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EXPERIMENTAL TEST CONDUCTED ON CONCRETE BY REPLACING SAND WITH GBFS AND ADDING COCONUT FIBRES

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Abstract - Sand is an essential material utilized for preparation of mortar and concrete, it additionally plays a noteworthy part in mix design. These days, there is a shortage of river sand because of disintegration of stream bed. GBFS is one of the promising feasible answer for substitution of sand as they are the waste acquired from steel industry. We realize that concrete is week in strain to defeat this reaction of concrete, natural fibre can be utilized in concrete. This review is directed by supplanting sand with GBFS and utilizing coconut fibre in cement.

Keywords: *Granulated Blast Furnace Slag, Coconut fibre.*

1.INTRODUCTION

Concrete is a mixture of cement, aggregates, water alongside some admixtures. In future it is critical to take care of the worldwide demand of cement, along these lines it is essential to locate a creative and appropriate methods for development technique and in addition development materials. Innovative construction should mainly aim to reduce the harmful environmental impacts which is readily to be produced from construction industry. As there is growth in construction field taking place there is a scarcity of raw materials which is necessary for construction process. There is lot of scarcity for fine aggregate in present days, therefore it is important to find alternative raw material for fine aggregate. Granulated Blast Furnace Slag is the raw material which has similar properties to that of river sand and it is the waste material obtained from steel industry. GBFS is one of the promising material that can be used as fine aggregate.

We all know that concrete is weak in tension and is good in compression. In order to make concrete good in tension reinforcing of concrete is done. In this project natural fibre is used in concrete for reinforcement, i.e., coconut fibre. Coconut fibre is one of the natural fibre which is easily available, cheap and environmental friendly material.. Addition of coconut fibre to the concrete will reduce the cracks in concrete by arresting it.

1.1 Objectives of the experiment

- To find the strength of concrete when sand is replaced by GBFS.
- To find out the properties of fresh concrete.
- To concentrate the conceivable outcomes to utilize the coconut fibre notwithstanding alternate constituents of cement and to concentrate the quality properties.
- To examine the compressive quality, flexural quality, split elasticity, and furthermore to direct non-ruinous test like Rebound mallet test and Ultra sonic Pulse speed test.

1.2 Scope of experiment

- GBFS is the waste obtained from steel industry, disposing this into environment is very dangerous therefore using GBFS in concrete will reduce the bad effect of disposal.
- Coconut coir which is easily available and is going waste it can be used effectively for reinforcing in concrete.
- Using coir and replacing fine aggregate with GBFS is economical as they are waste products and are easily available.

2. MATERIALS AND METHODOLOGY

2.1 Cement

In this study ordinary Portland Ramco cement of grade conforming to IS Requirement as per IS: 269- 2015 was used.

Table -1: Physical properties of cement

Test	Result obtained	Requirement as per IS : 269-2015 Clause 7 for OPC 53
Consistency	2.97	2.9 - 3.10
Initial setting time	140 minutes	Not less than 30 minutes
Final setting time	220 minutes	Max. 600 minutes
Soundness	0.50 mm	Max. 10mm

2.2 Coarse aggregate

The coarse aggregates used were angular in shape and of down size 20 mm and 12.5mm. Crushed stone fine aggregates conforming to Zone –II were used.

Table -2: Physical properties of Coarse aggregate

Test	Result obtained
Specific Gravity of coarse aggregate 12.5mm	2.67
Specific Gravity of coarse aggregate 20mm	2.71
Impact value	20.64

2.3 Fine aggregate

Due to the non-availability of river sand crushed rock sand is used. Crushed stone sand is economic and readily available. It is manufactured by crushing the quarry stone to a size that will completely pass through 4.75 mm sieve.

Table -3: Physical properties of Fine aggregate

Test	Result obtained
Specific Gravity	2.57
Water absorption	4.8%
Bulk Density	1.575 kg/lit

2.4 Granulated Blast Furnace Slag

The Granulated Blast Furnace Slag is the slag obtained from steel industry. It was brought from Quality Polytech Baikampady. The material going through 20mm strainer and holding on 4.76mm sifter is used. It is the waste slag acquired from steel industry.

