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An Effect of Mixing Oyster Shell Ash (OSA) and GGBS as Partial Replacement of Cement on Properties of BFRC Concrete

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ABSTRACT: The most popular building material is concrete, which is primarily made of cement. It is also the most widely available building material. Cement production releases a significant amount of CO2 into the atmosphere, contributing to environmental pollution. The practical solution to this is to replace cement with GGBS and Oyster Shell Ash (OSA). To address a clear shortage, the fibers are used in concrete. Steel, basalt, glass, polypropylene, carbon fibers, and polyethylene are the most widely used fibers. The workability of ternary mixes containing GGBS and Oyster Shell Ash (OSA) was superior to that of concrete made with close relatives, and it increased as the proportion of mineral admixtures was increased. Oyster Shell Ash (OSA) and GGBS substitutions at higher percentages had better and worse workability, respectively. By replacing 40% of the cement with GGBS and Oyster Shell Ash (OSA) and adding 3 kg/m3 of basalt fiber, the concrete's microstructure became more compact, and its compressive and tensile strengths .

In this experiment, supplementary materials GGBS and Oyster Shell Ash (OSA) in varying percentages were used to fix 0.25% of the total dosage of fiber content, including 0% GGBS and 100% Oyster Shell Ash (OSA), 20% GGBS and 80% Oyster Shell Ash (OSA), 40% GGBS and 60% Oyster Shell Ash (OSA), and 20% GGBS and 80% Oyster Shell Ash (OSA). Results are considered a To test the concrete's flexural and compressive strengths after 7 and 28 days, beams and cubes are cast. Fibers not only improve strength and durability but also assist in withstanding tensile stresses.

Comparative analysis between normal concrete Compressive strength are Mix design M-0 20.54 MPa, 28.66 MPa, and 31.40 MPa; to GGBS & Oyster Shell Ash (OSA) based multi blended concrete with basalt fibers Compressive strength are Mix design HS-5 24.30 MPa, 31.55 MPa, and 36.85 MPa, increase in percentage 18.31 %, 17.46 % and 14.17% at 7 days, 14 days and 28 days respectively.

Comparative analysis between normal concrete Flexural tensile strength are Mix design M-0 5.150 MPa ; to GGBS & Oyster Shell Ash (OSA) based multi blended concrete with basalt fibers Flexural tensile strength are Mix design HS-B5 6.550 MPa, increase in percentage 27.184 % at 28 days.

KEYWORDS; Concrete, Compressive strength, Flexural tensile strength, Cement, Fine aggregates, coarse aggregates , GGBS & Oyster Shell Ash (OSA).

I. INTRODUCTION

The most popular building material is concrete, which is primarily made of cement. It is also the most widely available building material. Cement production releases a significant amount of CO2 into the atmosphere, contributing to environmental pollution. The practical solution to this is to replace cement with GGBS and Oyster Shell Ash (OSA). To address a clear shortage, the fibers are used in concrete.Steel, basalt, glass, polypropylene, carbon fibers, and polyethylene are the most widely used fibers. The workability of ternary mixes containing GGBS and Oyster Shell Ash (OSA) was superior to that of concrete made with close relatives, and it increased as the proportion of mineral admixtures was increased. Oyster Shell Ash (OSA) and GGBS substitutions at higher percentages had better and worse workability, respectively. By replacing 40% of the cement with GGBS and Oyster Shell Ash (OSA) and adding 3 kg/m3 of basalt fiber, the concrete's microstructure became more compact, and its compressive and flexural tensile strengths increased by about 10% and 25%, respectively.In this experiment, supplementary materials GGBS and Oyster Shell Ash (OSA) in varying percentages were used to fix 0.25% of the total dosage of fibre content, including 0% GGBS and 100% Oyster Shell Ash (OSA), 20% GGBS and 80% Oyster Shell Ash (OSA), 40% GGBS and 60% Oyster Shell Ash (OSA), and 20% GGBS and 80% Oyster Shell Ash (OS Results are considered a To test the concrete's flexural and compressive strengths after 7 and 28 days, beams and cubes are cast. Fibers not only improve strength and durability but also assist in withstanding tensile stresses.

II. OBJECTIVE OF VIEW

The most important aim of the present work of thesis is to examine mechanical properties of M30 grade of concrete of made with basalt fibers. To reduce the deleterious effects of the production of cement on the environment, concrete is being developed by substituting admixtures like GGBS and oyster shell ash (OSA) in place of cement. Multi blended concrete developed with GGBS and oyster shell ash (OSA) showed depletion in the mechanical properties.
The following are the objectives of this thesis.

