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Sugarcane Fiber Reinforced Compressed Soil Brick With Rice Husk Ash

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Abstract: The increasing demand for sustainable and eco-friendly construction materials has led to the exploration of alternative building materials such as compressed soil bricks (CSBs) reinforced with agricultural by-products. This study investigates the potential of incorporating sugarcane fiber and rice husk ash (RHA) into compressed soil bricks to enhance their mechanical properties and sustainability. Sugarcane fiber, a natural and biodegradable material, is utilized to reinforce the soil matrix, while rice husk ash, a by-product of rice milling, serves as a partial cementitious material to improve the binding properties of the bricks. The research focuses on optimizing the proportions of sugarcane fiber and RHA in the brick mixture to achieve an ideal balance between strength, durability, and workability. Experimental testing, including compressive strength, water absorption, and shrinkage, was conducted to assess the performance of the composite bricks. The results indicate that the addition of sugarcane fiber and RHA improves the compressive strength and reduces water absorption, making the bricks suitable for low-cost, sustainable construction. Furthermore, the incorporation of agricultural waste materials enhances the environmental benefits of the bricks, reducing the carbon footprint associated with traditional clay bricks. This study highlights the viability of sugarcane fibre and rice husk ash as sustainable reinforcements in compressed soil bricks, offering a promising alternative to conventional building materials in rural and resource-constrained settings.

Index Terms: Sugarcane fibre, rice husk ash, compressed soil bricks, sustainable construction, agricultural waste, mechanical properties, eco-friendly material.

1. INTRODUCTION

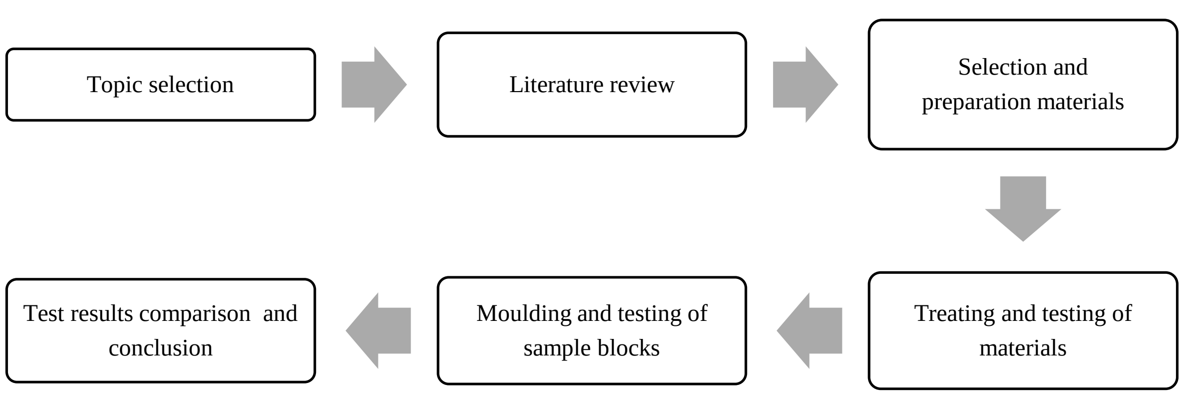
Compressed soil bricks, often referred to as stabilized earth blocks, are an innovative and sustainable building material that combines soil, water, and various additives to create durable bricks. The inclusion of natural fibers such as straw, sisal, sugarcane enhances the mechanical properties and overall performance of these bricks.

Current innovations are focusing to protect the environment by reducing the amount of carbon footprint produced by the conventional building materials and to reuse the waste materials, such as rice husk ash and agricultural fibers, transforms them into valuable, high-performance building products, promoting sustainability and reducing environmental impact.

