International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 5 ǁ May 2023 ǁ PP. 800-805

Partial Replacement of Cement with GGBS in Concrete

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Abstract— *In this present construction era concrete is the most used construction material in the world. Concrete is consumed widely that it is second most consumed material after the water in terms of per-capita consumption. As the pollution is increasing and the environmental sustainability is affected, researchers are seeking for other materials to reduce the consumption of cement. GGBS is one of these supplementary materials used to replace with cement to reduce the consumption of the cement.*
Keywords— GGBS, Compressive Strength, Workabality, eco-friendly, GGBS Concrete, Slump variation & Admixture.

Date of Submission: 14-05-2023 Date of acceptance: 26-05-2023

I. INTRODUCTION

Concrete is the most world widely used construction material. The increase in Demand of concrete more the new method and materials are being developed for production of concrete. Concrete is a mixture of cement, water, and aggregates with or without chemical admixtures. The most important part of concrete is the cement. Use of cement alone as a binder material produces large heat of hydration. Since the production of this raw material produces lot of CO_2 emission. The carbon dioxide emission from the cement raw material is very harmful to the environmental changes. Nowadays many researchers have been carried out to reduce the CO_2. The effective way of reducing CO_2 emission from the cement industry is to use the industrial by products or use of supplementary cementing material such as Ground Granulated Blast Furnace Slag (GGBS), Fly Ash (FA), Silica Fume (SF) and Metakaolin (MK). In this present experimental Work, an attempt is made to replace cement by GGBS to overcome these problems.

II. OBJECTIVES

A. *To use GGBS in concrete by partial replacement of cement.*
B. *To determine compressive strength of concrete.*
C. *To determine the workability of the concrete partial replacing the cement by GGBS.*
D. *To provide economical construction material.*
E. *To provide safe guard to the environment by utilizing waste properly*

III. MATERIALS

A) Cement

Ordinary Portland cement of 53 grade was used in this study confirming to IS12269-1987 the specific gravity of cement is 3.15 the initial and final setting time were found as 30 minutes and 600 minutes respectively standard consistency of cement wash 30%.

B) Fine Aggregate

The M sand is used as aggregate confirming to the requirements of IS 2386 (Part-III)-1963 having specific gravity of 2.60 fineness modulus of 5.02 has been used as saying aggregate for this study.

C) Coarse Aggregate

Coarse aggregate obtained from local quarry unit has been used for this study, confirming to IS-2386(Part-III)-1963 is used maximum size of aggregate used is 20 mm with specific gravity of 2.65

D) GGBS (Ground Granulated Blast Furnace Slag)

Ground granulated blast furnace slag, a co-product produced simultaneously with iron, molten blast furnace slag is cooled instantaneously by quenching in large volumes of cold water, known as granulation, to produce Granulated blast furnace slag.

Table -1: Chemical composition of (GGBS)

Content	Cao	Al_2o_3	Fe_2o_3	Sio_2
GGBS	37.34%	14.42%	1.11%	37.73%

Table -2: Physical properties of (GGBS)

SI. No.	**Test Conducted**	**Test Results**	**Requirement as per IS:16714-2018**
1	Specific Gravity	2.82	Not Specified
2	Fineness, m^2/kg,	362	Minimum 320
3	Slag Activity Index (%)		
	7 days	71.0	Not less than 60 percent of control OPC 43 Grade cement mortar cube
	28 days	89.5	Not less than 75 percent of control OPC43 Grade cement mortar cube

E) Water

The Water used for experiments was portable water confirming as per IS 456:2000.

F) Plasticizer

Fosroc ConPlast SP 430 DIS used as a Plasticizer, it has high-performance admixture used in concrete to improve its workability and durability. It is a specially formulated water-reducing and plasticizing agent that enhances the flow and consistency of concrete, making it easier to pour and shape. It also reduces the amount of water required in the mix, which results in stronger and more durable concrete.

IV. METHODOLOGY

Flow Diagram of Methodology

DATA COLLECTION

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SELECTION OF MATERIALS

↓

BASIC TESTS ON MATERIALS

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PREPARATION OF MIX DESIGN

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CASTING SPECIMEN

↓

TESTING ON SPECIMEN

↓

RESULTS

Fig 3.1 Flow Diagram of Methodology

PREPARATION OF CONCRETE MIXTURE

By referring to IS 10262-2019 and IS 456-2000, the mix design is carried out for M30 and M40 grade of concrete. The required materials are batched based on the values obtained by mix design. At first, the mix design values are calculated for 1 m^3 volume and then it is computed for standard cube moulds of size 150x150x150 mm.

