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An Experimental Investigation on M30 Concrete with Partial Replacement of Fine Aggregate by GBS

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ABSTRACT

Now a days construction material is more important in utilization of world . At present there are three materials are more important they are cement , coarse aggregate & fine aggregate . At present lack of utilization materials ,the raw materials of construction is less compare to the other materials .Our project deals with the replacement of fine aggregate by GBS (Granulated blast furnace slag) by 0% , 5 % , 10 % , 15 % , 20 % .As this percentage to increase the strength of concrete . Granulated blast furnace slag is less than 4.7mm is used. GBS is a by-product of the steel industry . It is defined as the non-metallic product consisting essentially of calcium silicates and other bases that is developed in a molten blast furnace slag is durable. Due to the consistent shape & volume the construction is safe. Indian construction companies have initiated the use of slag as replacement of sand where as in countries like brazil & japan have an established market. The granulated blast furnace slag is produced after the material is treated of about 1500 degrees celsuis , the material will be safe to use as chemicals in it becomes inert .

Keywords: Aggregate, Gbs, Compressive strength, Split tensile strength

I. INTRODUCTION

Sustainability was a big issue that being concern in making a development. This is because sustainable development has become a key aspect in society, Economics and development. Sustainable development shall meet the needs of the present without compromising ability of future generation to meets their own needs.it also shows that development that going to be made to sustain the planetary resources by using them effectively without making unnecessary wastage. The usage of GBS to replace the sand is because the production of the sand emits carbon dioxide gas to atmosphere. The sand industry is held responsible for some of the carbon dioxide emission, because the production of one on Portland cement emits approximately one ton of carbon dioxide gas into the atmosphere. The emission of carbon dioxide will increase the effect of global warming due to the emission of greenhouse gasses. Among the greenhouse gasses, carbon dioxide contributes about 65% of global warming.

II. METHODS AND MATERIAL

1. Granulated Blast Furnace Slag

Granulated Blast Furnace Slag (GBS) is a recyclable material created when the molten slag from melted iron ore is quenched rapidly and then ground into a powder. This material has cementations properties and has been used as a replacement for cement forever 100years. Recently, Wisconsin has begun using it in some of its high way projects. Wisconsin has experienced several problems with GBS, which includes low strength gain and decreased surface quality. Countering these problems, GBS concrete has higher late strength and lower permeability. This project investigates these GBS characteristics and has several objectives.

Granulated Blast Furnace Slag (GBS) is a byproduct of the steel industry. Blast furnace slag is defined as “the non-metallic product consisting essentially of calcium silicates and other bases that is developed in a molten condition simultaneously with iron in a blast furnace. “In the production of iron, blast furnaces are loaded with iron ore, fluxing agents, and coke. When

their on ore, which is made up of iron oxides, silica, and alumina, comes together with the fluxing agents, molten slag and iron are produced. The molten slag then goes through a particular process depending on what type of slag it will become. Air-cooled slag has a rough finish and larger surface area when compared to aggregates of that volume which allows it to bind well with Portland cements as well as asphalt mixtures. GBS is produced when molten slag is quenched rapidly using water jets, which produces a granular glassy aggregate.

2. Aim and Objective

The objectives of this study are:

1. To determine the performance of using Gabs as a fine aggregate in concrete.
2. To determine the most economic material that can be suitably replaced for construction.
3. To fulfill safe environment by using waste materials.
4. To investigate the basic properties such as Flexural Strength, Compressive strength of Gabs replaced concrete in comparison with Normal River sand used concrete.

3. Scope of the Study

The scope of the study will be focused on the performance of concrete using GBS as a partial replacement with 20mm nominal maximum aggregate size. The sample was taken on the cement industry.

4. Mix Design

Mix design can be defined as the process of selecting suitable ingredients of concrete and determining their relative propositions with the object of producing concrete of certain minimum strength and durability as economically as possible. The mix design is based on as IS: 10262-2009.

Table - 1: Shows Mix Design for M30 grade

Water	Cement	Fine aggregate	Coarse aggregate
140	333	740	1258
0.42	1	2.2	3.78

5. Test on Materials

5.1 Cement

OPC 53 Grade of Cement Maha cement was used in this study. The following physical test should be conduct in the laboratory as per IS codes

Sl. no.	Physical Tests	Obtained results	Requirements as per IS CODES
1	Fineness	3%	Not >10% as per IS 4031 part 1
2	Standard Consistency	32%	IS 4031 part 4
3	Initial Setting time	42min	Not less than 30 minutes as per IS 4031 part 5
4	Final setting time	265 min	Not more than 600 minutes as per IS 4031 part 5
5	Soundness	2 mm	Not>10mm as per IS 4031 part 3
6	Specific gravity	3.10	IS 2720 part 3

Table 2: Physical Test results of cement

5.2 Aggregates

The aggregate used in this study was Gbs and crushed stone aggregate collected from near Kurnool.

