Behavior Of Steel Fiber Reinforced Self Compacted Concrete of Short Column

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***Abstract* — This paper presents the results of an experimental investigation of In recent years fiber strengthened self-compacting concrete composite have found more and more wide applications in engineering. Self-compacting concrete is changed to perform in a very additional ductile type by the addition of every which way distributed separate fibers within the concrete matrix. Also, Fiber strengthened self-compacting Concrete is outlined as a stuff consisting of mixtures of cement, mortar or concrete together with discontinuous, discrete, uniformly spread fibers. Steel Fibers is outlined as tiny wire like reinforcements that square measure made from steel or polymers having high malleability. Self compacting concrete (SCC) mixes of variable strengths and performances were developed to satisfy the flow-ability, passing ability and segregation resistance criteria .Experimental investigation of behavior of tiny scale ferroconcrete short columns with steel fiber done.**

Keywords—SCC; Steel fiber; Compressive Strength; Short column; Load-Deformation behavior

I. INTRODUCTION

Concrete has some professionals and cons am passionate about it is nice at compressive strength, stiffness, low electrical and thermal conduction, low combustibility and toxicity however it's not enough smart in tension and bearableness and for sterilizing the deficiencies of concrete ,Steel Fiber bolstered Self Compacted Concrete (SFRSCC) square measure introduced. SFRSCC may be a reinforcing material that commonly contains cement, water, fine mixture, course mixture, super plasticizers and consistency modifying agent (VMA). a number of the opposite majorly used fibers despite of steel square measure glass, asbestos, plastic etc.

When the masses obligatory on the concrete approach that for failure, crack can propagate, typically chop-chop, fibers in concrete provides a method of impressive the crack growth. If the modulus of snap of fiber is high with relevancy the modulus of snap of concrete or mortar binder the fiber helps to hold the load, thereby increasing the lastingness of the fabric. Fibers increase the toughness, the flexural strength, and scale backs the creep strain and shrinkage of concrete.

Several European countries recognized the importance and potentials of SCC developed in Japan. Throughout 1989, they based European federation of natural trade associations representing producers and applicators of specialist building product (EFNARC). the employment of SCC started growing chop-chop. EFNARC, creating use of board sensible experiences of all members of European federation with SCC, has immersed specification and guide lines to produce a framework for style and use of top quality SCC, throughout 2002.

The main options of Self-Compacting Concrete (SCC) concern the recent state condition (high flowability that avoids external vibration and an honest segregation resistance); however within the last 20 years several researches are dispensed concerning the options of the hardened state of the SCC and therefore the structural effects attributable to its utilization. The behavior of structural components made-up victimization SCC, like walls beams, beam-column nodes and frames has been analyzed by suggests that of experimental tests and analytical studies.

The objective of the study is to spotlight the distinction in behavior of Steel fiber strengthened SCC in brief column and traditional moving Concrete (NVC) below the similar conditions. Numerous studies were dispensed by researchers and located that the performance of SFRSCC {higher|is best|is healthier} than NVC as a result of SFRSCC enable better crack management ability and at the most of the time crispiness is additionally over NVC.

Why SFRSCC?

1) To improve construction systems antecedently supported standard concrete that needed moving compaction.
2) To eliminate several undesirable property and to boost several fascinating property of the plain concrete.
3) To study the serving to behavior of fiber to transfer masses at the interior small cracks.
4) To improve the fatigue strength property in the slightest degree stress levels.
5) To arrest the first orthography of the duvet and increase the load taking capability furthermore because the malleability of the columns over that of comparable non fiber-reinforced specimens.

6) To study the structural behavior of steel fiber bolstered self compacting concrete column having sq. in cross section of size 150mm X 150mm X 600mm beneath axial loading.

