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EXPERIMENTAL STUDY OF S.C.C USING GGBS AS A ADMIXTURE AT VARIOUS PERCENTAGES FOR STANDARD CONCRETE

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Abstract-Ground granulated blast furnace slag (GGBS), due to its pozzolanic nature, could be a great asset for the modern construction needs, because slag concretes can be of high performance, if appropriately designed. The use of GGBS as a cementitious material as well as fine filler is being increasingly advocated for the production of High performance concrete (HPC), Roller compacted concrete (RCC) and Self compacting concrete (SCC), etc. However, for obtaining the required high performance in any of these concrete composites, slag should be properly proportioned so that the resulting concrete would satisfy both the strength and performance criteria requirements of the structure. The paper is an effort towards presenting a new mix design methodology for the design of self compacting GGBS concretes based on the efficiency concept. The methodology has already been successfully verified through a proper experimental investigation and the self compacting slag concretes were evaluated for their self compactability and strength characteristics. The results indicate that the proposed method can be capable of producing high quality SCC.

In this present experimental study M30&M40 design mix were made with replacement of 40%&50% GGBS, 24Cubes (150mmX150mmX150mm),24Cylinder (150mmX300mm) & 24Prisms (150mmX150mmX700mm). Were casted and tested for 7days & 28days**.**

Keywords- scc, ggbs, admixtures, plasticizers, strength

I. Introduction

General

Self – compacting concrete (SCC) is a fluid mixture, which is suitable for placing difficult conditions and also in congested reinforcement, without vibration. In principle, a self – compacting or self – consolidating concrete must:

- Have a fluidity that allows self – compaction without External energy
- Remain homogeneous in a form during and after the placing process and
- Flow easily through reinforcement

Self – consolidating concrete has recently been used in the pre – cast industry and in some commercial applications, however the relatively high material cost still hinders the wide spread use of such specialty concrete in various segments of the construction industry, including commercial and residential construction.

Compared with conventional concrete of similar mechanical properties, the material cost of SCC is more due to the relatively high demand of Cementation materials and chemical admixtures including high – range water reducing admixtures (HRWRA) and viscosity enhancing admixtures (VEA). Typically, the content in Cementation materials can vary between 450 and 525 Kg/m^3 for SCC targeted for the filling of highly restricted areas and for repair applications. Such applications require low aggregate volume to facilitate flow among restricted spacing without blockage and ensure the filling of the formwork without consolidation. The incorporation of high volumes of finely ground powder materials is necessary to enhance cohesiveness and increase the paste volume required for successful casting of SCC.

Proper selection of finely ground materials can enhance the packing density of solid particles and enable the reduction of water or HRWRA demand required to achieve high deformability. It can also reduce viscosity for a given consistency; especially in the case of SCC made with relatively low Water – Binder ratio. Reducing the free water can decrease the VEA dosage necessary for Stability.

High binder content typically includes substitutions of cement with 20 to 40% fly ash or GGBS and, in some cases low contents of micro silica employed. The cost of SCC can be reduced through the selection of adequate concrete - making materials and admixture constituents, including partial substitutions of cement and supplementary Cementations materials by readily available fillers.

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Regardless of its binder composition, SCC is characterized by its low yield value to secure high deformability, and moderate viscosity to provide uniform suspension of solid particles, both during casting and thereafter until setting. The mixture proportioning of SCC to simultaneously meet the various performance requirements at minimum cost involves the optimization of several mixture constituents that have a marked influence on performance. This process is quite complex and can be simplified by understanding the relative significance of various mixture parameters on key properties of SCC. This includes deformability, passing ability, filling capacity and segregation resistance.

Self-consolidating concrete or self-compacting concrete (SCC) is characterized by a low yield stress, high deformability, and moderate viscosity necessary to ensure uniform suspension of solid particles during transportation, placement (without external compaction), and thereafter until the concrete sets. Such concrete can be used for casting heavily reinforced sections, places where there can be no access to vibrators for compaction and in complex shapes of formwork which may otherwise be impossible to cast, giving a far superior surface than conventional concrete. .

