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STUDY ON PARTIAL REPLACEMENT OF CEMENT BY GGBFS AND FINE AGGREGATES BY GGBS IN CONCRETE MANUFACTURING

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Abstract:- Concrete is a major material used in a construction now a days. It is a composite material containing cement, sand, Coarse aggregate and water. Due to increase in the utilization of concrete in construction sector, the need of river sand and cement has been increased continuously. Limitations have been laid on the large scale of both cement as well as fine aggregate. This paper mainly presents the practical study of the compression strength, flexural strength of the concrete in which GGBFS is used as cement and GGBS as fine aggregate is partially replaced. For this study we were laid for M40 grade concrete. The cement and fine aggregate proportion for design mix was replace partial replaced in % of 10%,20%30% by GGBS and GGBFS respectively. Mix proportions are tested at 7 and 28 days of curing. The behaviour of concrete by partial replacement of cement and fine aggregate with GGBS and GGBFS respectively has been studied.

Keywords: *GBBF, GGBS, Compressive strength, Flexural strength.*

I INTRODUCTION

1.1 CEMENT

Cement is the most widely used material in nowadays. Ordinary Portland cement is commonly used building material throughout the world for construction, and it will retain its status in near future also because of demand and expansion of construction industry all over the world. Further the greatest challenge before the concrete construction industry is to serve the two pressing needs of human society, namely the environmental protection and meeting the infrastructure requirements of our growing population Structures which are constructed in aggressive environments are liable to be subjected to acidic attack Ordinary Portland cement is one of the main ingredients used for the production of concrete.

1.2 GGBFS

Ground Granulated Blast Furnace Slag is the by-product of iron manufacturing industry. Iron ore, coke and limestone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature between 15000C to 16000C. The molten slag has a composition of between 30% to 40% SiO2 and about 40% CaO, which is close to the chemical composition of Portland cement. After the molten iron is tapped off, the remaining molten slag, which consists of siliceous and aluminous residue is then water-quenched rapidly, resulting in the formation of glass granulate.

1.3 GGBS

GGBS is produced by the quenching process that is the process of sudden cooling of iron slag from a Blast furnace using Water or Steam. At the end of the process, a Glassy, granular product is obtained and then dried and grinded into fine powder. GGBS is a off white material. In mid-1800 the GGBS has been used all over the world and is discovered by EMIL LANGIN. It is also referred as slag cement by UK and it is used in Europe, United States and Asia GGBS is a binding Material and mostly used in RMC with the

ratio of 30-70%. It is used to produce Eco-friendly Concrete since it has less emission of Co2 and also more durable compare to OPC and other Pozzolanic Material. It extends the Life span of building from 50-100 yrs.

1.4 OBJECTIVES

1. To find of the cost effective in concrete.

2. To carry out the Workability of concrete

3.To carry out the compressive strength test and flexural strength test

4.Comparison between conventional and GGBS GGBFS concrete

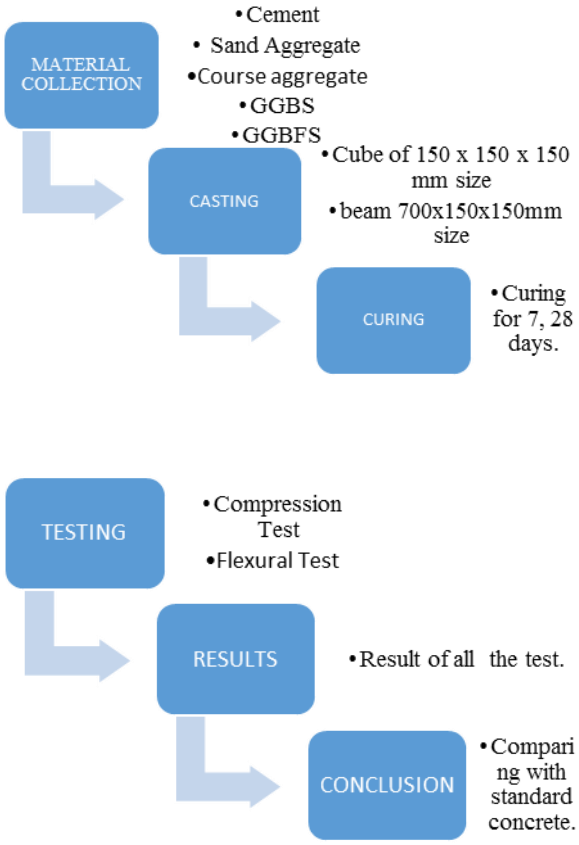
II LITERATURE REVIEW

Santosh Kumar Karri et. al. [1] selected 30%, 40% and 50% as cement replacement levels is cured and then the specimens of M20 and M40 grade of concrete is tested for 28 and 90 days. He found out that the workability of concrete increases with the increasing % in GGBS replacement level. He observed that the maximum compressive strength, split tensile strength and flexural strength is achieved about 40% cement replacement for both M20 and M40 grade concrete, beyond which the strength decrease slightly. Concrete cubes were also exposed to H2SO4 and HCl of 1% and 5% concentration and were tested for compressive strength at 90 days and 28 days respectively. It is observed that the resistance power increasing up to 40% replacement beyond which it decreases but the compressive strength values of acid affected concrete decreases on comparison with normal concrete.

