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STUDY ON SELF COMPACTING CONCRETE USING STEEL FIBER

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Abstract : Self-compacting concrete (SCC), which flows under its own weight without being compacted or vibrating, requires no outside mechanical force to move. But like normal concrete, SCC has a brittle character (weak in tension) that causes sudden collapse with no advance notification. The compressive strength of SCC has increased owing to the addition of steel fiber (SF). Various research concentrates on increasing the flexural strength (FS) of SCC by incorporating SF. To collect information on past research, present research developments, and future research directions on SF-reinforced SCC, however, a detailed review of the study is necessary. The main aspects of this project are the general introduction of SCC, fresh properties namely slump flow, slump test and strength properties such as compressive and flexure strength. Furthermore, failure modes of steel fiber-reinforced SCC are also reviewed. Results suggest that the SF decreased the filling and passing ability. Furthermore, improvement in strength properties was also observed. However, some studies reported that SF had effect or even increased compressive capacity. Additionally, SF improved the flexural strength capacity of SCC and avoid undesirable brittle failure. Finally, this project recommends the substitution of SF-reinforced SCC to improve its compressive capacity.

Index Terms **- M-sand, M30 Grade Concrete, superplsticizer and Hooked Steel Fiber.**

I. INTRODUCTION

Normal Cement Concrete: -
Is a very strong and versatile moldable construction material. It consists of cement, sand and aggregate (e.g., gravel or crushed rock) mixed with water. The cement and water form a paste or gel which coats the sand and aggregate. When the cement has chemically reacted with the water (hydrated), it hardens and binds the whole mix together. The initial hardening reaction usually occurs within a few hours. It takes some weeks for concrete to reach full hardness and strength. Concrete can continue to harden and gain strength over many years. It requires proper compaction for removal of voids & make it durable.

Self-Compacting Concrete: -
Was first developed in Japan in the year 1980. Prof. H. Okamura of University of Tokyo, Japan. is mainly responsible for initiating and initial development of this concrete and is now regarded as the Father of SCC. Self-Compacting Concrete can be defined as a high-performance material which flows under its own weight without requiring vibrators to achieve consolidation by complete filling of formworks even when access is hindered by narrow gaps between reinforcement bars. SCC can also be used in situations where it is difficult or impossible to use mechanical compaction for fresh concrete, such as underwater concreting, cast in-situ, pile foundations, machine bases and columns or walls with congested reinforcement. The high flow ability of SCC makes it possible to fill the formwork without vibration. The method for achieving self-compatibility involves not only high deformability of paste or mortar, but also resistance to segregation between coarse aggregate and mortar. Homogeneity of SCC is its ability to remain unsegregated during transport and placing.

Super plasticizer: - Is also used in concrete mix to avoid segregations and increase concrete workability Self- compacting concrete has been depicted “the most progressive improvement in concrete development for a very long while”. Initially created in Japan to balance a developing deficiency of talented work, it has proved to be beneficial from the following points. Speedier development, Reduction in site labour, better surface, Easier putting, Improved durability, Greater flexibility in outline, Thinner concrete sections, reduced noise level, Safer working environment.

Fiber-reinforced self-compacting concrete: -
(FRSCC) is a specialized type of concrete that combines the advantages of self- compacting concrete (SCC) with the enhanced mechanical properties provided by the addition of fibers. SCC is a highly flowable and cohesive concrete mix that can fill

complex forms and flow around reinforcement without the need for mechanical vibration. The addition of fibers further improves the concrete's properties, such as tensile strength, toughness, and resistance to cracking.

II. Experimental Investigation

2.1 The objectives are:

- To develop mix proportion for M30 grade using hooked steel fiber having M- sand
- To know the strength on mechanical properties of hooked steel fiber concrete such as compressive strength flexural strength
- To compare mechanical properties of hooked steel fiber to conventional concrete

2.2 Materials: The materials used in this experiment were cement, M-sand, coarse aggregate, hooked steel fiber, super plasticizer & water.

2.2.1 Cement: OPC 53 grade cement conforming to IS 012269--1987, from single batch was used overall of project work.

Fig.2.1 Cement

Sr. No.	Properties of cement	Result
1	Specific gravity	2.9
2	Fineness	1.33%
3	Standardconsistency(%)	28%
4	Initialsettingtime(min.)	62 min.
5	Finalsettingtime(min.)	470 min.
6	Soundness	1 mm
7	CompressiveStrength 28 day	45N/mm^2

Table. 2.1 Properties of cement

2.2.2 Coarse aggregate: Crushed blast stones of size 020mm down conforming to IS 0383--1970, were used. The material whose particles are retained I.S. Sieve No. 480 (4.75mm) is termed as Coarse aggregates.

