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A study on the properties of self-compacting concrete using glass fiber reinforcement

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Abstract: self-compacting concrete (SCC) is a special concrete which is really capable of flow on its own weight in complex, dense reinforcement and completely fill the formwork without any compaction and normal Self-Compacting Concrete (SCC) is good at compression and weak in tension, the addition of chopped glass fibers in SCC to increase the strength in terms of tension also so these kind of concrete is called as glass fiber reinforced self-compacting concrete (GFRSCC). And the addition of fibers like 0.75%, 1%, 1.25%, and 1.5%. By considering the weight of binder content and the fresh properties of SCC and GFRSCC were determined by slump flow, v-funnel etc. and the results for compression, split tensile, flexural strength and ultra-sonic pulse velocity for the respective days like 7, 28, and 56.

1. INTRODUCTION:

The self-compacting concrete is a concrete which is used in the dense reinforced areas, where we can't compact properly etc. SCC was developed in japan by okamura in the late 1980's to be mainly using for highly congested reinforced concrete structures in seismic regions. The growing need of concrete in special architectural configuration and closely spaced reinforcing bars has made it necessary to produce self-compacting concrete. The main purpose of the self-compacting concrete (SCC) is to cutoff the need for mechanical compaction during the placement phase of construction without any segregation and bleeding SCC possesses the inherent ability to flow and fill intricate formwork under its own weight, ensuring complete compaction without any compaction (external compaction). This not only enhance construction efficiency but also results in improved quality and durability of concrete structures. The normal concrete and self-compacting concrete is good at compression but in case of tension it is weak so the fiber reinforced concrete is helpful to increase the strength of structure in case of tension that means in flexural case. So by verifying the normal concrete and fiber reinforced concrete the fiber reinforced concrete is good at flexural strength. So the adding of chopped glass fibers to the self-compacting concrete and it is called as glass fiber reinforced self-compacting concrete (GFRSCC). The addition of chopped glass fibers in self-compacting concrete by considering the weight of the binder content and from that binder content the percentages like 0.75%, 1%, 1.25% and 1.5% among these four percentages the optimum of the chopped glass fibers is determined., by conducting the tests like compression test, flexural strength test, split tensile strength test and finally the non-destructive test like ultrasonic pulse velocity. For the respective days be like 7, 28 and 56. From the respective results the optimum content of chopped glass fibers in the self-compacting concrete were founded. This study will focus on the usage of chopped glass fibers in self-compacting concrete so that we can increase the strength in terms of the ductility, flexural, post crack resistance, energy absorption capacity etc.

2. OBJECTIVES:

1. Determine the workability for the M30 grade self-compacting concrete mix by the tests like slump-flow, v-funnel etc.
2. To prepare GFRSCC with chopped glass fibers at 0.75%, 1.0%, 1.25% and 1.5% of the weight of binder content of the mix and determine the optimum dosage of chopped glass fibers.
3. To study the mechanical properties of GFRSCC with chopped glass fibers.
4. To compare the destructive and non-destructive tests for GFRSCC and SCC.
5. To study the durability parameters for control mix (SCC) and optimum GFRSCC.

3. EXPERIMENTAL PROGRAMME

3.1 Materials

3.1.1 Cement:

The cement utilized in this investigation was zuari 53 grade ordinary Portland cement that met IS 12269:1987 standards. IS 4031:1988 was used to test the cement. The characteristics of cement are shown in Table 1.

Table 1: properties of cement:

S.No	Property	Value
1	Specific gravity	3.15
2	Fineness	2.5
3	Normal consistency	30%
4	Initial setting time	70 min
5	Final setting time	167 min

3.1.2 Fine Aggregate:

Locally available river sand which is free from the organic waste is used sand passing through 4.75mm sieve and retained through 150 micron IS sieve

Table 2: Properties of fine aggregate:

S.No	Property	Value
1	Specific gravity	2.56
2	Fineness modulus	2.63
3	Grading	Zone-1
4	Water absorption	nill
5	Bulk density	1712 kg/m^3

3.1.3 Coarse aggregate:

The coarse aggregate had nominal size of 12 mm was obtained from local quarry that met IS required

Table 3: Properties of coarse aggregate

S.No	Property	Value
1	Specific gravity	2.68
2	Water absorption	0.32
3	Bulk density	1445 kg/m^3

3.1.4 glass fibers

Glass fibers are obtained from kalyani polymers in Bangalore, the glass fiber parameters are provided in table 4

Table 4: Properties of glass fibers

S.No	Property	Values
1	Density	2.52
2	Tensile strength	3.302
3	Young's modulus	68.9
4	Elongation	4.8
5	Refractive index	1.533
6	Length & Diameter	12mm & 0.029mm

3.1.5 super plasticizer

Super plasticizer used in this investigation is build plast sp 200 super plasticizer based on new generation of modified poly-carboxylic ether (PCE) having a specific gravity of 1.1 and is supplied as a dark brown liquid instantly dispersible in water.

