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Experimental Study on Fiber Reinforced Self Compacting Concrete

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Abstract— Self-compacting concrete (SCC) represents one of the most outstanding advances in concrete technology during the last decade. At first developed in Japan in the late 1980s, SCC meanwhile is spread all over the world with a steadily increasing number of applications. Due to its specific properties, SCC may contribute to a significant improvement of the quality of concrete structures and open up new fields for the application of concrete. Self Compacting Concrete gets dense and compacted due to its own self-weight. An experimental investigation has been carried out to determine different characters like workability and strength of Self-Compacting Concrete (SCC). Tests involving various fiber proportions for a particular mix of SCC. Test methods used to study the properties of fresh concrete were slump test, U – tube, V – funnel and L – Box. The properties like compressive, tensile and flexural strength of SCC were also investigated. Test Results shows that the workability characteristics of SCC are within the limiting constraints of SCC. The variation of different parameters of hardened concrete (M30 & M40) with respect to various steel fiber contents were analyzed.

Keywords—Self compacting concrete,steel fiber,super plasticizicer,viscocity modifying agent,mechanical properties

I.INTRODUCTION

Self-compacting concrete (SCC) represents one of the most outstanding advances in concrete technology during the last decade. SCC describes a concrete with the ability to compact itself only by means of its own weight without the requirement of vibration. It fills all recesses, reinforcement spaces and voids, even in highly reinforced concrete members and flows free of segregation nearly to level balance.

The use of SCC offers many benefits to the construction practice: the elimination of the compaction work results in reduced costs of placement, a shortening of the construction time and therefore in an improved productivity. The application of SCC also leads to a reduction of noise during casting, better working conditions and the possibility of expanding the placing times in inner city areas. Other advantages of SCC are an improved homogeneity of the concrete production and the excellent surface quality without blowholes or other surface defects. However, when SCC is sensibly utilized, the reduction of costs caused by better productivity, shorter construction time and improved working conditionsSelf Compacting Concrete is a flowable concrete mixture that is able to consolidate under its own weight. It does not require any external vibration for compaction. The highly fluid nature of SCC makes it suitable for placing in difficult conditions and in sections with congested reinforcement .Self Compacting Concrete generally possesses a high powder content which keeps the concrete cohesive with a high flowability.

- Faster progress, as more amount of concrete free fall is possible
- Better surface finishes because of more fines and better fluidity
- Better molding ability, there by easy to shape the concrete for aesthetics

II.CHARACTERSTIC OF FRESH SCC

SCC mixes must meet three key properties:

1. Ability to flow into and completely fill intricate and complex forms under its own weight
2. Ability to pass through and bond to congested reinforcement under its own weight.
3. High resistance to aggregate segregation.

The main characteristics of SCC are
i) Passing ability ii) Filling ability iii) Resistance to Segregation

Passing Ability

- The ability of SCC to flow through tight openings such as spaces between steel reinforcing bars without segregation or blocking.
- The flow ability of the mix is tested by the slump flow, T_{50} slump flow, V funnel.

Filling ability

- This property of fresh concrete is related entirely to the mobility of the concrete
- The ability of SCC to flow into and fill completely all spaces within the formwork, under its own weight.

Resistance to Segregation

- The mix has to maintain its stability under high flow conditions i.e. it should not segregate and should remain homogenous in composition during transport and homogeneity.
- The normal concrete mix when it shows signs of segregation, a percentage of coarse aggregate is replaced by fine aggregate.
- In this study the stability of the SCC is maintained by using cementitious fines, fly ash in place of coarse aggregate.

III.MECHANISM FOR ACHIEVING SCC

- Limited aggregate content.
- Low water-powder ratio
- Use of super plasticizer

Materials Used:

The different materials used in this investigation are

- Cement
- Fine aggregate
- Coarse aggregate
- Fly ash
- Super plasticizer
- Viscosity modifying agent (VMA)
- Water
- Steel fiber

Admixtures

- Conplast SP 430 and Glenium Stream 2 are confirming to the requirement of IS: 9103-1979 as a high range water reducing admixture and viscosity modifying agent was used in this study.

Steel Fibers

- The steel fibers used in the project 60 mm in length and 0.75 mm in thickness. The aspect ratio of steel fiber is 80

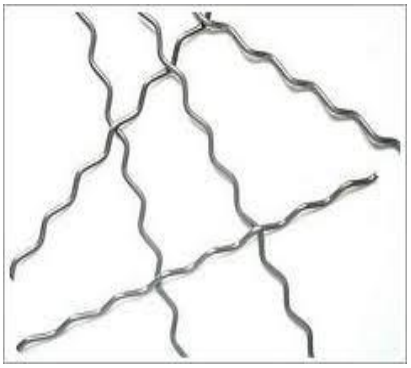

Fig.1Steel fiber

IV. TEST ON FRESH CONCRETE

TEST METHODS OF FRESH SCC

1. Slump flow & T_{50} test,
2. V- funnel test & V-funnel at T5 minutes
3. L- box test
4. U-box test

Table 1 - Acceptance criteria for SCC

Test Methods	Unit	Min.	Max.
Slump flow	mm	600	800
T_{50} cm Slump flow	Sec	2	5
V – funnel test	Sec	6	12
V – funnel testat T_5 min	Sec	0	+3
U – box test	mm	0	30
L – box test	h_2/h_1	0.8	1.0

