

A Study on Strength Properties of Hybrid Fiber Reinforced Self Compacting Concrete

D.V. Naresh Kumar*

*Assistant Professor, Sai Tirumala NVR Engineering College,
Narasaraopet, Guntur, India.*

Abstract

It is proposed to study the strength properties of the Fiber reinforced self compacting concrete and hybrid fiber reinforced self compacting concrete in comparison with plain self compacting concrete. The steel fibers used in this study are crimped steel fibers and Hooked end steel fibers. The fibers are added at different proportions to get total fiber content of 2% by weight of cement. The compressive strength of hybrid fiber reinforced SCC mixes is decreased compared to single fiber reinforced SCC mixes.

Keywords: self compacting concrete, hybrid fibers, steel fibers, hooked end fibers and crimped fibers.

1. INTRODUCTION

Self compacting concrete is a concrete that is able to flow and fill every part of the corner of the formwork, even in the presence of dense reinforcement, purely by means of own weight and without the need of for any vibration or other type of compaction. The work of Self Compacting Concrete is like to that of conventional concrete, comprising, binder, fine aggregate and coarse aggregates, water, fines and admixtures.

1.1 Advantages of SCC

- Faster construction times.
- Better surface finishes
- Easier placing

- Improved durability and reliability of concrete structures.
- Improvement of health and safety is also achieved through elimination of handling of vibrators
- Ease of placement results in cost savings through reduced equipment and labour requirement.
- Lower overall costs.

1.2 Hybrid fiber reinforced self compacting concrete

Hybrid fiber reinforced self compacting concrete gives the advantages of all the fibers which are added in self compacting concrete .It improves the properties of single fiber reinforced self compacting concrete.As for Hybrid fiber reinforced self compacting concrete, it is a new kind of composite material produced adding different type, shape and dimensions of fibers in a self compacting concrete.

2. OBJECTIVE & METHODOLOGY

The main objective of this study is to study the strength properties of hybrid fiber reinforced self compacting concrete.

The strength properties includes

- Compressive strength.
- Split tensile strength.
- Flexural strength.

Strength properties are studied through

- Compressive strength of cube specimens of size 150mm x 150mm x 150mm.
- Split tensile strength of cylinder specimens of size 150 mm diameters x 300mm height.
- Flexural strength of beam specimens of size 150mm x 150mm x 700mm.

3. MATERIALS

3.1Cement

Ordinary Portland cement (OPC) of 53 grade cement manufactured by KCP Company was used in this study.

3.2 Fly ash

Fly ash obtained from Vijayawada thermal power plant (VTPS), Vijayawada, Andhra Pradesh, India was used in this study.

3.3 Fine aggregate

Natural river sand is used as fine aggregate.

3.4 Coarse aggregate

Coarse aggregate of size confining to 10-12mm is used in this study.

3.5 Steel fibers

Hooked end steel fibers of size 0.5mm diameter x 30mm length x (aspect ratio 60) and Crimped steel fibers of size 0.4mm diameter x 30 mm lengths (aspect ratio 50) are used.

3.6 Superplasticizer

Master Glenium sky 8650 is used as water reducing agent which is free of chloride &alkali.

3.7 Water

Ordinary potable water available in the laboratory was used.

4. TEST PROCEDURE

M30 grade Self compacting concrete was used in this study. Steel hooked end fibers and crimped fibers are added in different percentages to get fiber reinforced self compacting concrete and hybrid fiber reinforced self compacting concrete. The following tests were conducted to study the strength properties of fiber reinforced and hybrid fiber reinforced self compacting concrete.

4.1 Compression test

Concrete cubes of control mix, fiber reinforced self compacting concrete and hybrid fiber reinforced self compacting concrete were casted and cured for 28 days. Concrete cubes were tested for compressive strength in compression testing machine.



Figure1 compression test on cubes

4.2 Split tensile test

Concrete cylinders of control mix, fiber reinforced self compacting concrete and hybrid fiber reinforced self compacting concrete were casted and cured for 28 days. Concrete cylinders were tested for split tensile strength in universal testing machine.



Figure 2 split tensile test on cylinders

4.3 Flexural test

Concrete beams of control mix, fiber reinforced self compacting concrete and hybrid fiber reinforced self compacting concrete were casted and cured for 28 days. Beams were tested for flexural strength in universal testing machine under two point loading.



