An Experimental Study on Glass Fiber Reinforced Recycled Aggregate Concrete With Fly Ash As Partial Replacement To cement

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Abstract- *Waste arising from construction and demolition constitutes one of the largest waste streams within the developed and developing nations. The use of Recycled coarse aggregate (RCA) and Fly ash (FA) is one of the approaches towards that need. Use of RCA and FA in concrete can be useful for environmental protection and economical aspects. In that experimental study the natural coarse aggregate is replaced with the recycled coarse aggregate at different percentage and the mechanical strength of concrete is tested. In addition, the fly ash is introduced as replacement of Cement and also glass fibers are added to improve the quality of concrete and tensile strength. Cylinders and cubes are casted with replacing coarse aggregate with 0, 25, 50, 75% and 100% recycled coarse aggregate. In addition 10% 20% & 25%of fly ash 0.05% 0.015% &0.025% glass fibers is introduced as replacement of Cement to improve the quality of concrete. Here the effect of replacement of fly ash and addition on of glass fibers on the properties of recycled aggregate concrete is studied and compressive strength and split tensile strength is compared with normal concrete with0ut fly ash. The target strength is achieved in compression at 20% replacement of fly ash, 0.015% addition of S-Glass fibers and in tension at 10% replacement of fly ash, 0.015% addition of S-Glass fibers.*

Keywords- Recycled aggregate, Fly ash, Glass fiber, Compressive strength, Split tensile strength.

I. INTRODUCTION

Any construction activity requires several materials such as concrete, steel, brick, stone, glass, clay, mud, wood, and so on. However, the cement concrete remains the main construction material used in construction industries. For its suitability and adaptability with respect to the various environments, the concrete must be such that that canbe conserve resources, protect the environment, economize and lead to proper utilization of energy. TO achieve that, major emphasis must be used of wastes and with products in cement and concrete used for new constructions.

The utilization of recycled aggregate is to particularly very much promising role of 75 to 80 percent of concrete is made of aggregates. In order to reduce the usage of natural aggregate, recycled aggregate can be used as the replacement materials. As innumerous numbers of materials are used as replaced for natural aggregate, some of them are slag powder plant wastes, recycled concrete, mining and quarrying wastes, waste glass, incinerator residue, red mud, burnt clay, sawdust, combustor ash and foundry sand. These materials are generally from buildings, roads, bridges, and sometimes even from catastrophes, such as wars and earthquakes. which are now posing a various serious problem of disposal in urban areas. That can easily be recycled as aggregate and used in concrete. Research & Development activities have been taken up all over the countries for proving its feasibility, economic viability and cost effectiveness.

II. OBJECTIVES OF THE WORK

S. R. Rabadiyaet al., (2015) studied on the "**Effect of Recycled Aggregate with Glass Fiber on Concrete Properties**". Use recycled coarse aggregate a partial replacement of coarse aggregate with different percentage for making concrete of different grade from l0wer to higher like M-20. The percentage replacement will be 0, 10, 20, 30, 40, 50 and 60 of percentage with natural coarse aggregate. They casted cubes, cylinders and finally Slump test, compressive strength test, splitting tensile strength test and flexural strength test will be conducted. They concluded that replacement of recycled coarse aggregate and glass fiber (volume of concrete)in concrete, the split and flexural strength was very increases up to 60 % as compare to a normal concrete test results.

DabhadeA.N et al., (2013) studied the "**Effects of fly-ash on recycled concrete**". They determined the effects of the fly ash on the hardened properties of recycled aggregate concrete (RCA). That can be replaced the natural aggregates with different percentages of recycled aggregate such as 0%, 20%, 30%, 40%, 50% and100 %. In addition fly ash was replaced with 10% and 20 % with weight of cement. They

prepared the concrete mixtures with water and cement W/C ratios 0.38 and0.45.

They concluded that workability of RCA based concrete can be improved with a replacing cement with fly ash with 10% weight of cement with0ut compromising the strength of aconcrete.

