Structural Performance of Self Compacting Fibre Reinforced Concrete

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Abstract: ***This study investigates the Structural Performance of Self Compacting Fibre Reinforced Concrete. Fibres are able to bridge cracks and to improve the ductility. Therefore, the addition of fibres might extend the possible fields of application of self compacting concrete, which has to satisfy minimum three characteristics such as passing ability, filling ability and segregation resistance. Superplasticiser is an essential component of Self compacting concrete to provide the necessary workability.In this study we have made self compacting concrete (SCC)and self compacting fibre reinforced concrete (SCFRC) satisfying above three characteristics with Super plasticisers Sulphonate Napthalene Formaldehyde. Filling ability was checked by using Slump flow and V-funnel tests. Passing ability was checked by using L-box and U-box tests. Segregation resistance was checked by using V-funnel after 5minutes.The mechanical properties of SCC were determined and the same were compared with SCFRC***

Keywords: Ductility, Fibres, Superplasticiser, SCC, SCFRC

1. Introduction

The concept of self compacting concrete was created and developed at the end of the eighties after the development of new organic additives. It has a high flowability and a modern viscosity, and no blocking may occur during flow. Several mix design methods for scc were prepared by many researchers [1, 2, 3].The term fiber reinforced concrete (FRC) can be defined as a concrete containing dispersed randomly oriented fibers. Inherently concrete is brittle under tensile loading and mechanical properties of concrete may be improved by randomly oriented discrete fibers which prevent or control initiation, propagation, (or) coalescence of cracks [4]. The character and performance of FRP changes, depending on the properties of fibers that are usually of interest are fiber concentration, fibers geometry, fiber orientation, and the fiber distribution moreover; using a single type of fiber many improve the properties of FRC to a limited level. However the concept of hybridization, adding two or more types of fiber into concrete, can offer more attractive engineering properties as the presence of one fiber enable the more efficient utilization of the potential properties of the other fiber [5, 6].

Use of fiber in to self compacting concrete mixes has been presented by many researchers [7, 8] Depending on many parameters such as maximum aggregate size, fiber volume etc. fiber inclusion to concrete. This study derives such a relationship based experimental data.

2. Experimental Investigation

2.1 Materials

Materials plays an important role is Self compacting concrete. The materials used for making self compacting concrete were Cement, Flyash, Fine aggregate (River sand&Crusher sand), Coarse aggregate, water, Super Plasticizer and steel fibres were used in SCFRC.

2.2 Mixture Proportions

For M30grade mix, the desired water powder ratio is taken from the IS: 10262-1982
Water-powder ratio = 0.45
225/0.45 = powder
Powder = 500 kg/m^3 , in powder 30% fly ash & 70%cement
Cement = 0.7x500 =350 kg/m^3, Fly ash = 0.3 x 500 =150 kg/m^3, Water absorption is taken as 2%

2.3 Specimen Details

For each mixture three cubes with the dimensions of 150mm x 150mm x 150mm were cast for the determination of compressive strength, three cylinders with the dimension of 150mm diameter & 300mm depth were cast for the determination of spilt tensile strength and three prisms with the dimension of 100mm x 100mm x 500mm were cast for the determination of flexural strength at 7, 14, 28 days.

Fibres were used in the SCC in various percentages (0.25%, 0.5% & 0.75%). For each percentage the cubes, cylinders and prisms were casted and the compressive strength, split tensile strength and flexural strength of SCC and various percentage of SCFRC were determined and compared with each other. The results were shown in tables.

2.4 Test methods for SCC

The Table 1 shows the test methods for checking workability of SCC

Table 1: Test Methods for workability of SCC

SI. No	*Method*	*Property*
1	Slump-flow	Filling ability
2	V-funnel	Filling ability
3	V-funnel at $T_{5minutes}$	Segregation resistance
4	L-box	Passing ability
5	U-box	Passing ability

3. Experimental Results

The result of an experimental investigation carried out on self compacting concrete based on supaflo special as an admixture. Five different proportion of trial mix were tested in laboratory. A concrete is said to be self compacting concrete means it has to satisfy the characteristics such as flowability, passing ability, segregation resistance these characteristics were tested in fresh state of concrete and the results were shown in Table2.

