

EXPERIMENTAL INVESTIGATION ON BAMBOO FIBER CONCRETE WITH RICE HUSK ASH AND MARBLE POWDER AND

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ABSTRACT

Through the partial substitution of waste materials for traditional elements, this study explores the viability of creating sustainable concrete. In particular, it investigates the use of rice husk ash as a cement substitute and marble powder as a fine aggregate substitute. The study also looks at how adding bamboo fiber can improve the concrete mix's ductility and mechanical qualities. The goal is to assess the tensile and compressive strengths of concrete mixtures that contain different proportions of these elements. The study also evaluates the environmental advantages of using agricultural and industrial waste, which helps to lessen the load on landfills and the carbon emissions linked to the manufacture of cement. It is anticipated that the results would offer insightful information about how to best adjust mix proportions for environmentally friendly and structurally sound concrete. Compressive and split tensile strengths should be tested after 28, 56, and 90 days.

KEYWORDS: Bamboo Fibre, Marble powder, Rice husk ash, Compressive strength, Split tensile strength

1. INTRODUCTION

One of the most used building materials in the world, concrete serves as the foundation for contemporary infrastructure. The main constituents of this composite material are cement, water, and aggregates such as gravel and sand. This adaptable material is essential for roads, bridges, buildings, and dams since it can be cast into nearly any shape and is incredibly strong and durable. Cement and water undergo a chemical reaction called hydration, which hardens the combination over time and creates a sturdy, stone-like structure. Its extensive use is further facilitated by its extended lifespan and minimal maintenance needs. However, the environmental impact of producing concrete, and especially the production of cement, is tremendous. This includes high water usage and carbon dioxide emissions, which has led to ongoing research into more sustainable alternatives.

A finely ground by-product of the marble processing business, which includes cutting, sawing, shaping, and polishing, marble powder is produced in vast amounts. It is mostly made up of calcium carbonate (CaCO₃) and poses a serious waste disposal problem, resulting in environmental issues like air pollution and landfill

burden. Nonetheless, its chemical makeup and tiny particle size make it a potential material for a number of uses, especially in the building industry. Marble powder can be used as a partial substitute for fine aggregates in concrete or as a sustainable alternative.

Particularly in rice-producing areas like India, rice husk ash (RHA), a highly promising supplemental cementitious material, is produced by carefully burning rice husks, a plentiful agricultural waste product. Significant environmental advantages result from this conversion of a waste product into a useful resource, such as a decrease in the amount of landfill space and the carbon footprint linked to the manufacturing of traditional cement.

One intriguing approach to creating more ductile and sustainable building materials is the use of bamboo fiber into concrete. A plentiful and quickly growing natural resource, bamboo provides a sustainable substitute for the synthetic fibers that are typically used for reinforcing. It is a desirable option for enhancing the mechanical qualities of concrete, especially its overall ductility and resistance to cracking, due to its high tensile strength-to-weight ratio. Bamboo fibers can improve the post-cracking behavior and energy absorption capacity of concrete by filling in microcracks that develop in the matrix. By using agricultural waste, this not only helps concrete structures last longer but also supports the global movement for environmentally responsible building methods.

2. OBJECTIVES:

1. To look at how concrete's fresh and hardened qualities are affected when marble powder is used in place of some of the fine aggregate.
2. To assess how concrete's mechanical and durability properties are affected when rice husk ash is used in place of some of the cement.
3. To evaluate how adding different proportions of bamboo fibers affects the split tensile and compressive strengths.

3. MATERIALS

3.1 Cement: Cement is a finely ground binding agent that is commonly used in mortar and concrete building. It binds and solidifies aggregates like sand and gravel when mixed with water to produce strong, durable constructions. For structures and infrastructure to be strong and stable, cement—which is composed of limestone, clay, and other minerals is required.

3.2 Fine aggregate: Fine aggregate is a construction material made up of tiny particles that may be passed through a 4.75 mm sieve. It is usually crushed stone or sand. It improves workability and strength by filling up the spaces between coarse particles in concrete and mortar. For construction projects, a thick, smooth mixture requires fine aggregate.

3.3 Coarse aggregate: A component of construction, coarse aggregate is composed of bigger particles, usually crushed stone or gravel, with sizes ranging from 4.75 mm to 50 mm. It establishes the framework of the concrete mix and gives it bulk, strength, and longevity. Coarse aggregate improves a structure's overall stability and ability to support loads.

3.4 Water: Water is an essential component for a number of construction processes, including mixing cement, making mortar, and curing. The quality of the water used directly affects the durability and strength of cement concrete and mortar, which in turn affects the overall performance of the project.

3.5 Marble Powder: Marble blocks are processed, mostly by cutting, grinding, and polishing, to produce marble powder, a fine, powdery byproduct. It poses a serious problem for the disposal of industrial waste and is primarily

made up of calcium carbonate (CaCO₃).It has the potential to be a sustainable material for a number of uses due to its tiny particle size and chemical makeup, especially when used in concrete as a partial substitute for cement or fine aggregate.

3.6 Rice Husk Ash:An abundant agricultural waste product, rice husks can be burned under regulated conditions to produce rice husk ash (RHA), a highly pozzolanic substance.Because of this, RHA is a useful additional cementitious material for improving the qualities of concrete and encouraging environmentally friendly building practices.