C. Marthonget al., 2012 examined the "**Effect of Fly ash Additive on Concrete Properties**". That a comparative study on the effects of concrete properties when OPC of various different grades 33, 43, 53 were partially replaced with fly ash. The main variable investigated in that study is variation of fly ash dosage of 10, 20 of percentage, The compressive strength, durability and shrinkage of concrete were mainly studied.imn Test results sh0ws that, inclusion of fly ash generally improves the concrete properties uptocertain percent or replacement in all grades ofOPC.

Y. V. Akbari et al., (2011) studied onthe "**Effect on recycled aggregate onconcrete properties**". The experimental program includes variation in water cement ratio and replacement of natural aggregates with recycled aggregates. Three different water ratios 0.60, 0.52 and 0.43 and aggregate replacement of 0%, 15%, 30%, 50% were accounted in experimental program. Experimental results sh0ws up to 25% reduction in compressive strength, and 23% reduction in flexural strength, and 26% reduction in split tensile strength and a noticeable reduction in workability were observed with the increase in a percentage of aggregate replacement.

K. JagannadhaRaoet al., (2009) examined the "**Suitability of glass fibers in High Strength Recycled Aggregate Concrete.**" In that study the fresh and hardened state properties of partially replaced recycled aggregate concrete, with varying percentages of glass fibers, are compared with a corresponding conventional aggregate concrete. The compressive, split tensile and flexural strengths of M50 grade concrete with 0% RCA and 50% RCA have increased as the fiber content increased. The maximum values of all these strengths were obtained at 0.03% of fiber content for both the concretes of 0% RCA and 50% RCA. Large deflections of beams before a failure indicated improved ductility with the addition offibers.

III. SCOPE OF THE WORK

COMPRESSIVESTRENGTH:

Compressive Strength is determined with loading properly prepared and cured cubic, cylindrical specimens under compression. The compressive strength of concrete specimens is calculated with using the compressive testing machine (CTM) which is having capacity of 2000KN. The measured compressive strength of the specimen shall be calculated with dividing the maximum load applied during the test with the cross sectional area calculated from mean dimensions of the section and shall be expressed to the nearest N/mm^2. Among many test applied to the concrete, that is given utmost important which has an idea view about all the characteristics of concrete. A. Bits and Pieces together

SPLIT TENSILESTRENGTH:

It is well known that the concrete is weak in tension. Tensile strength is one of the basic important properties of the concrete. The tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking takes place is a form of tension failure. The usefulness of the splitting cube test in assessing the tensile strength of concrete is widely accepted in the laboratory.

This approach works the best in guidance of fellow researchers. In this the authors continuously receives or asks inputs from their fellows. It enriches the information pool of your paper with expert comments or up gradations. And the researcher feels confident about their work and takes a jump to start the paper writing.

IV.RESULTS

Three Mixes of concrete cubes of size 150 150 150mm are prepared. These three are prepared with different percentage replacement of recycle coarse aggregate i.e. 25%, 50%, 75%, and 100%. Mix 1 is prepared with 0.45 w/c ratio with0ut any cement replacement and Mix 2 is prepared with replacing 10% cement with fly ash with 0.43 w/c ratio and Mix 3 is prepared with replacing 10% cement with fly ash with 0.43w/c ratio. Super plasticizer (SP 430) is also added (i.e., 0.9% of cement used) for the three mixes to improve the workability. The pozzolanic material fly ash is used in recycled aggregate to improve proper bonding between the cement paste and aggregate. For the three sets workability, compressive strength and split tensile strength arrested.

COMPRESSIVESTRENGTHRESULTS

The experimental results obtained after the curing of 7 days and 28 days are shown in the table 1. Figures1,2,3.represent the compressive strength for 7&28 days with0ut fly ash and with10% and 20% fly ash. Figures 6.7, 6.8 represent the combined values of compressive strength for mixes with0ut Fly ash and with 10% and 20% Fly ash. The

compressive strength of the3 sets is decreased with the increase in percentage of recycled aggregates. At 28 days 100% replacement of RCA with addition of fly ash achieves strength of 32.63MPa whereas target mean strength of M30is 38.92MPa. In short period of time that strength can be exceed to the strength of natural aggregate concrete.