Table 2: Details of Workability

S. No	*Workability Test*	*SCC*	*SCFRC (0.25%)*	*SCFRC (0.50%)*	*SCFRC (0.75%)*
1	Slump flow in mm	697	650	624	560
2	V- funnel 0 min	8	10	16	20
3	V- funnel 5 min	10.6	14	19.2	23.4
4	U- box factor in mm	20	26	32	39
5	L- box factor	0.82	0.89	0.93	0.97

4. Compressive Strength

The Compressive strength of the above three grades were tested at 7, 14 and 28 days respectively and average of these results were given in the Table3. The comparisons between the compressive strength wereshown in fig.1.

Table 3: Average Compressive Strength

S. No	*Mix*	*Grade*	*Average compressive strength (N/mm2)*		
			7 Days	*14 Days*	*28 Days*
1	SCC	M_{30}	12.11	20.44	31.11
2	SCFRC (0.25%)	M_{30}	14.88	24.22	33.22
3	SCFRC (0.5%)	M_{30}	16.11	27.76	34.92
4	SCFRC (0.75%)	M_{30}	18.00	28.77	37.55

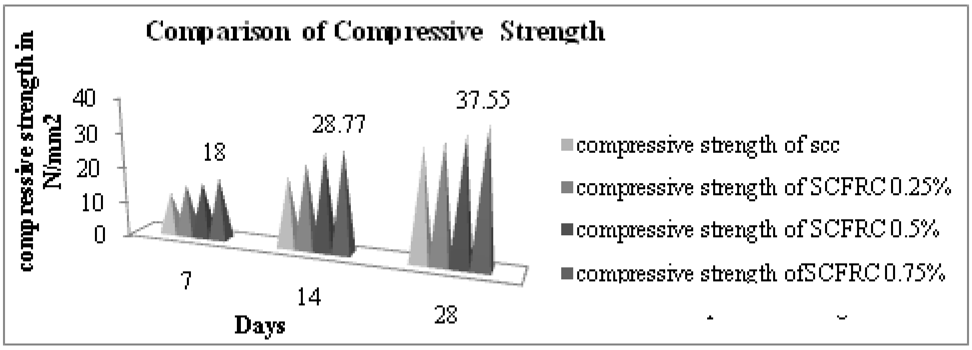

Figure 1: Comparison of Compressive Strength

5. Split Tensile Strength

The results of split tensile strength test were shown in Table 4 and the comparisons were shown in fig.2.

Table 4: Split Tensile Strength Results

S. No	*Mix*	*Gradeof Concrete*	*Average Split Tensile Strength (N/mm2)*		
			7 days	*14 days*	*28 days*
1	SCC	M30	1.9	2.1	3.5
2	SCFRC (0.25%)	M30	2.2	2.4	5.4
3	SCFRC (0.5%)	M30	2.29	3.9	6.6
4	SCFRC (0.75%)	M30	2.4	4.4	7.1

