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An Experimental Investigation on Elastic Properties of Triple Blended Fibrous Self Compacting Concrete

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ABSTRACT: *Self-compacting concrete (SCC) was developed in the context of skilled labour shortage in Japan. The concrete flows into moulds and forms on its own and consolidates without need for compaction .It commonly calls for a remarkable plasticizer to ensure fluidity and float for a sufficient length of time with out experiencing a huge slump loss. Viscosity enhancing sellers are also delivered to make certain a solid and fully cohesive mixture even after subjecting to vagaries at production websites like various moisture contents of aggregates, unintentional addition of excess water, ambient temperature, humidity versions and other elements.*

SCC is generally defined as the "concrete that doesn't want compaction". It way SCC gets compacted without outside efforts like vibration, floating, or poking. The mix therefore is needed to have the ability of flowing, filling voids and being strong. Due to these characteristics, SCC is ideally suited for concrete structures, that have closely congested reinforcement or hard get entry to situations.

The use of SCC in real creation is still in its infancy in India. Lack of awareness of generation, understand how, technical facts and experience will be noted as the main motives. For the adoption of any new material or generation, it typically desires tested overall performance document over traditional materials. Considerable research is carried out in India, in the direction of the era development in order that SCC should soon locate an area inside the Indian creation enterprise.

In the present project work, fibrous self compacting concrete is being produced by using steel fibres. The percentage of steel fibres is kept low between 0.1 to 0.4% of the volume of concrete. Aspect ratios (l/d ratio) are varied from 10,15,20&25. The percentages as well as aspect ratios of steel fibres are kept low so as not to interfere with the flow of SCC. A basic concrete mix of M40 is selected. Workability studies using L-box, U-box, V-funnel and slump are being conducted on various SCC mixes to satisfy EFFNARC guidelines.

Standard cube and cylinder specimens will be cast for various fibrous self compacting concrete mixes after satisfying the workability requirements. Tests will be conducted at the age of 28 days for compressive strength and elastic properties. Elastic properties include Young's modulus and Poisson's ratio. The variation of compressive strength for various fibre percentages and aspect ratios will be studied. Improvement in the elastic properties with the addition of fibres will be studied. They are correlated with the compressive strength.

Based on the experimental results obtained in the present project work conclusions will be drawn on the improvement of strength properties of SCC by employing fibres.

I.INTRODUCTION

Development of SCC is a desirable achievement in the construction industry in order to overcome problems associated with cast-in place concrete. SCC is an innovative concrete which does not require vibration for placing and compaction. It is able to flow under its own weight completely filling form work and achieving full compaction even in the presence of congested reinforcement. The hardened concrete is dense, homogeneous and has the same engineering properties and durability as traditional vibrated concrete.

It flows like "honey" and has a very smooth surface level after placing. With regard to its composition, self- compacting concrete consists of the same components as conventionally vibraj/ted concrete, which are cement, aggregates, and water, with the addition of chemical and mineral admixtures in different proportions. Usually, the chemical admixtures used are high-range water reducers (super plasticizers) and viscosity-modifying agents, which change the rheological properties of concrete. Mineral admixtures are used as an extra fine material, besides cement, and in some cases, they replace cement. In this study, the cement content was partially replaced with mineral admixture, e.g. fly ash and silica fume, admixture that improve the flowing and strengthening characteristics of the concrete.

II.Benefits and Advantages of SCC

Modern, present day SCC can be classified as an advanced construction material. The SCC as the name suggests, does not require to be vibrated to achieve full compaction. This offers many benefits and advantages over conventional concrete.

- Reduction in site manpower
- Better surface finishes
- Easier placing
- Improved quality, reliability and durability.
- Greater freedom in design
- Thinner concrete sections
- Low noise-level in the plants and construction sites
- Safer worker environment
- Elimination of problems associated with vibration
- Reduced labour involvement
- Higher strength
- Lower overall costs
- Better surface finishes

III.Objective of the Present Study

The main objective of the present project work is to study the properties of Triple Blended Fibrous Self-Compacting Concrete for development of concrete. The study includes the following details.

The present study deals with fibrous self-compacting concrete with triple blending. This triple blending includes the replacement of 20% of cement by fly ash and also replacement of 10% of cement by silica fume in every mix. Chemical admixtures like super plasticizers and viscosity modifying agent are also used for better flow ability and workability. Workability tests like T50 and V-funnel tests are conducted as per EFFNARC standards to satisfy the SCC requirements like flow ability and workability. Percentage of fiber reinforcement is varied from 0.1-0.4 (in 4 stages). Aspect ratios of 10, 15, 20, and 25mm are adopted for each percentage. The results of compressive strength, elastic modulus and poison's ratio are compared.

is a very useful aid for large scale constructions. By adding the required admixtures it can be designed to have the required flow ability satisfying the strength criteria.

