A paper on

Experimental study on glass fiber reinforced self compacting concrete.

[1]Tabish Izhar [2]Mahesh Singh
[1]Assistant Professor, Department of Civil Engineering, Integral University, Lucknow, Uttar Pradesh, India.
[2]P.G. Student Structural Engineering, Integral University, Lucknow, Uttar Pradesh, India

1. **Abstract:** - The change in hardened properties of fresh self compacting concrete and glass fiber reinforced self compacting concrete are compared. Also the influence of glass fiber on fresh and hardened properties of self compacting concrete is investigated. The utilized of glass fiber in SCC improved mechanical properties and durability an hardened concrete mixture SCC compare the fresh properties (compressive strength, splitting tensile strength, and flexural strength) of SCC with varying glass fiber percentage % .and SCC with (Glass Fiber Reinforced Concrete) GFRC were prepared with a water cement ratio of 0.35 .it was found that addition of glass fiber to be slightly reduced the workability properties of SCC. Compressive strength and splitting tensile strength of SCC were found to be slightly higher than fresh SCC. The purpose of this study is to investigate the workability and mechanical properties of plain SCC and GFRSCC. The laboratory testing included slump flow test, L – box test sieve segregation resistance test, density test compressive strength test splitting tensile strength, and flexural strength. The doses of super plasticizer required increased as fiber content increased there has been a lack of studies for productivity improvement in the construction industry. We have selected the major factor such as material Labor and accessed it both quantitatively for a real time construction project. The result enhanced profit and productivity.

Key words: self compacting concrete, glass fiber, mechanical properties, fly ash, glass fiber reinforced concrete.

2. Introduction

SCC also referred to as self compacting concrete that is also to flow under its own weight and completely fill the framework, while maintaining homogeneity even in the presence of congested reinforcement and then consolidating without the need of vibration. It is able to gush under its own load, completely filling form work and achieve the full compaction, even in the occurrence of congested support. The hardened concrete is dense, uniform and has the same property and durability as standard vibrated concrete. Fill Completely in the frame work even in the presence of dense reinforce while maintaining homogeneity without the need for any additional compaction. Self-compacting concrete (SCC) was first proposed by Prof. Hajimi Okamura and Ozawa in Tokyo University Japan 1986. Glass fiber reinforced concrete was developed in the 1960's and rapidly established it's an efficient construction material with major benefit in efficiency, weight saving and durability. Glass Fiber Reinforced Self-Compacting Concrete (GFRSCC) combines the advantages of SCC in its fresh state and that of fibers in its hardened state. Because of the superior performance of SCC in its fresh state, addition of fibers will lead to a more uniform dispersion of fibers which is very critical for the performance of any fiber reinforced composite. Also the compactness of SCC matrix due to higher amount of finer particles may improve the interface zone properties and consequently the fiber-matrix bond leading to enhanced post-cracking toughness and energy absorption capacity. It was developed to offset the growing shortage skilled labor. L&T construction took initiation to implement this technique in INDIA A as of the year 2000 SCC use for pre fabricate product precast members & ready mix concrete (cast - in- situ)] in JAPAN, USA, later on INDIA etc.

2. Objective

The main objectives of present study are

1. To compare the normal and hardened properties (compressive strength, splitting tensile strength and flexure strength) of SCC with varying glass fiber %.
2. To investigation the influence of glass fibers on fresh and hardened properties of SCC.

Material to be used:

The mix consists of Portland cement, fine aggregate, glass fiber reinforcement, additives, acrylic co-polymer and water.
Material to be used:

(1) Cement (PPC)
(2) Coarse Aggregate
(3) Fine Aggregate
(4) Glass fiber reinforced
(5) Super plasticizer

All required material is available in market. You can either buy them online or offline.

Cement; Pozzolana Portland cement (PPC) manufactured by Ambuja cement was used throughout the experimental study. The quality of the cement was confirming to IS: 1489 P-I (20) was used.

Coarse and Fine Aggregate; Fractions from 20 mm to 4.75 mm are used as coarse aggregate. The coarse aggregate are obtained from a local quarry, conforming to IS 383: 1970 is used. Sieve analysis was carried out confirming to IS 383: 1970

Glass fiber reinforced: Glass fiber has roughly comparable mechanical properties to other fibers such as polymers and carbon fiber. Although not as rigid as carbon fiber, it is much cheaper and significantly less brittle when used in composites. Glass fibers are therefore used as a reinforcing agent for many polymer products; to form a very strong and relatively lightweight fiber-reinforced polymer (FRP) composite material called glass-reinforced plastic (GRP), also popularly known as "fiberglass". This material contains little or no air or gas, is denser, and is a much poorer thermal insulator than is glass wool.

