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COMPARATIVE STUDY ON SCC BY PARTIAL REPLACEMENT OF CEMENT WITH FLY ASH AND GGBS, RIVER SAND BY M-SAND, WITH & WITHOUT USE OF GLASSFIBERS

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ABSTRACT

Due to lack of concrete material and requirement of strength there is various types of concrete is producing by using alternative materials in the market. Self compacting concrete is the one of the new type of concrete. It full fills the required workability and stability of concrete without applying any external vibration it will maintain the homogeneity with its own weight it will pass early in the complex form of steel work. This type of concrete will also reduce the cost of construction due to use of industrial by products. There is various types of experiments are done on SCC by replacement on cement and natural river sand. In this present study to achieve "comparative study on SCC by partial replacement of cement with fly ash and GGBS, river sand by M-sand, with and without the use of glass fibers". By using super plasticizer achieved require workability that will be tested by L-box, U-box, slump flow, V-funnel etc. Also differentiate the strength factors of concrete by with and without use of glass fibers. By use of glass fibers can achieve good compressive and flexural strength. The main special case in this study is to achieve the optimum results by using combination of fly ash and GGBS for the cement replacement with different percentage variation and sand is completely replacing by M- sand, comparing the strength with and without use of glass fibers in concrete.

Keywords— Workability; Homogeneity; Fly ash; GGBS; M-Sand; Glass Fibers; Self Compacting Concrete.

I. INTRODUCTION

Concrete is a flexible material that can be utilized for development of numerous types or shapes of structural components. Self Compacting Concrete (SCC) was created by the Japan specialists in 1989. SCC is an special type of concrete that is capable to flow and consolidate under its own weight with no segregation and bleeding between the strengthening bars. SCC is one of the broadly utilized sorts of concrete in the present world since it makes the work less demanding and it doesn't bleed at the joints of the molds. In the present work, an endeavor will be made to set up a high quality SCC of grade 60 by replacing the cement content with the industrial by product like fly ash and ground granulated blast furnace slag (GGBS) and furthermore replacing 100 percent Natural sand by Manufactured sand.

The present work additionally manages the investigation of mechanical properties like compressive strength, split tensile, flexural strength of self compacting concrete for different rates of powder substance and 100 percent of manufactured sand, with and without the utilization of glass fibers.HSC involve copious preferred standpoint everywhere throughout the world in substantial structure, dams, spans and structures in brutal condition. As a rule, structure's segments arranged by HPC will be firmly strengthened. These sorts of thick fortifications prompt extreme damages amid at the time of concrete placing.

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The development in infrastructure is a pre-imperative for the money related advance of any country, of which electric influence and generation of iron is a key factor. In India, the power prerequisites are for the most part met by coal based warm power plants, of which coal ashes remains are created in huge amount up to 170 million metric tons for each day. The coal ash remains contains Pond Ash, Bottom Ash & fly ash. GGBS, a liquid slag gotten at a temperature of around 1500ºC (2730ºF) is immediately solidified by stifling in water to make a smooth sand like granulated substance. The granulated substance, which is smaller than 45µ, has a fine surface region of 400 to 600m^2/kg blain.Glass fiber is named as fiberglass which is light in weight,. despite the fact that the quality qualities are genuinely lesser than carbon fiber and additionally less stiff, the material is actually pretty much sensitive and its crude materials are moderately cheap. [1] proposed a system, this fully automatic vehicle is equipped by micro controller, motor driving mechanism and battery. The power stored in the battery is used to drive the DC motor that causes the movement to AGV. The speed of rotation of DC motor i.e., velocity of AGV is controlled by the microprocessor controller.This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

II. OBJECTIVES

SCC more often than not contains high volume of powder substance and this is impossible including high substance of bond because of the confinements of codal arrangements, the substance of cement should not to more than 450 kg/m^3 of cement from shrinkage contemplations. Subsequently, it is required to utilize FA and GGBS as supplementary materials for concrete. In this examination, the regular SCC that contains 70% of cement and 30% of Fly Ash and the triple mixed SCC which contains, 25% of Fly Ash and 25% of GGBS are utilized, the following tasks are involved:

