EXPERIMENTAL INVESTIGATION ON CONCRETE WITH REUSED AGGREGATE AND SILICA FUME

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ABSTRACT:- *The amount of construction wastes are recently increased in this decade because of demolition of old buildings. These concrete wastes are generally useless, they are being disposed by means of earth embankments and landfills. The availability of natural aggregates are also decreasing because of the construction activities. So we need to identify the replacements for this coarse aggregates.*

This paper is about the usage of Recycled Concrete Aggregate (RCA) to replace 50% of natural coarse aggregate in the Concrete. Due to usage of Recycled Concrete Aggregate, strength of the concrete will be reduced. So to improve the strength of concrete, admixtures can be added in it. Silica fume is added in 5 different percentages 5%,10%,15%,20%,25% in concrete. The Compressive strength is calculated for 7days, 14days, 28days and split tensile strength is calculated for 14 days and 28 days. This paper mainly focused on what percentage of silica fume in concrete gives the required strength.

Key words: Reused aggregate, Silica Fume, Strength , Mineral Admixture

1. INTRODUCTION

Demolition of the old buildings produce a large quantity of waste concretes. The waste concrete has low strength and lifetime. The waste concrete are generally useless and they are used for earth fills. The recycled concrete aggregates(RCA) are derived from waste concretes. The RCA were separated from waste concretes either manually or mechanically. RCA construction is very use full technique for future, because million tonnes of waste concretes will be produced every year. RCA construction is an environmental protection technique; it reduces the usage of natural coarse aggregates. RCA have low strength because it is derived from waste concrete. The RCA is used for construction in many countries, due to its lower strength they are used for non-structural member construction.

To improve the mechanical properties of RCA, admixtures are added. It improves the physical properties of RCA like workability, compressive strength, etc. This paper discussion is about the partial replacement(50%) of RCA in coarse aggregates with various percentages of silica fume replacements in cement. Silica fume is one of the important mineral admixture. It is collected from silicon and ferrosilicon alloy production industry. Silica fume is used for HPC and HSC construction. Using of RCA will reduce the strength and lifetime of concrete. So to improve the strength and lifetime of RCA concrete, silica fume is added. This paper mainly focus on the what percentage of silica fume in RCA concrete gives required values for Slump cone test, Compression test and Split tensile strength.

2. LITERATURE REVIEW

1)**"Use of Recycled Aggregate in Concrete"S. Muneera, A. Rupa**

The average reduction in compressive strength and tensile strength are approximately 5 to 10%. This reduction in compressive strength is contributed to the decrease in adhesive strength between the RCA aggregates and the cement binder.

2)"**COMPRESSIVE STRENGTH OF RECYCLED AGGREGATE CONCRETE WITH VARIOUS PERCENTAGE OF RECYCLED AGGREGATE"Suraya Hani Adnan, Lee Yee Loon, Ismail Abdul Rahman, Hamidah Mohd Saman, Mia Wimala Soejoso**

a) With the same w/c ratio, the slump value decreases if percentage of RA is increased.

b) The compressive strength of Recycled Aggregate Concrete is lower than that of Natural Aggregate Concrete.

c) Lower water-cement ratio of Recycled Aggregate Concrete lead to higher in compressive strength. RAC could increase its compressive strength by reducing the water-cement ratio of concrete.

d) The relationship of w/c ratio and compressive strength of RAC is inversely proportional.

3)**Hanumesh, Varun & Harish (2015)** observes the Mechanical Properties of Concrete Incorporating Silica Fume as Partial Replacement of Cement.The main aim of this work was to study the mechanical properties of M20 grade concrete and silica fume concrete with different percentages (5, 10, 15 and 20%) of silica fume as a partial replacement of cement. The result showed that The compressive strength of concrete is increased due to the use of silica fume up to 10% replacement of cement. From 10% there is a decrease in compressive strength and The split tensile strength of concrete is increased by the use of silica fume up to 10% replacement of cement.

3. OBJECTIVES

1) To reduce the use of fresh aggregates in construction activities.

