MECHANICAL AND SHORT TERM DURABILTY CHARACTERISTICS OF ROBO SAND AND GGBFS BASED CONCRETE

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***ABSTRACT*: According to 2017 two hundred and seventy million metric tons of cement is utilized worldwide for the production of concrete. It is consumed next to water by considering per capita demand. More than concentrating the new techniques, there is a need to give the alternatives to the existing one. Which should reduce the environmental impact such as to conserve the natural resources and to reduce the CO_2 emission to the environment. If that alternative is a waste product of other productive material means it will added another value. When it's combined with calcium hydroxide, produces cementations properties. Commonly used pozzalonas are fly ash, silica fume, metakaolin and ground granulated blast furnace slag. This paper deals with the M_{25} grade concrete with the replacement of 0%, 10%, 20%, 30% and the compressive, tensile and flexural strength is determined. Then short term durability is estimated with the help of phenolphthalein indicator.**

***Keywords*: GGBFS (Ground Granulated Blast Furnace Slag).**

I. INTRODUCTION

Concrete is one of the material which is massive in production. Here the problem is the natural extraction directly and indirectly affect the environment in a larger manner. The need is to give the alternative which should reduce the environmental impact and also the sustainability.in this GGBFS is one of the pozzalonic material which partially replaces the cement in the order of 0%, 10%, 20%, 30%.

GGBFS is nothing but a byproduct of steel plant. While the manufacturing of steel a layer of waste will be accumulated at the top of the pure one. It is furtherly decanted and processed to give the required form of slag. The main reason to add this in the cement is its having the chemical composition is similar to the cement clinker even it requires more water due to its fineness. Another thing is it releases the less amount of CO_2 emission.

Another alternative such as Robo sand for river sand. Natural sand extraction leads to the change in natural bed this will affect the eco system which depends on that river. Robo sand is nothing but a quarry dust gained from the production 10mm & 20 mm size coarse aggregate. These replacements combination will produce the better results than the control concrete or not and it will be judged through the strength and short term durability characteristics.

II. LITERATURE REVIEW

Anil Kulkarni et al: Comparison Study on Natural River Sand and Crushed Stone Sand – Evaluation for Pump ability & Durability of Concrete. They evaluated the strength for the grade of M_{25} and M_{40} concrete as per code provisions.by their research crushed stone sand composed concrete slump value is poor. To get an initial value for slump we have to add a 310% of excess in sand compared to the M-sand. Crushed stone perform in the way of less in workability and pump ability. Final setting time of all type of sand is same. Comparing to the control concrete nothing but a natural sand based concrete the compressive strength is moderately high for the M-sand based concrete by comparing it with crushed stone it obtained 10% more than the M-sand based concrete. So M-sand is one of the best alternative for river sand is concluded by them through this investigation did in these two proportions such as M_{25} & M_{40}.

Arivalagan: Sustainable studies on Concrete with GGBS as a Replacement Material in Cement. In this study they examined the level of efficiency is determined by using the grade of M_{35} by the replacement of 20%, 30% and 40% in cement with GGBS. The GGBS consists of 30-40% of silicon dioxide and 40% of calcium oxide. The main criteria of GGBS is adding with cement will increase the impermeability character and resistance sulphate attack. By adding this GGBS the setting time of concrete is extended it will increase the workability of concrete.

Kimmi Garg and Kshira Kapoor: A Review on Ground Granulated Blast Furnace Slag as a Cement replacing material. By the replacement of this GGBFS in concrete workability get increased due to the slow setting time caused by the slow pozzolanic reaction generates the less in CO_2 emission. Also better in strength good compatibility. Reduction in permeability of moisture there is an increase in durability and reduce the energy consumption in the manufacturing of cement. Less release of temperature resulting in less shrinkage and crack. It resist to the attack of sulphate components externally. By their research results shows that the replacement of GGBFS increases the strength and stability properties of a concrete.

Krishna Rao et al: Effect of M-sand and GGBS on Strength and Compaction Characteristics of Roller Compacted Concrete Pavement (RCCP). In this the effect mainly focusses on RCCP. They concluded that slow pozzolanic reaction tends to induce the strength at the age of 3 and 7 days. In the later stage such as 28 and 90 drastically changes the strength to the higher level.

Manjunatha et al: D Good impermeability will be gained by rising the proportions of M-sand. 50% replacement reaches the positive value more than we expected in the case of split tensile strength. In the case of curing, treating with HCL the concrete which possess the grade of M_{20} and M_{30} leads to the decrement in split tensile strength. In this the proportion of replacements were 0%, 20%, 40%, 60%, 80%, 100% and submitted to the severe exposure condition. These results were mainly focuses the M-sand based concrete. Durability studies on Concrete by Replacing Natural Sand with M-sand – A Review.