- To build up a superior self-compacting concrete of M_{60} grade with and without the utilization of glass fiber.
- Fragmentary supplanting addition of cement by FA(25%) and GGBS(25%) along with supplanting addition of normal sand with 100% of manufactured sand (M.Sand).
- To know the qualities of SCC by measuring segregate resistance, passing & filling ability by utilizing various tests like slump flow, V – Funnel & L – Box test for substitution of cement with FA and also GGBS.
- To assess the properties of harden concrete like split tensile flexural, and compressive strength.

III. MATERIAL PROPERTIES

A. Cement

higher quality OPC that is 53 grade confirm to Indian standard code IS:12269 – 1987 accessible in locally utilized as a part of this examination. The physical properties of cement are dictated by performing the different tests according to the guidelines of IS: 269 and IS: 4831, fulfills the necessities of IS:12269 – 1987 as given.

Table 1. Cement physical properties

Sl no	Test conducted on cement	Results	Permeable value IS:12269-1987
1	Normal consistency	29%	28% - 34%
2	Initial setting time	45 min	Not <30min
3	Final setting time	450 min	Not >600min
4	Specific Gravity	3.1	2.95 – 3.15

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B. Fly ash

(PFA)Powdered fly ash is utilized as an optional cement material, gotten from Ready mix concrete plant, which affirms to the guideline of IS: 3812 Part 1&2 – 2003 & the tests are accomplished for according to the code guidelines IS:1727–1967.

Table2. Flyash physical properties

Sl no	Test conducted on Fly ash	Results	Permeable value IS:1727-1967
1	Normal consistency	25%	-
2	Initial setting time	45 min	Not <30min
3	Final setting time	500 min	Not >600min
4	Specific Gravity	1.92	1.85-2.85

C. GGBS

GGBS additionally utilized as tertiary cementitious material it is also gotten from Ready Mix Concrete, affirming to the Indian code IS: 12089 – 1987. The physical properties of GGBS are organized in Table 3

Table 3. GGBS Physical properties

Sl no	Test conducted on GGBS	Results	Permeable value IS:1727-1967
1	Normal consistency	30%	-
2	Specific gravity	2.95	2.95-3.15

D. Fine aggregate

Because of the shortage of river sand, various experimental works are conducting for interchange materials to use as sand contents. Fabricated sand (M-Sand) affirming to IS: 383–1970(Zone II), gotten local market is utilized as a sand material in this project. The properties of M-sand are as appeared in Table 4.

Table 4. Physical properties of Fine aggregate

Sl no	Test conducted on Fly ash	Results
1	Specific gravity	2.43
2	Fineness modulus	3.3
3	Loose bulk density	1789 Kg/m^3
4	Compacted Bulk density	2045 Kg/m^3

E. Coarse aggregate

The total aggregate – cement proportion is emphatically impacted by the sort of materials utilized for the investigation, which assistant required to get the workability and water cement proportion. The coarser materials size of 12.5mm down size are utilized as a part of this project and fulfils the details of IS:383–1970. The experiments were carried according to the guidelines IS:2386 Part-1 and the readings are entered in the Table 5.

Table 5. Physical properties of Fine aggregate

Sl no	Test conducted on Fly ash	Results
1	Specific gravity	2.6
2	Water absorption	0.84
3	Loose bulk density	1618.86 Kg/m^3
4	Compacted Bulk density	1867.54 Kg/m^3

F. Chemical admixture

Chemical admixtures 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. Subsequently the admixture utilized as a part of this work is SUPERFLOW PC900

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given from the Don Construction Chemicals India Ltd. The superplasticizer is added up to volume of 0.6% to weight of the cementitious materials.

G. Water

Consumable locally available water free from wide range of chemical, fulfilling the necessities guidelines of IS: 456 – 2000 was utilized in this project.