Table -4: Physical properties of GBFS

Test	Result obtained
Specific Gravity	2.44

2.5 Coconut Coir Fibre

Coconut fibre - Fibres are freely available, strong, light in weight. The addition of coconut fibre can reduce the thermal conductivity in concrete. Processed coconut fibre is obtained from Skanda Products Kasaragod. Coconut fibre were cut at 5cm length.

2.6 Chemical admixture

Admixture used in this project is Master Rheobuild 918RM- which is a retarding super plasticizer which is made up of synthetic polymers.

Table -5: Physical properties of Admixture

Test	Result obtained
Physical state	Dark brown free flowing liquid
Specific gravity	1.18
Recommended dosage	0.2% - 0.9%

2.5 Methodology

The process and methods adopted in the project is briefly shown in flow chart below.

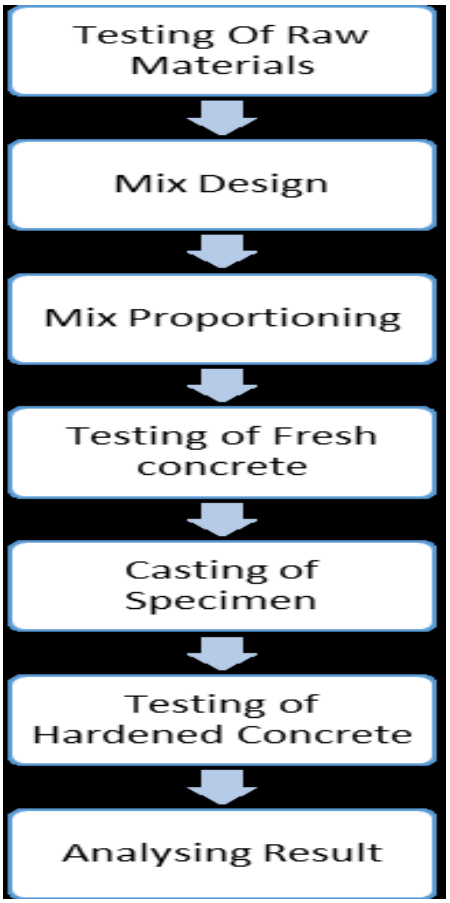

Fig -1: Name of the figure

Initial test like specific gravity, fineness test, sieve analysis etc.. are done on raw materials i.e., sand, coarse aggregate, cement, GBFS are conducted. Then mix design is done M35 of concrete based on IS codes. Plain concrete cubes are initially casted as control specimen. Nominal cubes are casted by adding 1%, 2%, 3%, and 4% of fibre by the weight of cement in the concrete blend. The cubes were casted to find the nominal percentage of fibre which gives high strength concrete. Compression test for nominal mix is conducted for 7 days and 28 days. Percentage of fibre for which compression test result is higher is taken. Then preparing test cube specimen by keeping nominal percentage of fibre

constant with 10%, 20%, 30%, 40% and 50% replacement of sand by GBFS. The size of cube specimens 150x150x150mm as per the Indian Standards. A blend of concrete was designed for M-35 grade. The specimens was cured using portable water under room temperature. The mechanical tests conducted on specimens are given below

1. Compressive Strength on cube
1. Flexural Strength on beam
2. Splitting Tensile Strength on cylinder
3. Ultra sonic pulse velocity

3. MIX PROPORTION

3.1 The data required for the mix design is as follows:

- Grade of concrete: M35
- Type of cement : Ramco cement OPC 53 grade
- Nominal size of aggregate: 20 mm downsize
- Water cement ratio: 0.40
- Workability of concrete: 100mm slump
- Admixture used: Master Rheobuild 918RM

3.2 Various trial of concrete mix

There was 5 different mixes in this study by keeping the fibre content constant and varying the percentage of GBFS replacement over sand. Also control specimen of M35 grade concrete are casted.

