# An Experimental Investigation on Partial Replacement of Cement with Ground Granulated Blast Furnace Slag and Sugar Cane Baggage Ash

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*Abstract*— The idea of halfway substitution of concrete which is proficient for supportable advancement is portrayed by use of mechanical squanders to lessen utilization of normal assets and vitality and contamination of nature. A by and by enormous measure of ground granulated impact heater slag is a side-effect of assembling of pig iron with a significant effect on condition and people, And India being the second most sugarcane delivering nation on the planet, likewise creates a generous measure of Sugar Cane Bagasse Ash which is a sinewy waste result of sugar industry and can be utilized as another restricting material in concrete. This would help in squander the board as well as result in sparing in concrete creation the concrete has been supplanted by blend of GGBS and SCBA appropriately in the scope of 0%, 5%, 10%, 15%, 20% and 25%by load of concrete for M-25mix. After iterative preliminary blends the water cement ratio 0.5.

***Keywords:*** GGBS, Sugar cane Bagasse Ash, Compressive strength, Split tensile Strength, Flexural Strength

## I. INTRODUCTION

For every ten tons of sugarcane squashed, a sugar industrial facility delivers almost three tones wet bagasse debris. Bagasse debris is buildup acquired from consuming of bagasse in sugar delivering production line. At the point when bagasse squander is scorched under the controlled way. It additionally gives debris having shapeless silica, which has pozzolanic properties. The ignition yields cinders containing high measures of unburned matter like silica and alumina oxides. Sugarcane bagasse debris use as concrete substitution material to improve quality and lessen the expense of solid pavers, soil concrete interlocking square. India alone creates roughly 90 million of bagasse as a strong waste from the sugarcane business. Removal of strong waste created from modern creation movement is the different significant issue. . The collection of squanders isn't just a weight to the business, yet additionally influences the earth antagonistically. What's more, one of the known elective materials to OPC in the solid blend is Ground Granulated Blast Furnace Slag (GGBS). GGBS is a side-effect extricated from impact heaters used to create iron. It is typically created by warming the mix of iron-mineral, coke, and limestone in the shoot heater to 1500 8C. The results of these materials are liquid iron and liquid slag. The liquid slag which contains silicates and alumina has lower thickness, consequently coasts over the liquid iron and make it is anything but difficult to isolate the liquid slag from the liquid iron. After division, the liquid slag is chilled off by utilizing high weight water stream which extinguishes the slag into squashed particles which are regularly under 5 mm. Such particles are then left to dry and pounded in a turning ball-factory to deliver an exceptionally fine powder of GGBS, This paper presents test work did to decide the impact of incomplete supplanting of OPC with GGBS and Sugar Cane Bagasse Ash

## II. MIX DESIGN FOR M25 –GRADE OF CONCRETE

Characteristic Compressive Strength Required at end of 28 Days – 25 N/MM2
Maximum Size of aggregate -20mm
Degree of Quality – Good
Target Mean Strength of concrete

From Table of IS 10262 -2009 Standard deviation =4 N\mm2

25+1.65*4= 31.6

Therefore Target Strength = 31.6N\MM2

### *A. MIXING PROPORTION*

The mixture Proportioning was done according the Indian standard, the target mean strength was 31.6N/MM2.

For OPC control Mixture the total binder content 394.32 kg/m3 , coarse aggregate is taken 1181.29 kg/m3,fine aggregate is taken 721.45 kg/m3,water is taken 197.16 kg/m3, Water to cement ratio was kept constant 0.5

Hence cement was replaced by combination of GGBS and SCBA accordingly in the range of 0%, 5%, 10%, 15%, 20% & 25%by weight of cement

## III. MATERIAL TESTS

### *A. Specimen for Compressive Strength*

Compressive strength of Concrete depends on many Factors Such as water cement ratio, cement strength, quality of concrete material quality during production of concrete etc.

To Study Compressive strength, The Cubes of 150mm*150mm*150mm are casted of various mix ,the quantities of cement ,coarse aggregate ,fine aggregate ,GGBS,SCBA And water for each batch replacement are weighed separately

### *B. Split-Tension Test*

One of the important properties of concrete is "tensile strength" as structural loads make concrete vulnerable to tensile cracking. Tensile strength of concrete is much lower than its compressive strength (that's why steel is used to carry the tension forces). It has been estimated that tensile strength of concrete equals roughly about 10% of compressive strength. To determine the tensile strength, indirect methods are applied due to the difficulty of the direct method. Noting that the values obtained of these methods are higher than those got from the uniaxial tensile test.