II. LITERATURE REVIEWS

K.C Denesh administered experimental investigation to see completely different characters like workability and strength of Self-Compacting Concrete (SCC). Tests involving varied fiber proportions for a selected combine of SCC. check strategies wont to study the properties of contemporary concrete were slump check, U – tube, V – funnel and L – Box. The properties like compressive, tensile and flexural strength of SCC were conjointly investigated. check Results shows that the workability characteristics of SCC square measure at intervals the limiting constraints of SCC. The variation {of different of varied} parameters of hardened concrete (M30 & M40) with relation to various steel fiber contents were analyzed.

Vasudev R, Dr. B G Vishnuram observed the results were conducted to review the compressive & tensile behavior of composite concrete with varied proportion of such fibers more thereto. The concrete combine adopted were M20 and M30 with varied proportion of fibers starting from 0, 0.25, 0.5, 0.75 & 1%. On the analysis of check results the concrete with flip steel fibers had improved performance as compared to the concrete with typical steel fibers that were without delay on the market in market. These property enhancements or modifications can be simply adopted by the human in their regular constructions.

Efe Ewaen Ikponmwosa experimented within the analysis work that the result of short haphazardly orientating and discontinuous steel fibers on the structural behavior of laterized concrete columns. The density and cube strength of fiber bolstered laterized concrete will increase because the fiber content of the concrete is accumulated. 1.5% fiber content by volume is taken into account as optimum worth of fiber in laterized concrete. The plasticity of fiber bolstered laterized concrete will increase because the proportion of fiber content is accumulated and therefore the plasticity reaches its most at regarding a 1% fiber content.

Bhoopathi Vivek Reddy allotted experimental investigation on strength aspects like compressive, flexural and split enduringness of self-compacting concrete containing altogether completely different mineral admixtures and workability tests for numerous mineral admixtures (slump, L-box, V-funnel, U-box and T50) ar allotted. The methodology adopted is "Nan–Su" method of combine style as per "EFNARC" specifications (i.e., 55, 56, 57, 58 %) that satisfies the contemporary properties and in addition the hardened properties of SCC confine the water/powder quantitative relation is constant. The influence of mineral admixtures on the workability, compressive strength, and flexural strength of self-compacting concrete was investigated. the combination proportion is obtained as per the principles given by European Federation of producers and contractors of special product for structure. As a result, overall enhancements at intervals the flow ability, filling ability and segregation resistance of the self-compacting concrete were determined.

III. MIX DESIGN

We have used IS 10262 -2009 for M -30 grade of concrete with the 3 trials.

We used OPC 53 grade cement, regionally out there Sand We used OPC 53 grade cement, locally available Sand, Aggregates having a max size of 20 mm in that 40% of was passing through 20 mm IS sieve and retaining on 12.5 mm IS sieve and 60% was passing on 12.5 mm IS sieve and retained on 4.7 5mm sieve. Commercially out there super plasticiser CICO Plast Super C 300.

Fig 1: Super plasticizer

SPL BS 3000 Modifying Admixture (VMA) and Steel Fibers with hook end.

Fig 2: Steel Fibers

Table 1: Properties of Steel Fibers

Fiber Type	**Aspect Ratio**	**Length (mm)**	**Diameter (mm)**	**Tensile Strength N/mm^2**
HKL HT 80/60	80	60	0.75	1250 N/mm^2

Table 2: Properties of Steel Fibers

Mix Proportion	Cement kg/m^3	Fine Aggregate kg/m^3	Coarse Aggregate kg/m^3	W/C ratio
Trial-1	350	896	1140	0.40
Trial-2	388.88	849.24	1153.69	0.36
Trial-3	318.18	949.08	1114.13	0.44