3.1.6 viscosity modifying agent

A viscosity-modifying agent is a substance added to a liquid to alter its viscosity, improving flow or thickness.

We used to get the VMA from astral chemicals and it is a transparent liquid in color.

3.1.7 water

Concrete is typically made with potable water. Water should be free of acids, oils, alkalis, and vegetables and other organic impurities. This experimental project employed impurity-free local drinking water for mixing and curing.

3.2 concrete mix design

The M30 grade of self-compacting concrete was designed in accordance with the EFNARC 2005 shows the mix proportions for each and every material as shown in table.

Table 5: mix design proportions

Mixes S.no	Cement (kg/m3)	Fly ash (kg/m3)	Coarse aggregate (kg/m3)	Fine aggregate (kg/m3)	Water content (kg/m3)	Super plasticizer (kg/m3)	VMA (kg/m3)	Glass fibers (kg/m3)
Mix 1 (0%)	350	150	882	754	210	5	5	0
Mix 2 (0.75%)	350	150	882	754	210	5	5	3.75
Mix 3 (1.0%)	350	150	882	754	210	5.5	5	5
Mix 4 (1.25%)	350	150	882	754	210	6	6	6.25

Mix 5 (1.5%)	350	150	882	754	210	7	6	7.5

3.3 Test specimens

The cubes of size 150 mm * 150 mm * 150 mm, cylinders with dimensions of 150 mm diameter and 300 mm height and prism with dimension of 100 mm * 100 mm * 500 mm are prepared for each type of mix to obtain the mechanical properties such as compressive strength, split tensile strength, flexural strength, modulus of elasticity of concrete and durability by subjecting to chloride and acid attack.

4. Results and Discussions

4.1 slump flow test

The slump flow test, using the traditional slump cone, is the most common field test and it is in the process of being standardized by EFNARC. The slump cone is completely filled without consolidation, the cone lifted, and the spread of the concrete measured. The spread can range from 18 to 32 inches (455 to 810 mm).

Table 6.2: slump flow values with addition of chopped glass fibers to the control mix of SCC

Mixes	Flow (mm)
Mix 1	700
Mix 2	660
Mix 3	630
Mix 4	590
Mix 5	550

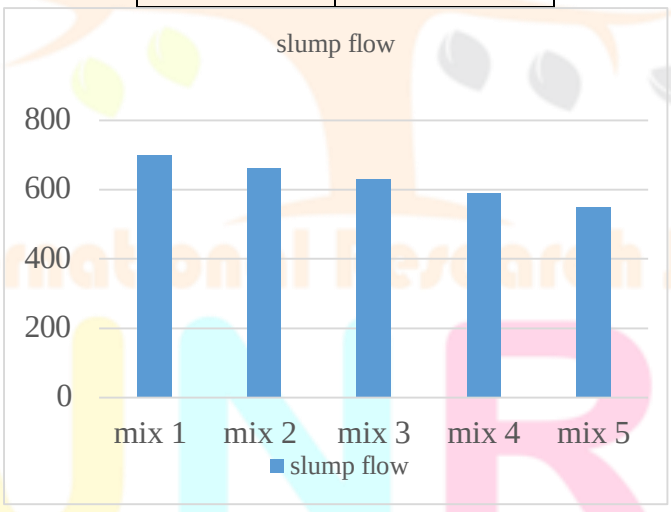


Fig 6.1 variation of slump flow w.r.t different mixes

4.2 v-funnel test

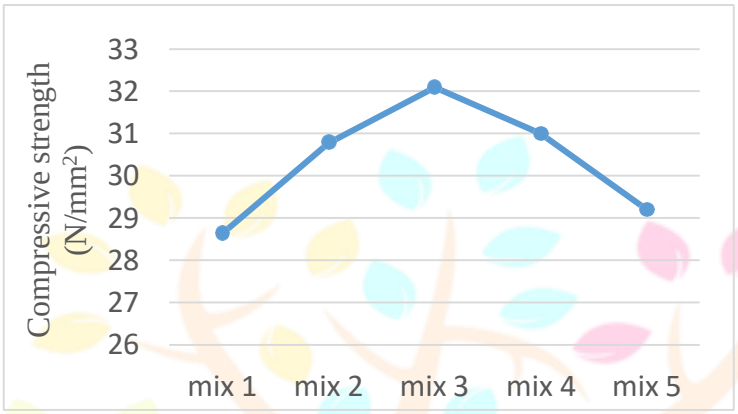
The v-funnel test is used to evaluate the ability of the SCC to flow through a tapered section of v- shaped funnel without segregation and blocking the test measures the ease to flow of the concrete: shorter flow times indicates great flow ability.