Table -6: Different Mix proportion

Mix	FG 10	FG 20	FG 30	FG 40	FG 50
Cement Kg/m³	380	380	380	380	380
F.A Kg/m³	771	617	540	463	386
GBFS Kg/m³	0	154	230	308	386
C.A Kg/m³	1095	1095	1095	1095	1095
Fibre Kg/m³	7.6	7.6	7.6	7.6	7.6
Water Kg/m³	165	165	165	165	165
Admixture Kg/m³	2.66	2.66	2.66	2.66	2.66

4. RESULT AND DISCUSSION

4.1 Compression test Result

Table -7: Compression Test results

Mix	Description of Mix	7 days Average Strength (N/mm²)	14 days Average Strength (N/mm²)	28 days Average Strength (N/mm²)
FG 0	Normal concrete	51.08	48.72	52.49
FG 10	2% coconut fibre + 10% GBFS	40.73	41.58	50.68
FG 20	2% coconut fibre + 10% GBFS	41.98	42.10	52.96
FG 30	2% coconut fibre + 10% GBFS	42.16	42.46	54.81
FG 40	2% coconut fibre + 10% GBFS	51.68	49.81	57.01
FG 50	2% coconut fibre + 10% GBFS	40.96	44.77	50.11

Fig -1: Compression Test

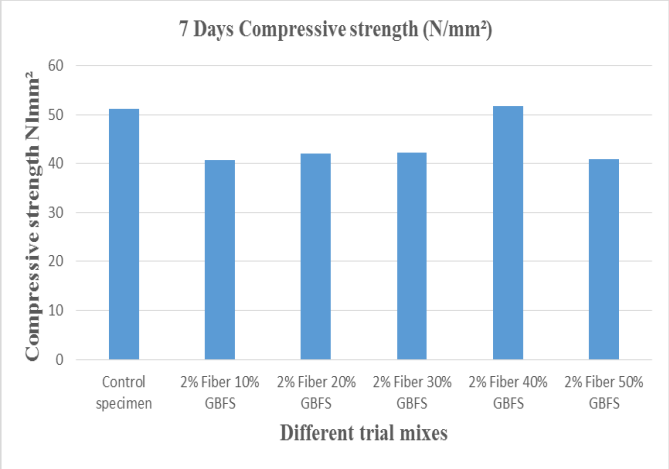

Chart -1: 7 Days Compression test results

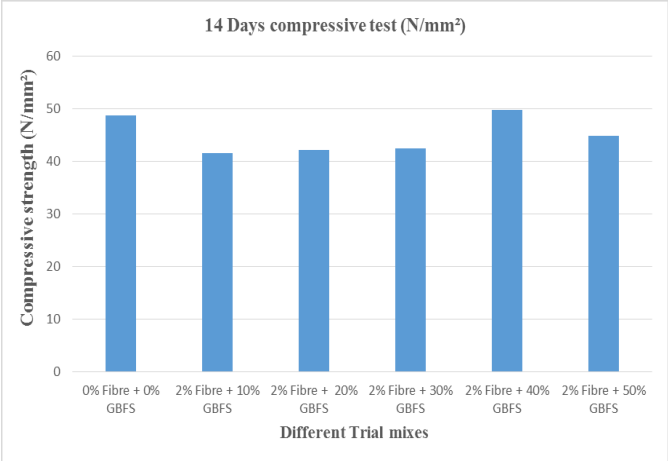

Chart -2: 14 Days Compression test results

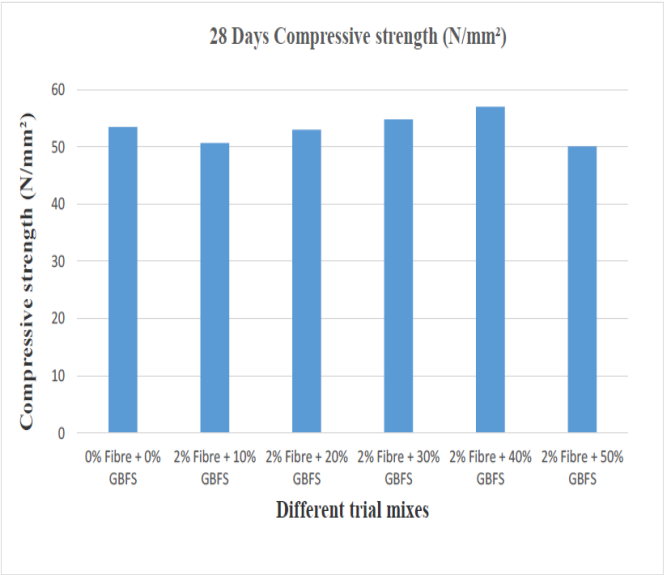

Chart -3: 28 Days Compression test results

4.2 Flexural test Result

Table -8: Flexural Test results

Mix	Description of Mix	7 days Average Strength (N/mm^2)	28 days Average Strength (N/mm^2)
FG 0	Normal concrete	6.32	6.44
FG 10	2% coconut fibre + 10% GBFS	5.78	5.12
FG 20	2% coconut fibre + 10% GBFS	5.85	5.66
FG 30	2% coconut fibre + 10% GBFS	5.91	6.22
FG 40	2% coconut fibre + 10% GBFS	6.20	6.35
FG 50	2% coconut fibre + 10% GBFS	5.47	5.94

