

Comparative Study on SCC Mix with Cement Partially Replaced by Fly Ash and GGBS, with or without Use of Glass Fibers 2019-20

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Abstract: Self compacting concrete is fluid mixture applicable for introducing in structures with congested reinforcement without giving any vibration. SCC does not require any external devices for compaction so that it reduces the noise pollution at work sites. Additionally, SCC technology has improved quality surface, increment in strength and good durability. Due to productivity of SCC is rapidly improved through the absence of vibration compaction, the cost of construction becomes low. This work aimed to investigate the effect of glass fiber with the addition of different admixtures such as fly ash and GGBS on fresh and hard properties of SCC and obtained conclusions will be compared with the normal concrete without glass fibers. Addition of glass fiber to the SCC is known as glass fiber reinforced self compacting concrete. By the use of super plasticizers, required amount of workability can be achieved and that will be tested by L-box, U-box, slump flow, V-funnel etc.

The main advantage of introducing glass fiber is to achieve good compressive strength as well as flexural strength and it would act as a good crack arrester in the SCC. Percentage of glass fibers added to the SCC ranges from 0 to 0.2% by the volume of mix. Mix design is done for M50 grade of concrete and percentage of weight of cement is replaced by 25% of fly ash and 25% of ground granulated blast furnace. Usage of mineral admixtures in SCC mix, will help to improve the rheological properties of SCC such as strength properties, durability, workability etc.

Keywords: Glass fibres, self-compacting concrete, GGBS, Fly ash.

I. INTRODUCTION

From the last few decades, the use of self-compacting concrete was enriched. Self compacting concrete is the concrete, which can flow under its own weight and fill congested reinforcements and gets compacted without giving any vibration and compaction. Due to the high porosity in the conventional concrete there may be chances of forming cracks on the structural member due to high autogeneous shrinkage value. Concrete possesses high compressive strength and stiffness but it is brittle and weak in tension. Addition of glass fiber in concrete helps in resisting crack growth and helps to increase the flexural and tensile strength. Glass fiber reinforced self compacting concrete (GFRSCC) is a new invention. Considering the advantages and innovation of SCC and GFRSCC an attempt has been made to combine these two to produce glass fiber reinforced self compacting concrete (GFRSCC) and to study the mechanical properties such as fresh and hardened properties of both SCC and GFRSCC. Introducing fly ash and GGBS as the mineral admixture by addition of glass fibers in various percentages to the mix. A study has been done on the compressive, split tensile and flexural strength with these various mixes.

Generally Self compacting concrete has three main following characteristics:

- i. Filling ability: capability of filling the formwork completely under its own weight.
- ii. Passing ability: capable to come out of obstacles such as congested reinforcement areas without undergoing any compaction and without hindrance.
- iii. Segregation resistance: homogeneous composition of concrete after and during the process of the transport and placing.

II. MATERIALS AND METHODOLOGY

Cement

Birla Super cement of grade 53 grade of ordinary port land cement conforming IS: 12269-1987 available in local market has been used in this present work. The physical properties of cement are selected according to the guidelines of IS: 269 and IS: 4831, fulfill the requirements of IS: 12269 – 1987 as given.

**Fig. 1 cement****Fly Ash**

Fly ash which should full fill the requirements of 3812. it is manufacturing from some power project. 85% of fly ash particles are passed through 45um sieve. Class F fly ash has been used in this project work and its brought from 'Anand Sunvik pvt ltd'.

**Fig. 2 Fly ash****Ground Granulated Blast Furnace Slag (GGBS)**

Ground granulated blast furnace its a slag (ggbs) and it is a byproduct of iron industry and which is extracted during the manufacture of iron. The molten slag is a secondary product of sintering of the raw materials and this is quenched under high pressure of water jets. For the present work ggbs is brought from Zonje Solar LLP Peenya.

**Fig. 3 GGBS****Coarse Aggregate:**

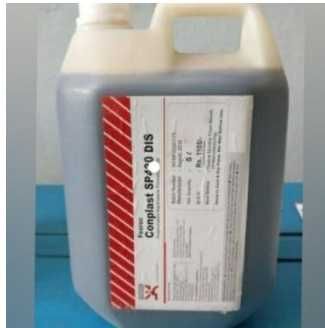
Coarse aggregates are Aggregates Are Primarily Naturally Occurring, Granular Materials Such as Sand, Gravel, Or Crushed Stone. But Technology Is Broadening to Include the Make Use of Recycled Materials and Man-Made Products. These are the aggregates having a nominal size more than 5mm. in this work coarse aggregates are brought from 'Bharathi Crushers'.