H. Glass fibers

To get more strength of the concrete glass fibers are added to the concrete to minimize the initial stage of cracks that accurse in the concrete. In this project glass fiber is added like 0.1%, 0.2% and 0.3% to the total weight of the concrete mix.

Table 6. Physical properties Glass Fibers

Sl no	Properties	Results
1	Color	White
2	GF Type	Alkali resistance
3	Diameter	14 μ
4	Length	12mm

IV. MIX PROPORTIONS

There is no proper code for preparing mix proportion for SCC as like normal vibrated concrete. The mix design for M_{60} grade concrete has been prepared based on the previous literatures and the use of EFNARC guidelines. This strategy is one of the simple most straightforward techniques for to get SCC mix. In the present examination, two distinct sorts SCC blends are calculated. The mix design for both conventional and triple blend mix is given below

A. Conventional SCC (CSCC)

Cement = 330 kg/m3.
Fly Ash = 141.42 kg/m3.
Fine Aggregate = 859.89 kg/m3.
Coarse Aggregate = 696.62 kg/m3.
Water = 169.71 kg/m3.
Super plasticizer = 6 ml/kg of powder content.

B. **Triple Blended SCC (TBSCC)**

Cement = 235.71 kg/m3.
Fly Ash = 117.85 kg/m3.
GGBS = 117.85 kg/m3.
Fine Aggregate = 859.89 kg/m3.
Coarse Aggregate = 659.89 kg/m3.
Water = 169.71 kg/m3.
Super plasticizer = 6 ml/kg of powder content.

V. WORKABILITY TESTS ON FRESH CONCRETE

The test steps point by point in this part are the sort of process rather than entire systems. These tests are essentially unique techniques, which are determined especially for SCC. Different sorts of fresh concrete tests are directed on scc in wet condition. In this investigation, V – funnel, slump flow, T50 & L- box tests are directed to know the workability of SCC in wet condition. Various types of tests can be directed on SCC in solid state. Flexural, split tensile and compressive strength tests are the three sorts of tests completed in this trial work. The test methodology for every one of the tests done on SCC in wet and solid state[EFNARC 2002] is given below.

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Figure 1: Slump flow test

Figure 2: V-funnel test

Figure 3: L-box test

Table 7. Requirements of SCC as per EFNARC Guidelines

Sl no	Properties	Units	Ranges
1	Slump flow	Mm	650-800
2	T50 slump flow	Sec	2-5
3	V- funnel	Sec	6-12
4	L-box	Ratio	0.8-1

Table 8: Workability Test Results

Sl no	Type of mix	Slump flow (mm)	T50 slump (sec)	V-funnel (sec)	L-box (h2/h1)
1	NCSCC	700	5	11	0.93
2	TBSCC	720	4	10.6	0.95

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VI. TESTS ON HARDEND CONCRETE

A. Compressive Strength

The different cement mixes fulfilling the rheological properties are casted and cured for 7, 28 and 56 days. The examples are fixed in compression testing machine (CTM) at that point a ultimate failure load is noted. The after effects of the compressive strength of normal SCC and triple blend SCC for different rates of glass fibers are resolved. The consequences of the compressive quality for various blends are entered in the Table 9 and variety of quality is given in Fig. 4 and 5.

Table 9. Compressive Strength of SCC

Sl no	Type of mix	Compressive strength (Mpa)		
		7 day	28 day	56 day
1	CSCC 0% GF	35.34	58.21	63.56
2	CSCC 0.1%GF	39.49	60.88	67.56
3	CSCC 0.2%GF	37.32	59.99	65.78
4	CSCC 0.3%GF	36.15	59.13	64.39
5	TBSCC 0% GF	34.21	56.98	64.44
6	TBSCC 0.1%GF	36.88	60.67	69.33
7	TBSCC 0.2%GF	35.98	59.78	66.24
8	TBSCC 0.3%GF	34.12	58.12	65.37

From the Table 9 following observation are made More Compressive strength obtained in the addition of 0.1% Glass fibers from both the type of mixes. At the 28th day Compressive strength obtained from CSCC is 60.88Mpa and from the TBSCC is 60.67Mpa but 56th day the strength in TBSCC is more when compared to CSCC that is in CSCC is 67.56Mpa and in TBSCC is 69.33Mpa.