Some studies have investigated the application of agricultural wastes such as sugarcane bagasse and rice husk ash in the production of green building materials. The following literature reviews briefly summarize the research on sugar cane fibre reinforced compressed soil brick with rice husk ash, Kumar et al. (2022) emphasized the role of sugarcane bagasse fibers to enhance the mechanical and physical characteristics of compressed earth blocks for promoting green construction. In the same way, Binici et al. (2007) investigated the influence of fiber reinforcement on mud bricks, illustrating how natural fibers can improve the thermal insulation and mechanical characteristics of conventional building materials. Additionally, the use of RHA in soil-cement blocks, as illustrated by Aquino Rocha et al. (2015), offers great performance improvements, further validating the utilization of waste materials in sustainable construction.

Using locally available materials like soil, natural fibers, and rice husk ash promotes sustainable building by reducing waste and supporting a circular economy. As demand for eco-friendly materials grows, fiber-reinforced compressed soil bricks with rice husk ash offer an affordable, durable, and energy-efficient solution for housing. This study explores optimal brick formulations and the impact of natural fibers and rice husk ash on their performance, encouraging greener construction practices while addressing the need for affordable housing.

2. METHODOLOGY



3. SUGARCANE FIBRE REINFORCED COMPRESSED SOIL BRICK WITH RICE HUSK ASH

The sugrarcane fiber reinforced compressed soil brick is an advanced building material design to enhance both sustainability and structural integrity in construction.

As we know that introduction of reinforcement makes the materials to increase their ductile nature and there by sudden breaking of material can be avoided. here we introduce natural reinforcement to the soil brick to enhance their properties of strength and durability. The inclusion of natural fibers such as straw, sisal, sugarcane enhances the mechanical properties and overall performance of these bricks. As a byproduct of the sugar industry, sugar cane fibre is a sustainable material that helps reduce waste, making the bricks more ecofriendly. Sugarcane fibers are considered one of the best natural fibers for reinforcement in construction because Sugarcane fibers have relatively good resistance to moisture, which helps prevent the bricks from weakening or degrading over time when exposed to humid conditions, compared to some other fibers that are more susceptible to rot or decay and also Sugarcane is widely available material, this makes them a cost-effective option compared to other natural fibers that may be more expensive or harder to source.

4. TREATMENT

The treatment of sugarcane fiber with sodium hydroxide (NaOH), also known as alkali treatment, enhances the biodegradability of the fiber by removing lignin, hemicellulose, and other non-ce The treatment of rice husk ash (RHA) to make it resistant to degradation in soil or water typically involves a process called calcination, where the ash is heated at high temperatures to enhance its chemical stability.

5. TESTS PERFORMED

A. Compressive Strength Test

To perform a compressive strength test on bricks, select the brick. Its surface must be smooth and clean. Measure their dimensions accurately and find the loaded area. Place the brick axially in a Compression Testing Machine. Gradually apply load at 14 N/mm² per minute until the brick fails, then record the maximum load. The compressive strength is calculated using the formula:

$$\text{Compressive strength } (N\ /\ mm^2) = \frac{Load\ at\ failure}{Area\ of\ brick}$$

Fig 1. Compressive Strength Test

B. Water Absorbtion Test

The water absorption test on bricks are done to determine their porosity and suitability for construction. While doing this test first record their dry weight as W1. Next, fully immerse these bricks in water for 24 hours, then take them out, wipe off excess water, and record their wet weight as W2. By using the following formula water absorption can be calculated.

$$\text{Water absorption} = \frac{W2-W1}{W1} \times 100$$

Fig 2.Compressive Strength Test

C. Drop Test

The drop test is a field test conducted to access the durability and strength of bricks. In this test, a brick is dropped from a height of 4ft on to a hard surface. The brick is then inspected for any sign of damage, such as cracks or breaks. If the brick withstand the impact significantly, is should be in good quality brick. As per our tests we have observed that the brick is slightly damaged at the edges hence it is in good quality and capable of withstanding impacts.

Fig 3. Drop Test

6. RESULTS AND DISCUSSION

Table 1 gives the compressive strength and water absorption test values of bricks with varying percentages of rice husk ash and and sugarcane fibre.