**Fig. 4 Coarse aggregate****Fine Aggregate :**

Fine aggregate can be natural or manufactured sand, but its grading should be uniform. The particle fineness than 150um sieve are considered as fines. the total content of fineness have to be more , generally it is about 520 to 560kg/m3. According to IS 383:1970 the fine aggregate is classified as four similar zones that is zone-i, zone-ii, zone-iii, and zone-iv. For this study fine aggregates are brought from 'Bharathi Crushers'.

**Fig. 5 Fine aggregate****Chemical Admixture**

Chemical admixtures such as super plasticizers are typically added to water to get great flow ability and make it to the workable concrete. To accomplish superior quality concrete, utilization of chemical admixture is basic which will decrease the water-cement proportion. In this particular work we used Super Plasticizer CONPLAST SPH23 from 'Indian Mart'.

**Fig. 6 Conplast SPH23****Water**

Consumable locally available water free from dirt and chemical, fulfilling the necessities guidelines of is: 456 – 2000 has been used.

Glass Fiber

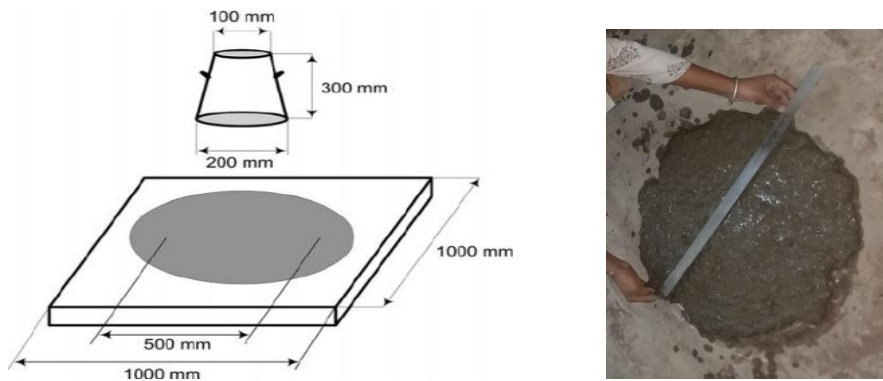
Fibers are raw materials that are used for the production of fibre reinforced concrete. Glass fibers brought from 'Indian Mart' a general reselling marketing app for this present work. The reinforced fiber in concrete may helps to enhance the tensile and flexural strength, impact strength, toughness of the concrete, drying shrinkage, and failure pattern of the concrete. Glass fibres also acts as crack arresters in the concrete

**Fig. 7 Glass Fibres****METHODOLOGY**

Present work is mainly aimed to find the effect of glass fiber with the addition of different admixtures such as fly ash and GGBS on fresh and hardened properties of SCC and obtained results will be compared with the normal concrete without glass fibers. By the use of super plasticizers, needed amount of workability can be achieved and that will be tested by L-box, U-box, slump flow, V-funnel etc. percentage of glass fibers added to the SCC is ranges from 0 to 0.2% by the volume of mix. Mix design is done for M50 grade of concrete and percentage of weight of cement is replaced by 25% of fly ash and 25% of ground granulated blast furnace. In Conventional concrete 50% cement is replaced by flyash.

EXPERIMENTAL TEST:**Slump Flow and T₅₀ Test**

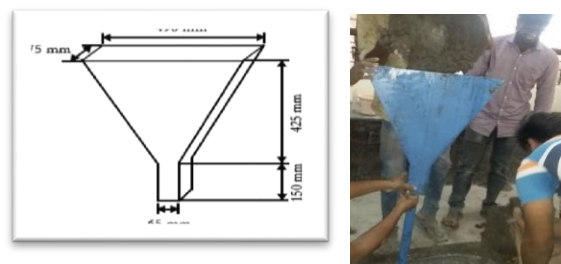
Slump flow and T50 test is performed to find the flow capability of SCC horizontally without any kind of impediments. Now a days it is one of the mainly used tests to find the workability characteristics of SCC. And T₅₀ test is performed during slump flow test. It is the total time taken by concrete to flow a circle of dia. 500mm. The standardized time for T₅₀ cm test is from 2 to 5 seconds. The slump and T50 test is also shown in below Figure