 

Fig. 1: Universal Testing Machine

### C. *Flexural Test*

Flexural test (150*150*700) evaluates the tensile strength of concrete indirectly. It test stheability of unreinforced concrete beam or slab to with stand failure in bending. The results of flexural test on concrete expressed as a modulus of rupture which denotes as (MR) in MPA or psi. The flexural test on concrete can be conducted using either three point load test (ASTMC78) or center point load test (ASTMC293).

## IV. Result and Discussion

### A. *Compressive Test Result*

| Details of Replacement | 7 Days (Mpa) | 14 Days (Mpa) | 28 Days (Mpa) |
|---|---|---|---|
| Conventional Concrete (0% Replacement) | 28.4 | 32.5 | 40.1 |
| 5% SCBA & 25% GGBS | 29.5 | 33.6 | 38.9 |
| 10% SCBA& 20% GGBS | 31.9 | 35.8 | 39.4 |
| 15% SCBA & 15% GGBS | 30.4 | 34.8 | 38.5 |
| 20% SCBA& 10% GGBS | 29 | 31.5 | 33.4 |
| 25% SCBA & 5% GGBS | 27 | 29.2 | 32.5 |

Table 1: Compressive Test Result

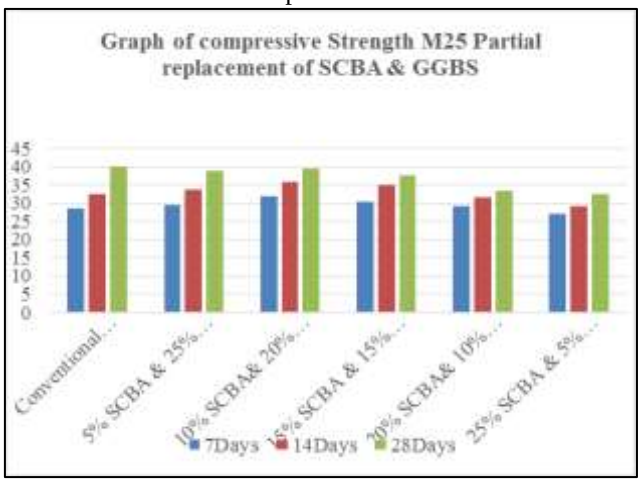


Chart 1: Graph of compressive Strength M25 Partial replacement of SCBA & GGBS

### B. *Split Tensile Strength*

| Details of Replacement | 28 Days (Mpa) |
|---|---|
| Conventional Concrete (0% Replacement) | 3.4 |
| 5% SCBA & 25% GGBS | 3.1 |
| 10% SCBA& 20% GGBS | 2.4 |
| 15% SCBA & 15% GGBS | 2.1 |
| 20% SCBA& 10% GGBS | 1.82 |
| 25% SCBA & 5% GGBS | 1.63 |

Table 2: Split Tensile Test Results

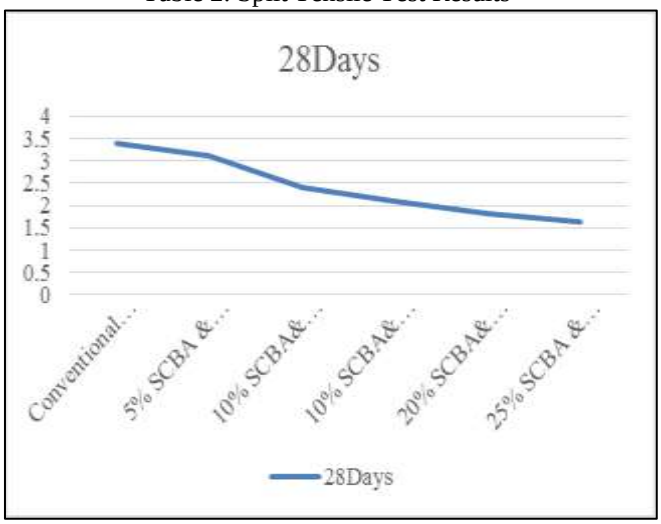


Chart 2: Graph of Split Tensile Strength M25 Partial replacement of SCBA & GGBS

### C. *Flexural Strength*

| Details of Replacement | 28 Days (Mpa) |
|---|---|
| Conventional Concrete (0% Replacement) | 4.5 |
| 5% SCBA & 25% GGBS | 4.0 |
| 10% SCBA& 20% GGBS | 3.8 |
| 15% SCBA & 15% GGBS | 3.2 |
| 20% SCBA& 10% GGBS | 2.8 |
| 25% SCBA & 5% GGBS | 2.5 |