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Mohan Kumar et al: Strength and Durability Studies on Concrete with Partial Replacement of Cement by GGBS. The compressive strength results were suitable only in 3 and 28^{th} days of curing. According to split tensile strength estimate the results in the day of 28. Considering that flexural strength of concrete obtain in the days of curing periods are 3, 7 and 28 days.

Santhosh Kumar Karri et al: Strength and Durability Studies on GGBS Concrete. They did their study in the M_{20} & M_{40} based concrete with the replacement of 30%, 40%, 50% of cement by GGBS attained results for the days of curing was 28 and 90. In the case of finding the durability performance they taken the chemicals such as 1% of HCL and 10% of H_2SO_4. Increase in GGBS leads to the great workability. Maximum compressive strength, flexural strength and split tensile strength is obtained for the 40% replacement of GGBS for both the grades of concrete.

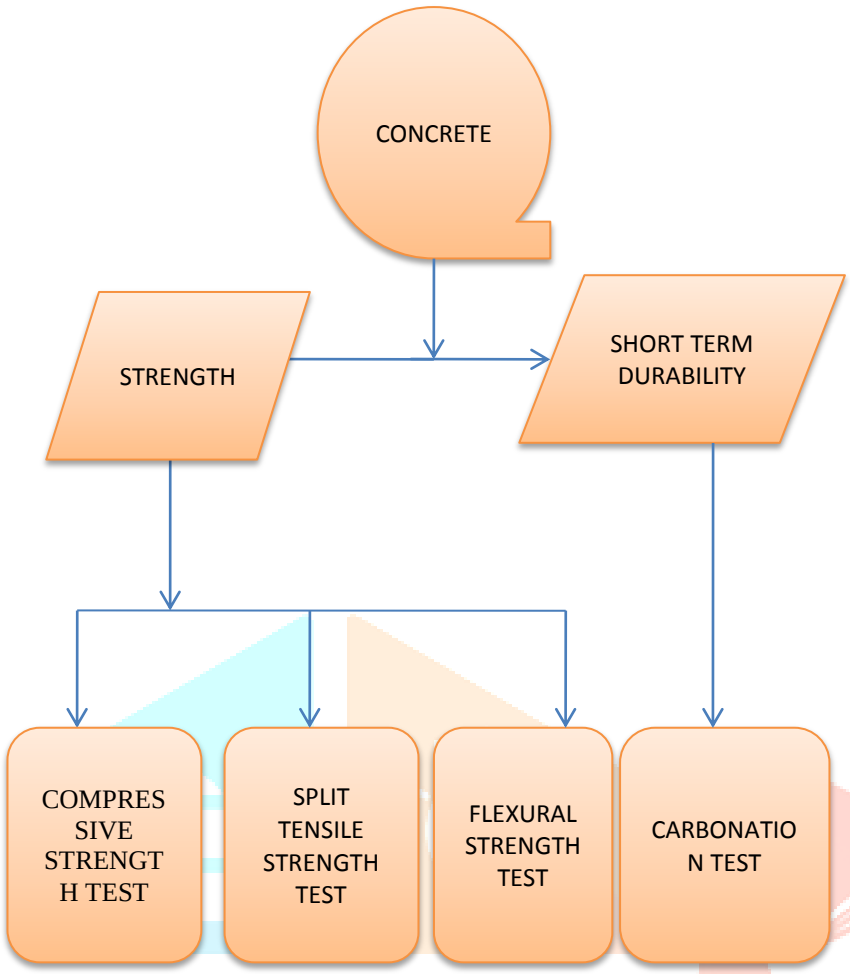
Suseela & Baskaran: Strength and Analysis on Concrete with M-sand as a Partial Replacement of Fine Aggregate. They concluded that increase in the addition of M-sand will decrease the workability of concrete. Compressive and split tensile stresses gained in the days of 7 and 28 is probably high compared to conventional one. M-sand is a dust gained from quarry so it's a cost effective one and performance wise also gives the betterment. Compressive stresses increases in the range of 40.1% and 64% for 7 and 28 days respectively and other tests such as durability, permeability, acid resisting capacity and thermal resistivity is also be in the good range.

