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AN EXPERIMENTAL INVESTIGATION ON THE STRENGTH CHARACTERISTICS OF HYBRID FIBER REINFORCED SELF COMPACTING CONCRETE

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ABSTRACT

The concrete is one of the most recognized society development materials in the construction industry. Today's challenge in the construction field is to improvise the strength and durability characteristics of concrete. Usually, the concrete is innovated by appropriating most popular supplements for the ingredients of concrete. In this study, the impact of metal (steel) and polypropylene fibers on the strength features of self-compacting concrete (SCC) has been analyzed. Self - Compacting Concrete may compact with the help of its own weight and is a viscous concrete mixture with no segregation. From the density and strength results of the experimental analysis, the mix and dose combination of superplasticizer and VMA to obtain better quality of Self Compacting concrete was selected.

Keywords: *SCC, hybrid, super plasticizer, M sand.*

INTRODUCTION

Concrete is one of the most broadly utilized building materials that is versatile. Its excellent strength and durability may be cast to suit almost any form of structural element. The concrete fill may stream each part of the formwork, even at the existence of reinforcement that is compact and with no necessity of using vibration (Abrams 1987, Bapat et al., 2004, Devi et al., 2002, EFNARC 2005, Lohani et al., 2012).

Fiber Reinforced Self Compacting Concrete integrates the qualities of Fibers as Well as SCC's privileges. Among the prominent probl-ems of employing the cementitious material is its susceptibility to cracking and so fibers are used as crack arresters (Abrams (987, Bapat et al., 2004, Devi et al., 2002, EFNARC 2005, Lohani et al., 2012).

The project started with the objective of achieving the following:

- ✓ To determine the optimum percentage combination of Hybrid fiber reinforced SCC.
- ✓ To compare the strength behavior of hybrid fiber reinforced SCC with conventional concrete specimens.
- ✓ To substitute river sand with M-sand in construction and safeguard the environment.

MATERIALS USED

Cement: Ordinary Portland cement of 53 with properties shown in table 1 was used.

Table 1: Properties of Cement

Property	Values	Unit
Grade of Cement	53	-
Specific Gravity	3.11	-
Setting Time	33 (Initial)	Minutes
	545 (Final)	

River Sand: Properties of Sand are shown in table 2.

Table 2: Properties of River Sand

Property	Values
Specific Gravity	2.47
Zone of Passing	Zone II

M-Sand: M-Sand passing through IS 4.75-millimeter sieve was utilized. In the literature analysis, it has been discovered that replacement of river sand by M-sand at 30% gives better results for SCC. Hence for assessing the exact fiber reinforced behavior of SCC consequently with M-sand, 30 percent of fine aggregate was substituted in this study work.

Table 3: Properties of M-Sand

Property	Values
Specific Gravity	2.42
Zone of Passing	Zone II

Coarse aggregates: Properties of Coarse aggregates are described in table 4.

Table 4: Properties of Coarse Aggregate

Property	Values
Specific Gravity	2.70
Aggregate size	20 mm

Fly ash: In this experimental program, fly ash (Viscosity modifying Agent) obtained from thermal power station was utilized and table 5 shows the chemical composition of the flyash used.

Table 5: Chemical Compositions of Flyash

Component	SiO_2	Al_2O_3	Fe_2O_3	MgO	SO_3	Na_2O	CaO	LOI
% Composition	57.3	27.13	8.06	2.13	1.06	0.73	0.03	1.60

Steel Fiber: Steel fibers having an aspect ratio in the range of 20-100, with properties as shown in Table 6 are used in this experimental program.

Table 6: Properties of Steel Fiber

Specification	Values
Length(mm)	35
Modulus of Elasticity (GPa)	200
Fibertype	Straight, corrugated, hooked

Polypropylene Fiber: Polypropylene Fibers, the most popular of the synthetics, are chemically inert and light in weight. The properties of the polypropylene fibers used in this work are recorded in table 7.

Table 7: Properties of Polypropylene Fiber

Specification	Values
Length(mm)	6
Melt point	165°C
Fibertype	Monofilament

Super Plasticizer: Polycarboxylic, ether-based superplasticizer named "Master Glenium SKY 8233", was used for this research work. Super plasticizer has been initially formed for purposes of developing high-performance concrete, where the highest performance and durability is required.

Mix Proportion: Table 8 and table 9 shows the specimen details and mix proportions of SCC.

Table 8: Specimen details

Specimen Name	Proportions (C,F.A,C.A)	Hybrid proportions (S:PP)
CC1	0%,0%,0%	0%,0%
CC2	0%,30%,0%	0%,0%
SP1A	0%,0%,0%	0.5%,1%
SP2A	0%,30%,%	0.5%,1%
SP1B	0%,0%,0%	1%,0.5%
SP2B	0%,30%,0%	1%,0.5%

Table 9: Mix proportions

Materials	By weight	By proportion
Cement	421	1
Fine aggregate (River Sand)	694	1.65
Coarse aggregate	1229	2.92
Water	189	0.45
Fly ash (VMA)	2.52	0.6%

EXPERIMENTAL INVESTIGATION

WORKABILITY: For the final acceptance of SCC various tests are conducted which are mentioned in table 10 and 11.