The materials which are free from the organic impurities were sieved before batching and after that, the mixing is done. The calculated amount of materials is taken and dry mixing is done and then required amount of water is added and mixed thoroughly to make a concrete. In this work, hand mixing is used for mixing the materials.

After casting, the cubes are demolded in the laboratory after 24 hours of casting. During demolding, the care should be taken so as to not affect the concrete cubes, as they may lead to the development of cracks due to improper demolding. After demolding, the concrete cubes are kept in water for curing for 28 days. The compression tests are conducted on hardened concrete for 28 days.


Fig 4.2 Preparing Moulds


Fig 4.3 Casting


Fig 4.4 After Demoulding.

FRESH CONCRETE TEST

SLUMP CONE TEST: concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check the workability of freshly made concrete. The procedure for the test is asfollows:

1. Clean the internal surface of the mould and apply oil.
2. Place the mould on a smooth horizontal non- porous base plate.
3. Fill the mould with the prepared concrete mix in 4 approximately equal layers.
4. Tamp each layer with 25 strokes of the rounded end of the tamping rod in a uniform manner over the cross section of the mould. For the subsequent layers, the tamping should penetrate into the underlying layer.
5. Remove the excess concrete and level the surface with a trowel.
6. Clean away the mortar or water leaked out between the mould and the base plate.
7. Raise the mould from the concrete immediately and slowly in vertical direction.
8. Measure the slump as the difference between the height of the mould and that of height point of the specimen being tested.

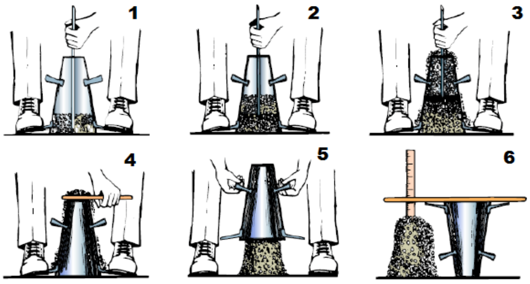

Fig 4.5 Slump Test

V. RESULTS

Slump Cone Test

The concrete slump test measures the consistency of fresh concrete before it sets. It performed to check the workability of freshly made concrete, and therefore the case with which flows. It can also be used as an indicator of an improperly mixed batch.

Table 5.1 Slump cone Test for M30 Table

SL NO	% of GGBS	Slump value(mm)
1	Normal concrete	62
2	20%GGBS	68
3	30%GGBS	74
4	40%GGBS	78

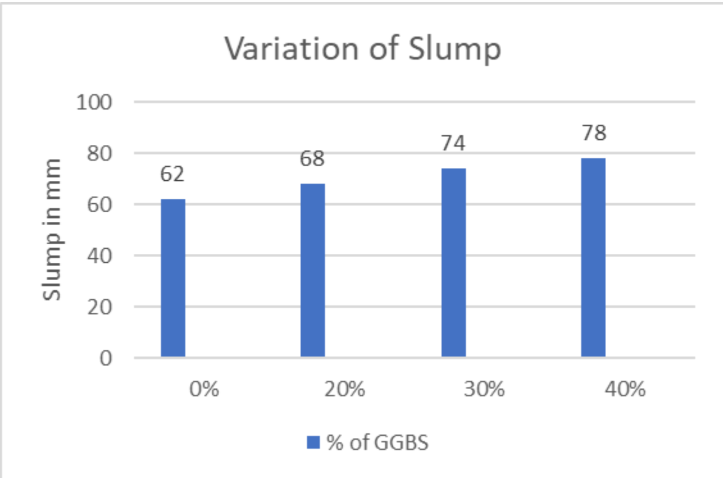

Fig 5.2 Variation of Slump of M30

Table 5.2 Slump cone Test for M40 Table

SL NO	% of GGBS	Slump value(mm)
1	Normal concrete	60
2	20%GGBS	63
3	30%GGBS	68
4	40%GGBS	73

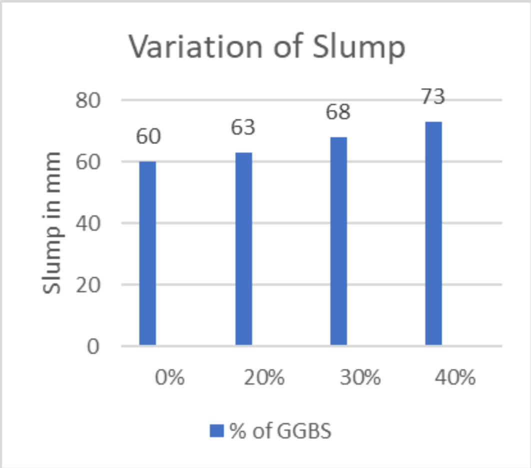

Fig 5.3 Variation of Slump of M40

Compressive Strength Test

Table 5.3 M30 Grade Compressive Strength Results Test Table

% Replacement of cement with GGBS	**Compressive strength at 28 days**
0% (Normal concrete)	31
20%	31.5
30%	32.6
40%	30.12

