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EVALUATION OF STRENGTH AND RESISTANCE CHARACTERISTICS OF M25 CONCRETE MIXES USING GGBS AND ROBO SAND FOR RIGID PAVEMENTS

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ABSTRACT - In this we determine the suitability of GGBS (Ground Granulated Blast Furnaces Slag) as a partial replacement of cement an a Robo sand as a partial replacement of fine aggregates. It has been watched that in late 10 years, the nature of regular sand is debasing day by day and nowadays the construction industry in India is confronting a noteworthy issue because of intense lack of normal river sand. The work was undertaken to evaluate the strength characteristics of concrete proportioned to have five levels 0 % 15% 30% 45% 60% of cement replacements with GGBS and fine aggregates with robo sand. The GGBS and Robo sand makes concrete more impermeable and denser as compared to ordinary Portland cement. The strength of GGBS and robo sand concrete is better compared to the plain concrete. The following project also gives an idea about the characteristics of skid resistance, and also methods to reduce skid resistance on concrete cubes.

Keywords *– GGBS, Robo sand, Compressive strength, split tensile strength.*

1. INTRODUCTION

The evaluation of strength and resistance characteristics of M25 concrete mixes incorporating Ground Granulated Blast Furnace Slag (GGBS) and Robo sand has emerged as a promising approach for enhancing the durability and performance of rigid pavements.

The incorporation of GGBS, a by-product of the steel industry, offers improved resistance to chemical attacks, reducing the permeability of concrete, while Robo sand, a manufactured sand substitute, has shown to be a viable alternative to natural river sand, offering consistent particle size distribution. This study investigates the impact of varying proportions of GGBS and Robo sand on the compressive strength, flexural strength, and durability properties of M25 concrete, with the aim of optimizing the mix design for rigid pavement applications.

The primary goal of this project is to investigate the qualities of concrete utilizing Granulated Blast Furnace Slag (GBS) and robo sand which is used in place of natural sand and cement in percentages of 15, 30, 45 and 60%. This study focused on the workability, compressive strength, and split tensile strength of concrete made with M25 grade mix. Results indicate that the inclusion of these materials enhances the overall strength and durability, making it a sustainable and cost-effective solution for pavement construction.

2. LITERATURE REVIEW

Dr. Chandrashekar A, Pramod K, and Chaithra H L (2015). Based on their experimental examination, it was discovered that the amount of GGBS in concrete increased with workability. As the proportion of quarry sand rises, it further falls. Maximum compressive and flexural strength was achieved when 40% GGBS was used to replace cement. Maximum split tensile strength is attained when sand is replaced with 40% QS and

50% GGBS in the cement.

C. S. Mallikarjuna and Dr. D. V. Prasada Rao (2016). According to their test results, using 40% GGBS and 50% Quarry Dust leads in an increase of 18% in Compressive Strength at 28 days. At a replacement rate of 40% GGBS and 50% quarry dust, split tensile strength increases by a maximum of 23.5 percent when compared to control concrete. At 40% and 50% substitutions of cement and fine aggregate with GGBS and quarry dust, respectively, the greatest percentage gain of 29% in flexural strength compared to control concrete is achieved. The Water Absorption has the lowest value with a replacement percentage of 40% cement with GGBS and 50% fine aggregate with Quarry Dust. Finally, it is fascinating to see that different test variations in test results followed the similar trend

Ananthi Arunachalam (2018). Based on her findings, relevant inferences can be drawn about the workability, strength, durability, and other properties of concrete. Natural sand is replaced with manufacturing sand, and cement is partially replaced with 20 percent GGBS in concrete of the M25, M30, and M40 classes. Overall, it has been found that artificial sand is the strongest and most durable alternative to natural sand. After using GGBS and M-sand, the concrete's compressive strength rose. At the seventh day, the M30 grade concrete reaches a higher starting strength than the M25 and M40 grade concretes. The M30 grade of concrete is discovered to be more effective from the comparison results of the three classes of concrete.