Fig -2: Flexural Testing

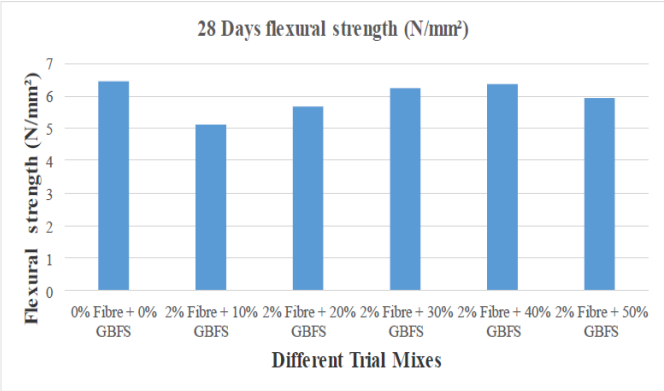

Chart -4: 28 Days Flexural test results

4.3 Split Tensile test Result

Table -9: Split Tensile Test results

Mix	Description of Mix	28 days Average Strength (N/mm^2)
FG 0	Normal concrete	4.29
FG 10	2% coconut fibre + 10% GBFS	3.27
FG 20	2% coconut fibre + 10% GBFS	3.34
FG 30	2% coconut fibre + 10% GBFS	3.82
FG 40	2% coconut fibre + 10% GBFS	4.49
FG 50	2% coconut fibre + 10% GBFS	3.43

Fig -3: Split Tensile Testing

Fig -4: Failed Specimen

4.4 Ultra Sonic Pulse Velocity test Result

Table -10: Ultra Sonic Pulse Velocity Test results

Mix	Description of Mix	Path Length (mm)	Transit time (µs)	Velocity (Km/Sec)
FG 0	Normal concrete	150	30.32	4.94
FG 10	2% coconut fibre + 10% GBFS	150	34.21	4.38
FG 20	2% coconut fibre + 10% GBFS	150	34.06	4.40
FG 30	2% coconut fibre + 10% GBFS	150	32.26	4.64
FG 40	2% coconut fibre + 10% GBFS	150	29.89	5.0
FG 50	2% coconut fibre + 10% GBFS	150	32.58	4.6

Fig -5: Ultra Sonic Pulse Velocity Testing

5. CONCLUSIONS

The conclusion for this study can be given as follows:

- Compression strength increases in case of addition of coconut fibre up to 2% of fibre by weight of cement in concrete and further increase in fibre content reduced the strength of the concrete.
- Coconut fiber being low in thickness lessens the general weight of the fiber fortified solid therefore its utilized as a basic light weight concrete.
- The compressive quality of solid increments with increment in GBFS rate up to a 40 rate supplanting of fine total alongside 2% fibre and after that it diminishes.
- Compressive strength for 40% replacement of fine aggregate and 2% fibre is found to be maximum for 7 days, 14 days and 28 days test.
- Utilizing of GBFS as a substitution of fine total might demonstrate a temperate and earth cordial arrangement.
- Addition of coconut fibre to concrete will give good strength but there is reduction in workability for all replacement levels therefore it is must to add super plasticizers to increase workability.
- Addition of coir fibre will arrest the micro cracks present in the concrete.
- By using coconut fibres as reinforcing material in concrete, the environmental waste can be eliminated as well as it is easily available and cheap.
- Coconut fibre fortified cement can upgrade higher sturdiness. Coconut fiber strengthened cement has indicated less number of break advancements and split width.

5.1 Scope for future study

- When fibre is added to concrete blending turns out to be extremely difficult and prompts arrangement of a different blend. The homogeneous blend can be obtained by adding different chemicals.
- Addition of some admixtures can help to lessen the quantity of voids which are shaped to the present of strands in the solid.
- Further acid attack, permeability test, water absorption test, corrosion test can be done on concrete specimen.

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