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Experimental Study of Partial Replacement of Cement with GGBS and Silico Manganese with M30 Grade Concrete

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Abstract: ***Cement in concrete is a several disadvantages when used without any replacement to it in concrete such as high carbon footprint high cost of construction, and low tensile strength. To address these materials such as GGBS, and silico manganese can be used, designing concrete mixtures with lower cement content can reduce the carbon print, cost, and potential cracking, resulting in more sustainable, cost effective and durable concrete structures. In our project we are going to use GGBS (Ground granulated blast furnace slag) and silico manganese as a replacement of materials to cement in varying percentage. GGBS and silico manganese cementitious properties and can particularly replace cement in concrete mixtures. It improves the durability, workability, and strength of concrete. GGBS has a lower carbon footprint than traditional cement, making it an environmentally friendly alternative. Silico manganese is the process involves high temperature to melt the raw materials and reduce them to their metallic forms. This project represents the results of an experimental investigations accomplish to understand the suitability of GGBS and Silico manganese on strength of referral concrete M30 Grade concrete was prepared by replacing PART OF 0%, 30%, 40%, 50% (by weight of cement) for GGBS and Silico manganese. Fresh concrete was properties viz. slump cone was carried out. Strength of concrete were determined by performing compressive strength test on (150mm×150mm×150mm) size cubes.***

Keywords: ***GGBS, Silico manganese, partial replacement, compressive strength, M30 Grade concrete***

I. INTRODUCTION

Concrete has been the major instrument for providing stable and reliable infrastructure since the days of Greek and civilization. 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.

A. Ground granulated blast furnace slag (GGBS)

Partial replacement of cement with ground granulated blast furnace slag (GGBS) is a technique that has gained popularity in the construction industry due to its numerous benefits. GGBS is a by product of iron and steel industry, produced by quenching molten slag from a slag from a blast furnace with water or stream, which results in a granular material. It has cementitious properties and can partially replace Portland cement in concrete mixes.

B. Silico Manganese

Silico manganese, a byproduct of ferroalloys, has been exploded as a potential replacement for cement in concrete mixing due to its pozzolanic properties. When used in concrete, reacts with calcium hydroxide to form calcium silicate hydrate, contributing to the strength and durability of concrete. This substitution can reduce the environmental impact of concrete production by utilizing industrial byproducts and decreasing cement consumption. However careful testing and optimization are necessary to ensure the desired properties of the concrete mix are maintained.

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II. REASEARCH ON GGBS & SILICO MANAGNESE

A. *Ground granulated blast furnace slag (GGBS)*

The use of GGBS in concrete has several advantages. Firstly, it significantly reduces the amount of Portland cement needed in the mix, thus reducing the carbon footprint of concrete production. This is because of the production of port land cement requires high temperatures and releases significant amounts of carbon dioxide in to the atmosphere. By replacing of some of cement with GGBS, the amount of port land cement. GGBS can improves the long-term strength of concrete. This is because it reacts with calcium hydroxide, a by product of the hydration of port land cement, to form additional cementitious compounds. The results increased strength over time, making the concrete more durable and long-lasting.

B. *Silico manganese*

The partial replacement of cement with silico manganese offers several advantages in terms of cost effectiveness, mechanical properties enhancement, sustainability, workability, mitigation of alkali-silica reaction, reduction of heat of hydration. However, its essential to consider factors such as proper mix design, material compatibility, and local regulations when incorporating silico manganese into concrete mixes.

III. MATERIALS USED

Materials that are used for making concrete for this study were tested before casting the specimen. The preliminary tests used for making concrete for this study were tested before casting the specimen. The preliminary tests were conducted for the following materials.

1) Cement

Table No.1 properties of cement

Properties	Results
Grade	53 Grade OPC
Initial setting time	45min
Final setting time	625min
Normal consistency	32%
Specific Gravity	3.15

2) Fine aggregate

Table No.2 properties of F.A

Properties	Results
Specific Gravity	2.62
Water absorption	1.43%

3) Coarse aggregate

Table No.3 properties of C.A

Properties	Results
Specific Gravity	2.76
Water absorption	0.51%

4) Ground granulated blast furnace slag (GGBS)

Table No.4 properties of GGBS

Properties	Results
Specific Gravity	2.85
Initial setting time	80 min
Final setting time	300min

5) Silico manganese

Table No.5 properties of silico manganese

Properties	Results
Specific Gravity	2.9
Initial setting time	70min
Final setting time	325min

6) Mix Design

Table No.6 mix design:

Grade of concrete	53 Grade OPC
Cementitious material	31.364kg
GGBS (@30%,40%, 50%)	28.22kg
Silico manganese (@30%, 40%, 50%)	28.22kg
Fine aggregate	60.624kg
Coarse aggregate	82.17kg
water	14.085litres

IV. RESULTS AND DISCUSSIONS

In this research we present found on to investigate the strength properties of GGBS and Silico manganese. The partial replacement of GGBS and silico replacement of GGBS and silico manganese with cement is performed in this experiment. M30 grade of concrete is used in these experimental 30%, 40%, 50% of GGBS and Silico manganese were used as an cement replacement. The specimens for testing were prepared the cubes are cured for 7&28 days.

