A REVIEW PAPER ON EFFECTS OF MIXING M-SAND AND GGBS AS A PARTIAL REPLACEMENT OF FINE AGGERGATE AND CEMENT ON PROPERTIES OF CONCRETE

Anshul kumar Shrivastava[1], Pankaj Chakravarti[2],Kamlesh kumar chuodhary[3]
*(M.Tech Student, Department of civil engineering, Saraswati Institute of Engineering & Technology, Jabalpur, India
Email: shrianshul91@gmail.com
**(Assistant Professor of civil engineering Department, Saraswati Institute of Engineering & Technology, Jabalpur, India
Email: chakravartipankaj98@gmail.com
***(HOD & Assistant Professor of civil engineering Department, Saraswati Institute of Engineering & Technology, Jabalpur, India
Email: prof.kamlesh.siet@gmail.com

***Abstract:** As is well knowledge, the components of concrete, a building material used in civil engineering, are binding agent, water, and coarse aggregate. Taking into account all of its aspects from preparation to recycling, it provides an excellent contribution to sustainable development. The research is conducted using synthetic sand, especially in light of environmental concerns. due to the depletion of natural resources limited resources, environmental considerations, and a lack of the highest quality Artificial sand can be one of the best substitutes for natural river sand, which forces concrete manufacturers to search for an acceptable alternative to fine-aggregate. The goal of the concrete industry is to reduce the damaging carbon dioxide emissions by using additional cementitious materials or industrial by-products that have disposal issues and pose a threat to the environment.. The solid wastes produced by industry, known as ground-granulated blast-furnace slag (GGBS), are utilized as a substitute for cement. As the properties of GGBS is very similar to that of cement that makes it the best substitute of cement. The partial replacement of cement with GGBS and sand with manufactured sand , the comparison is done with that of conventional concrete and differences will be presented in this study.*

***Keywords** — compressive strength, ground granulated blast furnace slag (GGBS), manufactured sand (M-sand) and fine aggregate workability, Compressive strength, Split tensile strength, Flexural strength.*

I. INTRODUCTION

Concrete is one of the most used building materials with a strong compressive strength. The primary ingredient used to create concrete is ordinary Portland cement (OPC). About two tonnes of shale and limestone are needed to make one tonne of cement, and a significant amount of carbon dioxide is also released into the atmosphere during cement production, which contributes to greenhouse gas emissions . The replacement of ground-granulated blast-furnace slag (GGBS), an industrial waste byproduct utilized as an additional cementitious component in concrete, is one way to lower the carbon dioxide emissions from the material. By substituting some of the cement with these pozzolonic elements, additional cementitious materials not only enhance the mechanical qualities of concrete but also lower the consumption of cement. Additionally, because it is becoming harder to find conventional fine aggregate river sand, its excessive use degrades riverbeds and lowers ground water recharge. The usage of manufactured sand, which is made from granite stone and is significantly superior than river sand in every way, as a fine aggregate has fully replaced the use of river sand. An effort has been made to balance out these two difficulties make concrete using additional and substitute materials. The purpose of this research is to ascertain the mechanical and durability properties of cement, GGBS, aggregates, and manufactured sand.

II OBJECTIVES OF THE STUDY

The objectives of the study are:

- Partial Replacement of FA with M-Sand and cement by GGBS.
- To find the workability of concrete for different percentage replacement of M-Sand and GGBS.
- . The replacement of cement by GGBFS is in the scale of 0% to 50% through self weight of Cement for a mix.
- The flexural behavior, Compressive-strength, and Split tensile-strength behavior should be studied by using available equipments in the laboratory. To determine the strength properties of concrete for different percentage replacement of M-Sand and GGBFS.