T. Venkat Das and S. K. Sirajuddin (2019). They came to the conclusion from their inquiry that the test results showed an increase of 10%, 12%, and 15% in Compressive strength, spilt tensile strength, and Flexural strength attained at 40% GGBS and 50% QD replacements of

cement and fine aggregate, respectively. Finally, we draw the conclusion that substituting 40% GGBS for cement and 50% QD for fine aggregate will result in mixes with greater strengths than the control mix.

Sajidulla Jamkhandi, Mallesh M., and Nandeesh M. (2019). In their investigation, the mean goal strength for concrete of grade M25 is attained by partially substituting GGBS for cement and fine aggregate for robo sand. According to the results of this experimental study, the ideal replacement ratio for M25 grade concrete mix is 20% GGBS replacement for cement and 25% Robo sand replacement for fine aggregate, which results in a 61 percent increase in compressive strength over conventional concrete results and the M25 Mix target strength. Experimental research has shown to be a more effective method of getting rid of industrial waste and byproducts like ground-granulated blast furnace slag and Robo sand. We can reduce environmental waste and improve economics by reinforcing concrete with readily accessible GGBS and Robo sand.

3. MATERIALS AND METHODOLOGY

Cement

We had collected the cement from nearest store and using Ultra tech Ordinary Portland cement 53 grade in this project research.

Table 1: Test results on cement

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Property	Values
Fineness of cement	96.63%
Standard consistency of cement	30%
Setting time: Initial setting time Final setting time	45min <7hrs
Soundness of cement	3
Compressive strength of cement	53
Specific gravity of cement	3.15

Robo Sand

Well graded crushed stone powder passing through 4.75 mm was used as fine aggregate. Prior to mixing, the stone dust was air dried and sieved to remove any impurities. We are testing stone dust for its ability to absorb water, its specific gravity, and its fineness modulus.

Fig 1: Robo sand

Table 2: Test results on fine aggregates

S.no	property	values
1	Specific gravity of FA	2.61
2	Bulk density of FA	1373.33kg/m3
3	Water absorption of FA	1.27%
4	Grading	Zone-II

Coarse Aggregates

The typical coarse material used for this project is crushed granite with a maximum particle size of 20 mm. We are testing coarse aggregate for its ability to absorb water as well as its specific gravity and fineness modulus.

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Fig 2: Coarse Aggregates

Table 3: Test results on coarse aggregates

S.No	Proportions	Values
1	Flakiness test	19.15%
2	Elongation test	18%
3	Specific gravity of coarse aggregate	2.47%
4	Aggregate crushing value	26.27%
5	Aggregate impact value	19.01%

Ground Granulated Blast Furnace slag

Slag is a by – product from steel plants, which is obtained from blast furnaces, during the separation of iron from ironore. The process involves cooling of the slag through high-pressure water jets; this leads to formation of granular particles. The granulated slag is further processed by drying and then grinding in a vertical roller millor rotating ball millor roller press to a very fine powder, which is called GGBS.

4. METHODOLOGY

The method used for the mix design in this research follows the IS recommendations (as per IS: 10262-2019) for all tests related to both fresh and hardened concrete properties. This process involves selecting approximate mix grade designing it with the correct procedure creating test batches and determining the final mix ratio.

Additionally, the following steps are undertaken

- Calculating total amount of concrete required for project
- Estimating the quantities of cement, F.A, Robo sand, C.A and GGBS for the work.

Table 4: Required Proportions for the Mix

Materials	45 Cubes	15 Cylinders
Cement	49.86Kgs	30.208Kgs
Robo Sand	32.076Kgs	16.92Kgs
GGBS	21.384Kgs	11.232Kgs
Fine Aggregate	75.4316Kgs	39.37Kgs
Coarse Aggregate	161.55Kgs	84.9 Kgs