Compressive strength

Average of 3 cubes formula:

Compressive strength = Load / Area of cube (150*150mm²)

1) Conventional concrete:

Compressive strength is calculated in N/Mm²

Material replacement (0%)	7 days	28 days
Nominal cubes	13.18	31.40

2) 30% GGBS and Silico manganese:

Compressive strength is calculated in N/Mm²

Materials replacement (30%)	7 days	28 days
GGBS	19.26	31.85
Silico manganese	19.32	32.36

3) 40% GGBS and silico manganese:

Compressive strength is calculated in N/Mm²

Materials replacement (40%)	7 days	28 days
GGBS	20.28	32.56
Silico manganese	21.32	33.26

4) 50% GGBS and silico manganese:

Compressive strength is calculated in N/Mm²

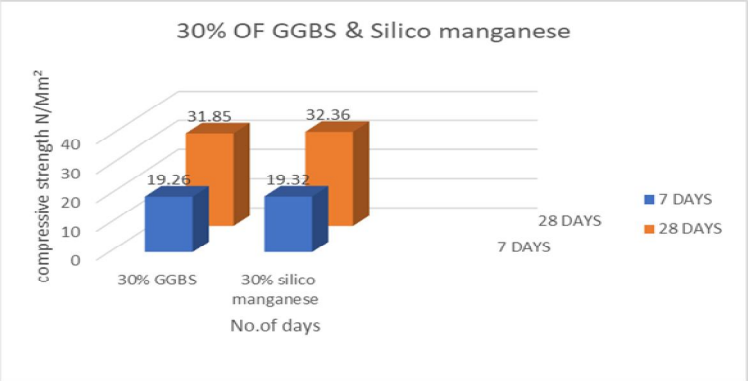
Materials replacement (50%)	7 days	28 days
GGBS	22.20	34.26
Silico manganese	23.16	34.52

V. GRAPHS

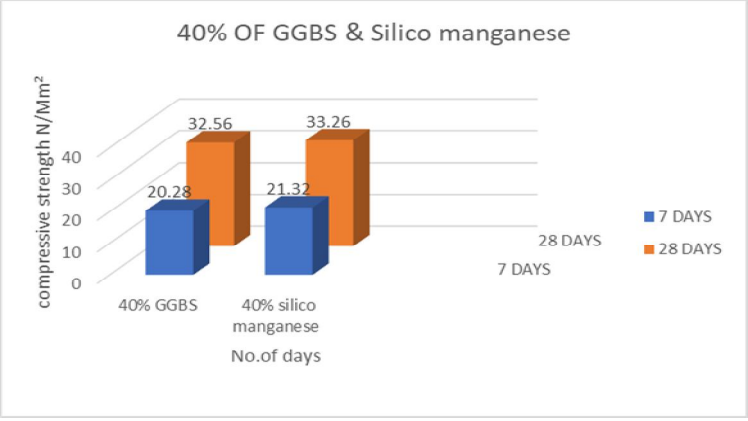
Graph is plotted between conventional concrete, 30%, 40%, 50% of GGBS & Silico manganese and days of curing Conventional concrete



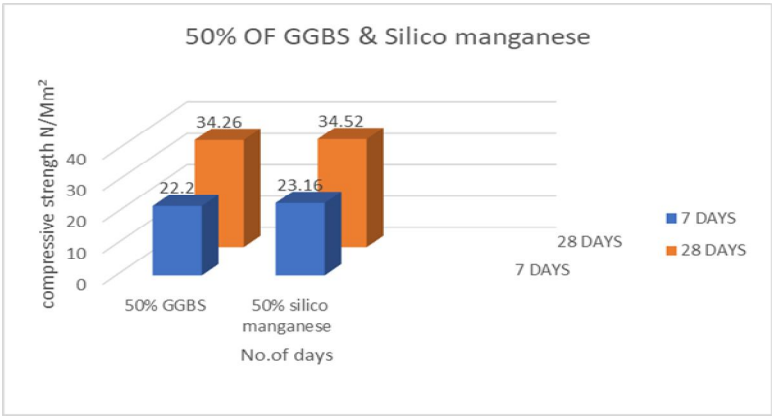
1) 30% of GGBS & Silico manganese:



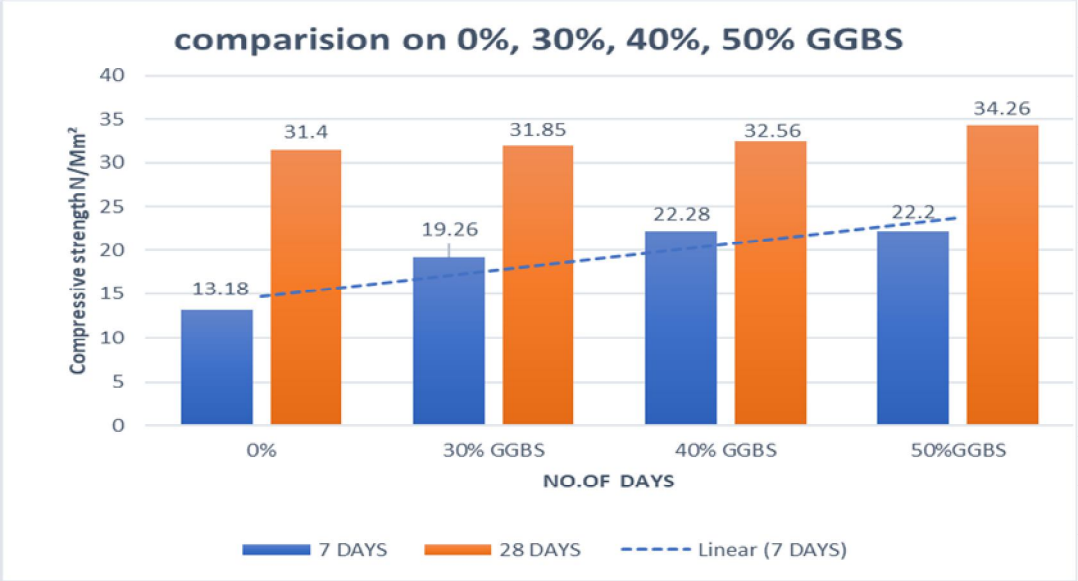
2) 40% of GGBS and Silico manganese:



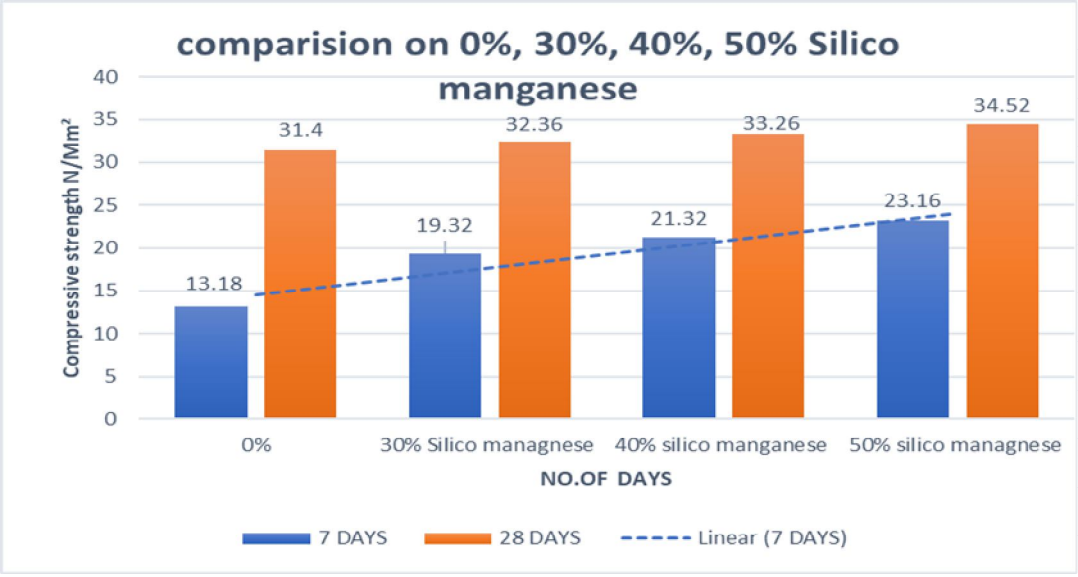
3) *50% of GGBS and Silico manganese:*



4) *Compressive strength for 7 days and 28 days of CC, 30%GGBS, 40%GGBS, 50% GGBS*



5) *Compressive strength for 7 days &28 days of CC, 30%silico manganese, 40%silico managnese, 50%silico manganese*