III LITERATURE REVIEW

Himanshu Mishra, Kamlesh Kumar Choudhary (2022)
The feasibility of employing granite dust, copper slag, and iron dust as a partial replacement of sand in concrete has been explored through an experimental inquiry. Concrete containing Granite Dust (GD), Copper Slag (CS), and Iron Dust (ID) totaled 27 cubes and 9 beams in total tested Granite dust (GD), copper slag (CS), and iron dust (ID) were substituted for sand at weight ratios of 5%, 10%, 15%, 20%, 25%, and 30%, respectively.

Bhargavi J , Adana Gouda (2020)
The experimental study focuses on increasing the compressive strength of self-compacting concrete by replacing some of the GGBFS with fine aggregate combined by M-sand. The GGBFS

was substituted for cement in this instance in a range of 0 to 50%. For the strength development process over the course of 7 and 28 days, a chemical additive known as VMA (Viscosity Modifying Admixture) is used. Due to its unique qualities, msand gives concrete the needed amount of strength. Utilizing the necessary tools and the required mix proportion, the experiment is conducted to determine compressive strength at 7 and 28 days, split tensile and flexural strength at 28 days.

Arunachalam Ananthi (2018)
This essay discusses the efficient substitution of waste materials for sand and cement, respectively, in the making of concrete. For M25, M30, and M40 grade mixes, the cement has been substituted by GGBS to the tune of 20% of the weight of cement. The compressive strength of fresh concrete was tested, whilst the workability of fresh concrete was examined. In comparison to normal mix concrete, it was discovered that replacing some of the cement with GGBS and all of the sand with manufactured sand significantly increased the strength of the latter. The test of compressive strength was run for 7, 14, and 28 days.

M. Yajurved Reddy, D. V. Swetha and S. K. Dhani (2015)
The characteristics of concrete made with M-sand in place of natural sand are examined in this study. The findings indicated that workability decreases when compressive strength of M-sand increases in substitution of natural sand. A 20% strength improvement was seen after the 60% replacement.

Priyanka Jadav and K. Dilipp Kulkarni (2012)
studies on how manufactured sand affects cement mortar's characteristics in comparison to natural sand. The effect of water-cement ratio and percentage replacement of natural sand by M-sand on the strength characteristics of cement mortar showed an increase in compressive strength up to 14.53%, 46.95%, and 60.62% for proportions of 1:2, 1:3, and 1:6 with water-cement ratio as 0.5, respectively. It was shown that 50% replacements produce the strongest results. Overall, compared to the standard mix, the mortar is stronger.

P. M. Shanmugavadivu (2010)
He has demonstrated through water permeability testing that permeability decreased as the proportion of manufactured sand increased. This might be because manufactured sand exhibits greater bonding between the aggregate and cement paste, resulting in fewer voids in the concrete. According to the results of a quick chloride penetration test, concrete made with natural sand has a high chloride ion penetrability, whereas concrete made with produced sand has a lower level. They ascribe this to greater packing of particles caused by artificial sand's coarser grain size. They contend that using 70% artificial sand instead of natural sand is the best way to achieve better results.

IV. MATERIALS

Manufactured Sand
For construction reasons, manufactured sand, which is made by crushing hard granite stone, replaces river sand. Typically, the crushed sand is shaped like a cube with grounded edges. After being cleaned, it is categorized as construction sand with a size (M-sand) less than 4.75 mm.

Fig no.1 Manufactured sand

An alternative to river sand is manufactured sand. Due to the rapidly expanding building sector, there is a severe lack of adequate river sand in the majority of the world's regions. The usage of artificial sand has expanded as a result of the shortage of high-quality river sand used in building. The affordability and accessibility of M-sand are additional justifications for its use. This sand can be readily obtained locally because hard granite rocks can be broken to make it, which lowers the expense of transporting from distant river sand beds .
As a result, using synthetic sand as an alternative building material can reduce construction costs.