V.TEST ON HARDENED CONCRETE

Tests on Hardened Concrete

Testing of hardened concrete plays an important role in controlling and confirming the quality of concrete work. Systematic testing of raw materials, fresh concrete and hardened concrete are inseparable part of any quality control programme for concrete, which helps to achieve higher efficiency of the material used and greater assurance of the performance of the concrete with regard to both strength and durability.

The hardened property test such as compression test by using compression testing machine, split tensile test by using compression testing machine and flexural test by using ultimate testing machine are conducted. The results obtained for the various mixes of SCC, SCC with 0.25%, 0.5%, 0.75%, and 1% Steel Fiber are below

Fig.2 casting of specimens

Table 1 M30 Mix –various percentage of steel fiber

Test Methods	SCC – Conventional	SCC with 0.25% steel Fiber	SCC with 0.5% steel Fiber	SCC with 0.75% steel Fiber	SCC with 1.0% steel Fiber
Slump flow mm	775	750	720	710	700
T_{50} cm Slump flow Sec	5	5	4	4	3
V – funnel test Sec	6	8	7	8	9
V – funnel test at T_5 min Sec	10	13	12	14	12
U – box test mm	20	20	30	20	30

Table 2 M40 Mix –various percentage of steel fiber

Test Methods	SCC – Conventional	SCC with 0.25% steel Fiber	SCC with 0.5% steel Fiber	SCC with 0.75% steel Fiber	SCC with 1.0% steel Fiber
Slump flow mm	735	690	682	665	630
T_{50} cm Slump flow Sec	5	4	4	3	3
V – funnel test Sec	6	9	7	9	10
V – funnel test at T_5 min Sec	10	12	13	12	12
U – box test mm	20	20	10	10	10

Hardened Properties

The hardened property test such as compression test, split tensile test and flexural test were conducted

Fig.3 compression test on cube

Table 3Comparision of compressive strength M30& M40 grade of concrete at 28 days strength

% of fiber added	Compressive Strength of cubes at 28^{th} days(N/mm^2) M30	Compressive Strength of cubes at 28^{th}days(N/mm^2) M40
0%	29.8	43.3
0.25%	33.3	47.6
0.50%	37.6	49.6
0.75%	40.3	53.3
1.0%	43.6	58.6

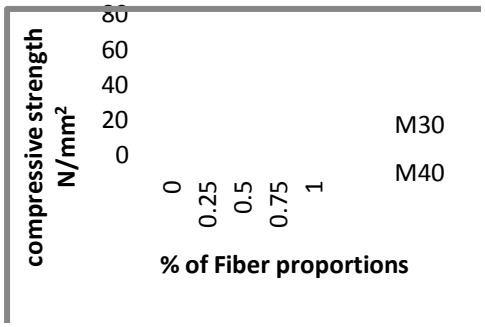

Fig.4 Compressive strength of SCC at 28 Days Strength for M30 & M40 grade of concrete

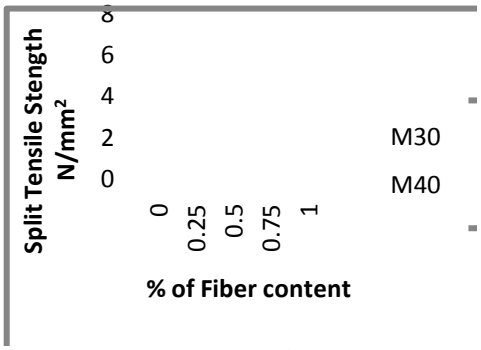

Fig.5 Split tensile strength of SCC at 28 Days Strength for M30 & M40 grade of concrete

Fig.6 Spliti tensile test on cylinder

Fig.7 Shows Failure of fiber reinforced SCC

Fig.8 Flexural test on Beam

V.CONCLUSION

The following conclusions have been made from the above experimental study:

- From the test results of hardened concrete, it is been found that the all the mixes achieved the designed characteristic strength of M40 grade.
- Use of fly ash improve the setting characteristics of the SCC mix ,but do not achieve the required flow properties of SCC. A VMA is required to achieve the flow.
- The compressive strength was conducted for all the different ratio of fibre mixes, it was found from the results that mix 5 (1% of fibers added) gives better strength.
- The compressive strength of steel fiber has been increased up to 13.3%, 14.3%, 12%, 13%, 15% compared with M30 grade SCC.
- The flexural strength of concrete has been increased with the addition of steel fiber in self compacting concrete.

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