The relatively high cost of material used in such concrete continues to hinder its widespread use in various segments of the construction industry, including commercial construction, however the productivity economics take over in achieving favorable performance benefits and works out to be economical in pre-cast industry. The incorporation of powder, including supplementary cementious materials and filler, can increase the volume of the paste, hence enhancing deformability, and can also increase the cohesiveness of the paste and stability of the concrete. The reduction in cement content and increase in packing density of materials finer than 80 µm, like fly ash, GGBS etc. can reduce the water-cement ratio, and the high-range water reducer (HRWR) demand. The reduction in free water can reduce the concentration of viscosity-enhancing admixture (VEA) necessary to ensure proper stability during casting and thereafter until the onset of hardening. It has been demonstrated that a total sand content of about 50% of total aggregate is favorable in designing for SCC

II. Literature Review

H. Venkataram Pai et al [1]: . Have experimentally aimed at producing SCC mixes of M25 grade by using the Modified Nan Su method, incorporating five mineral admixtures. This paper gives the comparison of these SCC mixes in terms of their properties. They have concluded that modified Nan Su method of developing SCC, the quantity of the powder mainly depends on the specific gravity and consistency of the powder itself. The SCC mix containing GGBS exhibiting greater strength could be because of the high pozzolonic activity of GGBS like compressive, split tensile, and flexural strengths. The fresh concrete properties are also included in the study.

Dr. DinakarPasla et al [2]: . Presented new mix design methodology for the design of self-compacting GGBS concretes based on the efficiency concept. In this study a new mix design methodology for the design of self-compacting concrete with ground granulated blast furnace slag (GGBFS) for percentage replacements varying between 20-80%. The results of the self-compacting GGBS 60 MPa concrete show even at 60% replacement, showed strength gain rate similar to normal concrete and attained target strength at 28 days and attained strengths much higher than normal concrete at 90 days.

Ganesh Babu et al [3]: Aimed to quantify the 28-days cementitious efficiency of ground granulated blast furnace slag (GGBFS) in concrete at the various replacement levels. From the results of the investigations reported that replacement levels in the concrete studied varied from 10% to 80% and the strength efficiencies at the 28 days were calculated. Finally concluded that the prediction of the strength of concretes varying from 20to 100 MPa with GGBFS levels varying from 10% to 80%.

Mallikarjuna Reddy V et al [4]: Investigated on the workability and mechanical properties of self-compacting concrete. In this research mix design used is based on NAN-SU method. This study represents specifications of the mixes used for obtaining the workability, compressive strength, split tensile strength and flexural strength of self-compacting concrete. From the result it is concluded that, Required minimum slump is achieved for a w/c ratio of 0.23 with optimum strength for M70 grade high strength self compacting concrete.

Mr. Dhruvkumar H. Patel et al [5]: According to study the use of Ground granulated blast furnace slag (GGBS) as a replacement of cement and understand its effects on the fresh properties, compressive strength weathering. The study also intended to quantify the amount of Ground granulated blast furnace slag (GGBS) to be added to the concrete according to the value of concrete properties Measured. The workability of self- compacted concrete is increased as content of GGBS increased. Compressive strength of SCC with GGBS is increased up to 10% replacement of cement with GGBS and also mineral admixture replacements have a better workable concrete.

III. Scope and Objective of Investigation

Involves to find the effect of GGBS (ground granulated blast furnace slag) when replace with cement of 40% and 50% percentages for both M30 & M40 grades, mainly to increase the compressive strength and bring down the emission of gas such as co_2 & cost & make the concrete cost effective.

In general increasing the CaO content of the slag results in raised slag basicity and an increase in compressive strength.

Adding super plasticizer as poly carboxylic either (ADVA960) is a (retarder) used to increase the initial setting time and the secondary effect reduce the W/C ratio 20% to 30%.