**Fig. 8 Slump Flow Test Apparatus**

L-box Test: The procedure for conducting L-box test is given below. Arrange the test apparatus by placing firmly on ground with respect to its level. Rinse the inner sides of the apparatus by applying oil. Then, fill the chimney area of the apparatus with the self-compacting concrete. Allow to settle for about 60 seconds. Open the sliding gate to flow the concrete into the trough like area of the apparatus.

**Fig 9 L -Box Test Equipment**

V-funnel Test: The V-funnel test is used to study the filling ability of concrete with a maximum size of coarse aggregates limiting to 20mm, the typical V-funnel apparatus is as shown in Figure

**Fig. 10 V-Funnel Test Apparatus**

III. STRENGTH TESTS

Compressive Strength: The compressive strength is measured in Compressive testing machine (CTM) with capacity of 3000kN. The compression strength is carried out on a cube specimen of the size 150x150x150mm. For conventional SCC & triple mixed SCC the compressive strength of cube determined as per the guidelines of IS516-1959, Reaff in 1999 for the curing time of 3,7,28 and 56 days.



Fig .11 Compressive Strength Test

Split Tensile Strength: The split tensile strength of cylinders of size 150mm dia. And 300 mm length for NSCC are calculated as per the IS 5816-1999 for the curing period of 3, 14, 28 &56 days. The different mixes which fulfil the fresh concrete properties are casted and cured for required number of days.



Fig. 12 Split Tensile Strength Test

Flexural Strength: The flexural strength of prisms of size 500 mm length 150 mm width for SCC are calculated as per the IS 5816-1999 for the curing period of 3, 14, 28 and 56 days. The different mixes which fulfil the fresh concrete properties are casted and cured.



Fig. 13 Flexural Strength Test

IV. RESULTS AND DISCUSSIONS

Table 1 Results of the fresh Properties of SCC

Sl No	Type of Mix	Cement %	Fly Ash %	GGBS %	Slump flow (mm)	T 50 Slump flow (sec)	L – Box (h2/h1)	V Funnel (sec)
1	NSCC	50	50	0	500	8.07	0.84	5.76
2	TBSCC	50	25	25	500	7.3	0.92	8.3

Results For Hardened Properties Of Concrete

Table 2 Compressive Strength of SCC

Si. No.	Type of mix	Compressive strength in n/mm ²			
		7 days	14 days	28 days	56 days
1	NSCC	20.50	38.05	41.47	46.57
2	TBSCC 0%	20.88	39.85	43.44	47.55
3	TBSCC 0.1%	21.29	41.02	44.78	49.4
4	TBSCC 0.15%	21.85	42.04	45.82	49.73
5	TBSCC 0.2%	20.35	40.65	44.31	46.62