Table 1 Compressive strength for 7 and 28 days without RCA

s. no	% fly ash (replacement of Cement)	S-glass Fibers	Compressive Strength (Mpa)	
			7 days	28 Days
1.	Normal mix		25.60	43.32
2.	0%	0.005%	26.54	40.51
		0.015%	27.65	41.63
		0.025%	27.35	41.20
3.	10%	0.005%	27.56	41.91
		0.015%	28.96	42.45
		0.025%	27.85	41.86
4.	20%	0.005%	28.52	42.86
		0.015%	29.75	43.45
		0.025%	28.61	42.97
5.	25%	0.005%	25.21	38.21
		0.015%	26.35	39.74
		0.025%	25.52	37.12

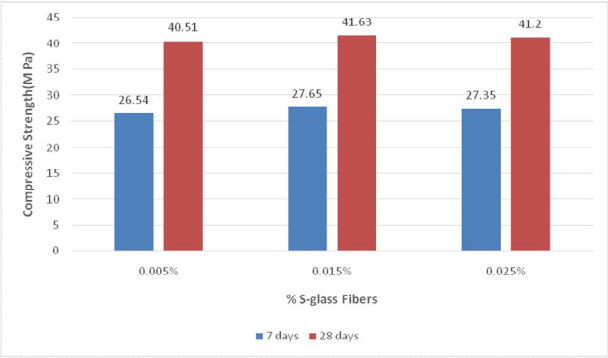

Figure 1 compressive strength of % glass fibers and %0 fly ash

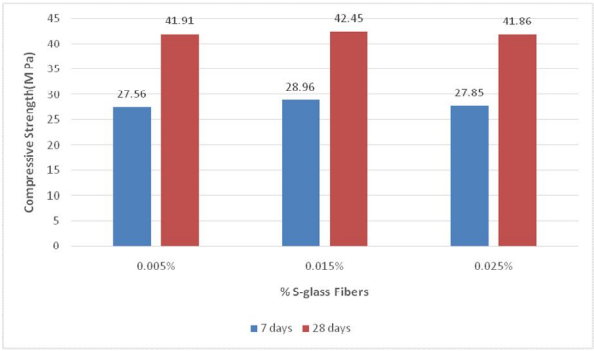

Figure 2 compressive strength of % glass fibers and 10% fly ash

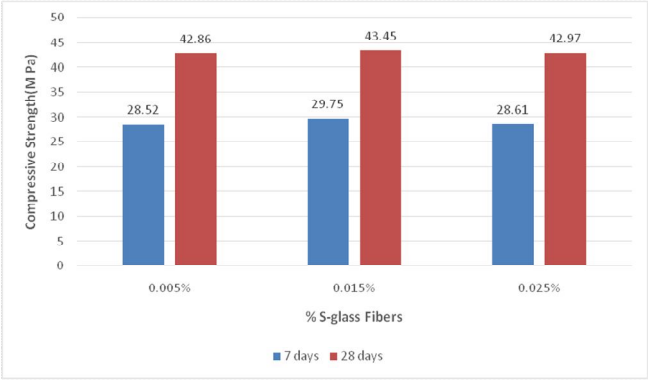

Figure 3 compressive strength of % glass fibers and 20% fly ash

Table 2Compressive strength for 7 and 28 days, 20% fly ash, 0.015% S-Glass fibers

Optimum		% of RCA	Compressive Strength (Mpa)	
Fly ash	S-Glass fibers		7 days	28 days
	0.015%	0	29.78	42.98
		25	27.56	39.96
		50	23.59	38.21
		75	22.01	34.36
		100	20.15	31.85

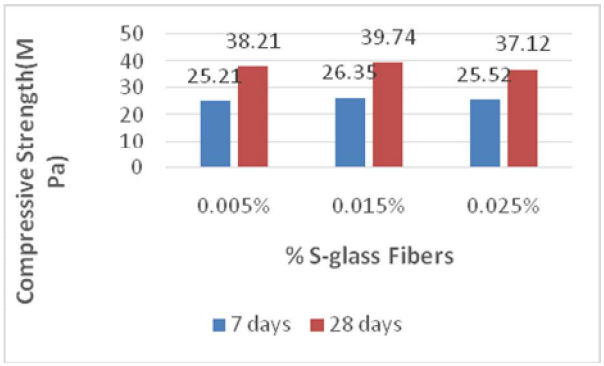

Figure 4 compressive strength of 0.015% glass fibers and 20% fly ash and % recycled coarse aggregate

Split tensile strength results:

Split tensile strength of the three mixes Mix 1, Mix 2 and Mix 3 is gradually decreased with increase in percentage of recycled aggregates. The set with 10% and 20% fly ash has less Split tensile strength compared to without silica fume. Split tensile strength with different % of RCA in is shown in table 3.