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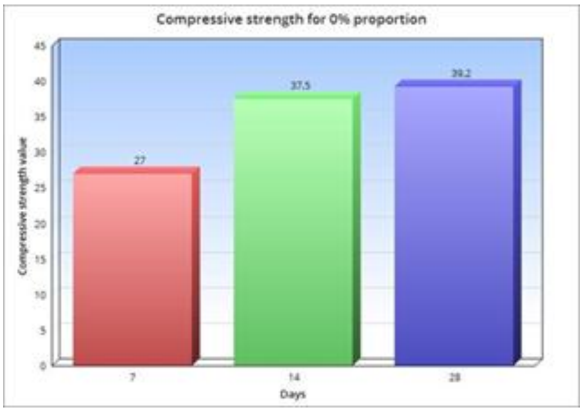
Table 5: Mix Proportions of M25 Grade Concrete

GRADEOFCONCRETE	M25
CEMENT	465kg/m³
COARSEAGGREGATE	1057.752/m³
FINEAGGREGATE	721.436kg/m³
WATER	186 kg/m³
W/C RATIO	0.45

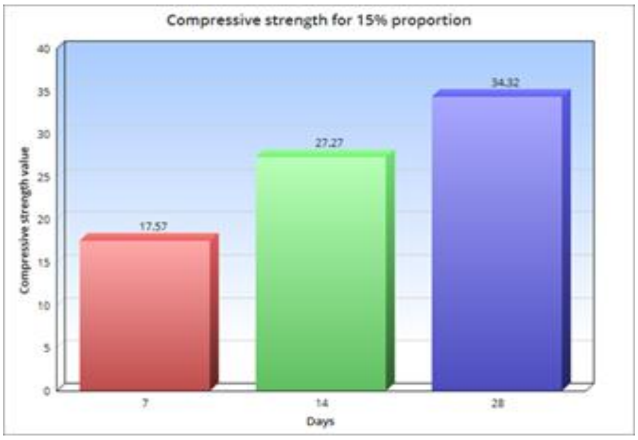
5. RESULTS AND ANALYSIS

GRAPHS FOR COMPRESSIVE STRENGTH PROPORTIONS

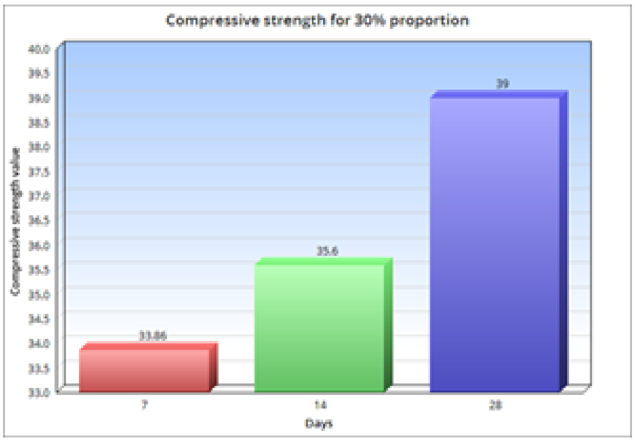
Graph 1: Compressive strength at 0%



