



Study on Recycled Aggregate and Steel Fibers in Self Compacted Concrete

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Abstract: The self compacting concrete is a binding composite which involves formworks without need of vibration and high resistance. However construction waste such as bricks is used as recycled coarse aggregate in order to improve the sustainability demands of structures. While introducing of RBC in SCC Will generate better improvement in construction sectors. In order to increasing of workability we introduce Super plasticizer in concretes. In order to enhanced the durability properties of SCC Crimped steel fiber are added as additive in the concrete mix. Crimped steel fiber develop good bonding properties with the recycled aggregate.

Index Terms - Recycled aggregate, steel fibers, SCC, Recycled Brick Aggregates (RBA).

I. INTRODUCTION

The self-compacting concrete is the concrete (SCC) which have the special properties like durability, tensile strength, flexural strength in recent years the use of Self Compacting Concrete (SCC) has gained acceptance worldwide Durable concrete structures can be achieved by employing SCC, which has the capability of getting compacted into every corner of the formwork under its own self weight without the application of mechanical vibration. Nowadays construction activities generate bulk volumes of solid wastes in the form of construction and demolition (C&D) wastes. Few works on the mix proportion optimization of SCC using recycled concrete aggregates have been reported, but there is only limited work carried out by using waste Recycled Brick Aggregates (RBA) in SCC. Also, no work has been reported regarding the use of RBA in Beam Column Joints (BCJ) and hence investigation of the behavior and suitability of use of RBA in SCC is absolutely essential for its extensive real time application.

II. REVIEW OF LITERATURE

Revathi and Vidhya (2022) is concluded that municipal incinerated ash is performed better in brick making with alkaline activated process. Kavitha and vidhya (2022) reported that strength and durability studies on sustainable solid blocks using greener materials. Sneha Paul Mary et al (2021) gives that unrivaled population development is a big problem that that developing-country cities are grappling with mushrooming of slums that dot the landscape serving as a conspicuous indication of this failure.

Abdul et al (2021) determined the properties of high strength concrete with partially replacement of fine aggregate using lathe scraps. Vidhya et al (2020) & Sudharsan (2018) discussed the [sustainable materials](#) are performed better durability. Rajeshkanna et al (2020) carried out the [study on innovative bricks at varying temperature](#). The eco sand is used to cast the innovative brick and the temperature increase the strength properties of the brick is increased upto 300°C.

Muthukumaran S et al (2018) & Sudharsan (2019) reported that in recent days Portland cement was used one of best construction materials for the purpose for high mechanical strength. Vidhya 2016 determined the coal ash is better pozzolanic properties. Ramya K and Muralimohan K (2016) study gives in the current years many different plants extract use to decreasing environmental effects. Kandasamy and Vidhya (2014) studied the Flexural Strength of coal ash brick masonry wall elements. The coal ash wall is performed better than conventional brick. Ali A Basetal (2014) made an analysis to investigate the practicability of steel-fiber concrete in beam-column connections for an effective precaution against seismic forces. ABAQUS software experimentally showed the results of FEA of beam-column connections embedded with steel fiber reinforced concrete. The 3D analysis of the frame was subjected to cyclic loading and an axial force on the column. This investigation reveals that an optimum usage of steel-fiber was an effective substitute for the normal reinforced concrete. Vidhya et al (2013) conducted an experiments on pond ash industrial by products for find the physical properties. Grit SadaSua-iam& Natt Makul (2013) study dealt with the use of alumina in SCC. The study says that alumina can be practically used as a substitute for fine aggregate in SCC. The mixture was optimized the flow dia during the slump. The properties such as rheological and mechanical were determined. By adding alumina, the filling, passing abilities decreased accordingly. The mixture having 75% of alumina yielded a compressive strength of 20Mpa at 3days and 45.3Mpa at 28-days. Vidhya et al (2013) carried out the properties of bricks manufactured by fly ash and pond ash from Mettur Thermal Power Plants. Vidhya and Swernalatha (2013) conducted a experiment on [utilization of fly ash and pond ash in self compacting concrete](#). Vidhya et al (2013) reported that the fly ash material is light in weight than pond ash. Adel Gorjina Kho shkenarietal (2012), carried investigation on establish the best use of recycled aggregates of size 0-2mm in concrete mix producing

standard properties of strength hand workability. Abi d Shah & Ribakov (2011) experimentally evaluated the optimum dosage of steel fibers to be used in SCC. With the aid of non-destructive testing methods, the effect of most design criteria and its control were evaluated. With the aid of the existing code sand standards the work reviewed the possibility of developing design techniques for steel fiber reinforced concrete structures with the provisions of existing codes and standards.

III. MATERIALS USED AND ITS PROPERTIES

In this current research work on HPC the materials used are OPC cement, coarse aggregate, fine aggregate, brick demolishing waste, steel fibers and Super plasticizer are taken for this study. The cement is conforming to IS 12269 – 1987. Accordingly, it is prescribed that the flakiness index of coarse recycled aggregates shall not exceed 30 and 40 respectively. The water absorption by coarse recycled aggregates shall not exceed 0.8%, 10%, respectively. Brick Aggregates of size from 12 mm to 10 mm prepared by splitting down brick bits obtained from a demolished building were used as a replacement material for natural coarse aggregates.