Table 3: Split tensile strength for 7 and 28 days without RCA

S No.	*%fly ash (replace ment of Cement)*	*S-glass Fibers*	*split tensile strength (MPa)*	
			7 days	*28 days*
1.	*Normal mix*		*2.79*	*4.15*
2.	*0%*	*0.005%*	*2.82*	*3.89*
		0.015%	*3.07*	*4.21*
		0.025%	*3.01*	*4.10*
3.	*10%*	*0.005%*	*3.19*	*4.31*
		0.015%	*3.31*	*4.40*
		0.025%	*3.24*	*4.32*
4.	*20%*	*0.005%*	*3.18*	*4.19*
		0.015%	*3.19*	*4.28*
		0.025%	*3.11*	*4.09*
5.	*25%*	*0.005%*	*2.92*	*3.91*
		0.015%	*2.97*	*3.97*
		0.025%	*2.99*	*3.81*

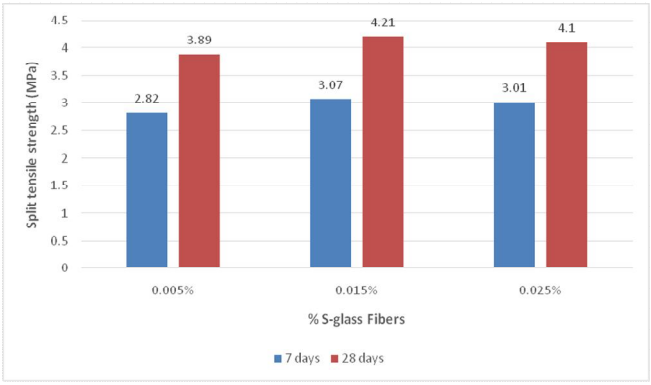

Figure 5: split tensile strength of % glass fibers and % fly ash

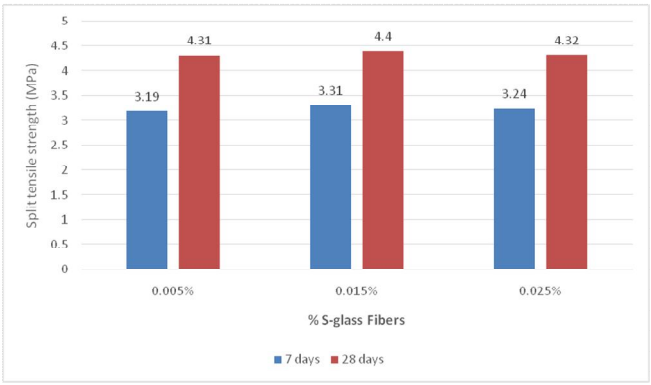

Figure 6: split tensile strength of % glass fibers and 10% fly ash

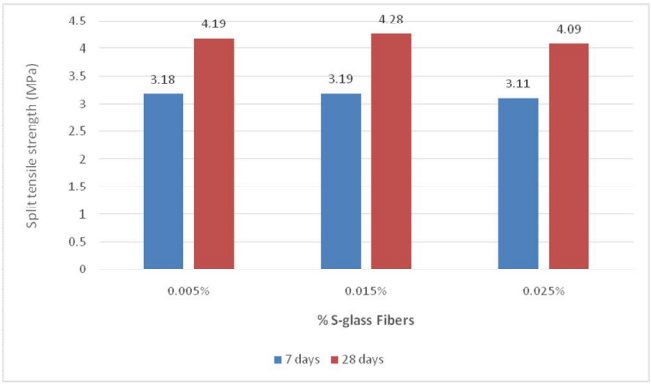

Figure 7: split tensile strength of % glass fibers and 20% fly ash

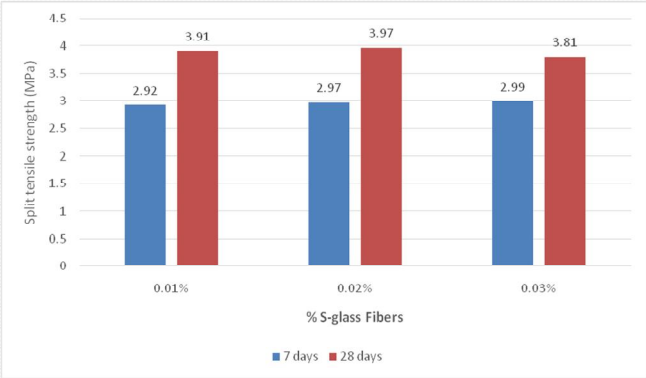

Figure 8: split tensile strength of % glass fibers and 25% fly ash

Table 4: split tensile strength for 7 and 28 days, 10% fly ash

Optimum		% of RCA	split tensile strength (M pa)	
Fly ash	S-Glass fibers		7 days	28 days
10%	0.015%	0	3.31	4.45
		25	3.20	4.11
		50	2.87	3.84
		75	2.63	3.65
		100	2.34	3.31

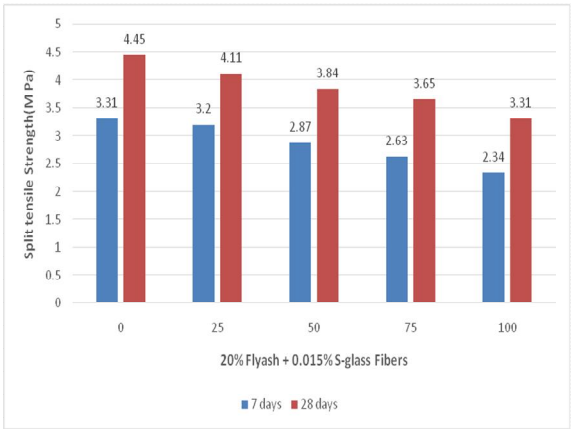

Figure 9 :split tensile strength of 0.015% glass fibers and 20% fly ash and % recycled coarse aggregate

V. CONCLUSIONS

The following conclusions are made from the study

1. The strength of concrete decrease with increase in the percentage of recycle aggregate, that maybe because of the loose mortar around the recycle aggregate which donot all0w the proper bonding between the cement paste and aggregate.