Thejaskumar HM and Dr V. Ramesh [2] Compressive strength of concrete mixtures that were kept in water, 10% HCl and 15% H2SO4 solutions were determined at the ages of 7, 28 and 56 days with cement replacement ranging between 40 – 60%. It showed that as the days increase the compressive strength, split tensile strength and flexural strength soars up but it decreases with the increase in % of BFS. However, replacement up to 55% does not affect the strength negatively. After 56 days the samples having 53% of BFS.

Magandeep et. al. [3] Compressive strength and flexural strength decreases as the % of GGBFS increasing at the age of 7 and 28 days, but it increases with the increasing in % of GGBFS at the age of 56 days. He also observed that the split tensile strength of the mix with 20% to 30% cement replacement better performed than control mix at 56 days whereas the mix with 40% cement replacement shows a decrease in strength at 56 days.

III METHODOLOGY



3.1 PLAN OF EXPERIMENTATION

The Experimental investigation is planned as follows.

1. To obtain Mix proportions of OPC concrete for M40 by IS method (10262-2009).
2. To calculate the mix proportion with partial replacement such as 0%,10%,20% and 30% of GGBS and GGBFS.
3. To prepare the concrete specimens such as cubes for compressive strength, beams for flexural strength.

4. To cure the specimens for 28 days.
5. To evaluate the mechanical characteristics of concrete such as compressive strength, flexural strength.
6. To evaluate and compare the results.

3.2 Mix Design (as per IS 10262: 2009)

The following specifications for Mix design.

Type of Cement -OPC 43 grade

Maximum Nominal Aggregate Size -20 mm

Minimum Cement Content -310 kg/m3

Maximum Water Cement Ratio -0.55

Workability-25-50 mm (Slump)

Exposure Condition -Mild

Degree of Supervision -Good

Type of Aggregate Crushed -Angular Aggregate

Maximum Cement Content-540 kg/m3

Type of fine aggregate- Normal river sand

Type of vibration- Mechanical

3.3. Slump Cone Test

The concrete slump test is to measure the consistency of fresh concrete before it sets. To find out the workability of freshly made concrete, and therefore to know the ease with which concrete flows.

Figure 3.1 Slump Cone Test Conventional Concrete

Figure 3.2 Slump Cone Test GGBFS &GGBS Concrete

Figure 3.3Testing Of Concrete Cubes In Compressive Strength Of Conventional Concrete Block & GGBS Concrete Blocks

Figure. 3.4 Mixing Of Concrete

IV RESULTS AND ANALYSIS

4.1 COMPRESSIVE STRENGTH

Table 4.1: COMPRESSIVE STRENGTH OF CEMENT CONCRETE BLOCKS

CURING PERIOD IN DAYS	COMPRESSIVE STRENGTH OF CC BLOCKS (N/MM2)			
	BLOCK 01	BLOCK 02	BLOCK 03	Avg. STRENGTH
7 DAYS	34.2	35.1	34.4	34.56
28DAYS	41.1	39.8	41.3	40.74

Table 4.2: COMPRESSIVE STRENGTH OF CONCRETE BLOCKS WITH 10% OF GGBFS AND 10% GGBS

CURING PERIOD IN DAYS	COMPRESSIVE STRENGTH OF CC BLOCKS WITH 10% OF GGBFS AND 10% GGBS (N/MM2)			
	BLOCK 01	BLOCK 02	BLOCK 03	Avg. STRENGTH
7 DAYS	32.66	32.76	31.85	32.42
28DAYS	39.5	41.45	41.12	40.69

Table 4.3: COMPRESSIVE STRENGTH OF CONCRETE BLOCKS WITH 20% OF GGBFS AND 20% GGBS

CURING PERIOD IN DAY	COMPRESSIVE STRENGTH OF CC BLOCKS WITH 20% OF GGBFS AND 20% GGBS (N/MM2)			
	BLOCK 01	BLOCK 02	BLOCK 03	Avg. STRENGTH
7 DAYS	33.43	34.54	33.67	33.88
28DAYS	40.30	39.80	40.83	40.30

