

**EXPREMENTAL ANALYSIS OF TERNARY BLENDED CONCRETE BY USING PARTIAL REPLACEMENT OF GGBS AND SILICA FUME**

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**Abstract - In this study ,portland cement has been partially replaced with cement and which can also meet the requirements of strength by products Silice Fume and Ground granulated blast furnace slag. Compressive strength and flexural strength of the the ternary blended concrete age of 7 and 28 days for the various combination of GGBS and Silica fume were investigated. Silica fume of 5%,10% and 15% along with GGBS of 20%, 30% and 40%. All the mix contain the water cement ratio as 0.45%.**

**Keyword: Ordinary Portland cement, Silica fume, GGBS, compressive strength and Flexural strength.**

**1. INTRODUCTION**

Now a days the world is widening the construction is challenging and difficult. The main components of the conventional concrete in the cement .The amount of production of cement emits the carbon dioxide is emits in the atmosphere. To reduce the above effect, the advance new materials and construction techniques, are used. The use of the material replacing offers reduction of cost, energy saving arguably and few hazards to environment. The GGBS is waste from iron industry, used to replacement of cement in concrete. Blast furnace is a by-product of iron ore, coke and limestone is feed into the furnace, and the temperature of molten iron 1500°c to 1600°c. the moltan slag has 30% to 40% of silicon dioxide(Sio2) and 40% of CaO. The GGBS are in off-white colour. Silica fume in the ternary blended improve the strength of the concrete. Silica fume consist of fine particles 1/100<sup>th</sup> size of on average cement particles.

**1.1 OBJECTIVES**

The main objectives of the research work are following

1.The main effect of different levels of SF and GGBS in their ternary blended cement system on the following.

To find the Compressive strength, Split tensile strength and Flexural strength test. Accelerated curing strength of concrete.

2.The quantity of GGBS and silica fume are replaced by the quantity of OPC and analysis the variation of difference properties of concrete increasing the percentage of GGBS 20% to 40% and Silica fume 0% to 15 %.

**2. MATERIALS**

The used in the investigation are,

**2.1 Cement:**

53 grade cement with standard consistency and test has been carried out.

| SL NO | PROPERTIES           | RESULT |
|-------|----------------------|--------|
| 1     | Initial Setting time | 30min  |
| 2     | Final of cement      | 2.33%  |
| 3     | Specific gravity     | 3.15   |

Table 1 Properties of cement

**2.2 Fine Aggregate:**

The natural river sand conforming to the grading zone ii hav been used as a fine aggregate the test was done by as per the code

| SL NO | PROPERTIES       | RESULT |
|-------|------------------|--------|
| 1     | Specific gravity | 2.60   |
| 2     | Fineness modulus | 3.24   |
| 3     | Water absorption | 0.5%   |

Table 2 Properties of fine aggregate

**2.3 Coarse Aggregate:**

coarse aggregate of 20 mm size were used.

| SL NO | PROPERTIES       | RESULT |
|-------|------------------|--------|
| 1     | Specific gravity | 2.70   |
| 2     | Fineness modulus | 6.75%  |
| 3     | Water absorption | 2.4    |

**Table 3 properties of coarse aggregate**

**2.4 Silica fume:**

Silica fume is an mineral admixture in concrete. Silica fume consist of amorphous silicon dioxide. Specific gravity 2.2 and its fineness is approximately 1/100 the size of an cement.

**2.5 GGBS:**

GGBS was collected from the asthra chemicals.its specific gravity is 2.85 to 2.95. It size is less than 45 micron.

**2.6 Water:**

Cleaned drinking water available in college campus was used for mixing and curing of concrte as per the IS code 456-2000.

**2.7 STEEL:**

The steel bars 10 mm diameter at compression side and 12 mm diameter at tension side and the 8 mm diameter shear connecter are used.

**2.8 MIX PROPOTION**

**2.8.1 Control Mix:**

The mix design was carried out as per the IS: 10262-2009, the proportion of 1:1.26:2.73 with w/c ratio is 0.45 is used in the reference mix. Control concrete mixtures were prepared from the medium the workability of concrete without using super plasticizer.The mix proportioning for normal concrete is given in **Table 1**.

**2.8.2 Ternary concrete mixture:**

For the curing period, eighty ternary mixes(OPC+Silicfume+GGBS) were prepared with replacement with cement. The ternary concrete mix are given in the **Table 2**.