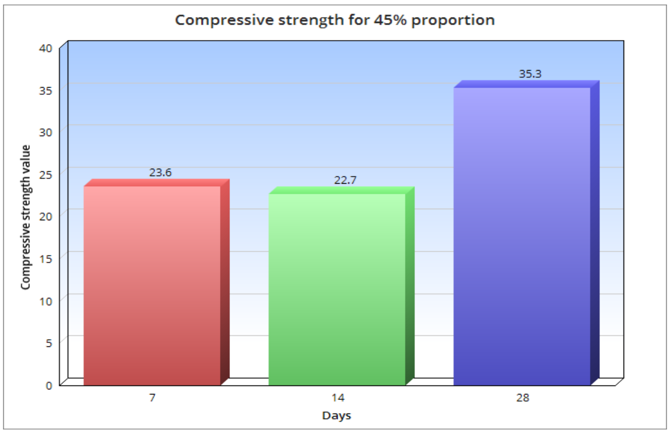
Graph 2: Compressive strength at 15%



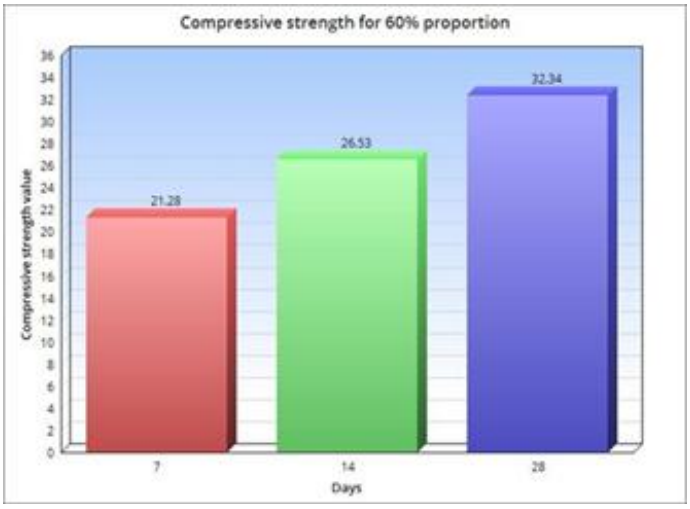
Graph 3: Compressive strength at 30%



Graph 4: Compressive strength at 45%



Graph 5: Compressive strength at 60%



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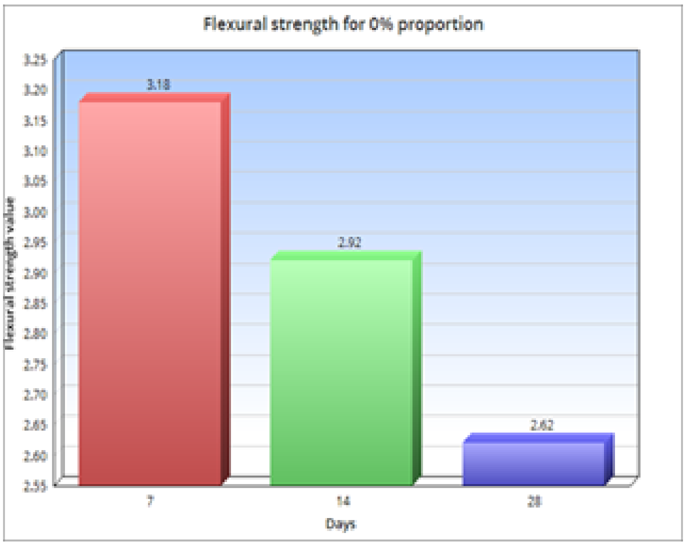
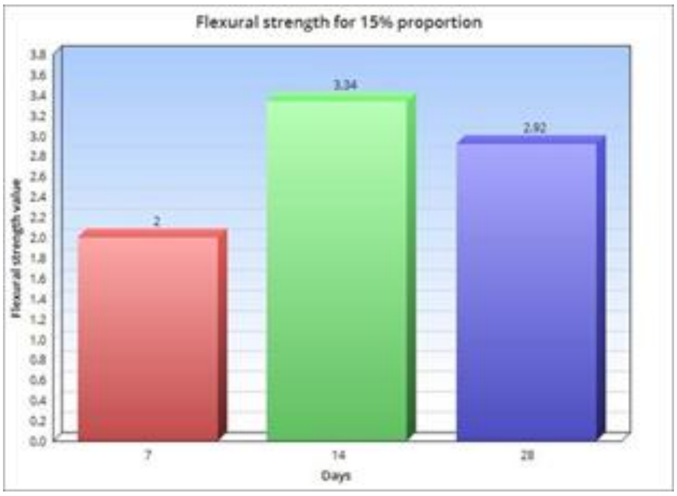
GRAPHS FOR FLEXURAL STRENGTH PROPORTIONS