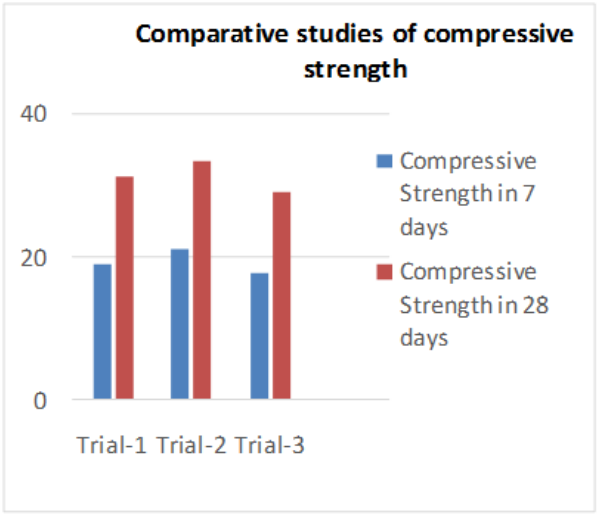

Fig.3: Comparative Study of Compressive Strength

From these three trials we conclude that the compressive strength for trial-2 is maximum as compared to other trials. So, I used trial-2 proportions.

IV. PREPARATION OF SFRSCC MIXES

Fibers are added in the proportions of 0.0% (reference mix), 0.5 %, 1% and 1.5 % with the volume for all mixes to cast various SFRSCC specimens.

The compressive strength test for the casted cubes of size 150 mm x 150 mm x 150 mm will be done following the requirements of IS: 516-1959. Three numbers of specimen will be tested at the desired ages for each and every mix and type. The testing of the specimens will be carried out on a hydraulic compression testing machine.

Table 3: Compressive Strength with different fiber content

Mix	Fiber Content (%)	Compressive Strength(MPa)	
		7 Days	28 Days
M-0	0	21.1	33.53
M-0.5	0.5	26.17	33.91
M1-1	1	27.16	35.40
M-1.5	1.5	26.43	34.22

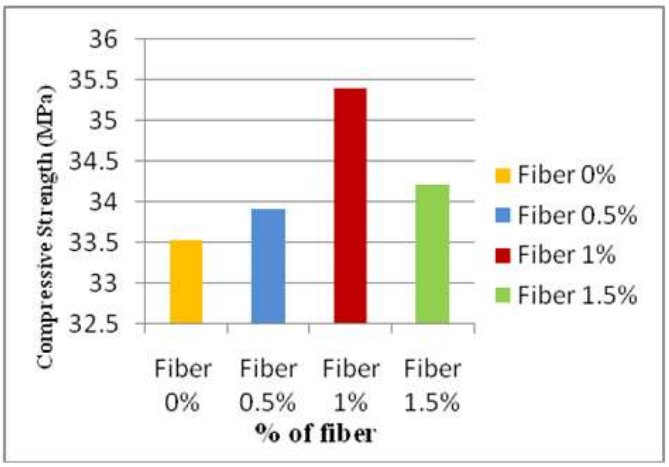

Fig.4: Comparative Study of Compressive Strength

V. TESTS ON FRESH PROPERTIES OF SFRSCC

We have performed the various test and got the result of those test as follows

A. Slump Flow Test

The slump flow take a look at is employed to assess the horizontal free flow of SCC within the absence of obstructions. On lifting the slump cone, crammed with concrete, the concrete flows. The typical diameter of the concrete circle may be a live for the filling ability of the concrete. The time T50 cm may be a secondary indication of flow. It measures the time taken in seconds from the moment the cone is raised to the moment once horizontal flow reaches diameter of 500 mm.

Fig.5: Slump Flow of SFRSCC

B. V- Funnel test

To assess the flowability and stability of freshly ready concrete, all the four mixes with totally different contents of steel fibers were take a look ated by V-funnel test. The flowability of the contemporary concrete are often take a look acted with the V-funnel test, whereby the flow time is measured.

The funnel is full of regarding 12 litters of concrete and also the time taken for it to flow through the equipment is measured. Further, T5 min is additionally measured with V-funnel that indicates the tendency for segregation, whereby the funnel are often refilled with concrete and left for 5 minutes to settle. If the concrete shows segregation, the flow time can increase considerably.

