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Experimental Investigation On Strength Properties Of Concrete With GGBS Sand, M Sand And Flyash

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ABSTRACT

In order to lessen concrete's negative effects on the environment, this article explores the possibility of using fly ash as a cement substitute. It goes on to say that fly ash may make concrete last longer and work better mechanically. The compressive strength of concrete was determined to be unaffected by the substitution of M sand for natural river sand in this experimental investigation. Additionally, it was shown that although using up to 15% fly ash as cement substitute somewhat boosts compressive strength, further increases in fly ash steadily lowers it. The impact of using GBS in place of natural fine aggregate on concrete mix characteristics was the subject of this investigation. Compressive and tensile strengths were also enhanced in GBS-bound concrete, according to the research.

Keywords: Concrete, GGBS, M-Sand, Flyash.

I. INTRODUCTION

Infrastructure development has raised demand for concrete as a building material. Using cement pollutes the environment and diminishes raw materials. Cement manufacture also uses a lot of energy. Natural river sand is depleting and becoming more expensive. Thus, an alternative to Portland cement, the most resource-intensive material, is necessary. One cement option is FLYASH, industrial waste. M-sand and GBS-sand are industrial waste alternatives to natural sand.

The use of HVFA is widespread. Due to its longevity, resource efficiency, sustainability, and economic effectiveness, it is becoming a national requirement. Any concrete with 50% fly ash is HVFA. Green concrete is environmentally friendly. We are substituting cement with fly ash at varying percentages and evaluating strength throughout our project. Hit-and-trail technique. We need the proportion at which strength peaks.

Sand is concrete's fine aggregate. Naturally occurring river sand is the best fine aggregate. River sand is formed by millions of years of rock weathering. Sand mining from riverbeds is environmentally devastating. Exploring alternatives to river sand is crucial as it becomes scarce. Manufacturing sand is rock crushed to the necessary grain size distribution. Coarser stone aggregates are crushed in a specific rock crusher and washed to remove particles to get the desired grain size distribution. This study evaluates M-sand-fine aggregate concrete. For comparison, concrete and river sand features were examined.

According to prior research, urban expansion and population boosted need for sustainable constructions. Due to rising demand for sustainable constructions, river sand, a concrete component, rose. Environmental issues such as river erosion have led to a shortage of river sand. Sand demand is rising, raising prices and causing a shortage. Due to river sand shortages, additional materials must be found. However, using discarded products may lessen environmental effect. In this project, GBS sand, a steel production byproduct, is employed. Researchers and engineers have developed new materials including M-sand, Granulated blast furnace slag (GBS) sand, stone crusher dust, sheet glass powder, and others to reduce or replace river sand.

The majority of civil engineering structures are made of concrete. Its affordability, durability, and ability to be made on-site make it a popular building material. The ability to MOD it into any form and size because to its flexibility in green stage and hard drink to develop strength is helpful. Concrete, like other engineering materials, must be strong, durable, workable, and cohesive. Concrete mix design determines the best quantity of concrete elements to obtain desired qualities at the lowest cost.

It is probably the most widely used construction material in the world, but when the high range water reducer or super Plasticizer was invented and started to be used to decrease the water cement ratio or water winders ratio rather than just as fluid modifiers for normal strength concrete, it was found that in addition to improving strength, concrete with very low water cement ratios or water binder ratios reduced permeability, greater factor strength, elastic modulus boost battery life and depression resistance This led to high-performance concrete. High-performance concrete is the newest concrete innovation. it has become more popular and is being used in many prestigious processes such as nuclear power projects flyover multi-story buildings but I Stunt concrete is being specified in the preliminary design as a sensible solution for concrete construction full stop the economic benefits of high strength concrete are well documented and dividend from the number of races construction projects where it has been used successfully.

Concrete has historically provided robust and dependable initial structures. Building projects have historically employed concrete with 12–40 Newton per mm square compressive strength. Demand for sophisticated structural forms and deterioration long-term poor performance of conventional concrete led to accelerated research for concrete development that would score on all the aspects that a new construction material is revalued constant long-term durability affordability and enable the construction of sustainable and economic buildings with an extraordinary slim design.

1.2 NEED FOR STUDY:

1. It is necessary to identify a substitute for the commonly used Portland cement and river sand.
2. To decrease CO_2 output and generate eco-friendly concrete.
3. For the purpose of creating an economical product.
4. Concrete made with this mix is stronger than that made with regular Portland cement and river sand.

1.3 OBJECTIVES:

1. For purpose of making the most efficient use of fly ash, M-sand, and GGBS sand in concrete.
2. To assess characteristics or outcomes, like compressive strength after7,14, and 28 days.
3. Decrease the need for cement and river sand that is naturally occurring.

