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Experimental Studies on Strength Properties of M60 Concrete with Partial Replacement of Cement by GGBS and Fly Ash

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Abstract: ***Among all the current construction materials, concrete occupies a unique position. Concrete is the most often utilised building material. Cement production emits CO2, which is harmful to the environment. One of the most crucial ingredients in concrete production is cement. Experiments were carried out to see how different percentages of Fly Ash and GGBS affected the mechanical qualities of M60 grade concrete. After 7, 14, and 28 days of curing, the compressive strength of concrete cubes with suggested replacement was determined. Compressive strength, split tensile strength, and flexural strength are all evaluated on the cubes, cylinders, and prisms. The primary goal of this study is to compare the fresh and hardened characteristics of M-60 grade control concrete with concrete prepared with varied ratios of fly ash and GGBS***
Keywords: GGBS, Fly Ash, Durability, Compressive Strength, Tensile Strength, Flexural Strength, Slum cone Test.

I. ROLE OF FLY ASH IN CONCRETE

Fly ash is a combustion residue (coal mineral impurities) in coal burning electric power plants, which flies out with the flue gas stream and is collected by mechanical separators, electrostatic precipitators or big filters. Fly ash has been widely utilized in concrete since it reduces cost of concrete materials, conserves energy resources and reduces environmental problems. It has become an essential ingredient in concrete mixtures



Fly ash

A. Ground Granulated Blast Furnace Slag

Blast furnace slag is a by-product of iron manufacturing industry. Iron ore, coke and limestone are fed in to the furnace, and the resulting molten slag floats above the molten iron at a temperature of about 1500-1600c. After the molten is tapped off, the remaining molten slag,



GGBS

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II. LITERATURE REVIEW

Many works have been carry out to explore the benefits of using various waste materials such as GGBS, Fly ash , stone dust and glass powder in making and enhancing the properties of concrete. The work done by various authors describe below

Amnon Katz 2003 studied the properties of concrete containing 100% recycled aggregate. He reported that the strength of concrete containing recycled aggregate was less compared to strength of concrete containing natural aggregate.

Khatib 2005 studied the properties of concrete containing recycled fine aggregate using crushed concrete and crushed brick. The results indicated that the strength of concrete containing crushed concrete is 15% - 30% less than the normal concrete

T.G.S Kiran, and M.K.M.V Ratnam (December, 2020) studie Fly ash as a partial replacement of cement in concrete and durability study of fly ash in acidic (H2SO4) environment. In this project report the results of the tests carried out on sulphate attack on concrete cubes in water curing along with H2SO4 solution

III. OBJECTIVE

A. To find out the mechanical properties of control concrete of M-60 grade at various percentage of fly ash and ground granulated blast furnace slag as a partial replacement of cement at 7 day ,14 day and 28 days tests are conducted.

B. To find the optimum % of replacement of cement by GGBS and Fly ash by imparting better strength and durability properties.

C. To find the optimum percentage of GGBS and Fly ash to give the maximum value of compressive ,flexural and split tensile strength

IV. MATERIALS AND METHODOLOGY

The following laboratory tests were performed on aggregates as per relevant IScode and mix design of M60 grade of concrete. The laboratory test programmed is
summarized below.

1) Physical properties of coarse aggregates (20mm and 10mm size)
- Sieve analysis
- Specific gravity
- Water absorption

2) Physical properties of cement
- Fineness
- Specific gravity

3) Physical properties of fine aggregates
- Sieve analysis
- Specific gravity
- Water absorption

4) Mix design (M 60 grade) as per IS 10262:2009.