Ground Granulated Blast-Furnace Slag (GGBS)
As a by-product of the blast furnaces used to make iron, GGBS is a cementitious material primarily used in concrete.About 1,500 °C is the operating temperature of blast furnaces, which are fed with a precisely regulated mixture of limestone, coke, and iron ore. The leftover components create a slag that floats on top of the iron once the iron ore is converted to iron. If this slag is to be used in the creation of GGBS, it must be quickly cooled in a lot of water after being often tapped out as a molten liquid. Quenching improves the cementitious properties and produces granules that resemble coarse sand. After drying, the 'granulated' slag is ground into a fine powder. Despite being referred to as "GGBS" in the UK, it can also be referred to as 'GGBFS' or 'slag cement'.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 05 | May - 2023 Impact Factor: 8.176 ISSN: 2582-3930

Fig no. 2 GGBS

GGBS offers great durability, reducing the likelihood of concrete thermal cracking, and it improves concrete's resistance to damage from alkali-silica reaction, sulphates and chlorides.

Cement: Ordinary Portland cement of grade 53 is used for this experimental work. On cement various experimental tests will be carried out to determine final & initial setting time, standard consistency, and compressive strength according to IS 4031 and IS 269-2015

Fig no. 3 cement

Table -1: Physical Properties of Cement

Sl no.	Test conducted on cement	Observation
1	Specific gravity	3.14
2	Normal consistency	29%
3	Initial setting time	140 min
4	Final setting time	280 min
5	Compressive strength7 days 28days	41 Mpa 55 Mpa

Fine aggregate (m-sand): River sand or crushed stone makeup fine aggregate, an important component of concrete. In this experiment, M-sand is used to substitute river sand as the fine aggregate. M-sand is a substance that is used in place of natural sand while making concrete. M-sand is produced by crushing tough Granite Stone. M sand is classified as a building material and is primarily cubical in shape with grounded shapes. M-Sand has particles that are smaller than 4.75mm.IS:383-2016 was the code book employed in this investigation.

Table-2: Properties of Fine Aggregate

Properties	Observations
Fineness modulus	3.02
Specific gravity	2.56
Bulk density(kg/m3)	1822 kg/m3

Coarse aggregate: The material which is retained on BIS test sieve number 4 (4.75mm) is termed as coarse aggregate. The broken stone is generally used as a stone aggregate. Coarse aggregate used is locally available crushed angular aggregate of size 20mm and 10mm are used for this experimental work.

Fig no. 4 Coarse aggregate

Table-3: Properties of coarse aggregate

Properties	12.5mm	20mm
Water absorption	0.6%	0.4%
Specific gravity	2.66	2.68
Bulk density (kg/m3)	1555kg/m3	1504kg/m3

Water: According to IS: 456-2000, for all works on concrete, potable water is used.

V. PROPOSED METHODOLOGY

Procedure

For the M35 mix, the cement has been proportionately replaced by GGBS in the following ranges: 0% (without GGBS), 5%, 10%, 15%, and 20% by weight of cement. For the M35 mix, the M sand has taken the place of the sand Concrete mixtures were created, tested, and compared to standard concrete in terms of compressive and flexural strength.

VI. CONCLUSIONS

In the current study an attempt has been made to minimize the cost of cement and sand with concrete mix grade M35 by studying the mechanical behavior of this concrete mix by partial replacing with advanced mineral admixtures such as GGBS in concrete mix. In this study, partial replacement of Cement with GGBS and Sand with M-sand considered. Experimental study is to be conducted to evaluate the workability and strength characteristics of hardened concrete, properties of concrete have been assessed by partially replacing cement with GGBS, and sand with M- Sand. The cement has been replaced by GGBS accordingly in the range of 0% (without GGBS), 5%, 10%, 15%, and 20% by weight of cement for M35 mix. Concrete mixtures are to be produced, tested and compared in terms of compressive, flexural strength with the conventional concrete.