2. The strength (30 MPa) is generally used for a wide range of structural uses. At 28 days 100% replacement of RCA with addition of fly ash achieved strength of 32MPa.
3. The split tensile strength value is maximum with the addition of S-Glass Fibers at 0.015%.
4. When the Natural Aggregate is replaced with 50% RCA, 20% fly ash and 0.015% S- Glass fibers achieved the target mean strength for M30 grade ofconcrete.
5. At 20% fly ash, 0.015% S-Glass fibers and 50% RCA replacement to NCA increases compressivestrength
6. At 10% fly ash, 0.015% S-Glass fibers and 50% RCA replacement to NCA increases split tensile strength.
7. It is concluded that with0ut decreasing the water-cement ratio, the target mean strengthof M25 grade of concrete can be achieved through recycled aggregates and Fly ash.

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REFERENCES

[1] S. R. Rabadiya S. R. Vaniya "Effect of Recycled Aggregate with Glass Fiber on Concrete Properties" IJIRST –International Journal for Innovative Research in Science & Technology| Volume 2 | Issue 01 | June 2015 ISSN (online): 2349-6010

[2] Dabhade A .N., Choudhari S.R., Gajbhiye A.R., "effects of fly-ash on recycled concrete", International journal ofa applied engineering and technology ISSN: 2277-212X(online). In 2013

[3] 3. C.Marthong, T.P.Agrawal examined the "Effect of Fly ash Additive on Concrete Properties". That is a comparative study on effects of concrete properties when OPC of varying grades 33, 43, 53 were partially replaced with fly ash in 2012

[4] Y. V. Akbari , N. K. Arora, M. D. Vaki l "Effect on recycled aggregate on concrete properties", International Journal of Earth Sciences and Engineering ISSN 0974-5904, Volume 04, No 06 SPL, October 2011, pp.924-928