Fig.2.2 Coarse aggregate

Sr. No.	Properties of Coarse aggregate	Result
1	Specific gravity	3
2	Fineness	7.09
3	Moisturecontent	0%
4	Waterabsorption	1.5
5	Density	1250k g/m^3

Table. 2.2 Properties of Coarse aggregate

2.2.3 Fine aggregate: Locally available river sand belonging to zone 2 of IS 383-1970 was used project work.

Fig.2.2 M-Sand

Sr.No.	Properties of M-sand	Result
1	Specific gravity	2.8
2	Fineness	3.5
3	Moisturecontent	0
4	Waterabsorption	3%
5	Density	1750kg/m^3
6	Fines<0.125mm	10%

Table. 2.2 Properties of M-sand

2.2.4 Ultra super plasticizer: For the present work we used CICO PLAST SUPER-C711 is a high range water reducing admixture based on specially designed poly carboxylate ether. It is a light amber colored liquid and gets dispersed immediately in concrete mix together with water. It's partially improves the water-proofing properties. It conforms to IS: 9103-1999and ASTMC-494Type G.

Fig.2.2 Cico Plast Super-C711

Sr.no.	Properties of admixtures	Results
1	Appearance	Lowviscousliquid
2	Colour	lightbrown/paleyellowish
3	Specific gravity	1.1
4	Chloridecontent	Nilas perBS 5075Part-1
5	PHvalue	>6as perIS9103-1999 amendmentno.2, August,2007
6	Shelf	12months
7	Compatibility	Compatiblewith alltypes ofOPC, PPC

Table. 2.2 Properties of M-sand

2.2.5 Steel Fiber: A hooked steel fiber is a type of reinforcement material used in concrete construction. It is a small, discrete filament made of high-strength steel with a hooked end. These fibers are typically added to concrete mixes to enhance its mechanical properties and improve its performance in various applications.

2.3 Mix Design: The mix design is done according to the IS 10262-2009 design method in this project work is carried on M30 grade of concrete. it is used to produce SSC with addition of 1% crimped steel fibers by total weight of material. Then concrete cubes and beams are prepared and have been tested for 28 days to find out the compressive strength and flexural strength of concrete.

The mix proportion for SSC using Hooked steel fiber

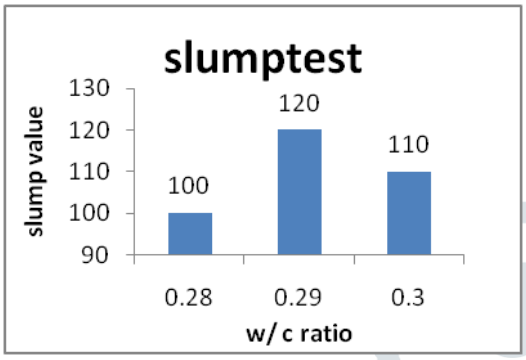
Ingredients	Cement	M-sand	Coarse aggregate	Water	admixture	Fiber2%
kg/m3	423	1270	604	190	2.96	8.46
Ratio	1	3	1.43	0.45	0.007	0.02

III. RESULTS AND DISCUSSION

3.1 Workability of Concrete Test:

(A.) Slump Test Results:

Slump test was conducted on conventional concrete. The slump value obtained is 120mm and the mix belongs to medium workable concrete. The variation of result shown in table5.1 & graph 5.1



Sl.no	w/c ratio	Slump value mm
1	0.28	100
2	0.29	120
3	0.3	110

3.2 Hardened concrete Test:

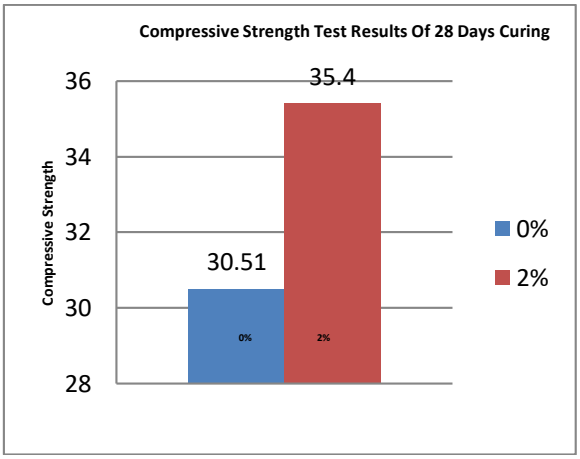
3.2.1 Compressive Strength Test :