Table 4.4: COMPRESSIVE STRENGTH OF CONCRETE BLOCKS WITH 30% OF GGBFS AND 30% GGBS

CURING PERIOD IN DAYS	COMPRESSIVE STRENGTH OF CC BLOCKS WITH 30% OF GGBFS AND 30% GGBS (N/MM2)			
	BLOCK 01	BLOCK 02	BLOCK 03	Avg. STRENGTH
7 DAYS	31.65	31.76	31.85	31.75
28DAYS	38.49	39.90	39.54	39.31

4.2 Flexural STRENGTH

Calculation of Flexural Strength

Length of specimen = 700 mm

Width of specimen = 150 mm

Thickness of specimen =150 mm

Modulus of Rupture = PL/BD^2

TABLE 4.5 FLEXURAL STRENGTH OF CONVENTIONAL CONCRETE

SR. NO	AGE OF SPECIMEN	LOAD RUPTURE (N)	MODULUS OF RUPTURE (N/MM2)
1	7 DAYS	20250	4.2
2	28 DAYS	29941	6.21

Table 4.6: FLEXURAL STRENGTH OF CONCRETE WITH 10% OF GGBFS AND 10% GGBS

SR. NO	AGE OF SPECIMEN	LOAD RUPTURE (N)	MODULUS OF RUPTURE (N/MM2)
1	7 DAYS	20539	4.26
2	28 DAYS	30037	6.23

Table 4.7: FLEXURAL STRENGTH OF CONCRETE WITH 20% OF GGBFS AND 20% GGBS

SR. NO	AGE OF SPECIMEN	LOAD RUPTURE (N)	MODULUS OF RUPTURE (N/MM2)
1	7 DAYS	23239	4.82
2	28 DAYS	31098	6.45

Table 4.8: FLEXURAL STRENGTH OF CONCRETE WITH 30% OF GGBFS AND 30% GGBS

SR. NO	AGE OF SPECIMEN	LOAD RUPTURE (N)	MODULUS OF RUPTURE N/MM2)
1	7 DAYS	20298	4.21
2	28 DAYS	29410	6.1

4.3 ANALYSIS OF COMPRESSIVE STRENGTH

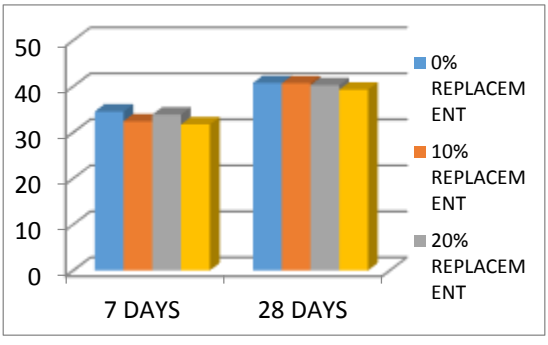


Figure. 4.1 Analysis Of Compressive Strength

4.4 ANALYSIS OF FLEXURAL STRENGTH

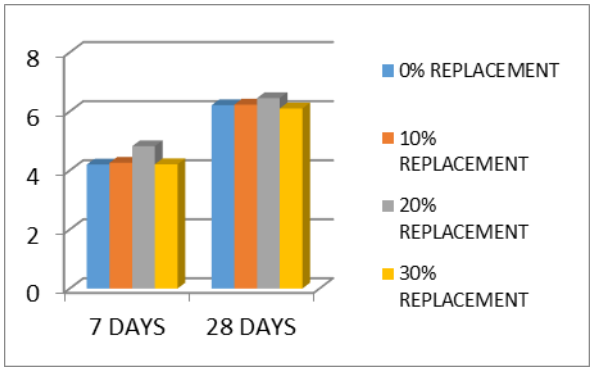


Figure 4.2 Analysis Of Flexural Strength

V CONCLUSION & FUTURE SCOPE

CONCLUSION

- According to our conclusion, the compressive strength of GGBS AND GGBFS concrete blocks decreases with increasing percentage. And it gives better compressive strength as compare to conventional concrete blocks
- In Concrete, the use of GGBS and GGBFS in replacement of cement reduces the cost. Hence it is economical.
- Workability of concrete increases with the increase in GGBS replacement level.
- The flexural strength of concrete is also increased when the cement is replaced by GGBS and GGBFS.

SCOPE FOR FURTHER STUDY

- Other levels of replacement with GGBS can be researched.
- Combination of GGBS with different other admixture can be carried out.
- Studies on replacements levels of high grade concrete can be carried out.

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