1. To find out the effect of GGBS and oyster shell ash (OSA) on strength when mixed with concrete sample. To study the workability of concrete on variation in different percentage of GGBS and oyster shell ash (OSA) when mixed with concrete.
2. Increase the economy of the construction with using the cheaper material as a replacement of the cement.
3. To find out the change in slump value.
4. To check the flexural strength and compressive of concrete at 7 days and 28 days.
5. To increase the service life.

III. PROBLEM STATEMENT

1. The most important problems faced in reinforced concrete construction are the decay of reinforcing steel, which considerably affects the durability and life of concrete structures.
2. Normal concrete gives a very low tensile strength, restricted ductility and small amount of resistance to cracking. Internal small cracks lead to brittle failure of concrete. In this new generation civil engineering constructions have their own structural and durability requirements.
3. In this thesis has attempted to examine mechanical properties of M30 grade of concrete of made with basalt fibers. To reduce the deleterious effects of the production of cement on the environment, concrete is being developed by substituting admixtures like GGBS and oyster shell ash (OSA) in place of cement.
4. Multi blended concrete developed with GGBS and oyster shell ash (OSA)showed depletion in the mechanical properties. Basalt fibers were added to this mix additionally to overcome this deficiency.
5. In this experiment 0.25% of total dosage of fiber content was fixed with Supplementary materials GGBS and Oyster Shell Ash (OSA) in varying percentages i.e. 0% of GGBS and 100% of Oyster Shell Ash (OSA) , 20% of GGBS and 80% of Oyster Shell Ash (OSA) , 40% of GGBS and 60% of Oyster Shell Ash (OSA) ,2 0% of GGBS and 80% of Oyster Shell Ash (OSA) , 100% of GGBS and 0% of Oyster Shell Ash (OSA) of total dosage (i.e.40%) by weight of cement. Results are taken as a Beams and Cubes are casted to check the flexural strength and compressive of concrete at 7 days and 28 days.

IV. METHODOLOGY

4.1 Methodology

In this Research work has attempted to examine mechanical properties of M30 grade of concrete as designed by using IS: 10262 (2000) with water binder ratio of 0.45. To reduce the deleterious effects of the production of cement on the environment, concrete is being developed by substituting admixtures like Oyster Shell Ash (OSA) and GGBS in place of cement. Multi blended concrete developed with GGBS and Oyster Shell Ash (OSA)) showed depletion in the mechanical properties. Basalt fibers were added to this mix additionally to overcome these deficiency Basalt fibers were added to this mix additionally to overcome this deficiency. Basalt Fibers used in this experiment. In this experiment 0.25% of total dosage of fiber content was fixed with Supplementary materials GGBS & Oyster Shell Ash (OSA) in varying percentages i.e. 0% of GGBS and 100% of Oyster Shell Ash (OSA) 20% of GGBS and 80% of Oyster Shell Ash (OSA), 40% of GGBS and 60% of Oyster Shell Ash (OSA), 20% of GGBS and 80% of Oyster Shell Ash (OSA) ,100% of GGBS and 0% of Oyster Shell Ash (OSA) of total dosage (i.e.40%) by weight of cement. Results are taken as a Beams and Cubes are casted to check the flexural strength and compressive of concrete at 7 days and 28 days.

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4.2 Mix Design of M30 grade of concrete

Table no.1; The final trial batch quantities per cubic meter of concrete are

Cement	Water	Fine aggregate	Coarse aggregate
kg/m^3	kg/m^3	kg/m^3	kg/m^3
414	**161**	**725.43**	**1089.86**
1	**0.39**	**1.75**	**2.63**

Table no.2: Composition of BFRC mixes - C –OPC, G- GGBS, O - Oyster Shell Ash (OSA), B- Basalt fibers