Figure3 flexural test on beams

5. TEST RESULTS

All the self compacting concrete mixes were brought to test after 28 days curing in water and their test results were tabulated below

Table1 Compressive Strength Split tensile strength and Flexural strength at 28 days

S.No	Mix designation	Compressive strength N/mm ²	Split Tensile Strength N/mm ²	Flexural Strength N/mm ²
1	SCC0	31.11	2.6	3.72
2	SFRSCC2C	44.44	2.7	4.06
3	SFRSCC3C	48	3.3	4.3
4	SFRSCC2H	46.22	3.27	4.28
5	HFRSCC (0.5C+1.5H)	40.44	2.34	4.3
6	HFRSCC (1.0C+1.0H)	34.66	2.967	4.76
7	HFRSCC (1.5C+0.5H)	46.22	2.76	4.0

SCC-Self Compacting Concrete

SCC 0-Self Compacting Concrete without fibers

SFRSCC2C-Single Fiber Reinforced Self Compacting Concrete with 2% of Crimped fibers

SFRSCC3C-Single Fiber Reinforced Self Compacting Concrete with 3% of Crimped fibers

SFRSCC2H-Single Fiber Reinforced Self Compacting Concrete with 2% of Hooked end fibers

HFRSCC (0.5C+1.5H)-Hybrid Fiber Reinforced SCC with 0.5% of Crimped fibers and

1.5% of Hooked end fibers

HFRSCC (1.0C+1.0H)-Hybrid Fiber Reinforced SCC with 1% of Crimped fibers and 1% of Hooked end fibers

HFRSCC (1.5C+0.5H)-Hybrid Fiber Reinforced SCC with 1.5% of Crimped fibers and

0.5% of Hooked end fibers

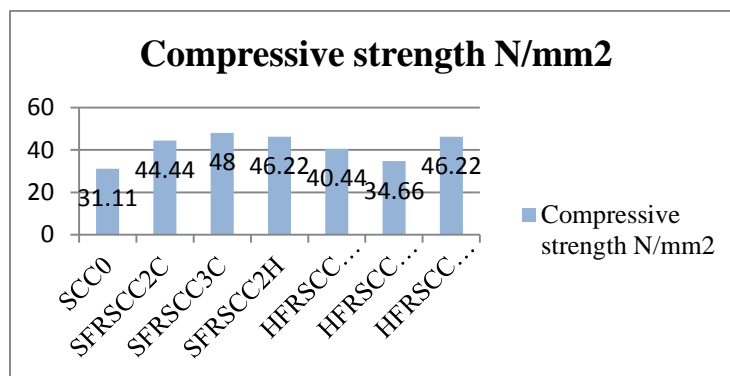


Chart 1 Compressive strength of SCC0, SFRSCC and HFRSCC mixes

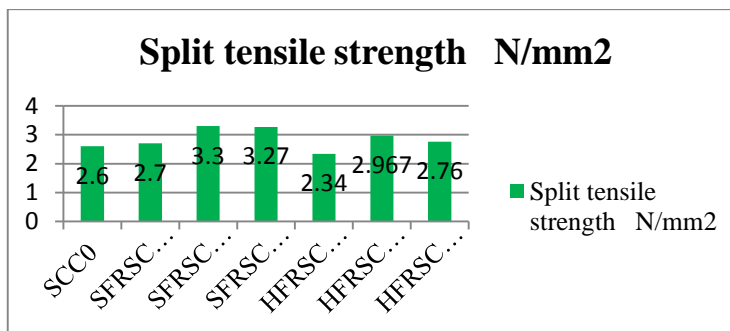


Chart 2 Split tensile strength of SCC, SFRSCC and HFRSCC mixes

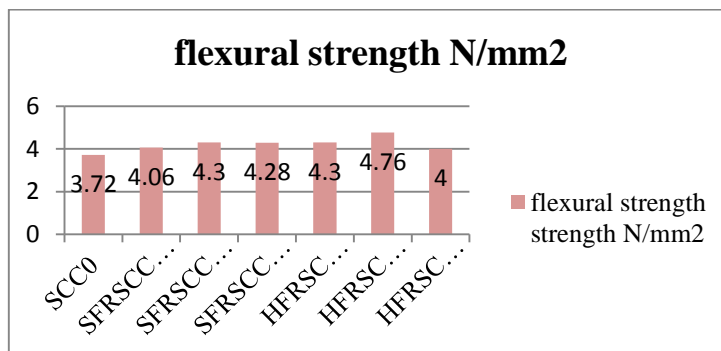


Chart 3 Flexural strength of SCC0, SFRSCC and HFRSCC mixes

6. CONCLUSIONS

- The compressive strength, split tensile strength and flexural strengths of all fiber reinforced self compacting concrete mixes giving better properties when compared to control mix.
- The compressive strength of hybrid fiber reinforced self compacting concrete mixes is decreased compared to single fiber reinforced self compacting concrete mixes
- Comparing hybrid fiber reinforced self compacting concrete mixes

The compressive strength of HFRSCC (0.5C+1.5H) or HFRSCC (1.5C+0.5H) is more than HFRSCC (1.0C+1.0H) but in case of split tensile strength and flexural strength which is reversed.

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