The properties of SCC have already been established by various authors. The strength properties like compressive strength and Elastic properties like Young's Modulus can be further enhanced by adding a small percentage of steel fibres to the SCC matrix.

In the case of SCC the percentage of steel fibres as well as its aspect ratio should be selected in such a way that no interference is caused to the flow of concrete. The present experimental investigation is aimed to use steel fibres in SCC and to obtain optimum properties of compressive strength and elastic modulus. For better workability, strength and other benefits mineral admixtures like Fly ash, Condensed Silica Fume (CSF) are also added to the SCC matrix in certain proportion.

IV. LITERATURE REVIEW

Annipeter. J et.al.[1] Made investigations on the structural conduct of each self compacting concrete (SSC) and conventionally vibrated concrete (CVC)

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beams with steel fibres. They located that thru SCC and CVC have different modes of compaction, both mixes yielded to similar strength levels at a long time of one,three,7 and 28 days. The load deflection conduct of each SSC and CVC beams were similar as much as the peak load stage. Beyond the peak load degree, CVC beams confirmed no drop in load with multiplied deformation. The height and failure load became nearly 25% lower compared to the height load SSC beams. Crack widths were within the limits designated via IS 456 at all load levels. The crack spacing of both CVC and SCC have been nearly the same.

A.R.Mardookhpour Performed tests on variation of structural properties of high strength mortar reinforced by steel fibres. An experimental evaluation was conducted on density, compressive strength , elasticity modulus, toughness and flexural strength of high – strength flow able Mortar (HSFM) reinforced by steel fiber. The results obtained from experiments slowed with the increasing fibres content ratio up to 1.75% the flexural strength toughness and density would be increased simultaneously. Also, the results indicated that utilizing steel fiber beyond 1.25% would decrease compressive strength.

III. Experimental Investigation

Materials used

Cement 53 grade

Ordinary Portland cement of 53 grade of Ultra Tech brand was used and tested for physical and chemical properties found to be confirming to various specifications.

The Cement used for this study is Ordinary Portland Cement confirming to the Indian Standard IS: 10269-1987.

Fine aggregate

In the present investigation, fine aggregate (sand) was obtained from local market. The physical properties of fine aggregate like specific gravity, bulk density, gradation and fineness modulus are tested.

The sand was collected from nearby area and the sand was sieved.

Coarse aggregate

The crushed coarse aggregate of 10-12mm maximum size was obtained from the local market. The physical properties of coarse aggregate like specific gravity, bulk density, gradation, and fineness modulus are tested in accordance with IS -2386.

The coarse aggregate chosen by shape as per IS: 2386 (part I) (1963), surface texture characteristics of the aggregate as classified in IS: 383-1970.

Fly ash

In the present investigation work, the TYPE-II fly ash was used as cement replacement material. It is obtained from Ramagundam thermal power station in Telangana.

Condensed Silica Fume (CSF)

CSF was obtained from M/S V.B.Ferro Alloys Ltd, Rudraram near Hyderabad. Its fineness was found to be more than 10,000 cm2/gm as per the information provided by the supplier.

IV. PROCEDURE FOR MIX DESIGN OF M40 GRADE

SL. NO.	CONCRETE GRADE	CEMENT	FINE AGGREGATE	COARSE AGGREGATE	WATER/CEMENT RATIO
1	M40	1	1.3	2.2	0.45

Quantities Of materials Required For $1m^3$ of concrete .

SL. NO.	MATERIALS REQUIRED	QUANTITY IN KG FOR M40	REMARKS
1	Cement	320.78	The quantities are for basic mixes without admixtures
2	Fine aggregates	595.45	
3	Coarse aggregates	1013.87	
4	Water	206.00 liters	

Quantities of Materials Required with Mineral Admixtures (20% fly ash and 10% CSF)

SL.NO	MATERIALS REQUIRED	QUANTITIES IN KG PER m^3 for M40
1	CEMENT	320.44
2	FLY ASH	91.56
3	CSF	45.78
4	FINE AGGREGATE	595.45
5	COARSE AGGREGATE	1013.87
6	WATER	206.00

Compressive Strength Test

The compressive strength testing was conducted by using the Standard Digital Compression Testing Machine (CTM) of 3000 KN capacity in the concrete lab. The dry specimen was kept on the bottom platen

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of the machine and the top platen was adjusted to be in contact with the specimen. The machine was put on with uniform rate of loading as per the specifications of IS 516.

