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Effects of Recycled Aggregates on Properties of Self Compacting Concrete Containing Silica fume and Steel fiber

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Abstract - Development of Self-compacting concrete (SCC) is considered as the most sought development in construction industry due to its numerous inherited benefits. Self-compacting concrete is a type of concrete that gets compacted under its self-weight. It is commonly abbreviated as SCC and defined as the concrete which can be placed and compacted in to every corner of a formwork, purely by means of its self-weight and eliminating the need of either external energy input from vibrators or any type of compacting efforts (Ouchi and Hibino, 1998; Subramanian and Chatopadyay, 2002). It is also referred as self-leveling concrete, super workable concrete, highly-flowable concrete, non-vibrating concrete etc.

I. INTRODUCTION

Self-compacting concrete (SCC) was first developed in 1988 by Professor Okamura intended to improve the durability properties of concrete structures [Okamura, H.; and Ouchi, M. (2003)]. SCC is defined as concrete that is able to flow and consolidate under its own weight, completely fill the formwork even in the presence of dense reinforcement, whilst maintaining homogeneity and without the need for any additional compaction. In order to do this, SCC requires higher paste content and lower coarse aggregate fraction compared to conventional vibrated concrete, and uses superplasticizer [Okamura, H.; and Ouchi, M. (2003)]. These would ensure high deformability of paste and resistance to segregation. In order to reduce the use of cement in a high paste concrete, inert or reactive mineral additives have been employed as partial cement replacement. The use of mineral additives in SCC was also found to produce other advantages such as enhancement of SCC properties in fresh and hardened states, reuse of industrial and agricultural byproducts in concrete production and reduction of greenhouse gases into the atmosphere

II. EXPERIMENTAL PROGRAM

Research on natural aggregates used to produce SCC with silica fume, but less research available for RCA in SCC and with silica fume. Almost no data on SCC with the combination of RA and Silica fume. so objective of the study to SCC by using RA with Silica fume.to achieve similar properties as it's in natural aggregate concrete.

Mix design and specimens preparation

The mix design is prepared by EFNARC guidelines.

Materials	**(kg/m^3)**
Cement	320
Sand	852
Silica fume	80
Aggregate	850
Water	161

Table 1Mix design

Compressive Strength Test

For the compressive strength test, cubes of size 150mm x 150mm x 150 mm are tested in compression in accordance with the test procedures given in IS : 516-1959.

Flexural Strength Test

The specimen is then placed in the machine in such a manner that the load is applied to the uppermost surface as cast in the mould then strength is calculated as per IS:516-1959.

LITERATURE REVIEW

"A.N.Dabhade, Dr.S.R.Choudhari, Dr.A.R.Gajbhiye(2012)"
There were total of sixth batches of concrete mixes, consists of every 20% increment of recycled aggregate replacement from 0% to 100%.Moreover, 100% of recycled aggregate mix batches included, different water/cement ratio of 0.5,0.6 and 0.7. The workability of concrete considerably reduced as the amount of recycled aggregate increased. For the strength of characteristics, the results showed that a gradually increasing in the compressive strength up to 20% of recycled aggregate and as well as for the tensile strength as the percentage of recycled aggregate.

EFNARC Guidelines
In 2002, the European Federation of Specialist Construction Chemicals and Concrete Systems (originally EFNARC, the European Federation of National Association Representing Concrete producers) published the first edition of their Specification and Guidelines for SCC which provided state of the art information for both producers and users. The same group published, in May 2005, comprehensive guidelines "The European Guidelines for Self-Compacting Concrete" for its specification, production and use (EFNARC 2002 & 2005). This represents a state of the art document addressed to specifies, designers, producers, and users of the product

"V. Bhikshmaand K. Manipal(2012)"
In this study concrete mixesM20 and M30 with 0.0%, 0.5%, 1.0% and 1.5% volume of the steel fibres. Water cement ratio of 0.54 and 0.42 for the above two grades of concrete have been used with aspect ratios of 40 and 60.Theoverall compressive strength increases 3% and 2% for aspect ratio 40 and 60 respectively. For flexural strength it increases 6% and 2%. In splitting tensile strength increases 8% and1%. There is a significant improvement in the properties of concrete when recycled aggregate is used.

Felekoglu et al. (2005) has done research on effect of w/c ratio on the fresh and hardened properties of SCC.According to the author adjustment of w/c ratio and super plasticizer dosage is one of the key properties in proportioning of SCC mixtures. In this research, fine mixtures with different combinations of w/c ratio and super plasticizer dosage levels were investigated. The results of this research show that the optimum w/c ratio for producing SCC is in the range of 0.84-1.07 by volume. The ratio above and below this range may cause blocking or segregation of the mixture.

Nagataki, Fujiwara (1992) performed the slump flow test of SCC mix to find out whether the concrete mix is workable or not. They also performed the segregation test of SCC mix, by using locally available materials, the value ranging from 500- 700 mm is considered as the slump required for a concrete to be self-compacted.

CONCLUSION

Variation in Compressive Strength due to different R.A. Content with 10% silica fume of M20

	7 DAYS		28 DAYS	
Recycled Aggregate (%)	Compressive Strength (N/mm^2)	Variation in Strength due to increase of R.A. (%)	Compressive Strength (N/mm^2)	Variation in Strength due to increase of R.A. (%)
0%	13.32	0.45	27.42	
10%	13.24	-0.58	27.03	-1.42
20%	13.13	-1.42	26.84	-2.11
30%	12.92	-3.00	26.07	-4.94
40%	12.86	-3.50	25.66	-6.44
50%	12.54	-5.84	24.14	-11.95

Table 2 Compressive strength test for 10 % silica fume

M 20 GRADE,20 % Silica fume				
	7 DAYS		28 DAYS	
Recycled Aggregate (%)	Compressive Strength (N/mm²)	Variation in Strength due to increase of R.A. (%)	Compressive Strength (N/mm²)	Variation in Strength due to increase of R.A. (%)
0%	12.78		26.92	
10%	12.54	-1.83	26.12	-2.97
20%	12.43	-2.70	25.43	-5.53
30%	12.36	-3.30	24.13	-10.36
40%	11.87	-7.13	23.28	-13.54
50%	11.66	-8.78	22.84	-15.15

Table 3 Compressive strength test for 20 % silica fume

It gives good result in Compressive strength at 10% Silica fume in M20 compare to 20% silica fume. And also gives flow able concrete. We are getting more strength than target strength in both flexure and compression in all mix.

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