The mix designs calculated for SCC M30 & SCC M40 for replacing 40% & 50% ggbs by using IS10262-2009 code.

This experiment is made to the self compacting ability by conducting test such as slump flow test, L box test, v box test when it replaced by GGBS and calculating the compressive strength by changing W/C ratio.

IV. Poly Carboxylic Ether

For the past 5 years the super plasticizers which are widely used to enhance the plasticity or fluidity of the concrete

To increase its strength. Apart from our range of Super plasticizers which include Sulphonated Melamine Formaldehyde (SMF), Sulphonated Naphthalene Formaldehyde (SNF), we also manufacturing the third Generation of Super plasticizers i.e. Ultra plasticizers called the Polycarboxylic Ether (PCE).

Polycarboxylic Ether Super Plasticizer show extremely high water reduction in concrete with improved workability and increase in strength by almost 20-30% depending on use. These show good workability in concrete at even at water cement ratios as low as 0.23.

V. Viscosity Modifying Admixtures for Pumping Concrete

For both economic and technical reasons pumped concrete has gained increasing importance over recent years but as a result of developments in construction practice,

The requirements on pumped concrete have become more demanding and have approached the limits of normal concrete technology.

VMA is used to meet these demands and to reduce fluctuations in concrete performance.

The most common problem with pumping concrete occurs when the coarse aggregate particles start to lock together, usually at a bend or other slight constriction.

VI. Properties of Fresh SCC

SCC differs from conventional concrete in that its fresh properties are vital in deter mining whether or not it can be placed satisfactorily. The various aspects of workability which control its filling ability, its passing ability and its Segregation resistance all need to be carefully controlled to ensure that its ability to be placed remains acceptable.

s.no	volume of dry loose sand v1	% moisture content added	volume of wet loose sand v2	% bulking (v2-v1)/v1
1	200ml	2%	150	33.3
2	200ml	4%	154	28.2
3	200ml	6%	156	29.9

Sl.No	Trails	Slump In Mm
1	SCCM30@ GGBS 40%	710
2	SCCM30@ GGBS 40%	698
3	SCCM30@ GGBS 40%	690
5	SCCM30@GGBS 50%	715
6	SCCM30@GGBS 50%	728
7	SCCM40@ GGBS 40%	766
8	SCCM40 @GGBS 40%	745
9	SCCM40 @GGBS 40%	733
10	SCCM40 @GGBS 50%	783
11	SCCM40 @GGBS 50%	765
12	SCCM40 @GGBS 50%	773

VII. Tests results on fresh scc

V-funnel flow time t_V [sec]	3	5	7	10	≥ 15
Repeatability r [sec]	0.38	1.05	1.7	2.7	4.4
Reproducibility R [sec]	0.58	1.56	2.57	4.07	6.58

Precisions of the L-box passing or blocking ratio

Passing ratio PL	1	0.9	0.8	0.7	<0.65
Blocking ratioBL	0	0.1	0.2	0.3	>0.35
Repeatability r	0.01	0.06	0.10	0.15	0.18
Reproducibility R	0.03	0.07	0.11	0.16	0.18

Mixing Ratio

(Ggbs+Cement): Fine Aggregate: Course Aggregate: W/C Ratio

(0.50+0.50)= 1 :1.64:2.74:0.36

Mix design ratios for M30 and M40 replacing 40%&50% ggbs :-

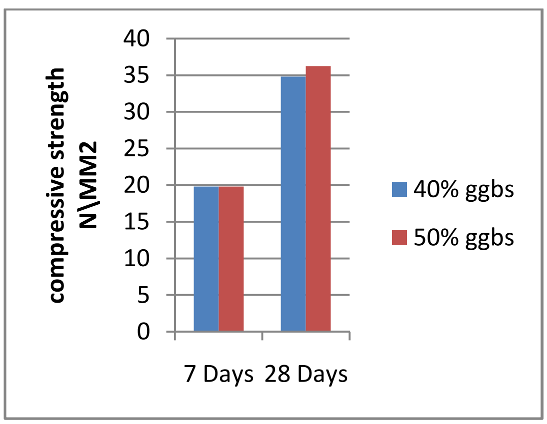
S. No	Mix	(Cement+g	F. A	C. A	S.P %	W/C	VMA %