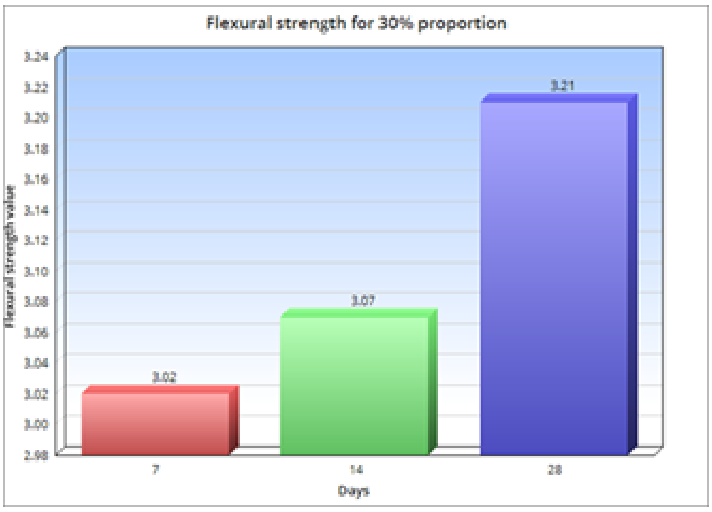
Graph 6: Flexural Strength at 0%



Graph 7: Flexural Strength at 15%



Graph 8: Flexural Strength at 30%



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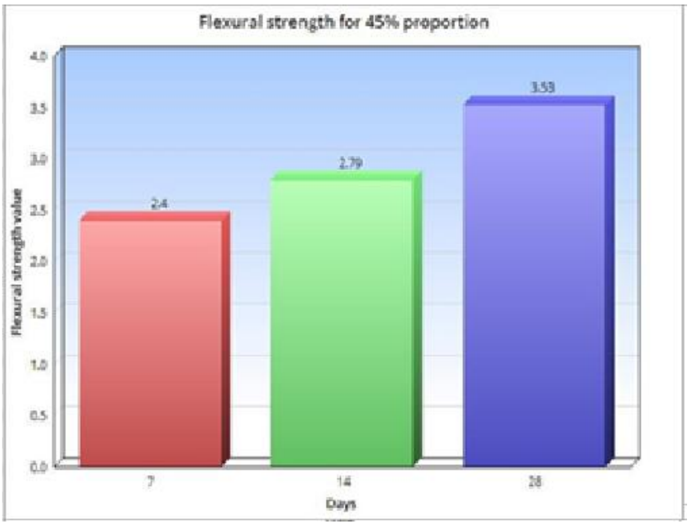
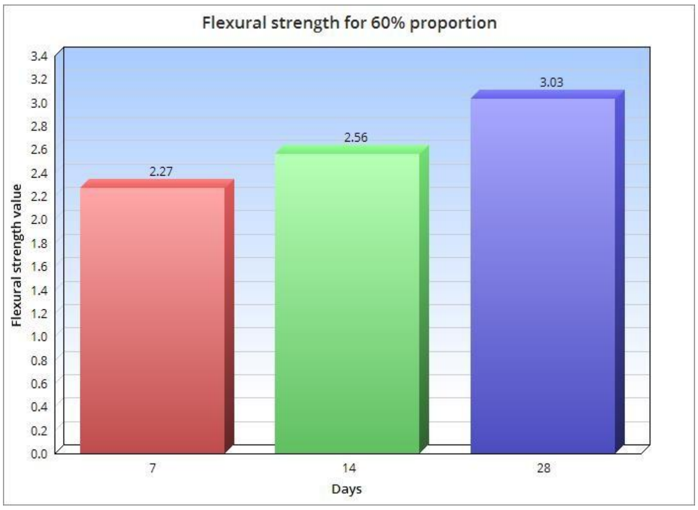
Graph 9: Flexural Strength at 45%



Graph 10: Flexural Strength at 60%



6. CONCULUSION

As the roads are the way of developing and it depends on an efficient road infrastructure, not only major highways i.e.., national highways but also other roads too, including link roads for rural connectivity, which can provide fast movement of goods and people with safety, economical cost during construction and maintenance and more design years. Since this way of development requires more quantities of raw materials for construction and it may cause depletion of quantities for future years. So, the different alternative materials are to be considered and, in this case, we have considered GGBS and Robo Sand for the partial replacement of sand and cement for the proportions of 0%, 15%, 30%, 45% and 60%.

From the Experimental study the partial replacement of M25 concrete mixes using GGBS and Robo Sand for sand and cement which gives more Compressive Strength and Flexural strength at 30% partial replacement than normal concrete.

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