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EXPERIMENTAL INVESTIGATION ON BAMBOO FIBER REINFORCED CONCRETE BY USING ZEOLITE POWDER AS FINE AGGREGATE AND GGBS AS CEMENT PARTIAL REPLACEMENT IN CONCRETE

[1]J. SREE NAGA CHAITANYA, [2] DR.K. CHANDRAMOULI, [3]SK.SAHERA, [4]K. DIVYA,[5]T. ANURADHA

[1,3&4] Assistant Professor, [2]Professor & HOD, [5]B. Tech Student
Department of Civil Engineering, NRI Institute of Technology, Visadala (V), Medikonduru (M), Guntur, Andhra Pradesh, INDIA

ABSTRACT

Concrete is used in construction the most frequently. Fine and coarse aggregate are combined to form concrete, a composite material, which is held together by a cement paste that can flow. In this work, a short trial is conducted to change the mechanical properties of bamboo fibre reinforced concrete using GGBS as a partial replacement cement and zeolite powder as the fine aggregate. In place of 0, 5%, 10%, and 15% of the fine aggregate, zeolite powder is used. The cement is partially replaced with 0%, 0.5%, 1.5%, and 40% GGBS, as well as bamboo fibre and 10%, 20%, 30%, and 40% GGBS. Compressive strength split tensile test and ultra-sonic pulse velocity results for concrete must be determined after 28, 56 and 90 days.

KEYWORDS: Zeolite powder, GGBS, Bamboo fiber, Compressive strength, Split tensile strength and ultra-sonic pulse velocity.

1. INTRODUCTION

Concrete is utilized for all kinds of structural development and is the most widely used building material in the world. Concrete will support post and pre tensioning techniques to obtain a stronger strength over time with the reduction of concrete. There are several ways to fulfil various requirements, some of which can be stronger than the usual. Concrete is a compound of water, coarse aggregate, and fine aggregate that is bound together by cement. An exothermic reaction takes place when cement and water is combined, making the constituent parts of concrete harder.

Sedimentary ash naturally transforms into the mineral zeolite. When molten rock and volcanic ash mix with seawater during an eruption, zeolite is produced. The crystalline solid known as zeolite is composed of the three

elements silicon, aluminium, and oxygen. They have ion exchange, filtration, smell removal, chemical sieving, and gas absorption capabilities. Water softeners are the most typical application for zeolites.

(Granulated blast furnace slag in the ground) A particular kind of slab called GGBS is created in iron ore-refining furnaces. This GGBS can replace some of the cement in concrete because it has certain cementitious qualities. Additionally, it guards against heat cracking and the alkali-silica reaction in concrete. If this slag is to be used in the creation of GGBS, it must be quickly cooled in a lot of water after being often tapped out as a molten liquid.

Bamboo is a bendable substitute that has a high strength to weight ratio and is simple to work with because of its natural properties. It is a nearby accessible natural reserve that is among those that are developing quickly. Bamboo has been utilised for construction since prehistoric times. The tensile and mechanical strength of the concrete is increased by adding bamboo fibres. The bamboo is 30 mm long.

2. OBJECTIVES

a) To use ggbs to optimise the cement.
c) To use Zeolite powder to improve the fine aggregate.
c) To assess the results of the compressive, split tensile strength and Upv tests.

3. MATERIALS:

a. Cement:

Cement is generally utilised as a binder material in concrete, which is used for construction and sets and hardens to link other materials. OPC (ordinary Portland cement) grade 53 is used in construction.

Table 1. Physical Properties of OPC

S.No	Description of item	Values
1	Specific gravity	3.153
2	Fineness modulus	9.68%
3	Bulk density	1440kg/m^3

b. Fine aggregate:

Fine aggregate is the most important part of concrete made from natural sand or crushed stone. The fine aggregate density and quality have a big impact on the concrete's hardened qualities.

c. Coarse aggregate:

Coarse aggregate is defined as material retained over IS Sieve 4.75 mm. As stated in IS 383:1970, the typical maximum size increases by 10 to 20 mm.

d. Water:

Water is one of the most essential elements in building and is required for several processes including creating mortar, mixing cement and curing work. The quality of the water used has an immediate effect on both the motor's strength and the strength of the cement concrete used in the construction project.

e. Zeolite powder:

Zeolite has been used as a fluidizing agent for carriers, an antibacterial agent, a strengthening agent for concrete, a humidity controller, and a strengthening agent for concrete.

f. ggbs:

GGBS (ground granulated blast furnace slag) is a white furnace slag created by the furnaces used to process iron ore. The majority of the components of GGBS are oxides of calcium, silica, aluminum, and magnitude.

g.Bamboo fiber:

The capacity of beams after cracking and the width and deflection of concrete fractures may both be reduced using bamboo fibre.