2) To calculate which percentage of Silica fume gives the required compressive strength

3) Do the experimental analysis of Concrete waste as aggregates in laboratory

4. MATERIAL & METHODOLOGY

4.1 MATERIAL

a) Cement

It is very fine powder with adhesive properties. It has better binding property and hence used as a binder in concrete. The Ordinary Portland Cement is used for construction worldwide. The Ordinary Portland Cement of 33 grade (Ultra-tech OPC) conforming to IS:8112-1989 is used.

b) Natural Coarse aggregate

The size between 20 mm to 4.75 mm are named as coarse aggregate. It gives the strength to concrete. The Coarse Aggregates are manufactured from Basalt rock. The properties of coarse aggregate conforming to IS: 383 are used.

c) Recycled Concrete aggregates

They were derived from waste concretes either manually or mechanically. It has less durability and strength when compared to normal aggregates. The shape and size of RCA is uneven and the water absorption is also high.

d) Fine aggregates

Fine aggregates are used as filler material in concrete. It reduces the amount of voids presents in the concrete. The fractions between 4.75 mm to 150 micron are named as fine aggregate. The crushed sand is used as fine aggregate conforming to the requirements of IS:383.

e) Silica fume

Silica fume is very fine and the size of silica fume is equal to $1/100^{th}$ size of cement particle. It has a very good binding property. It is used as mineral admixture in this concrete. The silica fume was bought from AASTRA CHEMICALS, Chennai.

f) Super plasticizer

It is a chemical admixture added with water during mixing of concrete. The super-plasticizers are used for the reduction of the water content and involves in the setting time of concrete. Conplast SP430 is used for this project.

4.2 METHODOLOGY

The mix design for the M20 grade of concrete was carried out based on the guidelines given in IS 456-2000. Volume batching method is used for the project. The water cement ratio of 0.45 is used. The Recycled Concrete Aggregate is 50% replace the natural coarse aggregates in all samples. Totally 6 samples of silica fume is added in 6 different percentages 0%,5%10%,15%,20%,25% in concrete. Workability of concrete is calculated, without super-plasticizer the workability is not obtained, but after adding the super- plasticizer the workability is good .The Compressive strength is calculated for 7days, 14days, 28days and the split tensile strength is calculated for 14 days and 28 days.

NCA=Natural Coarse Aggregate

RCA= Recycled Concrete Aggregates

FA= Fine Aggregates

Sample Name	Binder		Fine Aggregat	Coarse Aggregate		water cemet ratio
	Cement	Silica fume		Natural aggregate	Recycled Aggregte	
S1	100%	0	100%	50%	50%	0.45
S2	95%	5%	100%	50%	50%	0.45
S3	90%	10%	100%	50%	50%	0.45
S4	85%	15%	100%	50%	50%	0.45
S5	80%	20%	100%	50%	50%	0.45
S6	75%	25%	100%	50%	50%	0.45
S7	100%	0%	100%	100%	0	0.45

Table 1- Amount of material used

5. RESULTS

Slump test

Slump test is used to find the workability of concrete. RCA are uneven shape, so it reduces the workability of the concrete. The increase in amount of silica fume in concrete reduces the workability of the concrete. The slump test was conducted and all the readings are tabulated below in mm.

For the 50% replacement RCA with 0% silicafume concrete, the slump value is 90 mm. The addition of silicafume reduced the water content, so workability of the concrete gradually reduced. It will be directly proportional to the increase in amount of silicafume in the concrete

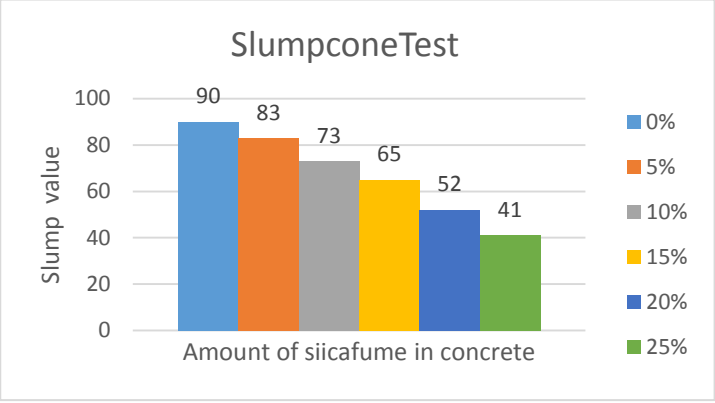

Fig -1 Slump test result

S.No	% of Silicafume	Slump Value	Slump Type
1	0	90	True Slump
2	5	83	True Slump
3	10	73	True Slump
4	15	65	True Slump
5	20	52	True Slump
6	25	41	True Slump

Table 2- Slump Test Result

Compression test

The compression test for recycled concrete are conducted at the end of 7 days, 14days and 28 days using compressive testing machine. The cube was casted at room temperature and cured well with water. Water cement ratio of 0.45 is used.