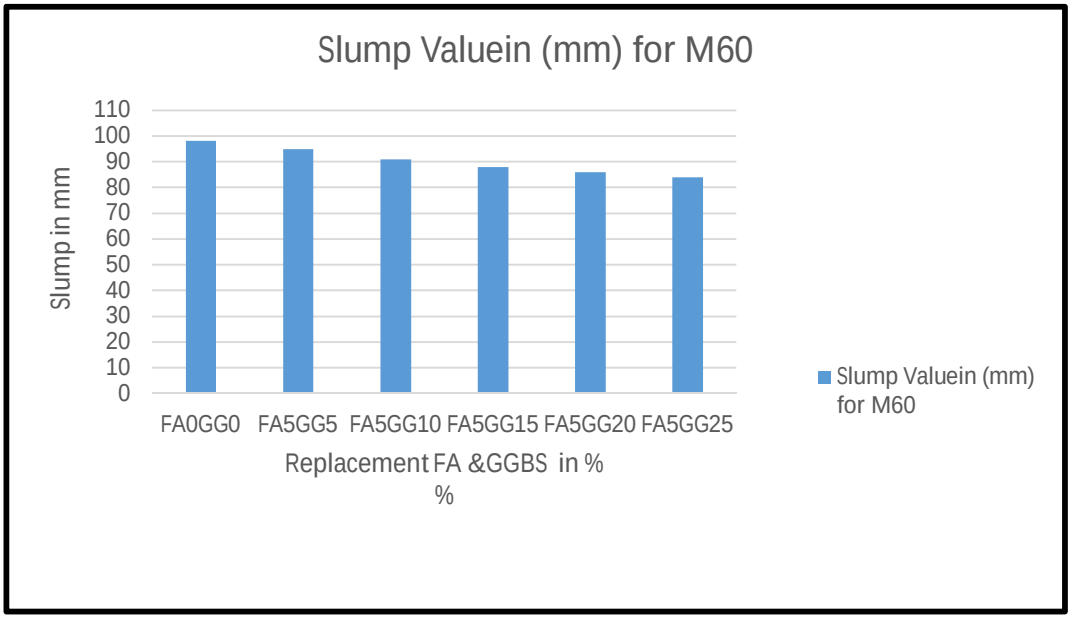
5) Preparation of specimens
- Concrete Cube of size 150x150x150
- Concrete Cylindrical columns of Dia 150mm and length 300 mm.
- Concrete beams 0f size 150x150x700 mm.

6) Testing of cubes for compressive strength.

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V. EXPERIMENTAL RESULT.

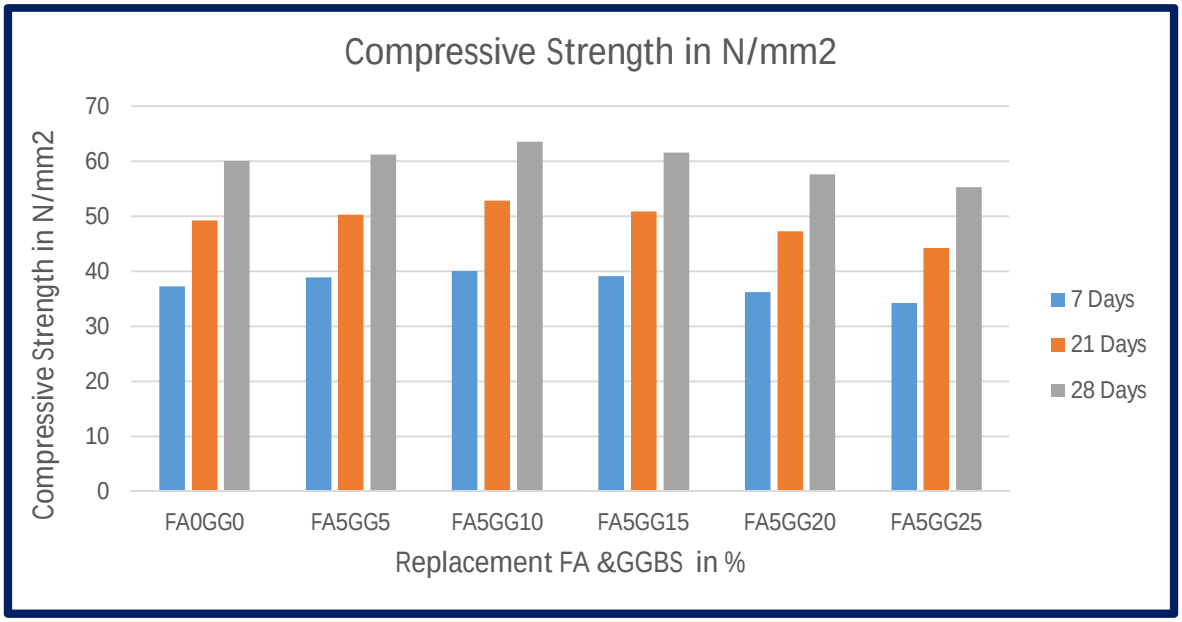
A. *Slump Values for Control Concrete and Concrete made with fly ash and GGBS as Partial Replacement of Cement*



Slump values for control concrete and concrete made with fly ash and ggbs as partial replacement of cement

From the results obtained from workability test, it is clearly observed that increasing in fly ash and decrease in the GGBS content leads to the decrease in workability

B. *Compressive Strength Test*



Compressive strength after 7&14 28 days curing for M60

From the above graph is seen that the compressive strength in M 60 grade of concrete at 7, 21 and 28 days increases when the percentage of the GGBS increase from 0% to 25% at constant percentage of FA ,The strength increase at 28 days is up to 5.72%, at 10% cement replace ggbs and 5% by FA. After increase the percentage of ggbs strength decreases ,optimum percentage of ggbs is 10% which give maximum value of compressive strength. ,the maximum value of compressive strength 63.566 N/mm2.

