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MECHANICAL PROPERTIES OF BAMBOO FIBER REINFORCED CONCRETE BY USING GGBS AS PARTIAL REPLACEMENT CEMENT AND ZEOLITE POWDER AS FINE AGGREGATE POWDER

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ABSTRACT

The most common building material is concrete. Concrete is a composite material consisting of fine and coarse aggregate that is bonded together by a flow able cement (cement paste) that eventually becomes hard. This work utilises GGBS as a partial replacement cement and zeolite powder as the fine aggregate to modify the mechanical characteristics of bamboo fibre reinforced concrete in a small trial. Zeolite powder replaces 0%, 5%, 10%, and 15% of the fine aggregate. 0%, 10%, 20%, 30%, and 40% GGBS is used to partial replaced to the cement, while 0%, 0.5%, 1.5%, and bamboo fibre are also included. At 7 and 28 days, concrete test results for compressive strength and split tensile strength must be determined.

KEY WORDS: Zeolite powder, GGBS, Bamboo fiber, Compressive strength, and Split tensile strength.

1. INTRODUCTION

Concrete is the most commonly used construction material in the world and is utilised for all types of structural development. Concrete will support procedures like post & pre tensioning to get a higher strength at a time with the reduction of concrete. There are many approaches to achieve various necessary conditions, some of which may be of a higher strength than the conventional. Cement serves as a binding agent in concrete, which is a mixture of water, coarse aggregate, and fine aggregate. When cement and water come into contact, an exothermic reaction occurs, which causes the concrete's components to become harder.

Zeolite is a mineral that naturally develops from sedimentary ash. Zeolite is created when volcanic ash and molten rock come in contact with seawater during an eruption. The three elements silicon, aluminium, and oxygen make up the crystalline solid known as zeolite. They are capable of ion exchange, filtration, eliminating odours, using chemical sieves, and gas absorption. Zeolites are most commonly used in water softeners.

(Ground granulated blast furnace slag) GGBS is a type of slab made from the furnaces used to refine iron ore. This GGBS has some cementitious properties and is a good material for replacing some of the cement in concrete. It also protects concrete from alkali-silica reaction and thermal cracking. This slag is regularly tapped out as a molten liquid and must be quickly cooled in a lot of water if it is to be employed in the production of GGBS.

Because of its inherent qualities, bamboo is a bendable alternative that has a good strength to weight ratio and is easy to work with. It is one of the natural reserves that is quickly growing and is accessible nearby. Since ancient times, bamboo has been used in construction. Bamboo fibers are added to concrete to boost its tensile and mechanical strength. The length of bamboo used is 30 mm.

2. OBJECTIVES

The objectives of this study as follows,

a) To optimize the cement with ggbs.
b) To optimize the fine aggregate with Zeolite powder.
c) To evaluate the compressive and split tensile strength tests.

3. MATERIALS:

a. Cement: In concrete, which is used for building and sets and hardens to bond other materials, cement is primarily employed as a binder material. Construction uses OPC (ordinary Portland cement) of grade 53.

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: The most important component of natural sand or crushed stone-based concrete is called fine aggregate. The hardened properties of the concrete are significantly influenced by the fine aggregate density and quality.

c. Coarse aggregate: The aggregate which is retained over IS Sieve 4.75 mm is termed as coarse aggregate. The normal maximum size is gradually 10-20 mm as per IS 383:1970.

d. Water: One of the most important components in construction, water is needed for a variety of tasks like making mortar, mixing cement concrete, and curing work. The strength of the motor and cement concrete in the

construction project is directly influenced by the quality of the water utilised.

e. Zeolite powder: Zeolite has been utilised as an antimicrobial agent, fluidizing agent for carriers, agent to strengthen concrete, agent to control humidity, and agent to increase concrete strength.

f. ggbs: A white-colored furnace slag produced by the furnaces used to refine iron ore is known as GGBS (ground granulated blast furnace slag). Calcium, silica, aluminium, and magnitude oxides make up the majority of GGBS's composition.

g.Bamboo fiber: Bamboo fibre may increase the capacity of beams after cracking and decrease the width and deflection of concrete cracks.

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	
		7 Days	28 Days
1	0%	27.22	39.51
2	5%	28.96	41.92
3	10%	30.88	44.18
4	15%	29.47	42.41

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

S.No.	GGBS	Compressive Strength, N/mm^2	
		7 Days	28 Days
1	0%	27.22	39.51
2	10%	28.02	40.68
3	20%	29.59	42.83
4	30%	30.81	43.84
5	40%	29.53	42.99

Table 4: Compressive strength of concrete with Bamboo fiber concrete

S.No.	Bamboo fiber	Compressive Strength, N/mm^2	
		7 Days	28 Days
1	0%	27.22	39.51
2	0.5%	31.26	45.57
3	1%	34.50	49.31
4	1.5%	32.39	46.66

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	
		7 days	28 days
1	0	27.22	39.51
2	10%ZP+30%GGBS+1%BF	37.61	53.81

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	
		7 Days	28 Days
1	0%	2.63	3.86
2	5%	2.82	4.11
3	10%	3.04	4.36
4	15%	2.96	4.23

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	
		7 Days	28 Days
1	0%	2.63	3.86
2	10%	2.77	4.01
3	20%	2.93	4.20
4	30%	3.08	4.37
5	40%	2.98	4.25

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

S.No.	Bamboo fiber	Split tensile strength, N/mm^2	
		7 Days	28 Days
1	0%	2.63	3.86
2	0.5%	3.05	4.45
3	1%	3.41	4.87
4	1.5%	3.23	4.65

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	
		7 days	28 days
1	0	2.63	3.86
2	10%ZP+30%GGBS+1%BF	3.75	5.38

5. CONCLUSION:

1. The Normal concrete of compressive strength result is 27.22 N/mm^2 and 39.51 N/mm^2 for 7 and 28 days.
2. At 10% partial replacement of zeolite powder with fine aggregate the compressive strength of concrete at 7 and 28 days are 30.88 N/mm^2 and 44.18 N/mm^2.
3. At 30% partial replacement of ggbs with cement the compressive strength of concrete at 7 and 28 days are 30.81 N/mm^2 and 43.84 N/mm$^{2.}$
4. At 1% addition of bamboo fibre with concrete the compressive strength of concrete at 7 and 28 days are 34.50 N/mm^2 and 49.31 N/mm^2.
5. The combined replacement of concrete is 10% ZP+30% GGBS +1% BF the compressive strength of concrete at 7 and 28 days are 37.61 N/mm^2 and 53.81 N/mm^2.
6. The Normal concrete of split tensile strength result is 2.63 N/mm^2 and 3.86 N/mm^2 for 7 and 28 days.
7. At 10% partial replacement of zeolite powder with fine aggregate the split tensile strength of concrete at 7 and 28 days are 3.04 N/mm^2 and 4.36 N/mm^2.
8. At 30% partial replacement of ggbs with cement the split tensile strength of concrete at 7 and 28 days are 3.08 N/mm^2 and 4.37 N/mm$^{2.}$
9. At 1% addition of bamboo fibre with concrete the split tensile strength of concrete at 7 and 28 days are 3.41 N/mm^2 and 4.87 N/mm^2.
10. The combined replacement of concrete is 10% ZP+30% GGBS+1% BF the split tensile strength of concrete at 7 and 28 days are 3.75 N/mm^2 and 5.37 N/mm^2.

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