Table 3: Physical Test of aggregates

Sl. No	Physical Tests	Obtained results	Requirements as per IS 383
1	Impact Test	19.74 %	Not more than 45%
2	Los Angeles Abrasion Test	9.89%	Not more than 50%
3	Specific gravity		
	a) Coarse Aggregate	2.72	2.6-2.9
	b) Fine Aggregate	2.61	2.6-2.8
4	Water absorption		Not>2%as per IS:2386-Part 3
	a) Coarse Aggregate	0.6%	
	b) Fine Aggregate	0.3%	

6. Tests on Concrete

Mix proportion: 1:1.5:2.6

The mix proportions of M30 concrete, along with GBS are tabulated in the table below.

Tabulation of quantities of Cement, Fine aggregate, coarse aggregate, GBS for mix proportion 1:1.5:2.6

Table 4. Mix Proportions of M30 Grade Concre

	TYPE OF DESIGN	CEMENT In kg/m^3	FIN E AG	COARSE AGG in	GBS In kg/m^3	WATER In lts
1	**Normal**	430	650	1130	_	172
2	**5% GBS**	395.6	650	1130	21.5	172
3	**10% GBS**	374.1	650	1130	43	172
4	**15% GBS**	352.6	650	1130	64.5	172
5	**20% GBS**	331.1	650	1130	86	172

III. RESULTS AND DISCUSSION

All specimens will be moist cured for one day and after moist curing the specimens will be water cured for required days. Traditional curing the cubes moulded with the cement concrete is subjected to curing in the water Tank and then checks the strengths at the age of 7 days and 28 days.

Table 5. Shows the Compression and Flexural strengths of sea sand used concrete cubes and beams

TABULATION OF COMPRESSIVE STRENGTH RESULTS

S.NO	TYPE OF CONCRETE	AGE OF CONCRETE IN DAYS	COMPRESSIVE STRENGTH FOR CUBES IN n/mm^2	% INCREASE IN STRENGTH
1	NORMAL CONCRETE	28	38	_
2	GBS 5%	28	46	21.05
3	GBS 10%	28	45	18.42
4	GBS 15%	28	40	5.26
5	GBS 20%	28	37	2.63

Tablel 6.1. Compressive Strength Results.

TABULATION OF FLEXURAL STRENGTH RESULTS

S.NO	TYPE OF CONCRETE	AGE OF CONCRETE IN DAYS	FLEXURAL STRENGTH FOR BEAMS IN n/mm^2	% INCREASE IN STRENGTH
1	NORMAL CONCRETE	28	12.41	–
2	GBS 5%	28	13.47	8.54
3	GBS 10%	28	15.4	24.09
4	GBS 15%	28	15.57	25.46
5	GBS 20%	28	13	4.83

Tablel 6.2. Flexural Strength Results

TABULATION OF SPLIT TENSILE STRENGTH RESULTS

S.NO	TYPE OF CONCRETE	AGE OF CONCRETE IN DAYS	SPLIT TENSILE STRENGTH FOR CYLINDERS IN n/mm^2	% INCREASE IN STRENGTH
1	NORMAL CONCRETE	28	8.9	–
2	GBS 5%	28	9.2	3.37
3	GBS 10%	28	9.4	5.61
4	GBS 15%	28	8.98	0.0089
5	GBS 20%	28	8.6	3.37

Tablel 6.3. Split Tensile Strength Results.