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VI. CONCLUSION

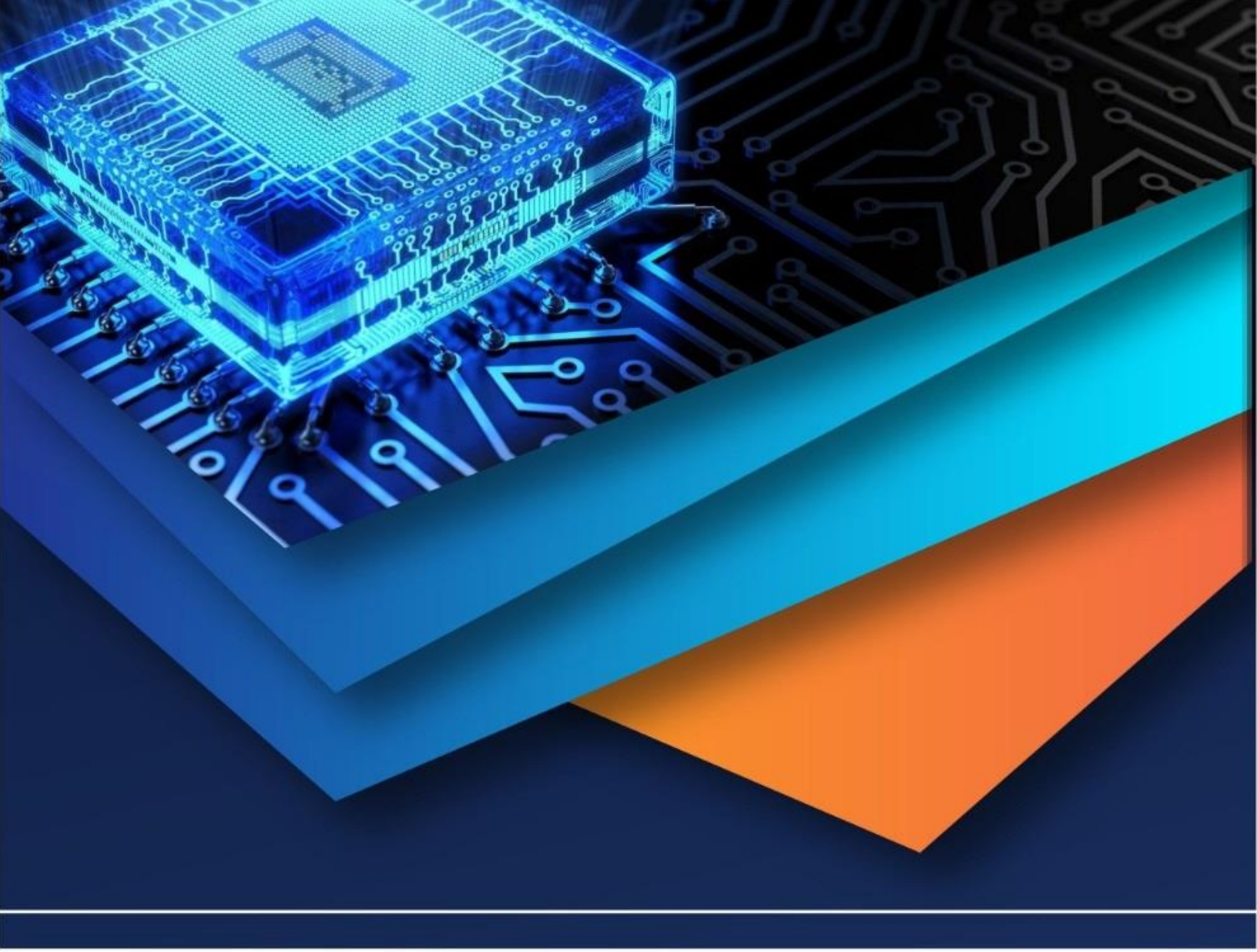
A. The following observations were made from the experiment conducted. To study the fresh properties of concrete Slum cone test are conducted for control concrete and concrete made with fly ash and GGBS as a partial replacement of cement. From the results obtained from workability test, it is clearly observed that increasing in fly ash and decrease in the GGBS content leads to the decrease in workability

B. From the Result it was seen that the compressive strength in M 60 grade of concrete at 7, 21 and 28 days increases when the percentage of the GGBS increase from 0% to 25% at constant percentage of FA ,The strength increase at 28 days is up to 5.72%, at 10% cement replace ggbs and 5% by FA. After increase the percentage of ggbs strength decreases ,optimum percentage of ggbs is 10% which give maximum value of compressive strength. ,the maximum value of compressive strength 63.566 N/mm2.

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