B. Split Tensile Strength

The different cement mixes fulfilling the rheological properties are casted and cured for 7,28 and 56 days. The examples are tested in compressive testing machine (CTM) likewise a ultimate failure lode is recorded. The after effects of the split tensile of ordinary SCC and triple mixed SCC for different rates of glass fibers are resolved. The consequences of the split tensile for different mixes are given in the Table 10

Table 10. Split Tensile Strength of SCC

Sl no	Type of mix	Split tensile strength (Mpa)		
		7 day	28 day	56 day
1	CSCC 0% GF	2.80	4.89	5.31
2	CSCC 0.1%GF	3.09	5.56	6.02
3	CSCC 0.2%GF	2.87	5.31	5.60
4	CSCC 0.3%GF	2.81	5.18	5.41
5	TBSCC 0% GF	2.60	4.73	5.60
6	TBSCC 0.1%GF	2.85	5.45	6.31
7	TBSCC 0.2%GF	2.68	5.19	5.81
8	TBSCC 0.3%GF	2.62	4.91	5.73

From the Table 10 the following observations are made, Split tensile strength obtained more in the addition of 0.1% Glass fibers from both the type of mixes. At the 28th day Split tensile strength obtained from CSCC is 5.56Mpa and from the TBSCC is 5.45Mpa but 56th day the strength in TBSCC is more when compared to CSCC that is in CSCC is 6.02Mpa and in TBSCC is 6.31Mpa.

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C. Flexural Strength

The different cement mixes fulfilling the rheological properties are casted and cured for a time of 28 days. The samples are tested in loading frame equipment and a ultimate failure load and deflection are noted. The after effects of the flexural strength of ordinary SCC and triple blend SCC for different rates of glass fibers are resolved. The after effects of the flexural strength for different blends are given in the Tables 11.

Table 11. Flexural Strength of SCC

Sl no	Designation of the specimen	Load (KN)		Failure load (KN)
		First crack	Second crack	
1	CSCC 0% GF	47	96	120
2	CSCC 0.1%GF	58	102	136
3	CSCC 0.2%GF	52	98	127
4	CSCC 0.3%GF	49	94	124
5	TBSCC 0% GF	55	79	125
6	TBSCC 0.1%GF	62	109	142
7	TBSCC 0.2%GF	59	96	130
8	TBSCC 0.3%GF	51	92	126

From the Table 11 can observe at the 56th day Flexural strength obtained more in the addition of 0.1% Glass fibers from both the type of mixes. That is in CSCC the Flexural strength obtained 136KN and in TBSCC 142KN.

VII. CONCLUSIONS

1. The TBSCC displays great workability properties compared with CSCC. This is because of the higher substance of better particles, for example, GGBS & fly ash which is used as partial replacement of cement.
2. 0.1% Glass Fibers is found for optimum dosage of total volume of the mix.
3. Increasing in age of concrete (28 to 56days) in addition of 0.1% GF, the compressive strength was observed 2.48% more in TBSCC when compared with CSCC.
4. The final setting time of Fly Ash(FA) and GGBS was known to be higher than the cement, showing later strength.
5. The split tensile strength in addition of 0.1% GF was observed 5.01% more in TBSCC when compared with CSCC.
6. The flexural strength in addition of 0.1% GF was observed 8.52% more in TBSCC when compared with CSCC.
7. Additionally, it can be concluded that M-sand can be utilized as 100% replacement material for natural sand.

VIII. FUTURE SCOPE

- Apply various loading conditions and examine the crack patterns in RC SCC beam.
- To get the mechanical properties of high grade SCC utilizing other interchange cementitious materials at various rates.
- Utilization of different sorts of fibers to achieve the execution of SCC for different extent of proportions. To know the fresh & hardness properties of SCC for higher grade of concrete.
- Compare the strength behaviours with different sizes of RC SCC beams.

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