VI. CONCLUSION

From the above study, we conclude the compressive strength of concrete cubes has gradually increased up to addition of 50% of GGBS & Silico manganese. Compared to compressive strengths of 30%, 40% and 50% of GGBS and silico manganese the compressive strength of conventional concrete is less. As per our study, the 7 days of compressive strength of 30%, 40% of GGBS is equal to nearly 28 days of compressive strength conventional concrete. The gain in the compressive strength is improve depending upon the replacement of fly-ash based cement with GGBS and Silico manganese. The cement replacement of GGBS and silico manganese generally improves bond strength. The increase in the individual properties depends upon the replacement level. The GGBS and Silico manganese in concrete can allow major carbon dioxide reduction and also increases the service life of concrete structures. Concrete made with GGBS and Silico manganese cements are more slowly as compared to ordinary concrete and its setting time depends upon the amount of GGBS and Silico manganese in the cementitious materials, but it endures to gain strength over a longer period.

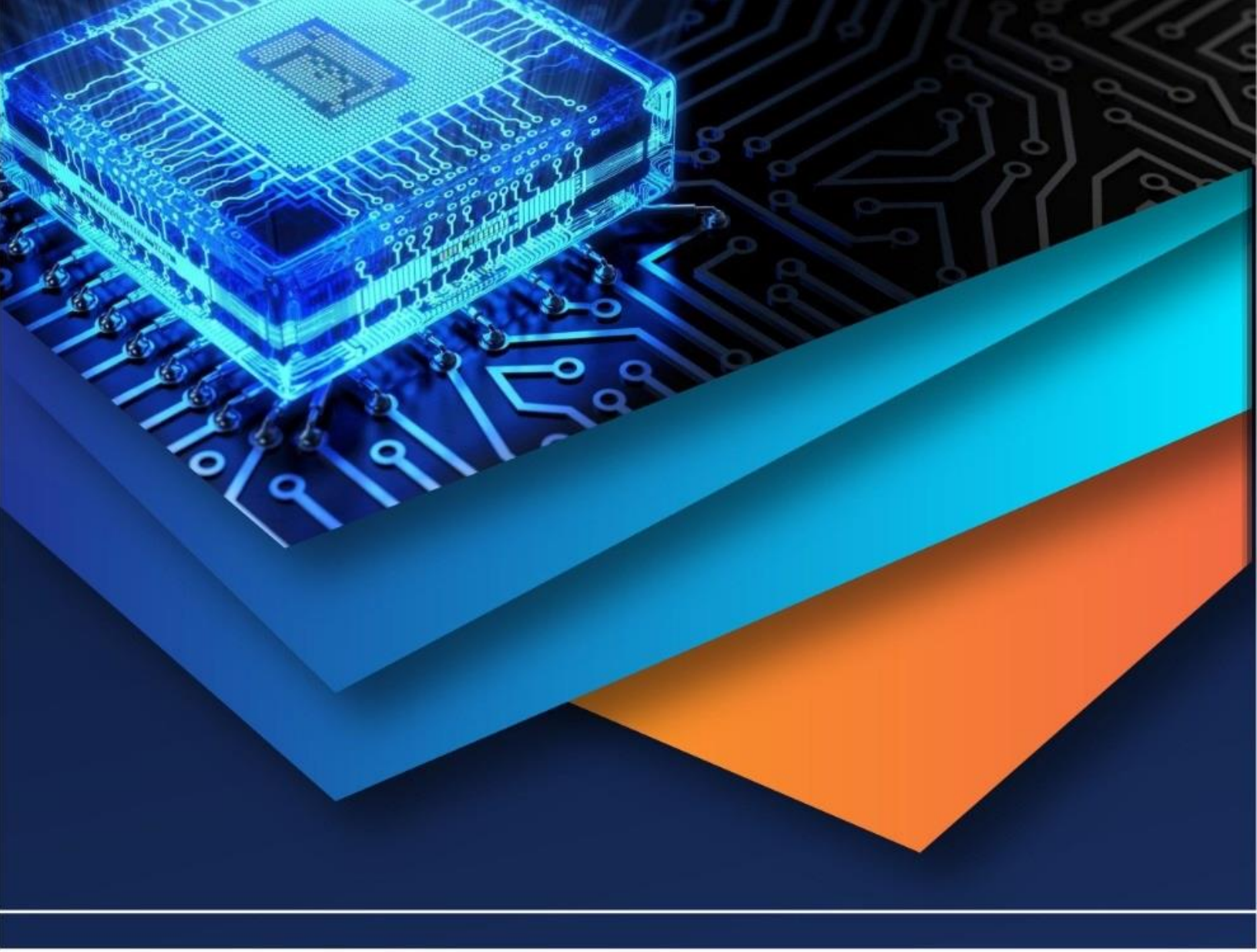
VII. ACKNOWLEDGMENT

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