		gbs)					
1	M30 SCC40% GGBS	1	2. 32	2. 95	2	0.41	0.5
2	M30SCC 50% GGBS	1	2. 28	2. 91	2	0.41	0.5
3	M40 SCC40% GGBS	1	1. 67	2. 73	2	0.36	0.5
4	M40SCC 50% GGBS	1	1. 69	2. 77	2	0.36	0.5

VII. Test Results

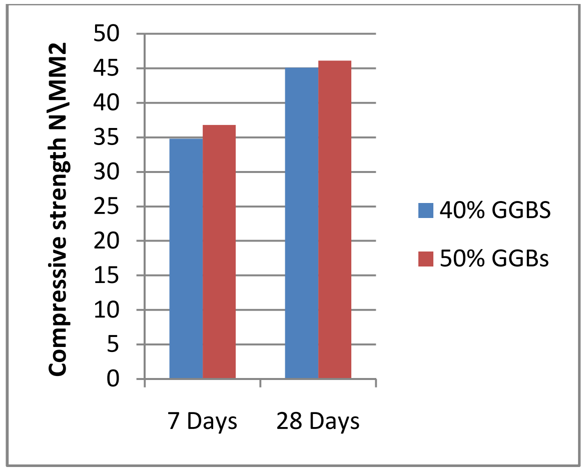
M30 Compressive Strength Replacing GGBS

S.NO	Cube Size	GGBS %	7 Days N/MM^2	28Days N/MM^2
1	150mmx150mm X150mm	40%	19.80	34.80
2	150mmx150mm X150mm	50%	19.80	36.24



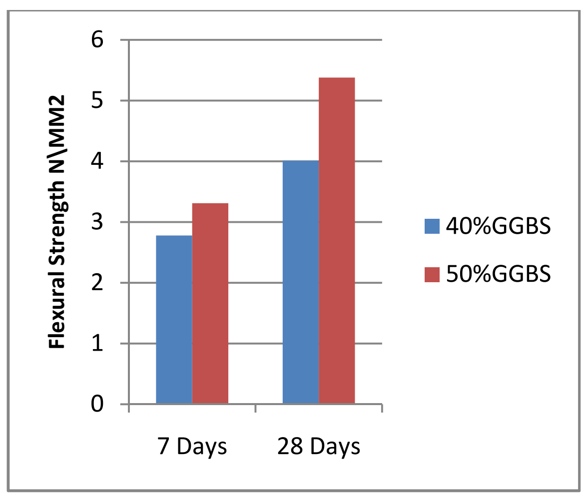
M40 Compressive Strength Replacing 40%&50% ggbs

S.NO	Cube Size	Ggbs	7 Days N/MM^2	28Days N/MM^2
1	150mmx150mm x150mm	40%	34.80	45.10
2	150mmx150mm x150mm	50%	36.80	46.10