Sample Name	Compressive strength in MPa		
	7day	14day	28 day
S1	12.4	18.18	21.64
S2	14.27	20..4	23.69
S3	14.88	21.42	26.53
S4	15.42	23.51	28.4
S5	15.2	22.09	26.88
S6	13.91	20.88	24.71
S7	13.4	21.5	24.6

Table 3- Compression Test Result

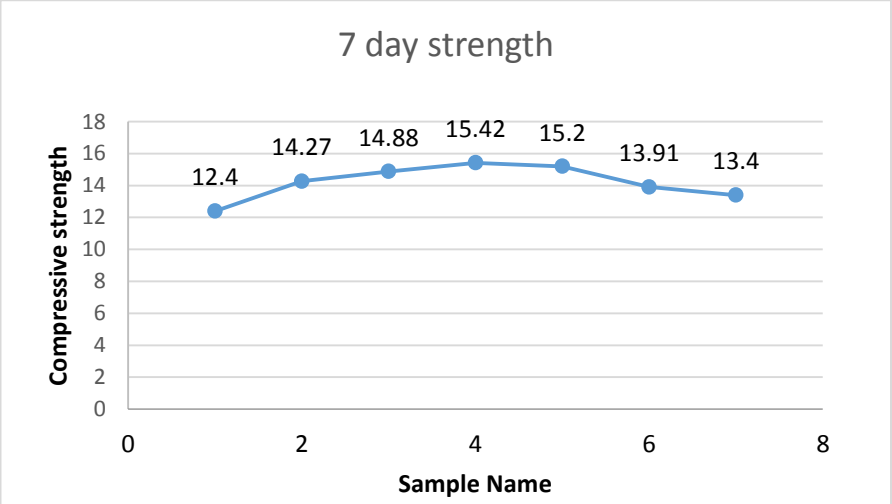

Fig 2-7day compressive strength test result

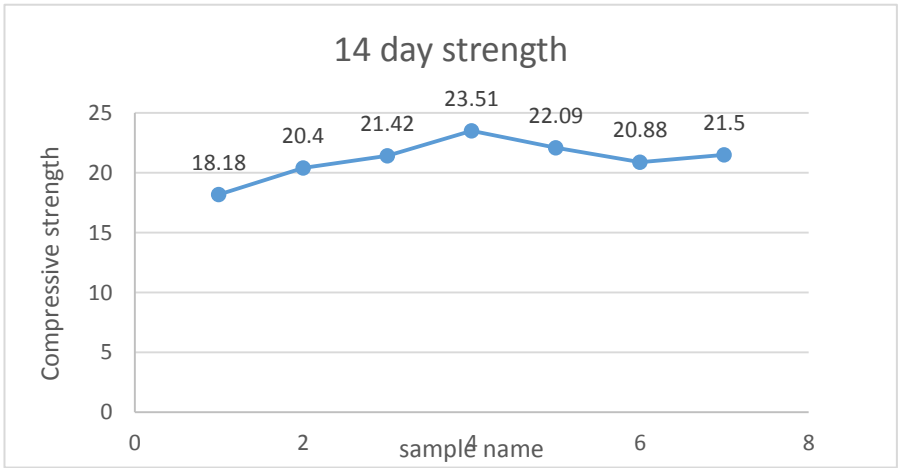

Fig 3-14day compressive strength result

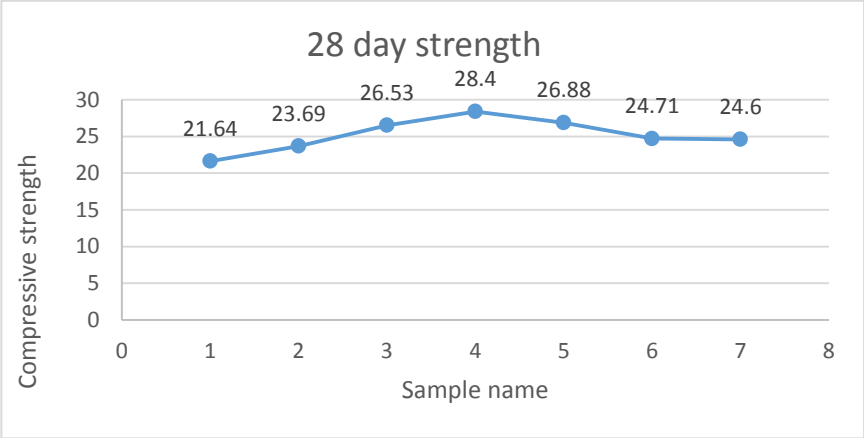

Fig 4-28day compressive strength result

Addition of silicafume affect the initial setting time, so the initial strength was low. After 7 days the strength gain was high. The strength will be increased up to 15% replacement of silicafume. After increasing silicafume amount strength will be reduced. The optimum replacement of Silicafume is 10% to 15%.