Fig.6: V- Funnel test of SFRSCC

C. *L- Box Test*

The L–Box check is employed to see the filling and spending ability of SCC. The interference quantitative relation (H2/H1) of assorted SCC mixes is shown in Figure 7. The interference quantitative relation ought to be between 0.8 and 1.0. Whereas assessing the contemporary concrete for passing ability, it's determined that each one the four mixes withstand the bars of L-box terribly simply and no blockage is seen in any of the mixes. The results of L-box check show that, though the interference quantitative relation (H2/H1) bit by bit decreases with the rise within the amount of fiber content, the quantitative relation (H2/H1) for all the mixes is on top of zero.8, that is as per EFNARC standards. Following graph shows the results of the check conducted on various mixes.

Fig.7: L- Box Test of SFRSCC

Table 4: Workability Results of SFRSCC

Sr. No	Fiber Content %	Slum Flow (mm)	T50 Slump Flow (sec)	V-Funnel (sec)	L-Box (H2/H1)
1	0	680	3	8	0.86
2	0.5	675	3	9	0.83
3	1	650	4	9	0.82
4	1.5	630	5	10	0.80

Table 5:Recommended values for different tests given by EFNARC for mix to be characterized as SCC mix.

Sr. No	Methods	Unit	Typical range of values	
			Minimum	Maximum
1	Slump flow test	Mm	650	800
2	T50cm slump flow	Sec	2	5
3	V-funnel test	Sec	6	12
4	L-Box test	H_2/H_1	0.8	1

VI. DESIGN OF COLUMN

Given l = 600 mm, b = 150 mm and D = 150 mm.
So, we have
l_{ex}/D= 600/150 = 4 < 12
l_{ey}/b= 600/150 = 4 < 12
Hence, it is a short column.

VII. LOAD- DEFORMATION BEHAVIOUR AND DUCTILITY

The load was applied gradually at the rate of 50 KN/min and the deformation readings were taken at regular intervals. The column was gradually loaded up to the ultimate load till failure. As the load level was increased in each interval, the observed displacement was greater than that it was in earlier interval. The ductility value has been calculated as the ratio of ultimate or maximum deformation to the yield deformation. Graph showing load deformation behavior is presented below.

Table 6: Ductility of columns

Type of Column	Ultimate load carrying capacity in KN	Ductility Factor
Plain SCC	539.5	2.24
SFRSCC with 0.5 % fiber	900	2.40
SFRSCC with 1 % fiber	976	2.84
SFRSCC with 1.5 % fiber	919	2.43