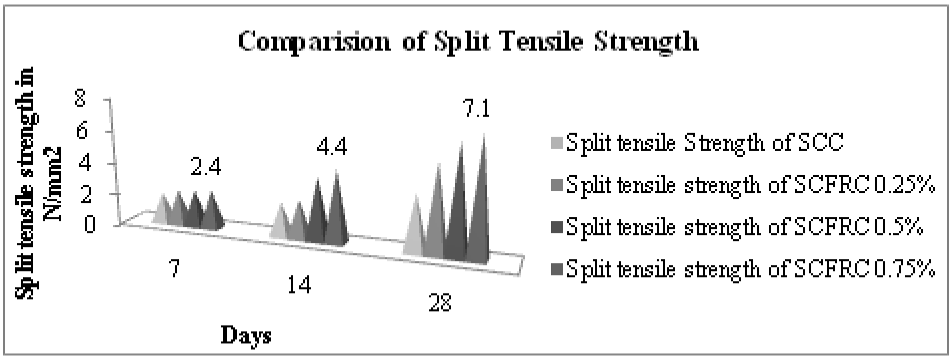

Figure 2: Split Tensile Strength Comparison

6. Flexural Strength

The results of flexural strength test were shown in Table 5 and the comparisons were shown in fig.3.

Table 5: Flexural Strength Results

S. No	Mix	Grade of Concrete	Average Flexural Strength (N/mm2)		
			7 days	14 days	28 days
1	SCC	M30	4.7	7.4	8.3
2	SCFRC (0.25%)	M30	5.0	8.1	10.15
3	SCFRC (0.5%)	M30	6.7	11.32	12.1
4	SCFRC (0.75%)	M30	9.6	13	15.25

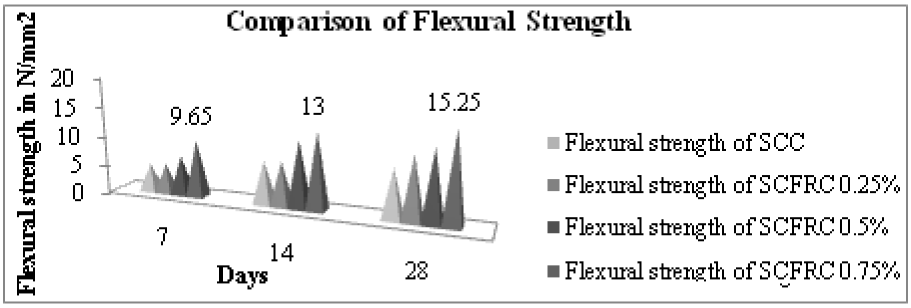

Figure 3: Flexural Strength Comparison

7. Results and Discussions

As can be seen from table-2, slump flow test result show that all mixes had enough deformability under their own weight; despite the fiber inclusion, and had a moderate viscosity which is necessary to avoid segregation. In addition to the fresh properties, some hardened properties of the self compacting fiber reinforced concrete are also determined. These include the compressive, tensile and flexural strength of concrete at various ages. As seen in fig.1. Compressive strength was observed as self compacting fiber reinforced concrete of 0.75% fibre content was increased in all ages. As for the tensile strength, which is determined by the split tension test, the split tensile strength seemed to be affected by the fibers from the fig.2 highest split tensile strength occurred in 0.75% SFRC, in which fibers were proportioned equally. As seen in fig.3 the increase in flexural strength was 83% when compared to the self compacting concrete.

8. Conclusion

Based on the investigations carried out, the following conclusions were drawn.

- The Self Compacting Concrete of M_{30} gradehas satisfied all the important characteristics of filling, passing ability and Segregation Resistance.
- Bleeding and segregation was caused due to over dosage of admixture, so many trials was conducted to achieve the satisfied mix.
- Replacing of Cement by flyash improved the stability of fresh concrete.
- By adding 0.25% of steel fibres, compressive strength has increased nearly by 6%, Split tensile strength has increased nearly by 54% and flexural strength has increased nearly 22%, when compared to ordinary self compacting concrete.
- By adding 0.50% of steel fibres, compressive strength has increased nearly by 12%, Split tensile strength has increased nearly by 88% and flexural strength has increased nearly 45%when compared to ordinary self compacting concrete.
- By adding 0.75% of steel fibres, compressive strength has increased nearly by 20%, flexural strength has increased nearly 83% and Split tensile strength has increased nearly by double the amount as compared to ordinary self compacting concrete.
- Increase in fibre content will increase the strength characteristics of SCC but it will reduce the filling, passing ability and segregation resistance characteristics.

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