Split tensile strength

The Split tensile strength test for recycled concrete are conducted at end of 7 day and 28 day using compressive testing machine. The cube was casted at room temperature and cured well with water. Water cement ratio of 0.45 is used.

Sample Name	Tensile strength in MPa	
	14 day	28 day
S1	1.91	2.54
S2	3.16	4.21
S3	3.74	5.12
S4	2.84	3.78
S5	2.4	3.21
S6	2.06	2.78
S7	2.75	3.85

Table 4- Split Tensile Strength

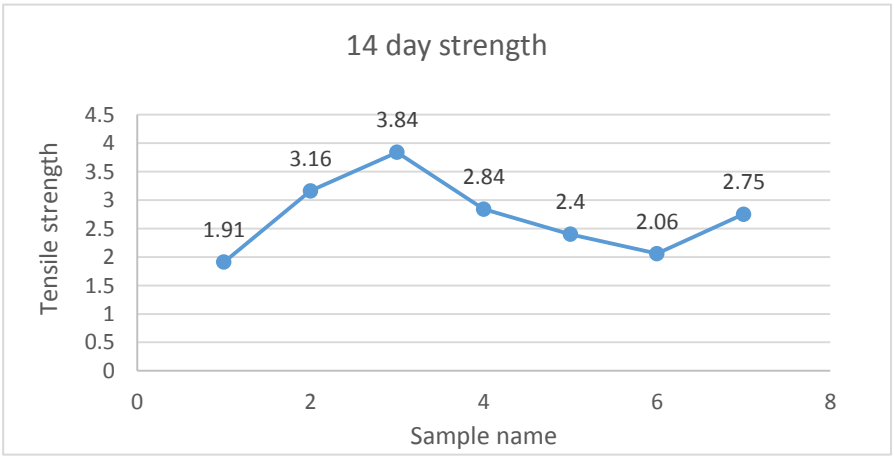

Fig-5 14day tensile strength

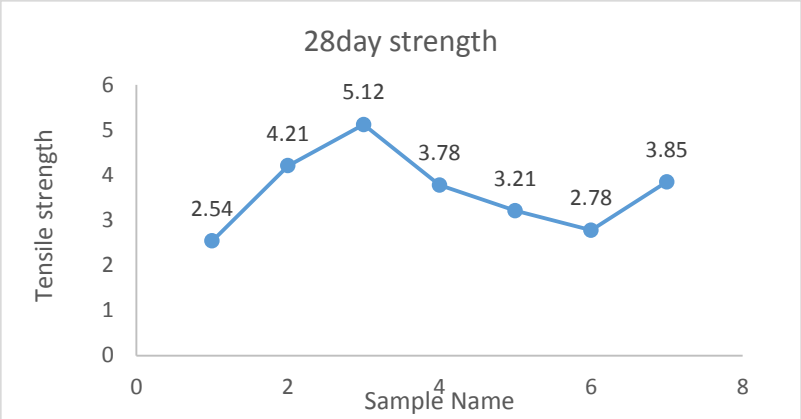

Fig-6 28day tensile strength

The RCA reduce the tensile strength of concrete, but silicafume improve the strength of concrete. Tensile strength increased upto 15% replacement of Silicafume, after increasing silicafume amount tensile strength will be decreased. The optimum amount of silicafum is 10 to 15%.

6. CONCLUSIONS

1) The 50% replacement of Recycled coarse aggregate reduced 10% to 15% of compressive and tensile strength. The addition of silica fume highly increased the tensile and compressive strength and reduced the workability of concrete.

2)The strength of recycled concrete increased up-to 15% replacement of silica fume, further increase of the silica fume content in concrete resulted in the decrement in the strength.

3) Maximum tensile and compressive strength is gained at 15% replacement of Silica fume.

4) The addition of silica fume reduced the workability of concrete.

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