GRAPHS

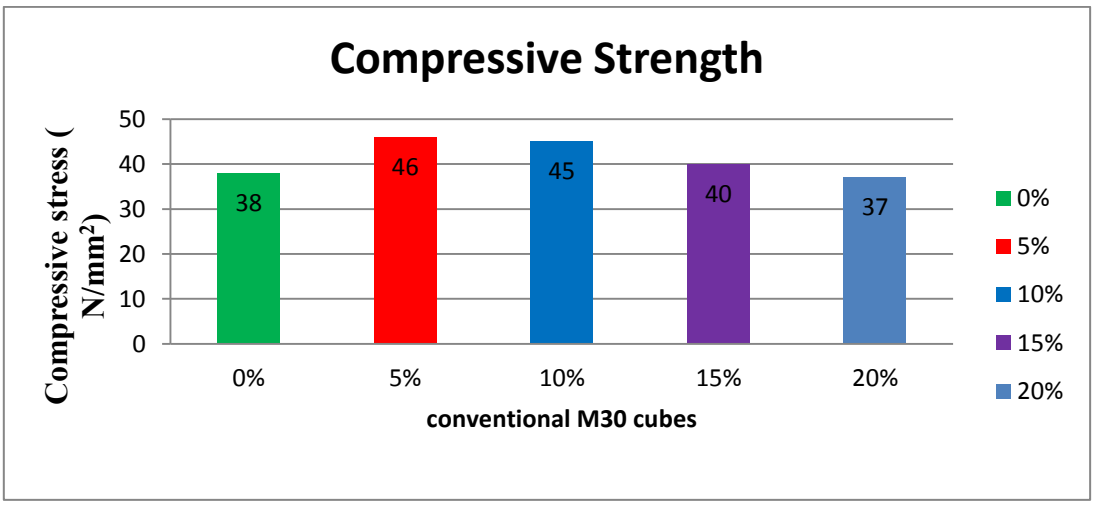

Figure 6.1.1. Compressive Strength Of M30 ConventionalConcrete On 28th Day

At 28days, by comparing the compressive strengths of normal concrete, 5%GGBS &, the last combination i.e,

5%GBS & achieves maximum strength of 46 N/mm² which is 21.05% more than the normal concrete.

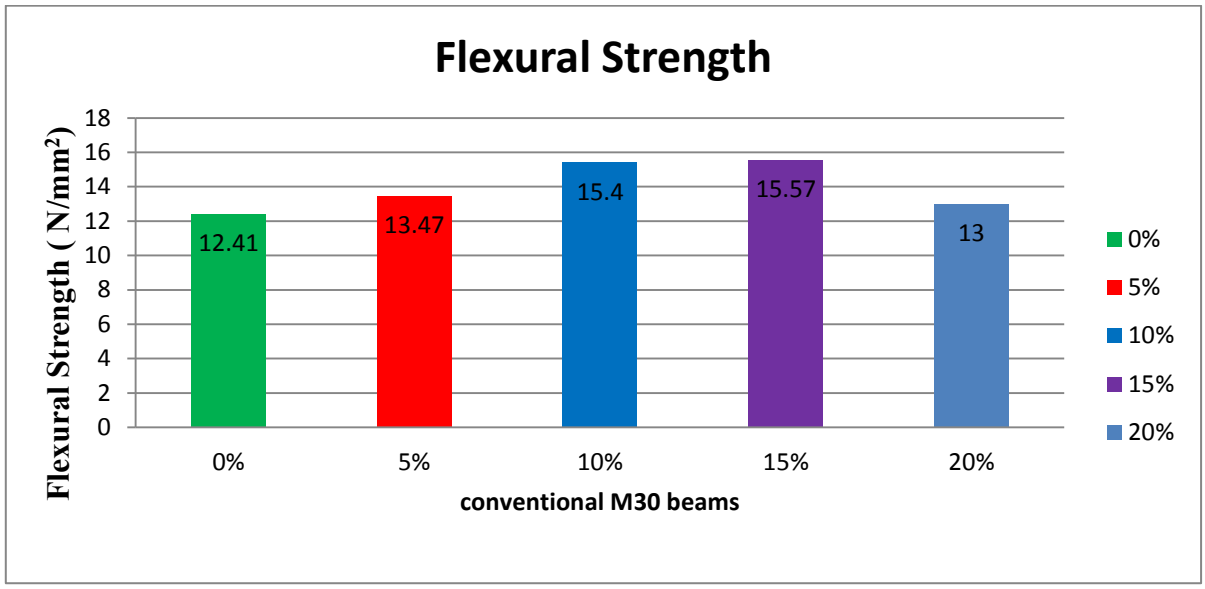

Figure: 6.1.2. Flexural Strength Of M30 ConventionalConcrete On 28th Day

At 28days, by comparing the compressive strengths of normal concrete, 10%GBS & the last combination i.e,

10%GBS achieves maximum strength of N/mm² which is 18.42% less than the normal concrete.