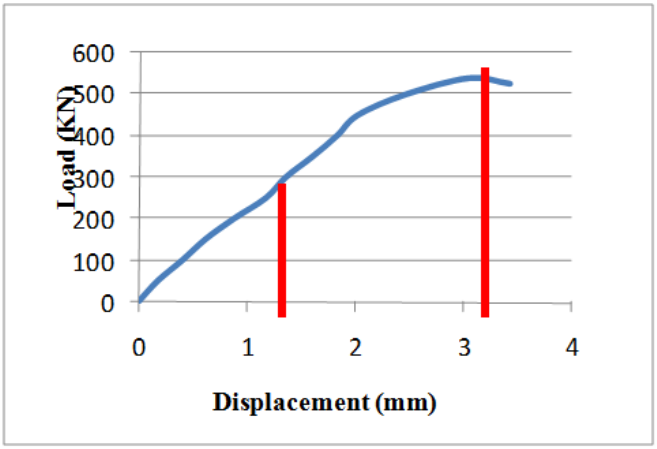

Fig 8: Average Load–deformation curve for Plain RCC column

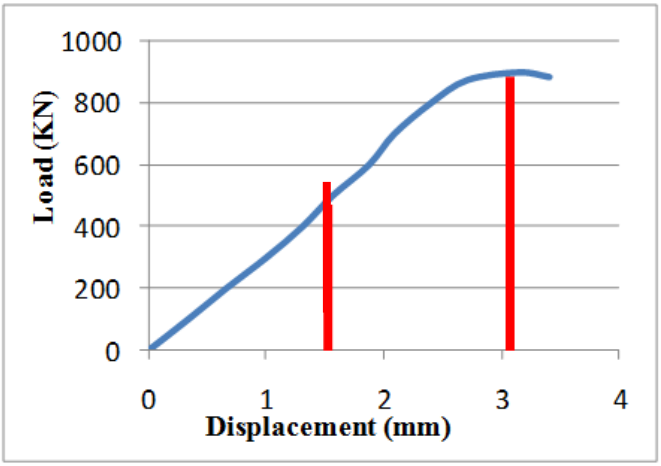

Fig 9: Avg. Load–deformation curve for SFRC column with 0.5% fibers

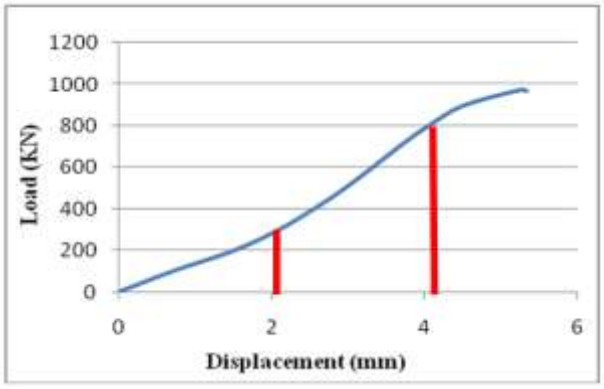

Fig 10: Avg. Load–deformation curve for SFRC column with 1% fibers

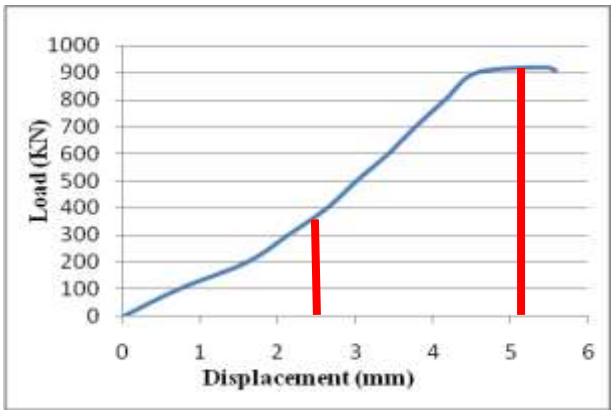

Fig 11: Avg. Load–deformation curve for SFRC column with 1.5 % fiber

VIII. CONCLUSION

The following conclusions are made of the on top of experimental study:

1.The workability results are found to be satisfactorily acceptable in line with EFNARC standards. SFRSCC with high workability and sensible slump retention are often obtained for a fiber content upto 1.0% for the fiber tested.
2. It's found to possess sensible consistency and workability for all the four mixes at a relentless w/c of 0.36 and constant super plasticizer dose of 2 % on weight of cement.
3. Comparison of workability take a look at results of various combos of combines with the reference mix shows that with increase within the fiber content within the mixes, the combination becomes dense and therefore less feasible.
4. It indicates that compressive strength in any respect ages will increase within the addition of steel fibers up to 1.0%.
5. The addition of 0.5% to 1.0% steel fiber to M-30 Grade of concrete has inflated the load carrying capability of the SFRSCC columns by 8.44 % at 28 days of maturity
6. The SFRSCC column having 1 % steel fibers showed stiff slope graph therefore it carried higher load with marginal axial deformation as compared to SFRC column with 0.5% steel fibers.
7. Generally it's found that SFRC column has higher values of malleability as compared to plain RCC column. SFRC column could also be required for earthquake resisting structures.

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