Admixture: polycarbonate Ether super plasticizer is chemical admixture used to increase the workbility of concrete and it reduces the water cement ratio without negatively affecting the workability IS: 9103:2007 (25) is referred.

Material properties:

Table: 1 Properties OF Material CA

Properties of coarse Aggregate		
S.No	Materials	values
1	Specific gravity	2.82
2	Apparent specific gravity	2.96
3	Water absorption	0.39
5	Fineness modules	3.2
6	Zone	II nd

Table: 2 Properties OF Material FA

Properties of Fine Aggregate		
S.No	Materials	values
1	Specific gravity	2.65
2	Apparent specific gravity	2.70
3	Water absorption	1.04

Table: 3 Properties OF Material GFR

Properties of glass fiber reinforced		
S.No	Materials	values
1	Length	20mm to 50mm
2	Diameter	0.25mm to 1mm
3	Tensile strength	1034 – 3792 Mpa
4	Young Modules	63X10^3 Mpa
5	Ultimate Elongation	1.5 to 3.5 %

Table: 4 Properties of super plasticizer

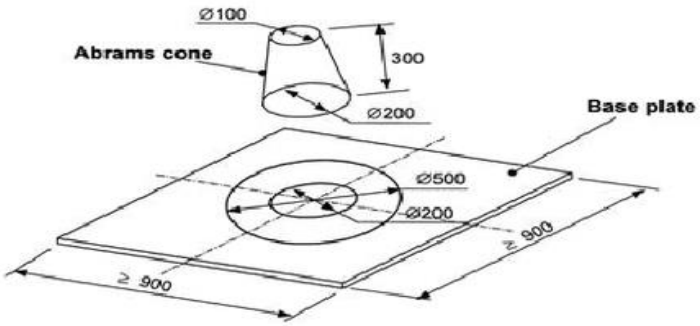
Properties	Value
Specific gravity	1.15
Chlorides	Nil
Nitrate	Nil
Sulphate	0.5%
Appearance	Straw colored liquid
Freezing point	+5 C material can be reconstituted by agitating at 30 C
Role in concrete	Improves workability and flow properties of concrete

WORKABILITY TEST

M30 cube will be cast by partially replacing fine aggregate by glass Fiber reinforced at different percentage. And properties of Concrete will be studied: -

A. Slump flow test

The slump flow test is used assess the horizontal free flow of self compacting concrete in the absence of obstructions. The test method is based on the test method for determining the slump.



The slump-flow Test using the traditional slump cone is the most common field test. It is simple and most widely used to assess the horizontal flow and the flow rate of SCC in the absence of obstructions. The test, which was developed in Japan, was originally used to measure underwater concrete and has also been used to Experimental study on glass fiber reinforced self compacting concrete measure highly flow able concretes. Also T500, which is the time required for the concrete to spread to a diameter of 500 mm is also measured to assess the flow ability. The higher the slump flow value, the greater its ability to fill formwork under its own weight. A value of at least 650mm is required for SCC under EFNARC guidelines. There is no generally

accepted advice on what are reasonable tolerances about a specified value, though ± 50mm, as with the related flow table test, might be appropriate. The T500 time is a secondary indication of flow. A lower time indicates greater flow ability and vice versa. In case of severe segregation most of the coarse aggregate will remain in the centre of the pool of concrete and mortar and cement paste at the concrete periphery. In case of minor segregation a border of mortar without coarse aggregate can occur at the edge of the pool of concrete. If none of these phenomena appear it is no assurance that segregation will not occur since this is a time related aspect that can occur after a longer period.