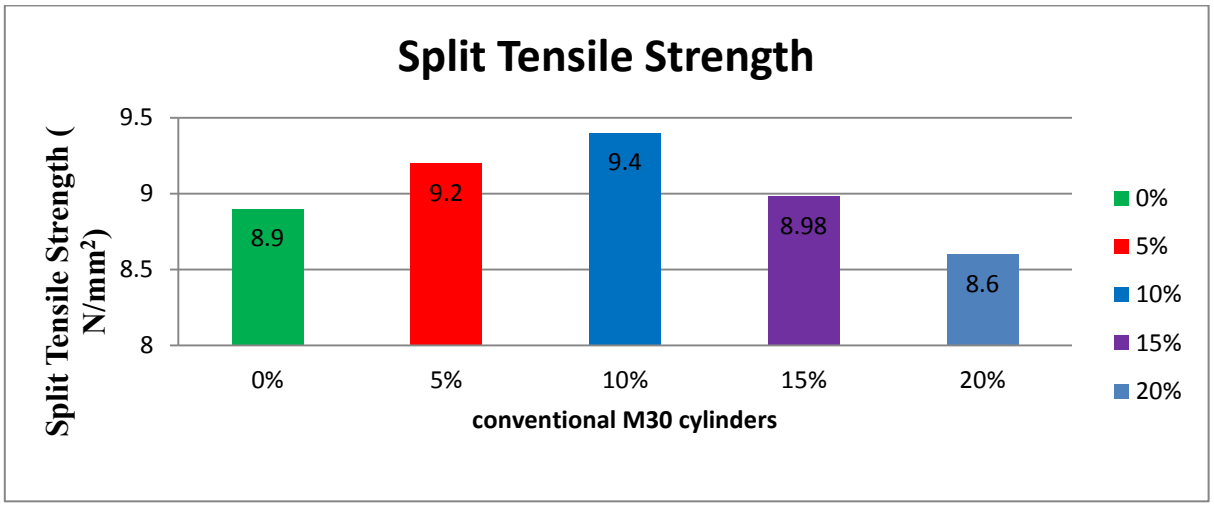

Figure 6.2. Split Tensile Strength Of M30 ConventionalConcrete On 28th Day

At 28days, by comparing the compressive strengths of normal concrete, 15%GBS & the combination i.e,
15%GBS & achieves maximum strength of 44.03 N/mm² which is 5% less than the normal concrete.
At 28days, by comparing the compressive strengths of normal concrete, 20%GBS & *the normal concrete achieves maximum strength of 46.21 N/mm²*

IV. CONCLUSION

Based on limited study carried out on performance of GBS and concrete in comparison with normal concrete of design strength of M30 following conclusion are drawn,

1) At 28 days from the 5%GBS & concrete had more compressive strength when compared with normal concrete.
2) At 28 days from the normal concrete and 10% GBS & have similar compressive strengths.
3) At 28 days from the normal concrete had more compressive strength.
4) At 28 days from the normal concrete had more compressive strength. The value of compressive strength with further addition of GBS to the concrete decreases gradually.
5) 5%GBS & concrete with 10% replacement level of concrete gain 3% of strength more than normal concrete.
6) Optimum of 5% of GBS and can be replaced with cement manufacture of concrete.

V. REFERENCES

[1]. Brooks JJ, Al-Kaisi AF. Early strength development of portland and slag cement concretes cured at elevated temperatures, ACI Materials Journal, 87(1990) 503-7.

[2]. Haque MN, Chulilung T. Strength development of slag and ternary blend concrete, Cement and Concrete Research, 20(1990) 120-30.

[3]. Swamy RN, Bouikni A. Some engineering properties of slag concrete as influenced by mix proportioning and curing, ACI Materials Journal, 87(1990) 210-220.

[4]. Jianyong L, Pei T. Effect of slag and silica fume on mechanical properties of high strength concrete, Cement and Concrete Research, 27(1997) 833-7.

[5]. Tan K, Pu X. Strengthening effects of finely ground fly ash, granulated blast furnace slag, and their combination, Cement and Concrete Research, 28(1998) 1819-25.

[6]. Miura T, Iwaki I. Strength development of concrete incorporating high levels of ground granulated blast-furnace slag at low temperatures, ACI Materials Journal, 97(2000) 66-70.

[7]. Douglas E, Pouskouleli G. Prediction of compressive strength of mortars made with Portland cement - blast furnace slag – fly ash blends, Cement and Concrete Research, 21(1991) 523-34.

[8]. Olorunsogo FT and Wainwright PJ. Effect of GGBFS particle-size distribution on mortar compressive strength, ASCE Journal of Materials in Civil Engineering, 10(1998) 180-7.