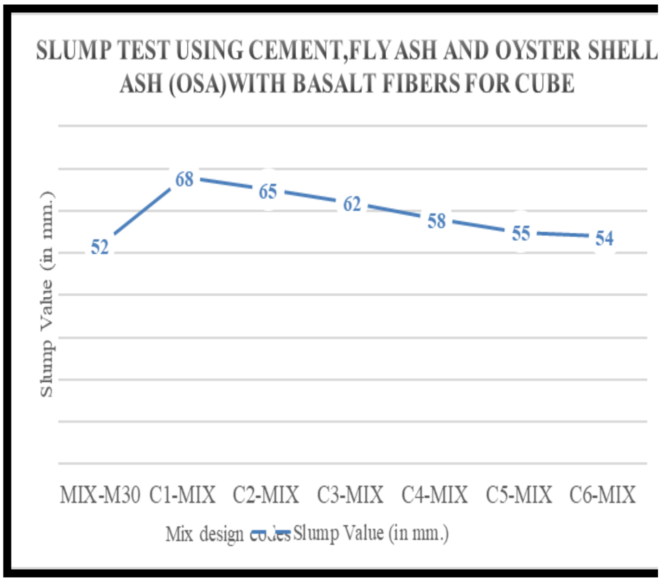
Mix designation	Cement kg/m3	GGBSk g/m3	(OSA) kg/m3	Basalt Fiber	Fine Aggregate kg/m^3	Coarse Aggregate kg/m^3	Water kg/m^3	W/ C ratio
C100	414	-	-	-	725.43	1089.86	161	0.45
C60+(O-00+G-100)	248.4	0	165.6	3	725.43	1089.86	161	0.45
C60+(O-20+G-80)	248.4	33.12	132.48	3	725.43	1089.86	161	0.45
C60+(O-40+G-60)	248.4	66.24	99.36	3	725.43	1089.86	161	0.45
C60+(O-60+G-40)	248.4	99.36	66.24	3	725.43	1089.86	161	0.45
C60+(O-80+G-20)	248.4	132.48	33.12	3	725.43	1089.86	161	0.45
C60+(O-100+G-00)	248.4	165.6	0	3	725.43	1089.86	161	0.45

4.3 Workability of various concrete mixes design for slump cone test

Table No. 3: Workability of various concrete mixes design for slump cone test in cube specimen

S.No.	Mix design codes	Mix designation	Slump Value (in mm)
1	MIX-M30	C100	52
2	C1-MIX	C60+(O-00+G-100)	68
3	C2-MIX	C60+(O-20+G-80)	65
4	C3-MIX	C60+(O-40+G-60)	62
5	C4-MIX	C60+(O-60+G-40)	58
6	C5-MIX	C60+(O-80+G-20)	55
7	C6-MIX	C60+(O-100+G-00)	54

Figure 1: Workability of various concrete mixes design for slump cone test in cube specimen



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4.4 Compressive Strength

Table No. 4: Compressive strength for M30 of GGBS & Oyster Shell Ash (OSA) based multi blended concrete mixes with Basalt fibers at 7 days.

S.No.	Mix design codes	Mix designation	Compressive Strength (in Mpa)
1	MIX-M30	C100	26.95
2	C1-MIX	C60+(O-00+G-100)	27.60
3	C2-MIX	C60+(O-20+G-80)	27.20
4	C3-MIX	C60+(O-40+G-60)	26.90
5	C4-MIX	C60+(O-60+G-40)	25.60
6	C5-MIX	C60+(O-80+G-20)	24.50
7	C6-MIX	C60+(O-100+G-00)	22.60

Figure 2: Compressive strength for M30 of GGBS & Oyster Shell Ash (OSA) based multi blended concrete mixes with Basalt fibers at 7 days.

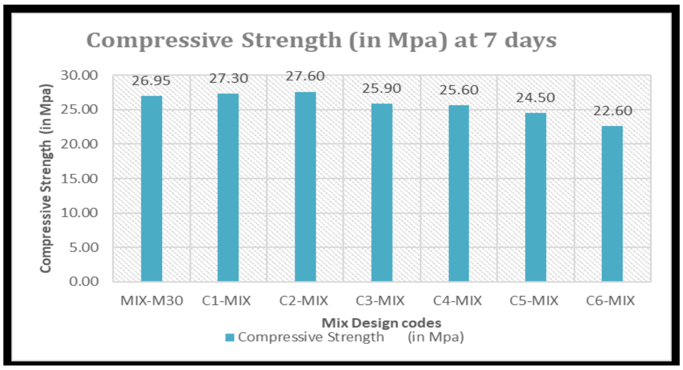
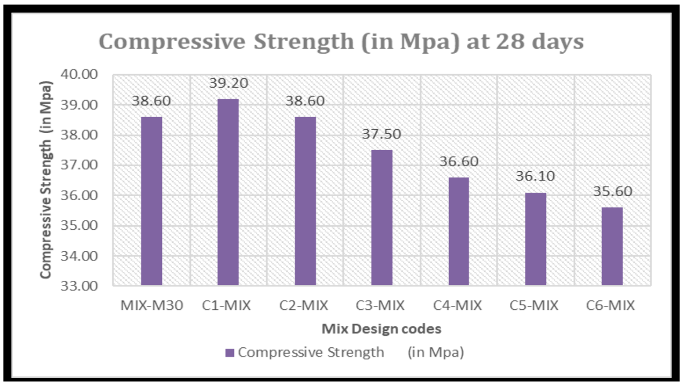


Table No. 5: Compressive strength for M30 of GGBS & Oyster Shell Ash (OSA) based multi blended concrete mixes with Basalt fibers at 28 days.