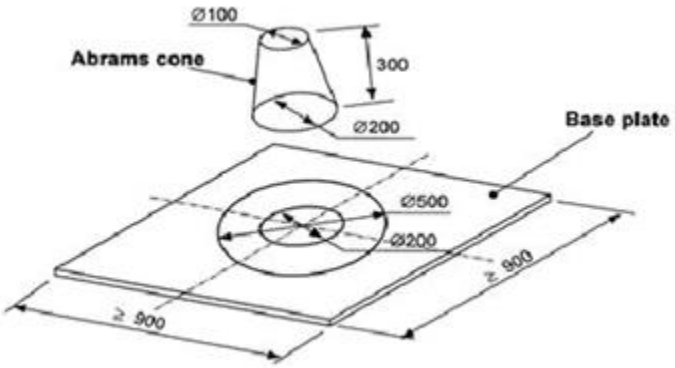


Fig 1: Slump flow test apparatus

B. V Funnel Test

V funnel test on self compacting concrete is used to measure the flow ability. But the flow ability of concrete is affected by its other properties as well which may affect the flow ability of the concrete during testing.

V-Funnel Test The described V-funnel test is used to determine the filling ability of the concrete with a maximum aggregate size of 20mm. The test was developed in Japan and used by Ozawa et al. The equipment consists of a V-shaped funnel as shown

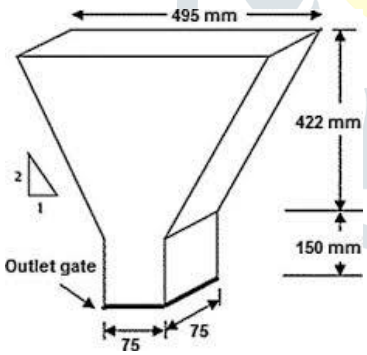


Fig 2: shows the V-funnel test apparatus.

An alternative type of V-funnel, the O funnel, with a circular section is also used in Japan. The funnel is filled with concrete and the time taken for it to flow through the apparatus is measured. After this the funnel can be refilled with concrete and left for 5 minutes to settle. If the concrete shows segregation then the flow time will increase significantly. This test measures the ease of flow of the concrete; shorter flow times indicate greater flow ability. For SCC a flow time of 10 seconds is considered appropriate under EFNARC guidelines. The inverted cone shape restricts flow, and prolonged flow times may give some indication of the susceptibility of the mix to blocking. After 5 minutes of settling, segregation of concrete will show a less continuous flow with an increase in flow time.

B. **L Box Test**

This test assesses the flow of the concrete and also the extent to which it is subjected to blocking by reinforcement.

L-Box Test: - The test assesses the flow of the concrete, and also the extent to which it is subject to blocking by reinforcement. The apparatus consists of a rectangular-section box in the shape of an L, with a vertical and horizontal section, separated by a moveable gate, in front of which vertical lengths of reinforcement bar are fitted.

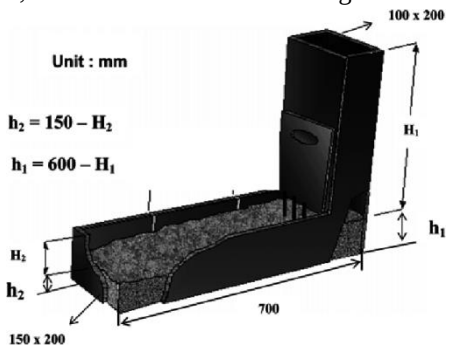


Fig 3: shows the L-Box test apparatus.

The vertical section is filled with concrete, and then the gate lifted to let the concrete flow into the horizontal section. When the flow has stopped, the height of the concrete at the end of the horizontal section is expressed as a proportion of that remaining in the vertical section. It indicates the slope of the concrete when at rest. This is an indication passing ability, or the degree to which the passage of concrete through the bars is restricted. The sections of bar can be of different diameters and spaced at different intervals: in accordance with normal reinforcement considerations, three times the maximum aggregate size might be appropriate. The bars can principally be set at any spacing to impose a more or less severe test of the passing ability of the concrete. Obvious blocking of coarse aggregate behind the reinforcing bars can be detected visually.

Result of normal fresh concrete properties of the self compacting concrete mixtures are presented in table with the guideline prescribed by EFNARC 2005(14).

Table: 4 recommended limits for different properties of SCC

S.No.	Properties	Range	values
1	Slump flow Diameter	500 – 700 mm	Filling Ability
2	T 50 cm	2 -5 sec	Filling Ability
3	V-Funnel	8 – 12 sec	Passing Ability
4	V-Funnel – T5 min	11 – 15 sec	Segregation Resistance
5	L- box H2/H1	≥ 0.8	Passing Ability

Table: 5 Mix proportion of SCC in kg/m3

S.No	Materials	Quantity
1	Water	190 Kg/m3
2	Cement	475 Kg/m3
3	Fine Aggregate	920 Kg/m3
5	Coarse aggregate	848.8 kg/m3
6	Super plasticizer	1.00% of cementations materials
7.	Glass fiber reinforced	0.2 %, 0.4 %, 0.6%

Since there is no proper design procedure is available for the final mix proportions were designed based on the trial and error method in which various proportions of glass fiber and super plasticizer have been tried to arrive at the mix giving the appropriate workability which meets the self compacting standers the different percentage of glass fibers (0.2%, 0.4%, and 0.6%) were added to the self compacting mix with different percentages.