**Table 4 Mix proportion (kg/m<sup>3</sup>) for controlled concrete.**

| Cement | Water | FA   | CA     |
|--------|-------|------|--------|
| 426    | 535   | 1164 | 191.61 |
| 1      | 1.26  | 2.73 | 0.45   |

Ratio= 1: 1.26: 2.73: 0.45

**Table 5 Ternary concrete mix proportioning (kg/m<sup>3</sup>)**

| Mix | Ternary concrete |
|-----|------------------|
| CC  | C100%SF0%GGBS0%  |
| T1  | C75%SF5%GGBS20%  |
| T2  | C65%SF5%GGBS30%  |
| T3  | C55%SF5%GGBS40%  |
| T4  | C70%SF10%GGBS20% |
| T5  | C60%SF10%GGBS30% |
| T6  | C50%SF10%GGBS40% |
| T7  | C65%SF15%GGBS20% |
| T8  | C55%SF15%GGBS30% |
| T9  | C45%SF15%GGBS40% |

**3 EXPERIMENTAL INVESTIGATION**

In this experiment the Cubes, Cylinder and Beam were casted. The standard size of the specimen of Cube 150 mm, Cylinder 150 mm and 300 mm height, and beam 1600 mm length, 100 mm breath and 150 mm height used. The mix design of M50 grade of concrete was done as per IS 10262. All the materials were batched separately by its weights. The concrete materials are will mixed thoroughly by hand till the uniform consistency. Concrete was poured into the mould and compacted and the top surface will be leveled. The specimen were removed after one day and the curing was done by 7 and 28 days. The specimen were taken from the tank before the test. The test were conducted as per the IS specification.

**3.1 Test conducted**

1. Compressive strength: The compressive strength test on the standard size of 150 mm x150 mm x150 mm for 7 and 28 days .the compression test on the CTM testing machine and the value will be tabulated accordingly.

2. Split tensile strength: The split tensile strength test on the standard size of 150 mm x 300 mm for 7 days and 28 days. The split tensile strength test on the CTM testing machine and the value will be tabulated accordingly.

3. Flexural strength test: The flexural strength test on the standard size of 1600 mm x 100 mm x 150 mm. The flexural strength test on the loading frame and the resulted were tabulated accordingly.

#### 4. RESULT AND DISCUSSION

The result of this work mainly obtained through conducting various laboratory test and analysis. The obtained results are as followed.

| Specimen  | SF         | GGBS       | 7 days       | 28 days      |
|-----------|------------|------------|--------------|--------------|
| Cc        | 0          | 0          | 31.355       | 52.71        |
| T1        | 5%         | 20%        | 34.12        | 56.63        |
| T2        |            | 30%        | 32.05        | 54.11        |
| T3        |            | 40%        | 31.81        | 53.62        |
| <b>T4</b> | <b>10%</b> | <b>20%</b> | <b>35.71</b> | <b>61.42</b> |
| T5        |            | 30%        | 34.73        | 57.46        |
| T6        |            | 40%        | 32.99        | 55.98        |
| T7        | 15%        | 20%        | 29.62        | 49.23        |
| T8        |            | 30%        | 27.78        | 45.57        |
| T9        |            | 40%        | 26.175       | 42.35        |

Table 6 Compressive strength result

| Specimen  | SF         | GGBS       | 7days       | 28 days     |
|-----------|------------|------------|-------------|-------------|
| CC        | 0          | 0          | 3.14        | 5.27        |
| T1        | 5%         | 20%        | 3.41        | 5.42        |
| T2        |            | 30%        | 3.21        | 5.33        |
| T3        |            | 40%        | 3.18        | 5.26        |
| <b>T4</b> | <b>10%</b> | <b>20%</b> | <b>3.57</b> | <b>5.95</b> |
| T5        |            | 30%        | 3.47        | 5.67        |
| T6        |            | 40%        | 3.29        | 5.59        |
| T7        | 15%        | 20%        | 2.96        | 4.92        |
| T8        |            | 30%        | 2.78        | 4.57        |
| T9        |            | 40%        | 2.62        | 4.24        |

Table 7 Split tensile strength result

| SL NO | LOAD (kN) | DEFLECTIN FO NORMAL (mm) | TERNARY BLENDED CONCRETE |
|-------|-----------|--------------------------|--------------------------|
| 1     | 25.51     | 5.00                     | 5.21                     |
| 2     | 27.47     | 5.55                     | 5.67                     |

|    |       |      |       |
|----|-------|------|-------|
| 3  | 29.43 | 6.05 | 6.10  |
| 4  | 31.39 | 6.45 | 6.65  |
| 5  | 33.35 | 7.10 | 7.15  |
| 6  | 35.32 | 7.80 | 7.50  |
| 7  | 37.28 | 9.15 | 8.15  |
| 8  | 39.24 |      | 8.70  |
| 9  | 41.20 |      | 10.25 |
| 10 | 43.16 |      | 11.25 |
| 11 | 45.13 |      | 12.45 |

Table 8 Flexural strength test for normal concrete

| SL NO | SPECIMEN         | LOAD(kN) |
|-------|------------------|----------|
| 1     | C100%SF0%GGBS0%  | 37.28    |
| 2     | C70%SF10%GGBS20% | 45.13    |