II. LITERATURE REVIEW

Mahendra R Chitlange et al. (2010) 'Strength appraisal of artificial sand as fine aggregate' experimentally demonstrated that both natural sand and manufactured sand concrete, when reinforced with steel fiber, exhibit consistently higher flexural and split tensile strengths, but only a slightly higher compressive strength. The bulk density of the reinforced concrete, which was downgraded, was 1.38 kg/m3. Its specific gravity was determined to be 2.82 and its fineness modulus to be 8, respectively.

Pofale, &Deo, (2010) "Comparative study of concrete for cement replaced by fly ash with minimum voids method and maximum density method " Their investigation found that by substituting 27% of the sand with low lime fly ash, the compressive strength and flexural strength of the concrete were around 20% and 15% higher, respectively, compared to the control concrete. The Portland pozzolana cement utilized in the research was based on fly ash. Additionally, they noted that the fly ash based concrete was about 25% easier to work with than the control concrete. Only the most relevant articles were included among the many that were reviewed in order to formulate the current goals. The literature reviewed indicates that, beginning on the third day, compared to control concrete, concrete that partially replaced scarce sand with fly ash exhibited greater strength. The control concrete had a long-term strength that was about 20% lower than this one. It is exciting to see that by partially replacing sand with fly ash, concrete may enhance in strength, workability, and durability. After looking at the data, it's clear that using fly ash in lieu of some of the sand improved the workability and strength of the mixture, thanks to its pozzolanic reactivity, the dispersion of cement particles, and the pore filling effect. Even while high-volume fly ash concrete loses strength after 28 days, the added strength and workability provided by partially replacing sand with fly ash more than makes up for it.

Chatterjee,(2011) "Indian fly ashes : their characteristics and potential for mechanochemical activation for enhanced usability " documented that current initiatives make use of around 50% of fly ash created. Additionally, he said that by combining high strength cement, very reactive fly ash, & sulphonated naphthalene formaldehyde superplasticizer, it is possible to reach a cement-to-fly ash ratio of up to 70%. Grind the fly ash until the particles are in the sub microcrystalline region, he said, and the properties will improve.

Shanmugapriya et al. (2012) "Optimization of partial replacement of M-sand by natural river sand in high performance concrete " results from experiments show that using silica fume and manufactured sand in lieu of some of the cement in concrete may increase its compressive and flexural strengths. According to their findings, using 50% synthetic sand instead of natural sand is the sweet spot.

Kartikey T, et al. (2013) "Effects on compressive strength when cement replaced by fly ash " He proposed that fly ash enhances the characteristics of structural concrete when used in part as a substitute for cement. This study compared the strength and characteristics of concrete of three different grades: M15, M20, and M25. The cement-to-fly ash ratios were 20%, 40%, and 60%, respectively. The workability of concrete improved as the proportion of fly ash rose when cement was partly substituted with it. The compressive strength was measured in three cubes for every concrete grade. When the replacement level was set at 20% for M15, M20, and M25 grades, the optimal strength was 14.48 N/mm2, 14 N/mm2, and 14.05 N/mm2, respectively. These results demonstrate that after 28 days of curing, all three classes benefit more from a 20% fly ash substitution than from 40% or 60%.

III. MATERIALS AND METHODOLOGY

3.1 MATERIALS:

3.1.1 FlyAsh
3.1.2 Cement
3.1.3 M-sand
3.1.4 GGBS-sand
3.1.5 Fine aggregate
3.1.6 Coarse aggregate

3.2 METHODOLOGY

- Cement replaced by Fly-Ash(50%)
- Natural river sand replaced by M-Sand (50%) and GBS-Sand (50%)
- A Grade of M25 are used for testing

3.3 TESTS CARRIED:

- Specific gravity of cement and fly-ash
- Fineness of cement and fly-ash
- Specific gravity of fine aggregate, M-sand and GGBS-sand
- Fineness modulus of fine aggregate, M-sand and GGBS-sand
- Impact value test, crushing value, specific gravity & water absorption on coarse aggregate
- Slump cone test on concrete mixture