Flexural strength of prism After Replacing M30 withGGBS

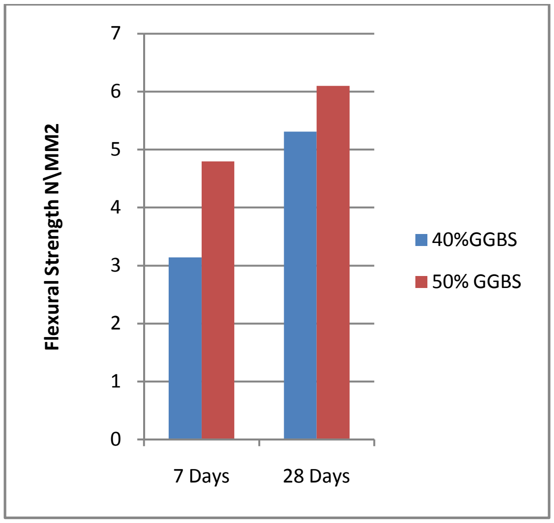
S.NO	Prism Size	GGBS	7 Days N/MM^2	28Days N/MM^2
1	150mmx150mm x700mm	40%	2.78	4.01
2	150mmx150mm x700mm	50%	3.31	5.38



Flexural strength of prism After Replacing M40 with GGBS

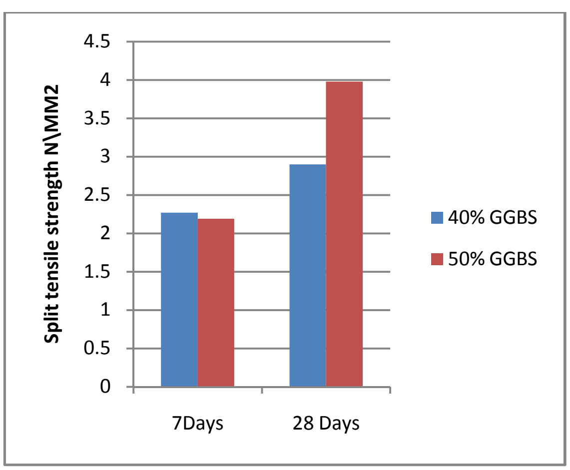
S.NO	Prism Size	Ggbs	7 Days N/MM^2	28Days N/MM^2

1	150mmx150mm x700mm	40%	3.14	5.31
2	150mmx150mm x700mm	50%	4.8	6.1



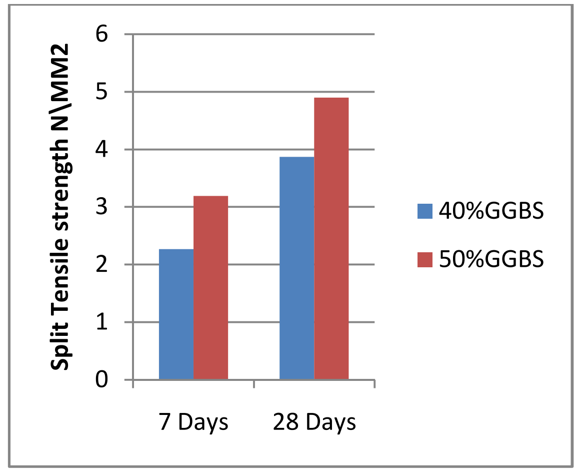
Split Tensile of Cylinder after Replacing M30 with GGBS

S.NO	Cylinder Size	ggbs	7 Days N/MM^2	28Days N/MM^2
1	150mmx300mm	40%	2.27	2.90
2	150mmx300mm	50%	2.19	3.98



Split Tensile of Cylinder After Replacing M40 with GGBS

S.NO	Cylinder Size	GGBS	7 Days N/MM^2	28Days N/MM^2
1	150mmx300mm	40%	2.27	3.87
2	150mmx300mm	50%	3.19	4.9



VIII. Conclusion

When compare to the previous papers test's on replacing GGBS above 30% the compressive strength have reduced, for every interval of replacing 5%.AddedConplast SP430 as super plasticizer and maintained w/c ratio is kept constant throughout the investigation as 0.45.

As per Results suggest that as much of 50% of cement can be replaced without any significant consequences on the concrete, by using the chemical admixture as super plasticizer ADVA960 (poly carboxylic either) is a retarder increase the initial setting time

Compressive strength is increased by replacing 50% of GGBS for cement and maintained w/c ratio as per mix design obtained, the mineral admixture replacement have a better workable concrete.

Flexural and split tensile strength were improved with addition of ggbs

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