Determination of Elastic Properties

For the determination of elastic properties of concrete like Young's Modulus and Poisson's Ratio the setup consisting of longitudinal and lateral extensometers were used on the standard cylinders of 28 days age. The arrangement was fixed on the cylinder. For the longitudinal extensometer the gauge length is 200mm and least count of the gauge is 0.025mm. For the lateral extensometer the gauge is fixed at the end of the diameter and its least count is 0.025mm.

Casted specimens

V.RESULTS AND ANALYSIS

Workability for different mixes of SCC

Sl NO	MIX NO.	Fly ash %	CSF %	Fibre Percentage	Aspect Ratio	T50cm slump flow	V-funnel	L-box	U-box	Remarks
1	S1	0.0	0.0	0.0	0.0	3	8	0.8	28	The SCC mix satisfies the EFNARC guidelines
2	S2	20	10	0.0	0.0	3.2	7	0.82	25	
3	C1	20	10	0.1	10	4	7	0.8	20	
4	C2	20	10	0.1	15	4.6	10	0.84	25	
5	C3	20	10	0.1	20	3.34	6.2	0.86	28	
6	C4	20	10	0.1	25	4.2	7	0.8	30	
7	C5	20	10	0.2	10	3	6.5	0.82	24	
8	C6	20	10	0.2	15	3.6	7	0.83	26	
9	C7	20	10	0.2	20	4.2	10	0.82	28	
10	C8	20	10	0.2	25	5	10.8	0.8	30	
11	C9	20	10	0.3	10	3.56	8	0.85	25	
12	C10	20	10	0.3	15	4.1	8.4	0.86	27	
13	C11	20	10	0.3	20	4.5	9.2	0.84	30	
14	C12	20	10	0.3	25	4.8	11.1	0.82	30	
15	C13	20	10	0.4	10	4.1	8.2	0.86	28	
16	C14	20	10	0.4	15	4.3	9.6	0.84	27	
17	C15	20	10	0.4	20	4.6	10.9	0.82	29	
18	C16	20	10	0.4	25	4.9	11.5	0.8	30	

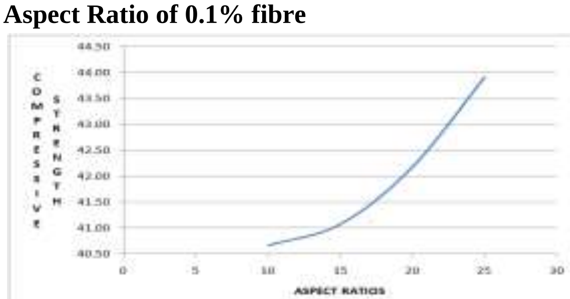
Compressive Strength of different mixes of SCC

Sl.No	Ultimate load in KN	Average cube compressive strength at 28 days in N/mm²
1	403	40.30
2	404.7	40.47
3	406.65	40.67
4	410.75	41.07
5	421.8	42.18
6	439.1	43.91
7	429.2	42.92
8	444.55	44.45
9	461.85	46.19
10	497.2	49.72
11	430.45	43.05
12	459.2	45.92
13	467.25	46.72
14	502.7	50.27
15	432.4	43.24
16	465.05	46.51
17	481.2	48.12
18	515.3	51.53

Young's Modulus and Poisson's ratio of different mixes of SCC

S.NO	YOUNG'S MODULUS (N/mm²)	POISSON'S RATIO
1	25284.19	0.156
2	25868.99	0.152
3	26629.84	0.150
4	27976.30	0.142
5	28973.27	0.133
6	31092.54	0.125
7	27400.71	0.147
8	28852.58	0.135
9	29398.58	0.130
10	32336.24	0.121
11	29580.31	0.129
12	30111.27	0.128
13	32669.60	0.117
14	33062.90	0.112
15	31689.52	0.124
16	34618.80	0.110
17	34951.12	0.107
18	35740.05	0.105

Showing Compressive Strength (N/mm2) and Aspect Ratio of 0.1% fibre



Showing Compressive Strength (N/mm2) and Aspect Ratio for 0.2% fiber

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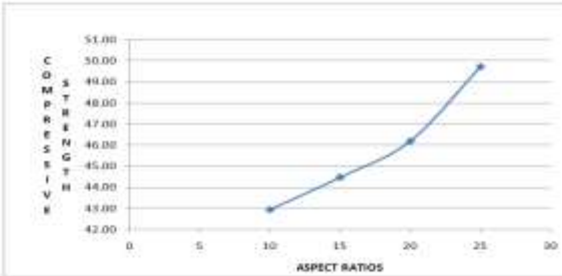