IV. RESULTS AND DISCUSSION

4.1 TEST RESULTS

SL.NO	TESTS	RESULTS	STANDARD RANGE
1.	SPECIFIC GRAVITY OF CEMENT	2.93	3-3.15
2.	SPECIFIC GRAVITY OF FLY ASH	2.88	2.5-3.0
3.	FINENESS OF CEMENT	4%	< 10%
4.	FINENESS OF FLYASH	7%	< 10%
5.	SPECIFIC GRAVITY OF FINE AGGREGATE	2.8	2.5-3.0
6.	SPECIFIC GRAVITY OF M-SAND	2.75	2.5-2.9
7.	SPECIFIC GRAVITY OFGGBS SAND	2.6	2.85-2.95
8.	FINENESS MODULUS OF FINE AGGREGATE BY SIEVE ANALYSIS	3.10%	FINE SAND: 2.2-2.6 MEDIUM SAND: 2.6-2.9 COARSE SAND: 2.9-3.2
9.	FINENESS MODULUS OF M-SAND BY SIEVE ANALYSIS	2.47%	FINE SAND: 2.2-2.6 MEDIUM SAND: 2.6-2.9 COARSE SAND: 2.9-3.2
10.	FINENESS MODULUS OF GGBS.SAND BY SIEVE ANALYSIS	2.2%	FINE SAND: 2.2-2.6 MEDIUM SAND: 2.6-2.9 COARSE SAND: 2.9-3.2
11.	IMPACT VALUE OF COARSE AGGREGATE	12.5%	< 10% EXCEPTIONALLY STRONG 10-20% STRONG 20-30% SATISFACTORY FOR ROAD WORK
12.	CRUSHING VALUE OF COARSE AGGREGATE	17.41%	< 30%
13.	SPECIFIC GRAVITY OF COARSE AGGREGATE	2.81	2.5-3.0
14.	WATER ABSORPTION OF COARSE AGGREGATE	0.70%	< 3%
15.	FINENESS MODULUS OF FINE AGGREGATE BY SIEVE ANALYSIS	8.77	6-8.0
16.	SLUMP TEST	75 mm	

V. EXPERIMENTAL PROCEDURE

5.1 Compressive Strength

Results from tests measuring the compressive strength of concrete with different amounts of flyash, M sand, GGBS sand, and different sized cubes are analyzed to determine the impact of these additives. Due to its accessibility, direct correlation to other desired concrete parameters, and relative ease of testing, compressive strength is by far the most often used metric for evaluating hardened concrete.

A specimen with a cubical form is subjected to the compression test. Its dimensions are 150 mm x 150 mm x 150 mm.

PROCEDURE :

- To begin, a cube-shaped specimen measuring 150 mm x 150 mm x 150 mm is prepared using a mold, ideally made of cast iron that is thick enough to avoid deformation.
- Before assembling, make sure the cube mold is clean and completely tightened. • Before applying a coat of oil to the molds, make sure the sides of the cube are parallel.

- The correct method of casting the cube is to take concrete samples and combine them.
- Manual compaction and casting
- For each layer of concrete, use a tamping bar with a minimum of 25 strokes, and make sure the bar is 16 mm in diameter, 0.6 mm in length, and bullet point at both ends.
- The specimen is marked and placed in water after this interval and maintained there until just before the test. The water that the specimens are placed in is changed every seven days. Until they are tested, they must not be allowed to dry out.

5.2 TEST RESULTS

Table 5.2.1 Compressive strengths of normal concrete.

Sample	7 Days Load (KN) 344	7 Days Strength (Mpa)	14 Days Load (KN)	14 Days Strength (Mpa)	28 Days Load (KN)	28 Days Strength (Mpa)
Cube 1	362	16.08	498	22.13	784	34.84
Cube 2	440	19.55	584	25.95	678	30.13
Cube 3	344	15.28	490	21.77	690	30.66
Average	**382**	**16.97**	**524**	**23.28**	**717**	**31.86**

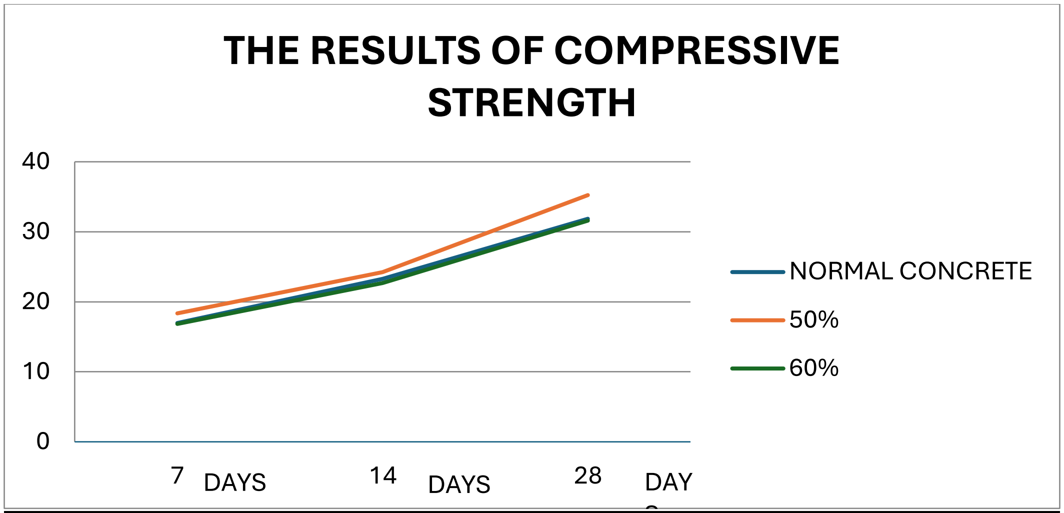
Table 5.2.2 Compressive strengths of Mixed concrete.
(50 % FLYASH, 50 % M.SAND, 50% GGBS SAND)