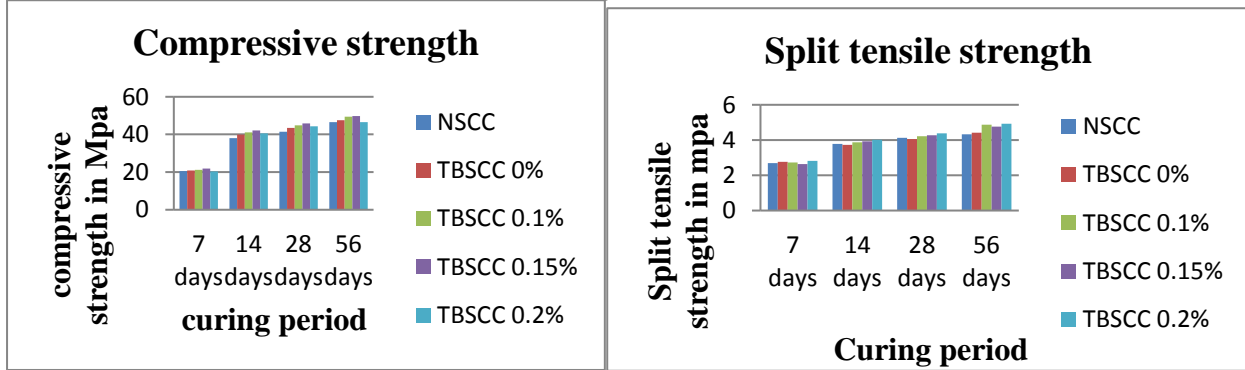
Table 3 Split Tensile Strength

Si. No.	Type of mix	Split tensile strength in n/mm ²			
		7 days	14 days	28 days	56 days
1	NSCC	2.70	3.78	4.12	4.33
2	TBSCC 0%	2.76	3.73	4.06	4.42
3	TBSCC 0.1%	2.73	3.88	4.22	4.88
4	TBSCC 0.15%	2.63	3.92	4.27	4.76
5	TBSCC 0.2%	2.81	4.02	4.38	4.92

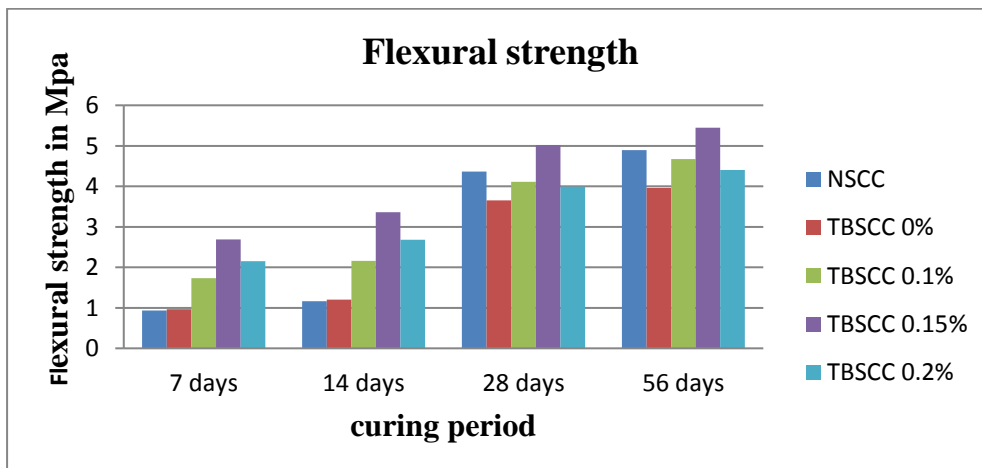
Table 4 flexural strength Strength

Si. No.	Type of mix	Flexural strength in n/mm ²			
		7 days	14 days	28 days	56 days
1	NSCC	0.933	1.163	4.362	4.89
2	TBSCC 0%	0.965	1.206	3.65	3.96
3	TBSCC 0.1%	1.73	2.162	4.11	4.67
4	TBSCC 0.15%	2.69	3.36	5.02	5.45
5	TBSCC 0.2%	2.15	2.68	3.99	4.40

Graph of compressive strength and split tensile strength of NSCC and TBSCC



Graph of Graph of flexural strength of NSCC and TBSCC



Summary

1. This experimental results shows that hardened properties of GFRSCC such as compressive strength, split tensile strength of SCC will be more than corresponding properties of the normal concrete.
2. By making the replacement of cement with GGBS increases consistency. With the use of super plasticizer it possible to get A mix with low water to cement ratio by this we got the desired strength.
3. The GFRSCC is displays great workability properties compared with normal SCC. This is because of the higher substance of better particles, for example, GGBS & fly ash which is used as partial replacement of cement.
4. It is Produce SCC By Combined Replacement Of FA And GGBS and it is Satisfies The Criteria For Fresh Concrete Properties Such As Slump Flow, Passing Ability, Filing Ability.
5. the scc with 0.15% addition of glass fibres possess greater compressive strength and flexural strength when compared with normal conventional concrete of self compacting concrete.
6. split tensile strength of scc with addition 0.2% of glass fibres gives higher split tensile strength when compared with normal convention self compacting concrete.
7. it is concluded that the triple blended scc possess good strength when compared to the normal scc.
8. in this experiment the usage of fly ash and GGBS were acts as good filler materials and helps to possess higher strength and also by the use of this we can reduce the problems of waste disposal

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