Table 3: Flexural Strength Test Results

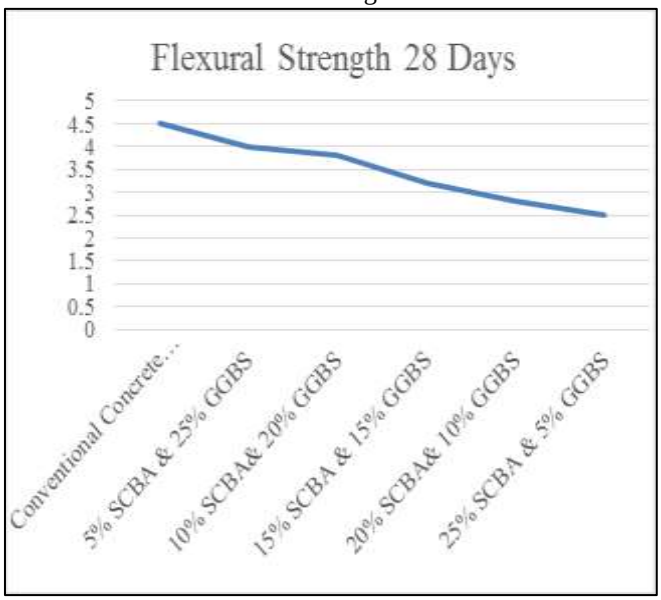


Chart 3: Graph of Flexural Strength M25 Partial replacement of SCBA & GGBS

*D. COST ANALYSIS*

| Material | Rate | Conventional Concrete | | M 25 ( Optimum 15 % SCBA + 15% GGBS ) | | % Saving |
|---|---|---|---|---|---|---|
| | | Quantity | Cost | Quantity | Cost | |
| Cement | Rs.400 Per bag (50 Kg) | 7.8 bags | 3120 | 5.5 bags | 2200 | 4.8 % |
| SCBA | RS. 3/ kg | 0 | 0 | 59.18 kg | 177 | |
| GGBS | Rs. 6 /kg | 0 | 0 | 59.18 kg | 355 | |
| Fine Aggregate | Rs. 945/m3 | 0.721.45 | 681 | 0.721 m3 | 681 | |
| Coarse Aggregate | Rs.875/M3 | 1.181 | 1033 | 1.181m3 | 1033 | |
| Super Plasticizer | Rs.40/kg | 0 | 0 | 3.9 kg | 156 | |
| Total Cost | | | Rs.4834 | | Rs.4600 | |

Table 4: Cost analysis

From The above table 4 we note that the use of SCBA and GGBS In Concrete Saves Money up 4.8% Over the Conventional Concrete For 1 m3 Volume, This is a significant saving of money

## V. CONCLUSION

The present experimental study was designed to determine the influence of varying percentages of SCBA & GGBS as partial replacement of cement in making concrete mixes. For this Combination 5%, 10%, 15%, 20%&25%,SCBA was introduced in concrete mixes containing 5%,10%,15%,20%,25% GGBS and properties of theses mixes were compared with corresponding conventional concrete. Properties of concrete mixes such as workability, CS after 7, 14 &28 days, Split Tensile, and Flexural Strength Test results are to be determined after 28 days of curing. The results of these experimental investigation has been analyzed on the basis of compressive strength results and the major finding of this study are presented as follows:

- This experimental investigation is carried out under mix proportion i.e. M25
- The Workability property of concrete property increases as the percentage of replacement of SCBA & GGBS increases.
- The compressive strength of cubes are increased with addition of SCBA and GGBS. The Optimum percentages of replacements obtained are –15% SCBA &15% GGBS
- Split tensile strength of Partial replacement SCBA %GGBS decreases with increases of percentage of replacement.
- SCBA and GGBS in Concrete Saves Money up 4.8% Over the Conventional Concrete for 1 m3 Volume, This is a significant saving of money.
- Hence, it can be recommended that the GGBS and SCBA can satisfactorily utilize as combined partial replacement for Cement respectively in concrete

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