4. RESULTS AND DISCUSSIONS:

Compressive strength test: The 150mm x 150mm x 150mm cube specimens were cast and tested in compression testing equipment for 7 and 28 days of cure time for various concrete mix proportions.

Table 2: Compressive strength of concrete with Zeolite powder as partial replacement of Fine aggregate in concrete

S.No.	Zeolite Powder	Compressive Strength, N/mm^2		
		28 days	56 days	90 days
1	0%	39.51	42.78	46.12
2	5%	41.92	45.46	48.78
3	10%	44.18	47.93	51.56
4	15%	42.41	46.19	49.61

Table 3: Compressive strength of concrete with Ggbs as partial replacement of Cement in concrete

S.No.	GGBS	Compressive Strength, N/mm^2		
		28 days	56 days	90 days
1	0%	39.51	42.78	46.12
2	10%	40.68	44.32	47.52
3	20%	42.83	46.41	49.96
4	30%	43.84	47.74	51.25
5	40%	42.99	45.79	48.91

Table 4: Compressive strength of concrete with Bamboo fiber concrete

S.No.	Bamboo fiber	Compressive Strength, N/mm^2		
		28 days	56 days	90 days
1	0%	39.51	42.78	46.12
2	0.5%	45.57	49.45	53.02
3	1%	49.31	53.59	57.65
4	1.5%	46.66	50.76	54.46

Table 5: Compressive strength of concrete for combined partial replacement of cement by 30% Ggbs+ fine aggregate by 10% of Zeolite powder and 1%Bamboo fibre

S.No	Combined replacements (%)	Compressive strength, N/mm^2		
		28 days	56 days	90 days
1	0	39.51	42.78	46.12
2	10%ZP+30%GGBS+1%BF	53.81	58.62	62.76

b. Split tensile strength test:

At the age of 7 and 28days, the cylindrical specimens (150mm diameter x 300mm height) were tested for evaluating the split tensile strength. The experiment is performed by putting a cylindrical sample horizontally between a compression testing machine loading surface and the load is applied until the cylinder fails along the vertical diameter.

Table 6: Split tensile strength of concrete with Zeolite powder as partial replacement of Fine aggregate in concrete

S.No.	Zeolite Powder	Split tensile strength, N/mm^2		
		28 days	56 days	90 days
1	0%	3.86	4.21	4.51
2	5%	4.11	4.47	4.78
3	10%	4.36	4.72	5.08
4	15%	4.23	4.59	4.93

Table 7: Split tensile strength of concrete with Ggbs as partial replacement of Cement in concrete

S.No.	GGBS	Split tensile strength, N/mm^2		
		28 days	56 days	90 days
1	0%	3.86	4.21	4.51
2	10%	4.01	4.35	4.66
3	20%	4.20	4.58	4.91
4	30%	4.37	4.77	5.12
5	40%	4.25	4.63	4.97

Table 8: Split tensile strength of concrete with Bamboo fiber concrete

S.No.	Bamboo fiber	Split tensile strength, N/mm^2		
		28 days	56 days	90 days
1	0%	3.86	4.21	4.51
2	0.5%	4.45	4.84	5.18
3	1%	4.87	5.29	5.72
4	1.5%	4.65	5.06	5.43

Table 9: Split tensile strength of concrete for combined partial replacement of cement by 30% Ggbs+ fine aggregate by 10% of Zeolite powder and 1%Bamboo fibre

S.No	Combined replacements (%)	Compressive strength, N/mm^2		
		28 days	56 days	90 days
1	0	3.86	4.21	4.51
2	10%ZP+30%GGBS+1%BF	5.38	5.84	6.33

C. ULTRASONIC PULSE VELOCITY TEST:

By monitoring the speed of an ultrasonic pulse as it passes through a concrete structure or a naturally occurring rock formation, this test determines the durability and quality of rock or concrete. The ultrasonic pulse used in this test is passed through the concrete being tested, and the time it takes for the pulse to exit the structure is then recorded.