Figure showing Compressive Strength (N/mm2) and Aspect Ratio for 0.3% fiber

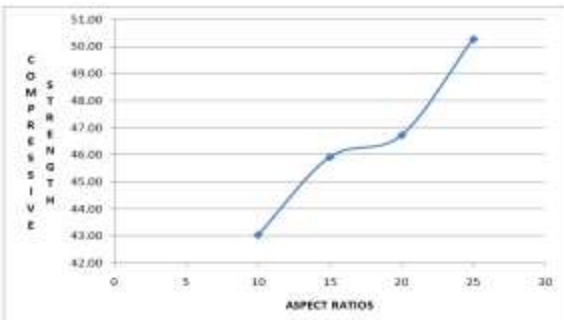

Figure showing Compressive Strength (N/mm2) and Aspect Ratio for 0.4% fiber

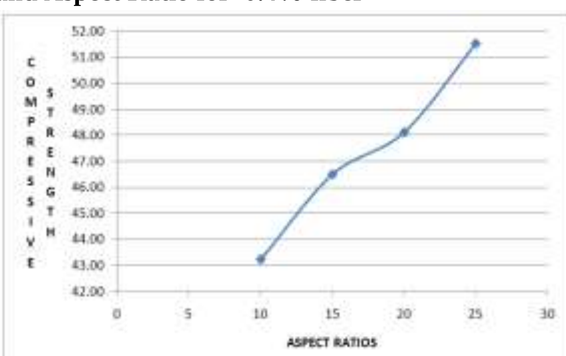

Figure showing Young's Modulus (N/mm2) and Aspect Ratio for 0.1% fibre

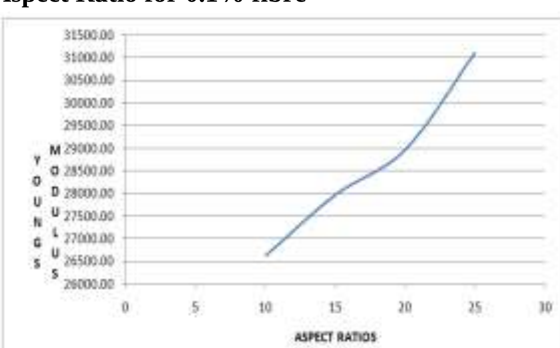

Figure showing Young's Modulus (N/mm2) and Aspect Ratio for 0.2% fibre

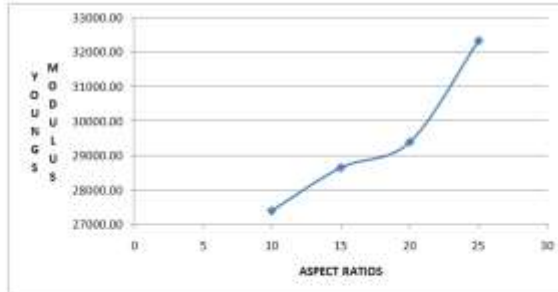

Figure showing Young's Modulus (N/mm2) and Aspect Ratio for 0.3% fibre.

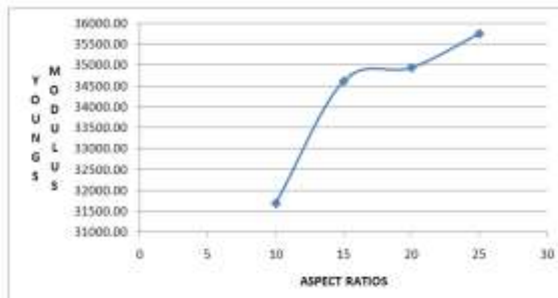

Figure showing Young's Modulus (N/mm2) and Aspect Ratio for 0.4% fibre

VI CONCLUSIONS

Based on experimental investigation conducted in present project, the following conclusions are drawn.

1. Young's Modulus of triple blended fibrous SCC of M40 grade increases with increase in fibre percentage and also with aspect ratio.

2. Poisson's ratio of triple blended fibrous SCC of M40 grade is decreasing with increase in fibre percentage and the increase in aspect ratio.

3. The optimum fiber percentage and aspect ratios are 0.4 and 25 respectively in the present investigation. Higher values than these would adversely affect the flow ability of SCC.

4. By triple blending SCC with 20% fly ash and 10% condensed silica fume (CSF), strength increase is marginal but the triple blending has given better flow ability.

5. In general, by resorting to triple blending with fly ash and condensed silica fume; strength loss due to fly ash can be compensated by condensed silica fume. The optimum mix obtained is economical.

SCOPE OF FURTHER STUDY

1. Elastic properties of SCC may be further studied that may by employing other types of mineral admixtures.
2. The properties may be further studies by in corporating mixed fibres.

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