Table.1 Tests Conducted On the RBA

S.No	Property	Test value
1	Specific gravity	2.19
2	Aggregate crushing value	23.8
3	Aggregate Impact Value	27.6
4	Aggregate water absorption	4.2

Fly Ash

Fly ash is used to reducing the heat of hydration, permeability and bleeding of SCC when used in partial replacement to cement.

Table.2 Chemical Composition of Fly Ash

S. No	Type of Chemicals	% by Weight
1	Silica (SiO ₂)	63.53
2	Alumina (Al ₂ O ₃)	27.40
3	Calcium oxide (Cao)	1.26
4	Ferric oxide (Fe ₂ O ₃)	3.67
5	Potassium oxide (K ₂ O)	0.85
6	Magnesium oxide (MgO)	0.35
7	Sodium oxide (Na ₂ O)	0.19
8	Sulphuric anhydride (SO ₃)	0.01

Super plasticizer

Super Plasticizers (SP) is to lend a peak degree of flow ability and workability of the SCC mix. Nevertheless, maximum doses may lead to segregation In this research work carried out polycarboxylate based SP was utilized to increase the workability of SCC.

Fiber Reinforcement

Steel Fibers can be used in SCC to inhibit cracking, impact and dynamic load resistance and to prevent material disintegration. Fiber is used to improve the properties of SCC similar to that of normal concrete. In these experimental investigation Steel Fibers of aspect ratio 50 % was used. The SCC trial mixes were prepared with various proportions of steel fibers of the order of 0.5 to 1% respectively.

Mix design

The trial mix design was repeated and adjusted for SCC until an ideal mixture proportion was obtained.

Table.3 Trial Mix Design

S. No	Materials	Quantity
1	Cement	291.2 kg/ m ³
2	Fly ash	124.8 kg/ m ³
3	FA	989.835 kg/ m ³
4	CA	809.87 kg/ m ³
5	Water	208 lit/ m ³
6	SP	7.23 lit/ m ³
7	SP dosage	2.5 % of powder content

TABLE.4 Test on Fresh Concrete

S No.	Description of test	Unit	Typical values	
			Min	Max
1	Slump	Mm	650	800
2	T ₅₀ Slump	Sec	2	5
3	Passing ability	Mm	0	10
4	Filling ability	Sec	6	12
5	L-Box	H2/H1	0.8	1

IV. RESULTS AND DISCUSSION

The tests results are evaluated and discussed the following section.

Compression Strength & Results

Dimension of cube is 150x150x150 mm is casted and made the water curing. the compression test is made for 7 , 14 and 28 days respectively.

Table.5 Compression Strength Test

SI No.	MIX ID	Compressive strength (N/mm ²)		
		7 days	14 days	28 days
1	NSCC	18.34	24.72	37.45
2	BB1	17.75	21.12	34.32
3	BB2	14.71	18.89	28.14
4	BB3	11.32	15.56	25.61
5	BBSF1	16.89	22.30	35.68
6	BBSF2	16.76	20.24	30.14
7	BBSF3	13.25	17.37	27.45

Split tensile test

The dimension of cylinder is 150mm diameter and 300mm height.

Table.6 Split Tensile Strength

SI No.	MIX ID	Split tensile strength (N/mm ²)		
		7 day	14 day	28 day
1	NSCC	1.85	2.91	3.22
2	BB1	1.82	2.32	2.94
3	BB2	1.75	2.44	2.75
4	BB3	1.65	2.22	2.82
5	BBSF1	1.96	2.45	3.15
6	BBSF2	1.82	2.40	2.95
7	BBSF3	1.95	2.45	3.1

Flexural strength

Beam specimens of standard size 150mm x 150mm x 500 mm were molded. All beams are SS over an span of 400mm and tested in a frame load test machine of capacity 2000 kN.

Table.7 Flexural Strength Results

SI No.	MIX ID	Flexural strength (N/mm ²)		
		3 Days	7 Days	28 Days
1	NSCC	2.52	3.25	3.58
2	BB1	2.35	2.32	3.25
3	BB2	2.32	2.56	3.05
4	BB3	2.35	2.82	2.92
5	BBSF1	2.53	2.75	3.30
6	BBSF2	2.45	2.85	3.35
7	BBSF3	2.55	2.95	3.50

V. CONCLUSION

From the obtained results, following conclusions are drawn.

- From this experimental investigation it is kept to the Recycled Brick Aggregate (RBA) proportion as to an ideal minimum value.
- Compressive Strengths in the range of 32.68 N/mm² were obtained by adopting the above percentage of the RBA in SCC as in the case of SFBB1 specimen.
- Further, it was found that the SF addition, enhanced the compressive strength and flexural strength, but the split tension did not have significant improvement in strength.
- From this it can be concluded that SF has only minor decreasing effect on the flow parameters of SCC.
- The flexural behavior of SCC specimens without fiber shows that it is a typical brittle material. The post peak part of load-deflection curve for plain SCC mix shows that the sudden decrease of load.

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