Table 10: Ultrasonic pulse velocity of concrete with Zeolite powder as partial replacement of Fine aggregate in concrete.

S.No.	Zeolite powder	Upv for 28 days	Quality of concrete
1	0%	4281	Good
2	5%	4374	Good
3	10%	4567	Excellent
4	15%	4683	Excellent

Table 11: Ultrasonic pulse velocity of concrete with Ggbs as partial replacement of Cement in concrete

S.No.	GGBS	Upv for 28 days	Quality of concrete
1	0%	4281	Good
2	10%	4525	Excellent
3	20%	4743	Excellent
4	30%	4924	Excellent
5	40%	4821	Excellent

Table 12: Ultrasonic pulse velocity of concrete with Bamboo fibre concrete

S.No.	Bamboo fiber	Upv for 28 days	Quality of concrete
1	0%	4281	Good
2	0.5%	4505	Excellent
3	1%	4747	Excellent
4	1.5%	4573	Excellent

Table 13: Ultrasonic pulse velocity of concrete for combined partial replacement of cement by 30% Ggbs+ fine aggregate by 10% of Zeolite powder and 1%Bamboo fibre

S.No.	Combined replacements (%)	Upv for 28 days	Quality of concrete
1	0	4281	Good
2	10%ZP+30%GGBS+1%BF	5297	Excellent

5. CONCLUSION

1.The Normal concrete of compressive strength result is 39.51, 42.78 and 46.12 N/mm^{2}for 28 ,56 and 90 days.
2. At 10% partial replacement of zeolite powder with fine aggregate the compressive strength of concrete is 44.18, 47.93 and 51.56 N/mm^2 for 28 ,56 and 90 days.
3. At 30% partial replacement of ggbs with cement the compressive strength of concrete is 43.84, 47.74 and 51.25 N/mm^2 for 28 ,56 and 90 days.
4. At 1% addition of bamboo fibre with concrete the compressive strength of concrete is 49.31, 53.59 and 57.65 N/mm^2 for 28 ,56 and 90 days.
5. The combined replacement of concrete is 10% ZP+30% GGBS +1% BF the compressive strength of concrete is 53.81, 58.62 and 62.76 N/mm^2 for 28 ,56 and 90 days.
6.The Normal concrete of split tensile strength result is 3.86, 4.21 and 4.51 N/mm^{2}for 28 ,56 and 90 days.
7. At 10% partial replacement of zeolite powder with fine aggregate the split tensile strength of concrete is 4.36, 4.72 and 5.08 N/mm^2 for 28 ,56 and 90 days.
8. At 30% partial replacement of ggbs with cement the split tensile strength of concrete is 4.37, 4.77 and 5.12 N/mm^2 for 28 ,56 and 90 days.
9. At 1% addition of bamboo fibre with concrete the split tensile strength of concrete is 4.87, 5.29 and 5.72 N/mm^2 for 28 ,56 and 90 days.
10. The combined replacement of concrete is 10% ZP+30% GGBS+1% BF the split tensile strength of concrete is 5.38, 5.84 and 6.33 N/mm^2 for 28 ,56 and 90 days.
11.The normal concrete of ultrasonic pulse velocity of concrete is 4281 m/sec at 28 days.
12.At 10% partial replacement of zeolite powder with fine aggregate the ultrasonic pulse velocity result is 4567m/sec at 28 days.
13.At 30% partial replacement of ggbs with cement the ultrasonic pulse velocity result is 4924 m/sec at 28 days.

14. At 1% addition of bamboo fibre with concrete the ultrasonic pulse velocity result is 4747 m/sec at at 28 days.
15. The combined replacement of concrete is 10% ZP+30% GGBS+1% BF the ultrasonic pulse velocity result is 5297 m/sec at 28 days.

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