Tajamul khan & Mohammed faisaluddin: An Investigation on Combined Replacement of Cement by GGBS and Natural sand by Slag sand on Strength of Concrete. Optimum strength is achieved for cube, cylinder and prism. Flexural crack propagated from tension fiber to compression. There is no horizontal cracks were observed. Load carrying capacity is high for GGBS compared to conventional concrete. The main objective of this work is to

1. To find out the strength and short term durability characteristics of GGBFS and Robo sand based concrete.
2. To find out the optimum mix combination.
3. To reduce the consumption of natural resources.
4. To utilize the GGBFS as a partial replacement of cement.

III METHODOLOGY

Fig 1 shows methodology



.Fig 1 shows methodology

IV MATERIALS :

a) Cement: OPC 53 grade was used for this work .Table 1 shows properties of cement

Table 1 cement properties

S.NO:	PROPERTIES	RESULTS
1	Specific Gravity	3.15
2	Fineness	90µ
3	(A) Initial Setting Time (B) Final Setting Time	30 minutes 10 hours

b) Fine Aggregate: Robo sand was procured from quarry and was replaced fully instead of river sand. Properties of ROBO Sand are shown in table 2.

Table 2 Fine aggregate properties

S.NO:	PROPERTIES	RESULTS
1	Specific Gravity	2.62
2	Zone	III

c) Coarse aggregate: Coarse aggregate passing 12.5mm and retained on 16mm was used. The properties of coarse aggregate are shown in table 3

Table 3 Coarse aggregate

S.NO:	PROPERTIES	RESULTS
1	Specific Gravity	2.85
2	Impact Value	26%

d)GGBFS: Ground granulated blast furnace slag obtained from salem steel factory was used in this work.

The properties were shown in table 4

Table 4 GGBFS Properties

S.NO:	PROPERTIES	RESULTS
1	Specific Gravity	2.8
2	Appearance	White
3	Fineness	45µ

e)Super plasticizer:

Conplast SP430 high range water reducer was used as admixture

MIX DESIGN

Mix design for M_{25} grade concrete was done according to 10262-2009 and mix ratio was found to be 1:1:2

V RESULT AND DISCUSSION

COMPRESSIVE STRENGTH TEST ACCORDING to IS 516-1959:

This test carried out in the cube specimen having the faces of 150 mm. after 24 hours placing which is immersed in water for curing 7,14 and 28 days. Then it's tested in the 2000 kN compression strength testing machine. Compressive strength was calculated using formula load/area and results are shown in Table 5

Table 5 Average Compressive strength Test result

Average Compressive strength in N/mm^2			
% of replacement in cement	Cured periods		
	7 days	14 days	28 days
0%	12.5	22	25.33
10%	14.9	23.8	28
20%	15.3	23.6	28.7
30%	15.9	24	30

SPLIT TENSILE STRENGTH ACCORDING to IS 5816-1999:

The hardened concrete gained from the specimen in the size of 150 mm diameter and 300 mm in height and it is cured for 7,14 and 28 days. It is tested in 2000 kN capacity based compression testing machine. Splitting tensile strength was calculated using the formula $\frac{2P}{\pi DL}$ The results are shown in Table 6

Table 6 SPLIT TENSILE STRENGTH TEST

Split tensile strength in N/mm^2			
% of replacement in cement	Cured periods		
	7 days	14 days	28 days
0%	1.23	2.1	2.5
10%	1.60	2.98	3.50
20%	1. 84	3.21	4.49
30%	1.99	3.34	4.65

FLEXURAL STRENGTH TEST ACCORDING to IS 516-1959:

This test is carried out with the specimen having the dimensions of 100 mm width & depth with the length of 500 mm. flexural strength was done in UTM and results are shown in Table7FlexuralstrengthTest

Flexural strength in N/mm^2			
% of replacement in cement	Cured periods		
	7 days	14 days	28 days
0%	1.62	2.32	3.8
10%	1.71	2.45	3.99
20%	1.77	2.66	4.2
30%	1.86	2.91	4.46

Short term durability by Carbonation test

The test is accomplished with the help of phenolphthalein indicator in that the surface is changed into the color of purple denotes that there is no chemical reaction caused by the external moisture. Which represents that the PH is more than 12 to 13. So the steel will not easily corroded and it reflects the durability character of concrete.

VI CONCLUSION

- Up to the replacement of 30% in cement the compressive, split tensile and flexural strength is in increasing order for M_{25} grade concrete.
- Using of GGBFS and Robo sand shows good resistance to carbonation

- The combination of GGBFS and Robo sand based concrete gives the betterment in strength.
- It is not affected to the external agents such as moisture so the short term durability is in the positive manner.
- Using of Robo sand and GGBFS saves Environment from pollution
- All the percentage of replacement was found to be good when compared to control concrete

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