The results of the compressive strength test for M30 grade concrete specimens with M-sand in addition of 2% steel fibres by total weight of material as follows:

At 28 Days Curing Period:

Table 3.2 Compressive Strength Test Results Of 28 Days Curing

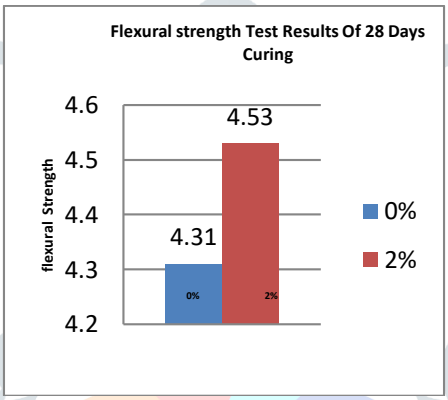
Sl.No.	**% Fiber**	**Compressive Strength (N/mm²)**			**Mean Compressive strength(N/mm²)**	**Minimum Requirement (N/mm²)**
1.	**0%**	**30.58**	**32.62**	**28.33**	**30.51**	**31.6**
2.	**2%**	**33.77**	**35.11**	**37.33**	**35.40**	**31.6**



3.2.2 Flexural Strength Test:
The results of flexural strength test for M30 grade concrete specimens with M-sand in addition of 2% steel fibres by total weight of material as follows:
At 28 Days Curing Period:

Table 3.3 Flexural Strength Test Results Of 28 Days Curing

Sl.No.	% WFS Replacement	Flexural Strength (N/mm²)			Mean Flexural strength(N/mm²)	Minimum Requirement (N/mm²) $0.7\sqrt{fck}$
1.	0%	4.31	4.7	3.92	4.31	3.5
2.	2%	4.39	4.7	4.31	4.53	3.5



Conclusion: -

This procedure with the given mix proportions has led to a Fiber reinforced self- compacting concrete (FRSCC) mix that was able to flow and fill the molds without any need of vibration. The following conclusions were obtained from this study.

- To establish this mix design in concrete, we did slump cone test gives a positive result.
- The 28days compressive strength of self- compacting concrete with hooked steel fiber is maximum at the fiber content 2% compare to conventional concrete.
- The 28days flexural strength of self- compacting concrete with hooked steel fiber is maximum at the fiber content 2% compare to conventional concrete.
- Hooked steel fibers at 2% addition to SCC were found to be the most efficient mix.

Reference: -

1. Ali R. Khaloo1 et al (2005) Flexural Behavior of small steel fibre reinforced concrete slabs, Research Gate Publication January 2005.
2. Abbas AL-Ameeri (2013) The effect of steel fiber on some mechanical properties of self- compacting concrete. American journal of civil engineering.
3. Abbas Shukla (2015). A Comparative Study of The Performance Of Self- compacting Concrete Using Glass Fibers. International journal of mechanical and production engineering, ISSN:2320-2092, Volume -5, Issue -10.
4. A Vennila (2016). Study on mechanical properties of self-compacting concrete with mineral admixture and glass fiber. Journal of advances in civil engineering, Vol. 2(1).
5. Abhishek Sachdeva and Pankaj Singla (2016) "Strength Evaluation of Steel Fiber Reinforced – Self-Compacting Concrete", International journal of Engineering Research & Technology, ISSN:
6. Ravi Shankar Yadav, Juned Ahmad (2017) "Study of workability and durability characteristics of Self

Compacting Concrete (SCC) with Viscosity Modifying Admixture (VMA), and containing fly ash."

7. M.S. Shetty, Concrete Technology theory and practice S Chand publication, 2013 New Delhi.

IS code:

1. IS 456:2000: Code of practice -plain reinforced concrete, BIS, New Delhi -2000
2. IS:10262-2019 "Concrete Mix proportioning Guidelines "BIS New Delhi -2009
3. IS 516-1959 "Methods of tests for strength of concrete.
4. IS 3466:1988 Specification of cement
5. IS 2386:1963, Methods of Test for Aggregates for Concrete, Bureau of Indian standards,New Delhi, India.
6. IS 383: 1970. Specification for Coarse and Fine Aggregates from Natural Sources forConcrete, Second Revision, Bureau of Indian Standards, New Delhi, India. M. Adams Joe,

A. Maria Rajesh, P. Brightson, M. Prem Anand; "Experimental Investigation on The EffectOf M-Sand In High Performance Concrete", Vol.2,201