Mixes	Time (sec)
Mix 1	12
Mix 2	14.5
Mix 3	16.5

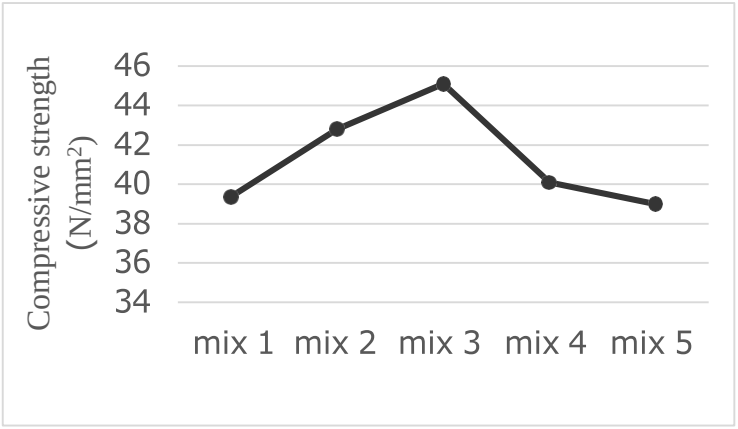
Mix 4	18
Mix 5	20

4.3 Compressive strength test

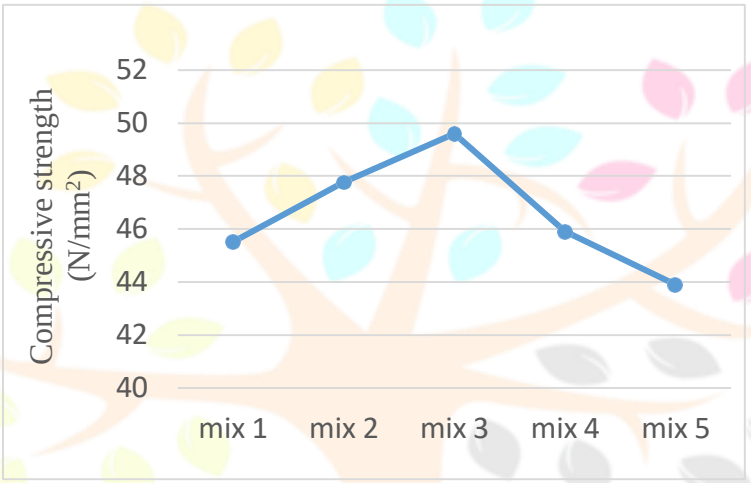
The compressive strength test of M30 grade concrete is carried out on 150 mm * 150 mm * 150 mm size cubes, as per IS 516:1959. The variation of cube compressive strength of self-compacting concrete containing various percentages of chopped glass fibers at the age of 7 days, 28 days, and 56 days is shown in figures. The cube compressive strength of controlled self-compacting concrete is at the age 56 days are 45.52 MPa. It can be observed that the cube compressive strength of self-compacting concrete with the glass fibers of 1% is found to be maximum 49.6 MPa



Compression strength for 7 days respectively



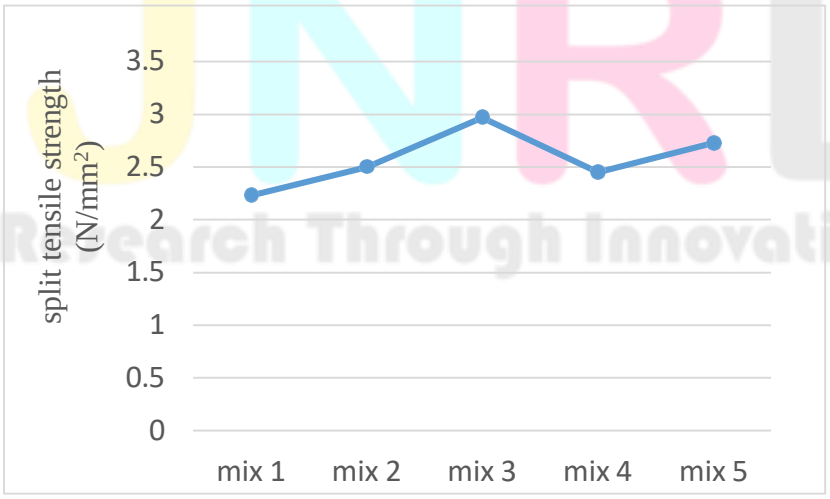
Compression strength for 28 days respectively