S.No.	Mix design codes	Mix designation	Compressive Strength (in Mpa)
1	MIX-M30	C100	38.60
2	C1-MIX	C60+(O-00+G-100)	39.20
3	C2-MIX	C60+(O-20+G-80)	38.60
4	C3-MIX	C60+(O-40+G-60)	37.50
5	C4-MIX	C60+(O-60+G-40)	36.60
6	C5-MIX	C60+(O-80+G-20)	36.10
7	C6-MIX	C60+(O-100+G-00)	35.60

Figure 3: Compressive strength for M30 of GGBS & Oyster Shell Ash (OSA) based multi blended concrete mixes with Basalt fibers at 28 days.

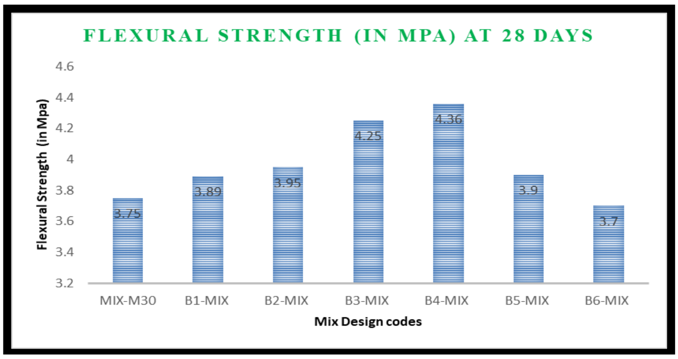


4.5 Flexural Strength

Table No. 6: Compressive strength for M30 of GGBS & Oyster Shell Ash (OSA) based multi blended concrete mixes with Basalt fibers at 7 days.

S.No.	Mix design codes	Mix designation	Flexural Strength (in Mpa)
1	MIX-M30	C100	3.75
2	C1-MIX	C60+(O-00+G-100)	3.89
3	C2-MIX	C60+(O-20+G-80)	3.95
4	C3-MIX	C60+(O-40+G-60)	4.25
5	C4-MIX	C60+(O-60+G-40)	4.36
6	C5-MIX	C60+(O-80+G-20)	3.90
7	C6-MIX	C60+(O-100+G-00)	3.70

Figure 4: Compressive strength for M30 of GGBS & Oyster Shell Ash (OSA) based multi blended concrete mixes with Basalt fibers at 7 days.



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V. CONCLUSION AND FUTURE WORK

1. This thesis is aimed to study an experimental study on strength of basalt fiber reinforced concrete produced by partially replacing cement with Oyster Shell Ash (OSA) and GGBS. Based on the discussions of the experimental results, it can be summarized that.
2. The flexural & compressive strength of GGBS & Oyster Shell Ash (OSA) based multi blended concrete with basalt fibers were improved when compared with conventional concrete mix design M30.
3. The workability of concrete increased with the addition of Hypo Sludge as partial replacement of Cement.
Mix design codes Slump cone test in mm.
H-5 (Multi Blended Concrete) 85mm
4. Compressive strength of GGBS & Oyster Shell Ash (OSA) based multi blended concrete with basalt fibers increase in percentage of GGBS & Oyster Shell Ash (OSA) at 7 days. It followed the similar trend at 28 days except at 40% of GGBS & Oyster Shell Ash (OSA) (i.e.40% by weight of cement) increase in percentage with basalt fibers.

Mechanical Properties	Days	Mix design	strength (N/mm^2)	% Increase in strength
Compressive strength (N/mm2) of conventional concrete	at 7 days	M-0	20.54	0.00%
	at 14 days	M-0	28.86	0.00%
	at 28 days	M-0	31.40	0.00%
Compressive strength (N/mm2) of addition of HS in Mix concrete	at 7 days	***HS-5***	24.3	18.31%
	at 14 days	*HS-5*	31.55	17.46%
	at 28 days	*HS-5*	35.85	14.17%

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