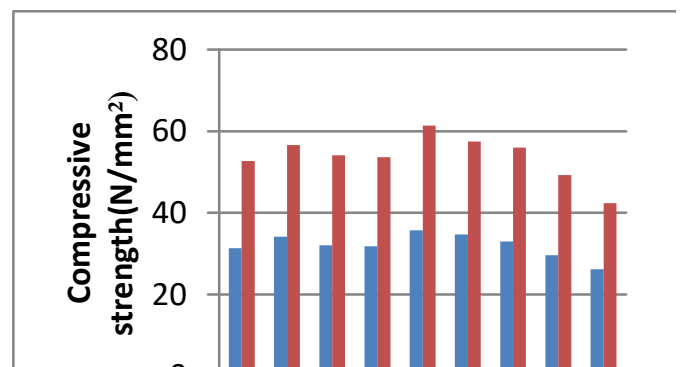


Fig 1 compressive strength test for various mix

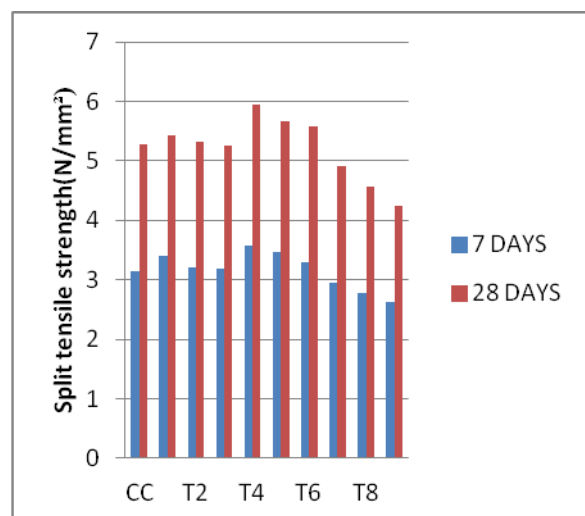


Fig 2 split tensile strength test for various mix

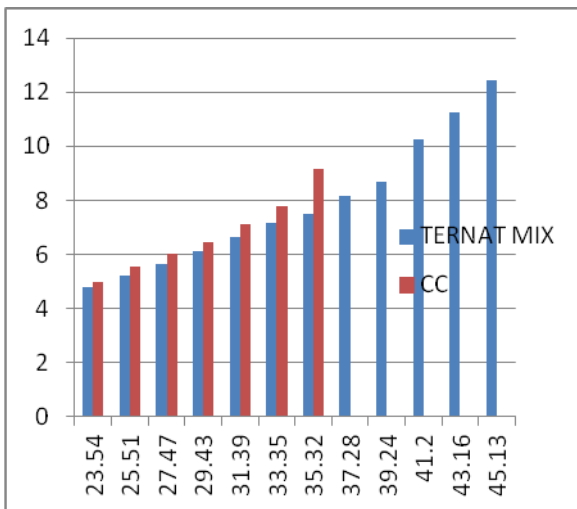


Fig 3 flexural strength



Fig 4 experimental set up

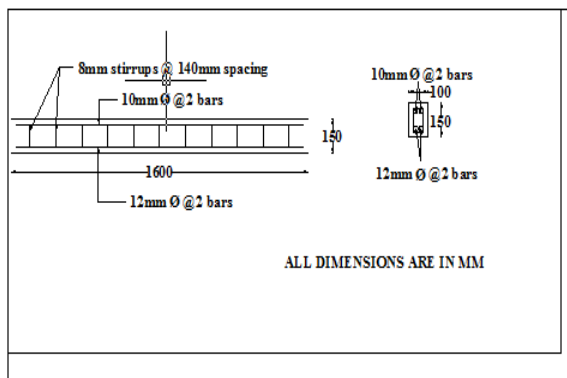


Fig 5 Large beam detail

5. CONCLUSION

From the above result, this paper concluded that the concrete can be replaced by some other material . The results are given bellow.

i.To study the properties such as compressive strength test, flexural strength test, and split tensile strength test of TB concrete mix with GGBS and SF were analyzed. The obtained results are compared with the conventional concrete M20 and ternary blended concrete

ii. In all the test, the test the ternary blended concrete cubes, cylinder and beam shows the strength with up to 10% of SF and 20% of GGBS of the cementitious material than the conventional M20 mix.

iii.After that 28 days the maximum strength of compressive as 61.42 N/mm<sup>2</sup>, split tensile strength as 5.95 N/mm<sup>2</sup> and flexural strength as 45.13 kN were obtained from the ternary blended concrete with the mix of 70% of cement, 10% of SF and 20 % of GGBS.

iv.From the compressive strength, the concrete with 20% of GGBS and 10% of SF achieved the maximum percentage increase as 18.78% when compared to conventional concrete and ternary blended concrete at 28 days.

v. From the split tensile strength, the with 20% of GGBS and 10% of SF achieved the maximum percentage increase as 12.9% when compared to conventional concrete and ternary concrete at 28 days.

vi. From the flexural strength test the maximum ultimate load at 45.13kN, when compared to the conventional concrete.

vii. From the above results, it will be concluded that, it is potential to the product of a concrete in rich grade of concrete using 70% of cement, 20% of GGBS and 10% of SF.

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