3.8Bamboo Fiber: The term "bamboo fiber" describes the naturally occurring cellulosic fibers that are taken from the bamboo plant.It is a high-tensile strength, sustainable material that is well-known for its quick growth and renewability.Bamboo fibers can improve the overall mechanical performance, ductility, and resistance to cracking of concrete.

4. EXPERIMENTAL RESULTS

4.1 Compressive strength

Compressive strength is a material's ability to withstand loads that tend to reduce its size or crush it. It's measured by applying a steadily increasing force to a specimen until it fails, typically by cracking or deforming. This property is crucial in construction, particularly for concrete, as it dictates how much weight a structure can safely bear. The cubes are usually assessed after 28, 56 and 90 days.

Table 1: Compressive strength results of concrete with Marble Powder used as a partial replacement for Fine aggregate.

Sl.no	% of Marble Powder	Compressive Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	27.34	29.52	31.71
2	5%	28.64	30.95	33.23
3	10%	29.77	32.16	34.52
4	15%	31.29	33.72	36.29
5	20%	30.13	32.54	34.95
6	25%	28.71	31.01	33.38

Table 2: Compressive strength results of concrete with Rice Husk Ash used as a partial replacement for cement.

Sl.no	% of Rice Husk Ash	Compressive Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	27.34	29.52	31.71
2	5%	28.59	30.87	33.16
3	10%	29.95	32.39	34.74
4	15%	29.52	31.88	34.26

Table 3: Compressive strength results of bamboo fiber as addition of concrete.

Sl.no	% of Banana Fiber	Compressive Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	27.34	29.52	31.71
2	0.5%	31.70	34.23	36.79
3	1%	33.44	36.18	38.64
4	1.5%	31.30	33.87	36.32

Table4: Ccombined Compressive strength of Bamboo fiber concrete with Marble Powder and Rice Husk Ash.

Sl.no	Combined Replacement(s)	Compressive Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	27.34	29.52	31.71
2	1%BF+15 % MP+10 % RHA	36.73	39.27	42.18

4.2 Split tensile strength

The maximum load at failure is then used to calculate the splitting tensile strength, providing a practical measure of the concrete's resistance to tensile forces and its ability to withstand cracking in concrete structures for 28,56 and 90 days.

Table 5: Split tensile strength results of concrete with Marble Powder used as a partial replacement for Fine aggregate.

Sl.no	% of Maarble Powder	Split tensile Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	2.61	2.84	3.07
2	5%	2.74	2.95	3.14
3	10%	2.87	3.09	3.32
4	15%	3.05	3.28	3.53
5	20%	2.94	3.17	3.42
6	25%	2.81	3.02	3.26

Table 6: Split tensile strength results of concrete with Rice Husk Ash used as a partial replacement for cement.

Sl.no	% of Rice Husk Ash	Split tensile Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	2.61	2.84	3.07
2	5%	2.66	2.92	3.19
3	10%	2.81	3.19	3.38
4	15%	2.78	3.01	3.22

Table 7: Split tensile strength results of bamboo fiber as addition of concrete.

Sl.no	% of Banana Fiber	Split tensileStrength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	2.61	2.84	3.07
2	0.5%	2.93	3.16	3.39
3	1%	3.14	3.42	3.78

4	1.5%	2.97	3.21	3.44
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Table8: Ccombined Split tensile strength of Bamboo fiber concrete with Marble Powder and Rice Husk Ash.

Sl.no	Combined Replacement(s)	Split tensile Strength Results, N/mm ²		
		28 days	56 days	90 days
1	0%	2.61	2.84	3.07
2	1%BF+15 % MP+10 % RHA	3.45	3.72	4.12

5. CONCLUSION

1. The normal concrete compressive strength results for 28, 56 and 90 days is 27.34, 29.52 and 31.71 N/mm².
2. At 15% partial replacement of fine aggregate with marble powder to concrete then the compressive strength result for 28, 56 and 90 days is 31.29, 33.72 and 36.29 N/mm².
3. At 10% partial replacement of cement with Rice husk ash which gives compressive strength result for 28, 56 and 90 days is 29.95, 32.39 and 34.74 N/mm².
4. At 1% addition of bamboo Fibre to concrete then the compressive strength result for 28, 56 and 90 days is 33.44, 36.18 and 38.64 N/mm².
5. The normal concrete split tensile strength result for 28, 56 and 90 days is 2.61, 2.84 and 3.07 N/mm².
6. At 15% partial replacement of fine aggregate with marble powder to concrete then the split tensile strength result for 28, 56 and 90 days is 3.05, 3.28 and 3.53 N/mm².
7. At 10% partial replacement of cement with Rice husk ash which gives split tensile strength result for 28, 56 and 90 days is 2.81, 3.19 and 3.38 N/mm².
8. At 1% addition of bamboo Fiber to concrete then the split tensile strength result for 28, 56 and 90 days is 3.14, 3.42 and 3.78N/mm².
9. By Combined Replacement of 15% MP+10% RHA+1%BF the compressive strength test result for 28, 56 and 90 days is 36.73, 39.27 and 42.18N/mm².
10. By Combined Replacement of 15% MP+10% RHA+1%BF the Split tensile strength test result for 28, 56 and 90 days is 3.45, 3.72 and 4.12 N/mm².

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