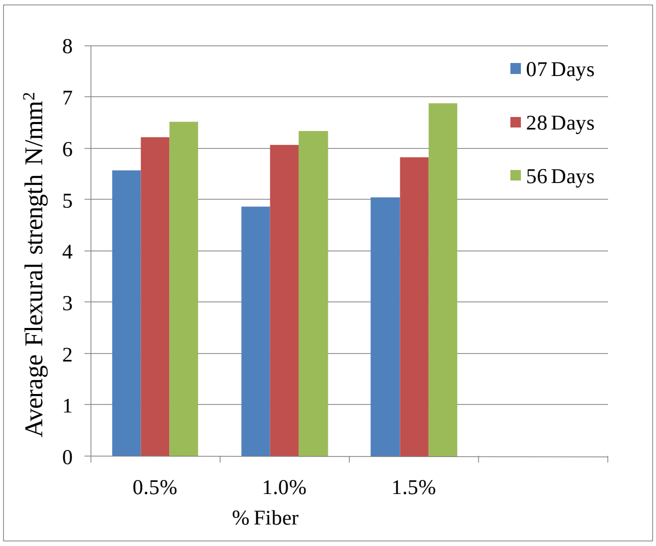
Graph 7- Split Tensile Strength of RAC-C Vs Steel Fiber

Table 10. Average Flexural Strength of NC

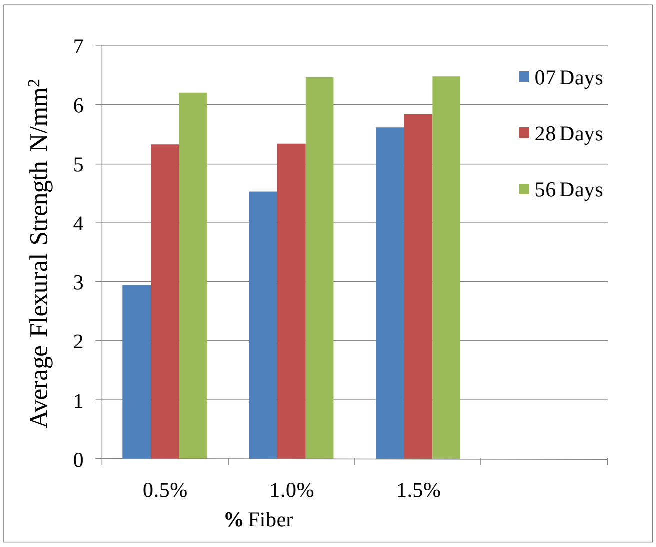
Sr. No.	Id mark	Flexural strength (Mpa)		
		7 days	28 days	56 days
1	NC	4.49	5.55	5.83

Table 11. Average Flexural Strength of RAC

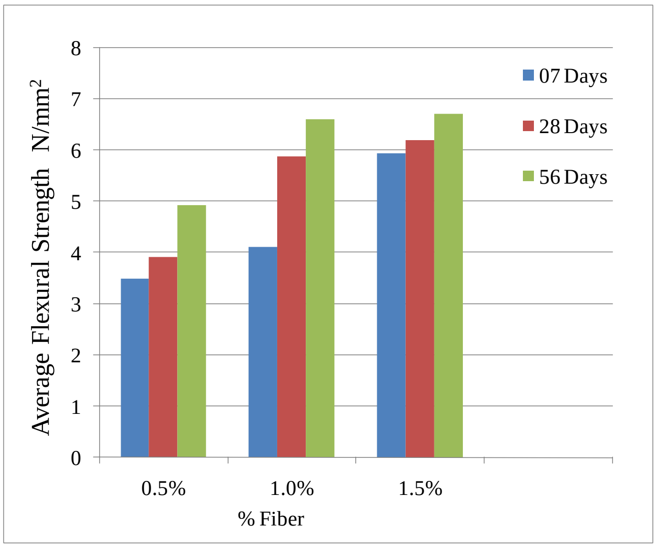
Sample ID	% of fiber No of days	0.5 %	1.0 %	1.5 %
RAC-A	7	5.58	4.87	5.05
	28	6.22	6.07	5.83
	56	6.53	6.35	6.89
RAC-B	7	2.95	4.53	5.63
	28	5.33	5.35	5.84
	56	6.21	6.48	6.49
RAC-C	7	3.50	3.91	4.93
	28	4.12	5.89	6.61
	56	5.94	6.20	6.71



Graph 8. Flexural Strength of RAC-A Vs Steel Fiber



Graph 9. Flexural Strength of RAC-B Vs Steel Fiber



Graph 10. Flexural Strength of RAC-C Vs Steel Fiber

CONCLUSION

Following conclusion is drawn on the result discussed in the previous chapter :-

1. Compressive strength increases by 30.90 % , 16.28 % and 12.33 % at 7 , 28 and 56 days respectively when 75 % RA , 10 % BA and 1.0 SF are used.
2. Split Tensile Strength increases by 55.55 % , 80.0 % and 38.78 % at 7 , 28 and 56 days respectively when 75 % RA , 15 BA and 1.5 % SF are used.
3. Flexural strength increases by 35.30 % , 21.92 % and 41.95 % at 7 , 28 and 56 days respectively when 75 % RA , 5 % BA and 0.5 % SF are used.
4. As % of fiber increases the workability of concrete decreases which was observed from slump values but 0.5 % fibers contents gives highest workability.

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