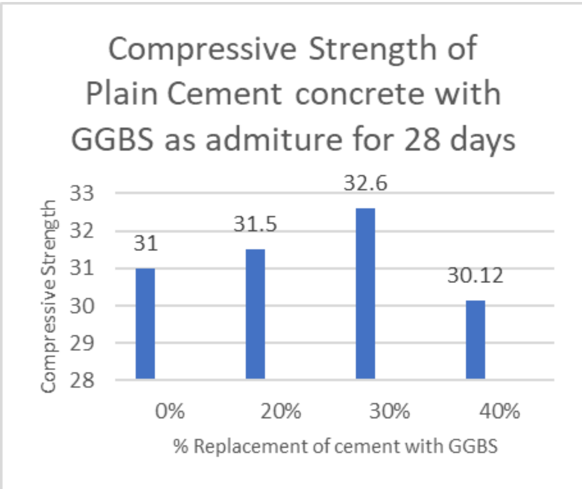

Fig 5.5 Compressive Strength of Plain Cement Concrete with GGBS as admixture for 28 days

Table 5.4 M40 Grade Compressive Strength Results Test Table

% Replacement of cement with GGBS	**Compressive strength at 28 days**
0% (Normal concrete)	40.6
20%	42.67
30%	43.8
40%	38.28

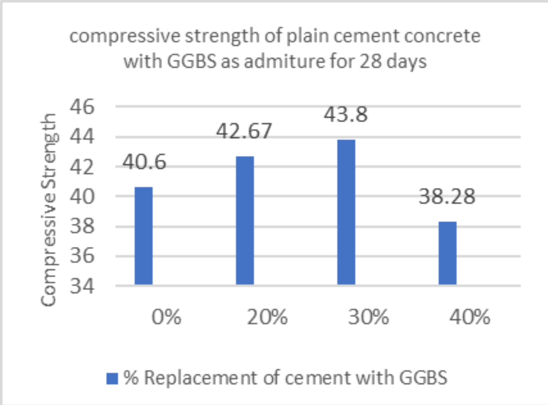

Fig5.6 Comparison between compressive strength of plain cement concrete with GGBS as admixture for 28 days

IV. CONCLUSION

Based on the experiments conducted and according to the results obtained, the following are the conclusions that can be drawn:

- Workability of concrete increases with the increase in the GGBS replacement level.
- The compressive strength of concrete is increased for the replacement of GGBS up to 30%.
- Beyond 30% of replacement of GGBS with cement the compressive strength decreases of concrete.
- It is observed that the strength level increases at 20% and 30% replacement of GGBS and falls at 40% replacement for compressive strength.

REFERENCES

[1]. Chaithra H L Pramod K Dr Chandrashekar A (2015) "An Experimental Study on Partial Replacement of Cement by GGBS in concrete" IJERT Vol.4 Issue 05May-2015.
[2]. J Vengadesh Marshall Raman, V Murali Krishnan (2017) "Partial Replacement of Cement with GGBS in Self Compacting Concrete for Sustainable" (SSRG – IJCE) – Volume 4 Issue 3 – March 2017.
[3]. Kasu Naveena, K. Anantha Lakshmi (2017) "Partial Replacement of Cement with GGBS And Metakaolin" ISSN: 2394-2827 Volume-4, Issue-2 April-2017.
[4]. Shreyas K (2017) "Characteristics of GGBS as an Alternate Material in Conventional Concrete" IJCRT Volume 5, Issue 4 December 2017.
[5]. M. N. Bajad, Sarang Sakhare (2018) International Journal of Civil Engineering and Technology (IJCIET) Volume 9, Issue 6, June 2018
[6]. IS:10262-2019 Recommended guidelines for concrete mix design, Bureau of Indian standard, New Delhi.
[7]. IS: 2386 (Part III) 1963 "specification for coarse and fine aggregate from natural sources for concrete",BIS, New Delhi.
[8]. IS 456: 2000 Indian Standard Plain and Reinforced Concrete - Code of Practice (Fourth Revision).