Sample	7 Days Load (KN)	7 Days Strength (Mpa)	14 Days Load (KN)	14 Days Strength (Mpa)	28 Days Load (KN)	28 Days Strength (Mpa)
Cube 1	386	17.15	562	24.97	804	35.73
Cube 2	394	17.51	544	24.17	792	35.20
Cube 3	458	20.35	588	26.13	781	34.71
Average	**413**	**18.35**	**545**	**24.22**	**793**	**35.24**

Table 5.2.3 Compressive strengths of Mixed concrete.
(60 % FLYASH, 50 % M.SAND, 50% GGBS SAND)

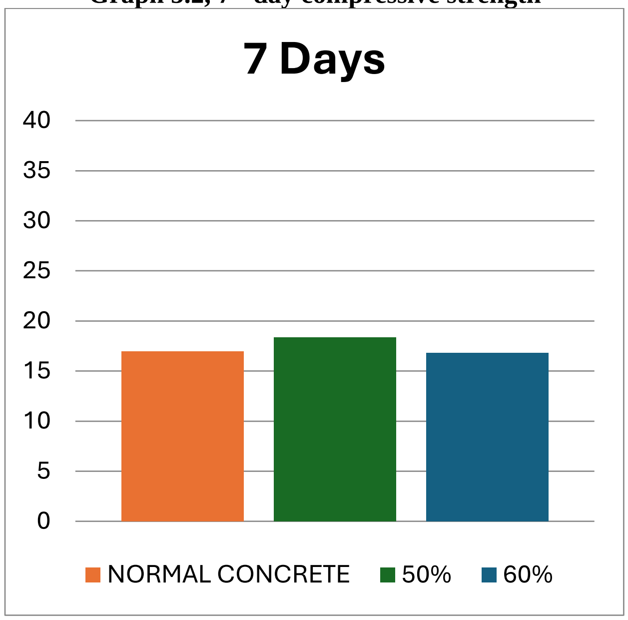
Sample	7 Days Load (KN)	7 Days Strength (Mpa)	14 Days Load (KN)	14 Days Strength (Mpa)	28 Days Load (KN)	28 Days Strength (Mpa)
Cube 1	350	15.55	500	22.22	770	34.22
Cube 2	386	17.15	540	24	680	30.22
Cube 3	400	17.70	490	21.77	684	30.40
Average	**379**	**16.84**	**510**	**22.66**	**711**	**31.60**

This is the graph comparison of average compressive strength of concrete.