Table 10: Workability tests 1

Tests	CC1 Values	SP1A	SP1B
Slump flow	720mm	679mm	684mm
V – funnel test	8 sec	9 sec	9 sec
L- box test	0.9	0.95	0.9

Fig 1: Slump Flow test

Fig 2: V- Funnel test

Fig 3: L– box test

Table 11: Workability tests 1.1

Tests	CC2 Values	SP2A	SP2B
Slump flow	720mm	664mm	659mm
V – funnel test	8 sec	10 sec	11 sec
L- box test	0.9	0.9	0.95

Compressive strength: For compressive strength test, cube specimens of were cast for M40 grade of fiber reinforced SCC. These specimens were examined for compression strength as per the IS 516-1964 guidelines after completion of required curing period.

Table 12: Compression Strength Results

Mix Code	Compressive strength in Days of curing (N/mm^2)		
	3	14	28
CC1	16.3	36.9	43.6
CC2	15.3	34.7	41.8
SP1A	20.5	46.1	51.3
SP2A	19.3	44.7	48.7
SP1B	21.6	47.9	52.5
SP2B	20.2	45.3	50.4

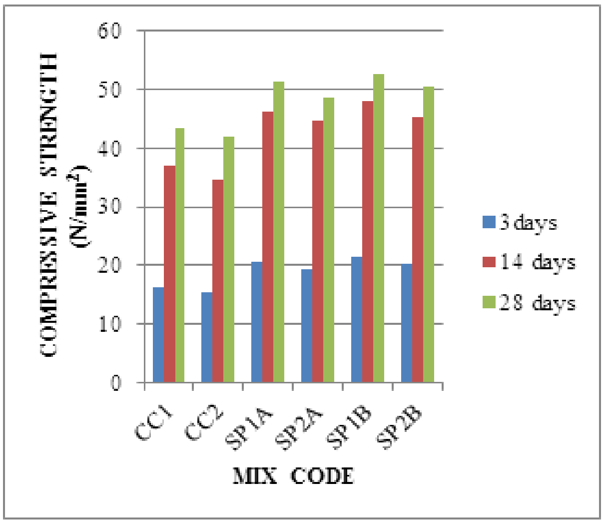

Fig 4: Compression strength Results

Split tensile strength: For tensile strength test, cylinder specimens were cast. These specimens were examined for split tensile strength after completion of required curing period.

Table 13: Split tensile strength results

Mix Code	Split Tensile strength in Days of curing (N/mm^2)		
	3	14	28
CC1	2.98	3.34	3.51
CC2	2.87	3.24	3.37
SP1A	3.1	3.42	3.67
SP2A	2.97	3.31	3.52
SP1B	3.19	3.52	3.71
SP2B	3.27	3.64	3.83

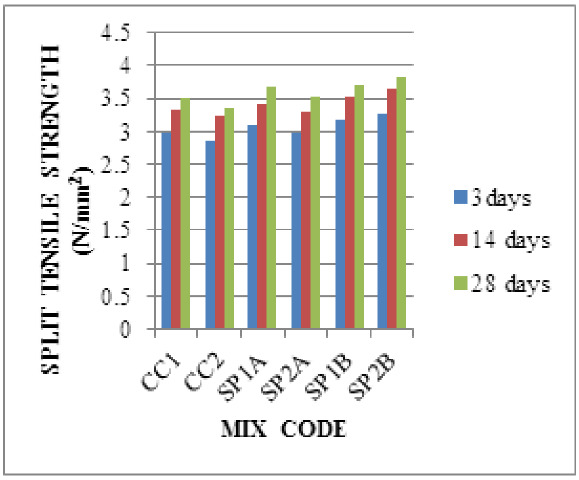

Fig 7: Split tensile strength results

Flexural strength: The flexural strength of concrete prism was determined after completion of required curing period.

Table 14: Flexural strength results

Mix Code	Flexural strength in Days of curing (N/mm^2)		
	3	14	28
CC1	2.87	3.17	3.43
CC2	2.74	3.08	3.28
SP1A	2.97	3.32	3.52
SP2A	2.87	3.11	3.35
SP1B	2.99	3.42	3.64
SP2B	2.89	3.19	3.73

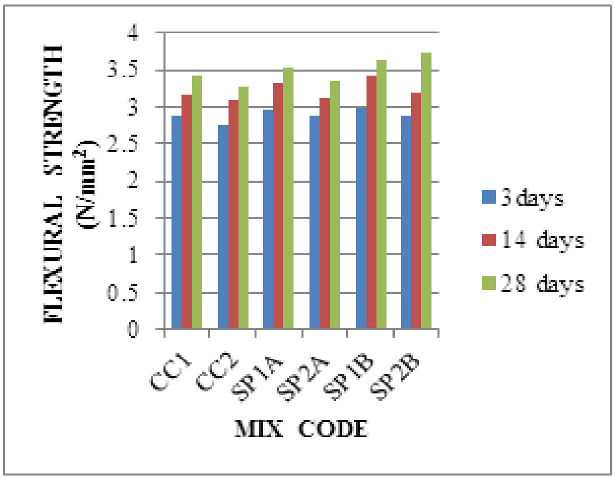

Fig 7: Flexural strength results

CONCLUSION

This study has explored experimentally the mechanical properties of a self-compacting concrete reinforced with steel any Polypropylene fibers respectively. The experimental results indicate that raising the volume fraction of steel fibers 1% and PP fibers 0.5% in fiber-reinforced SCC offers excellent strength. Among the various Fiber combinations used, 1% steel fiber and

0.5% Polypropylene fiber combination shows better result than the other fiber reinforced mix of SCC, with the enhanced strength.

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