The different fiber of were added to the self compacting mix with different percentages (0%, 0.2%, 0.4%, and 0.6%)

Test on hardened SCC the hardened concrete was tested for compressive strength, as per 516-1959 (12) and splitting tensile strength, and flexural strength according tom IS: 5816-1999(13).

STRENGTH TEST

CUBE TEST (FOR COMPRESSIVE STRENGTH)

Three cubes of each type will casted to check the strength at three different time 7 days, 28 days. Cubes of (150 X 150 X 150) mm will be cast by add on glass fiber at different percentage.

In this concrete is poured in the mould and tempered properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are put in water for curing. The top surface of these specimens should be made even and smooth. This is done by putting cement paste and spreading smoothly on whole area of specimen. These specimens are tested by compression testing machine after 7 days curing or 28 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per minute till the Specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete

SPLIT TENSILE STRENGHT TEST (FOR TENSILE STRENGTH)

Cylindrical cubes of dia. 150mm and length 300mm will casted 9 cylinders. In this cylinder is placed horizontally between the loading surfaces of compression testing machine. The compression load is applied diametrically and uniformly along the length of cylinder until the failure of the cylinder along the vertical diameter. To allow the uniform distribution of this load and reduce the magnitude of the high compressive stresses near the points of application of this load, strips of plywood are placed between the specimen and loading plates of testing machine.

FLEXURAL STRENGTH:

Flexural strength is a measurement that indicate the resistance of a material to deformation when place under a load. the value needed calculate flexural strength are measure by examination with rectangular sample of the material placed under load two point loading testing setup. The strength of material in bending, express as the stress on the outer most fibers of a bent test specimen , at the instant of failure concrete beam of size 150mmX150mmX700mm were casted and in this research total 6 beams were casted and tested for 28 days of curing and the result are tabulated below.

Result of compressive strength, splitting tensile strength, and flexural strength are given in table

Table: Mechanical properties of hardened concretes

Table: 6 Mechanical properties of hardened concretes

S.NO.	DESIGNATION	MIX PROPORTION	COMPRESSIVE STRENGHT	
		GFRC	7 DAYS	28 DAYS
1	SCC mix-1	0%	26.6 MPa	34.8MPa
2	SCC mix-2	0.2%	28.9 MPa	36.5 MPa
3	SCC mix-3	0.4%	28.4 MPa	37.8 MPa
4	SCC mix-4	0.6%	28.8 MPa	36.1 MPa

Table: 7 Mechanical properties of hardened concretes

	Splitting tensile strength (Mpa)	Modulus of rupture (Mpa)	Flexure strength (MPa)		
1	3	3.67	Mix –1	0.2%	6.23
2	3.3	4.60	Mix – 2	0.4%	6.59
3	3.75	4.90	Mix – 3	0.6%	6.64

3. Conclusion

The test result we conclude that the addition of glass fiber dose not affected the filling ability, passing ability and segregation resistance of the SCC. The workability test is conducted on four trial mixes of glass fiber reinforced self compacting concrete by varying the amount of glass fibers added to the mix. We can observe from the result that flow ability of glass fiber reinforced self compacting concrete.

Compressive and splitting tensile strengths of SCC were found to be slightly higher than the corresponding properties of natural concrete. And flexural strength to be increased of normal concrete .Addition of 0.2 to 0.6 kg/m3 of glass fibers slightly reduced the normal properties of SCC. Addition of glass fibers increased compressive strength and modulus of elasticity slightly but increased splitting tensile strength by considerable amount.

Super plasticiser increases workability of concrete. The slump value and compaction factor value of mixes containing super plasticizer are more than that of normal concrete. While adding fibers with concrete mixes, workability of concrete decreases with increase in the volume of fibers from 0.2% to 1%.

Concrete mixes with naphthalene based super plasticizers is more compatible with all types of fibers.

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