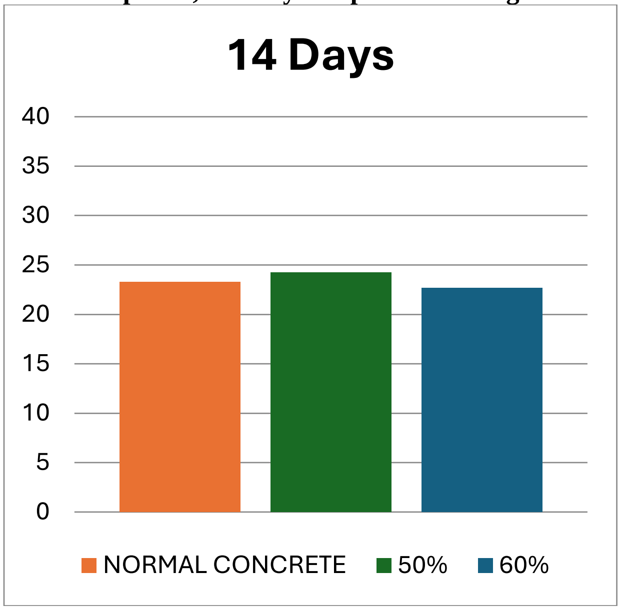
Graph 5.1 Average compressive strength

Graph 5.2, 7th day compressive strength



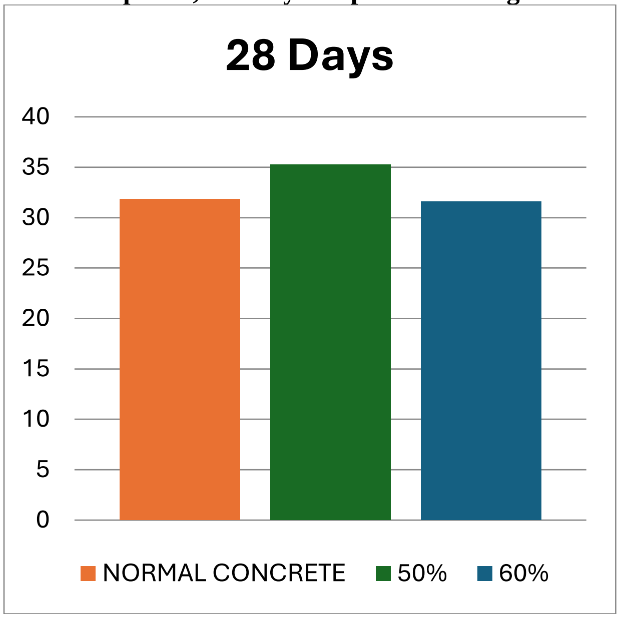
This is the bar graph comparison of average compressive strength of concrete at 7 days of testing

Graph 5.3, 14th day compressive strength



This is the bar graph comparison of average compressive strength of concrete at 14 days of testing

Graph 5.4, 28th day compressive strength



This is the bar graph comparison of average compressive strength of concrete at 28 days of testing

FIG.5.1

FIG.5.2

FIG.5.3

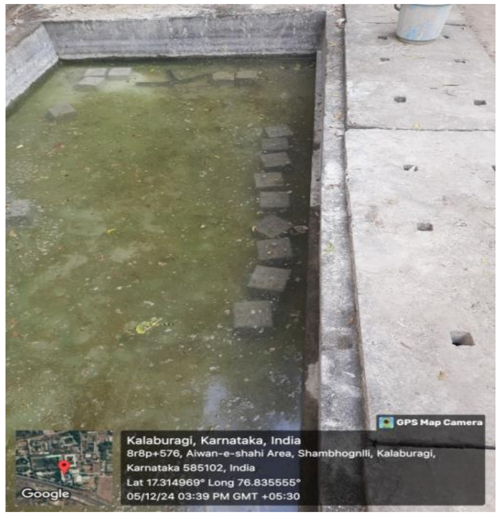


FIG.5.4

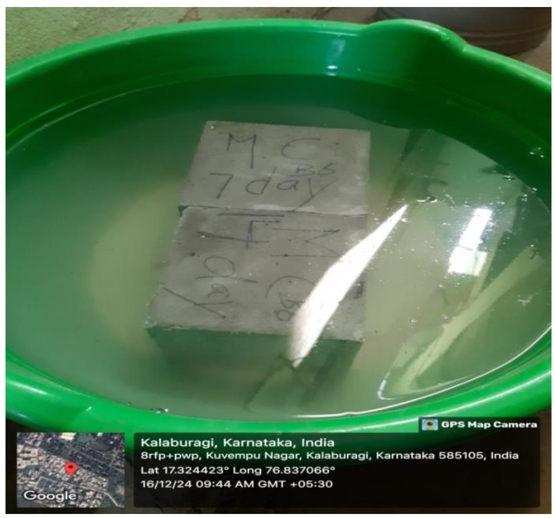


FIG.5.5

FIG.5.6

FIG.5.7

FIG.5.8

FIG.5.9

VI. CONCULSION

The experimental investigation has been useful in developing the mix design curves for concrete mix proportioning and studying the varied characteristics of Flyash, M.sand, and GGBS sand mix concrete.

The specimen testing led to the conclusion that regular concrete should be used instead of mixed concrete. Experimental findings clearly reveal that concrete mixes including 50% Flyash, 50% Msand, and 50% GGBS sand, as compared to other mixtures, exhibit much greater strengths. As a result, the ideal value of compressive strength is the proportion of regular concrete to mixed concrete. It follows that ggbs sand, flyash, and msand may be used effectively as a partial substitute for conventional concrete ingredients. It is feasible to use waste material in building in an environmentally responsible and mass-produced manner.

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    6. https://images.app.goo.gl/kUQaKKh66wHgrwXu8 (Coarse aggregate)