Compression strength for 56 days respectively

4.4 flexural strength test

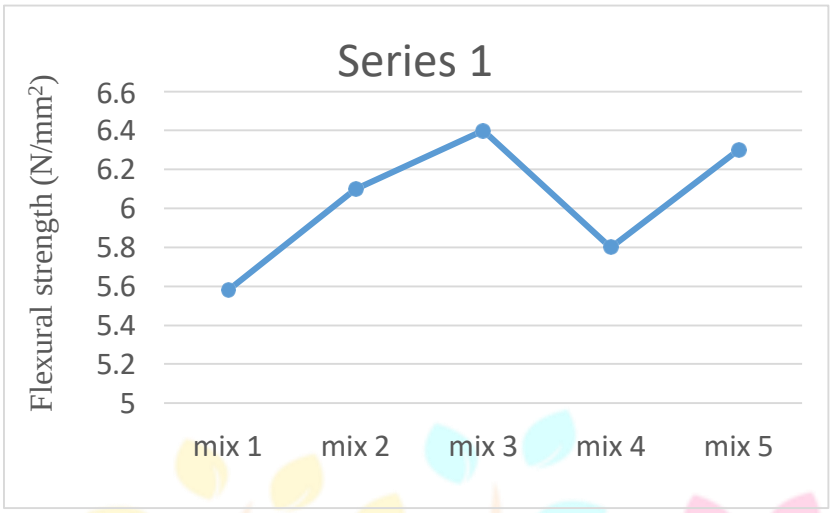
The flexural strength of the M30 grade concrete is carried on prisms with 100mm*100mm*500mm. the flexural strength controlled high strength concrete is at the age 28 days are 5.8 MPa. It can be observed that the flexural strength of glass fiber reinforced self-compacting concrete with adding of glass fibers is found to be maximum with 6.4 Mpa



Flexural strength for 28 days respectively

4.5 split tensile test

The split tensile strength of the M30 grade concrete is carried on cylinder with 150mm*300mm. the split tensile strength controlled high strength concrete is at age 28 days are 2.2 MPa. It can be observed that the split tensile strength of glass fiber reinforced self-compacting concrete with adding of glass fibers is found to be maximum with 3 MPa.



Split tensile strength for the respective mixes for 28 days

5. Conclusions:

The conclusions from the present research work is summarized below:

1) The Viscosity modifying agent (VMA) is played a key role to get the good slump for the mix which are having additional glass fiber concrete mixes.

2) The optimum percentage of glass fibers is found at 1% of the binder weight at which the compression strength obtained for 7 days is 32.1 N/mm^2, for 28 days is 45.1 N/mm^2, for 56 days is 49.6 N/mm^2.

3) The percentage difference obtained for self-compacting concrete with and without fibers for compression strength for 7 days is 12%, for 28 days is 14.5, for 56 days 8.3%.

4) For optimum mix the flexural and split tensile strength we got of 3 N/mm^2, 6.4 N/mm^2 were obtained at for 28 days.

5) The percentage difference obtained for self-compacting concrete with and without fibers for flexural and split tensile strength are 15% & 36.5%.

6) As the fiber content increases, the dosage of super plasticizer required was also increased in order to maintain the self-compactable characteristics.

7) Glass fiber reinforcement significantly improves the tensile strength and crack resistance of self-compacting concrete, enhancing its structural integrity and durability.

6. References

1) Self-Compacting Concrete using Fly Ash and Glass Fiber (Shahana Sheril P.T) International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181

2) Strength Self-Compacting Concrete using Fly Ash (Zeeshan Adib Ahmed, Dr.S.H.Mahure) International Journal of Engineering Research & Technology (IJERT) ISSN: 2321-9653

3) High Strength Self-Compacting Concrete using Fly Ash (Zeeshan Adib Ahmed, Dr.S.H.Mahure) International Journal of Engineering Research & Technology (IJERT) ISSN: 2321-9653

4) Experimental Methods on Glass Fiber Reinforced Self Compaction Concrete (A.Deepak Raj, M.Mergin Benzie, J.Esther Daisy, M.Sri Nikhil) IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684

5) Effect of Fly Ash in Self-Compacting Concrete using Glass Fibers (M.Seethapathi, S.R.R.Senthikumar, and K.Chinnaraju) International Journal of Applied Engineering Research, ISSN

6) T. Suresh Babu, M.V. Seshagiri Raoband D. Rama Seshu, "Mechanical Properties and Stress- Strain Behaviour of Self Compacting Concrete with and Without Glass Fibres", Asian Journal of Civil Engineering (Building and Housing) Vol. 9, No. 5 (2008) Pages 457- 472.

7) Prajapati Krishnapal, Chandak Rajeev and Dubey Sanjay Kumar, "Development and Properties of Self Compacting Concrete Mixed with Fly Ash", Research Journal of Engineering Sciences ISSN 2278 – 9472, Vol. 1(3), 11-14, Sept. (2012).

8) P Srinivasa Rao, G K Vishwanadh, P Sravana, T Seshadri Sekhar, "Flexural Behaviour Of Reinforced Concrete Beams Using Self Compacting Concrete", 34th Conference on Our World In Concrete & Structures: 16 – 18 August 2009, Singapore.