REFRENCES

[1]. Dr. M. B. Varma, 2 S. B. Magare, "Comparative Study Of Self Compacting Concrete Using Artificial Crushed Sand With Conventional Concrete Without Using Artificial Crushed Sand"

[2]. Biswadeep Bharali, " Experimental Study On Self Compacting Concrete (SSC) Using Ggbs And Fly Ash", International Journal Of Core Engineering & Management (IJCEM) Volume 2, Issue 6, September 2015.

[3] IS 456:2000 Annex J, self-compacting concrete.

[4] M.S.Shetty, "concrete technology", 6th Edition, 1982.

[5] MuctebaUysal, Mansur Sumer (May 2011)"Performance of self-compacting concrete containing different mineral admixtures" Science Direct, pp: 4112-4120.

[6] Pamnani Nanak J., Verma A.K., Bhatt Darshana R,(December2013) "Comparision between Mechanical Properties of M30Grade Self Compacting Concrete for Conventional Water Immersion and Few Non- Water based Curing Techniques "International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-3, Issue-2,pp:265-272.

[7] P. Dinakar , Kali Prasanna Sethy, Umesh C. Sahoo, "Design of Self-Compacting Concrete With Ground Granulated Blast Furnace Slag ''

[8] Vidivelli B, T. Kathiravan, T. Gobi (July 2013) "Flexural Behaviour of Self Compacting and Self Curing Concrete beams" International Journal of Engineering Mathematics & Computer Science ISSN: 2321 – 5143, Vol 1, Issue 2, pp: 64- 77.

[9] Wenzhong Zhu, Peter J.M. Bartos (December 2002), "Permeation properties of self-compacting concrete" Cement and Concrete Research pp: 921–926.

[10] Vinayak Supekar, Dr.Popat Kumbhar, "Properties of Concrete by Replacement of Natural Sand with Artificial Sand", International Journal of Engineering Research & Technology (IJERT), Vol. 1 Issue 7, September - 2012.

[11] M.Adams Joe1, A.Maria Rajesh2, "Study on the Effect of Ggbs & M Sand in Self Compacting Concrete"

[12] Manvendra Verma1, & Mayank Nigam2, "Mechanical Behaviour of Self Compacting and Self Curing Concrete"

[13] Prof. Wakchure, M.R., Er Shaikh A.P. "Effect of Types of Fine Aggregate on Mechanical Properties of Cement Concrete", International Journal of Modern Engineering Research (IJMER), ISSN: 2249-6645, Vol.2, Issue.5, Sep-Oct. 2012 pp-3723-3726.

[14] Himanshu Mishra1, Kamlesh Kumar Choudhary2 " Iron Dust, Copper Slag, And Granite Dust Mixed As Partial Sand Replacement And Their Effect On Concrete Properties", International Research Journal of Modernization in Engineering Technology and Science (IRJMETS), Volume:04/Issue:12/December-2022

ACKNOWLEDGEMENT

This research was partially supported by **Saraswati Institute of Engineering & Technology, Jabalpur, India**. I thank my Professors from **SIET, JBP** who provided insight and expertise that greatly assisted the research. I would like to thank **Mr.Kamlesh kumar choudhary,HOD & Assistant Professor SIET Jabalpur** for assistance with technique and methodology, and **Mr.Pankaj Chakravarti, Assistant Professor, SIET Jabalpur** for comments that greatly improved this work. Any errors are my own and should not tarnish the reputations of these esteemed persons.

Prof.Kamlesh kumar chuodhary
(HOD & Assistant Professor)
Department of civil engineering
Saraswati Institute of Engineering & Technology, Jabalpur, India
Email: prof.kamlesh.siet@gmail.com

Prof.Pankaj Chakravarti
(Assistant Professor)
Departmentof civil engineering
Saraswati Institute of Engineering & Technology, Jabalpur, India
Email: chakravartipankaj98@gmail.com

Mr. Anshul kumar Shrivastava
M.Tech Student
Department of civil engineering
Saraswati Institute of Engineering & Technology, Jabalpur, India
Email: shrianshul91@gmail.com