Table 1. Compressive Strength,Water Absorption Test Values

Type Of Brick	Specimen Identification	Compressive Strength (N/mm^2)	Water Absorption (%)
Controlled Brick	-	4.05	13.17
Compressed Soil Brick With RHA	C85A15	4.71	12.98
Sugarcane Fibre Reinforced Compressed Soil Brick	SCF0.4	4.88	1.31

7. COMPARATIVE ANALYSIS

The fiber-reinforced compressed soil brick with rice husk ash demonstrates impressive performance characteristics that exceed the minimum requirements established by the controlled soil brick.

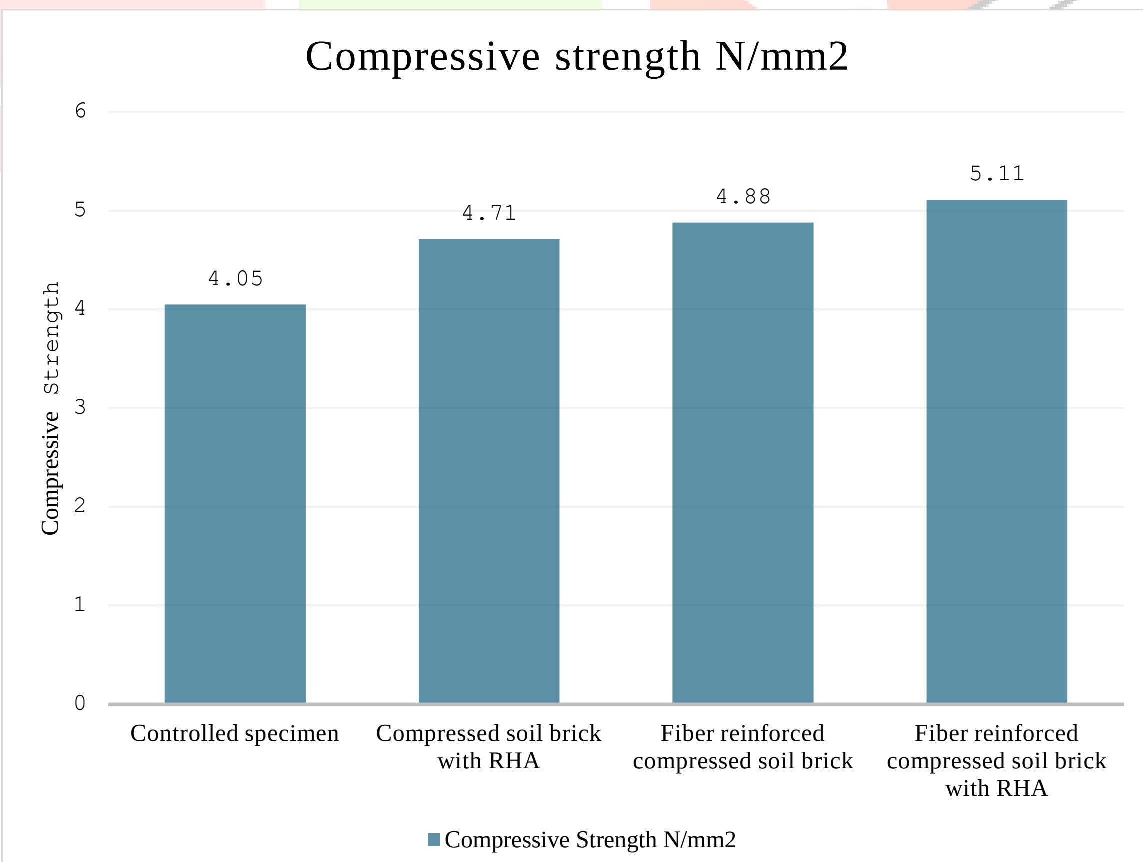


Fig 4. Result Comparison of Compressive Strength

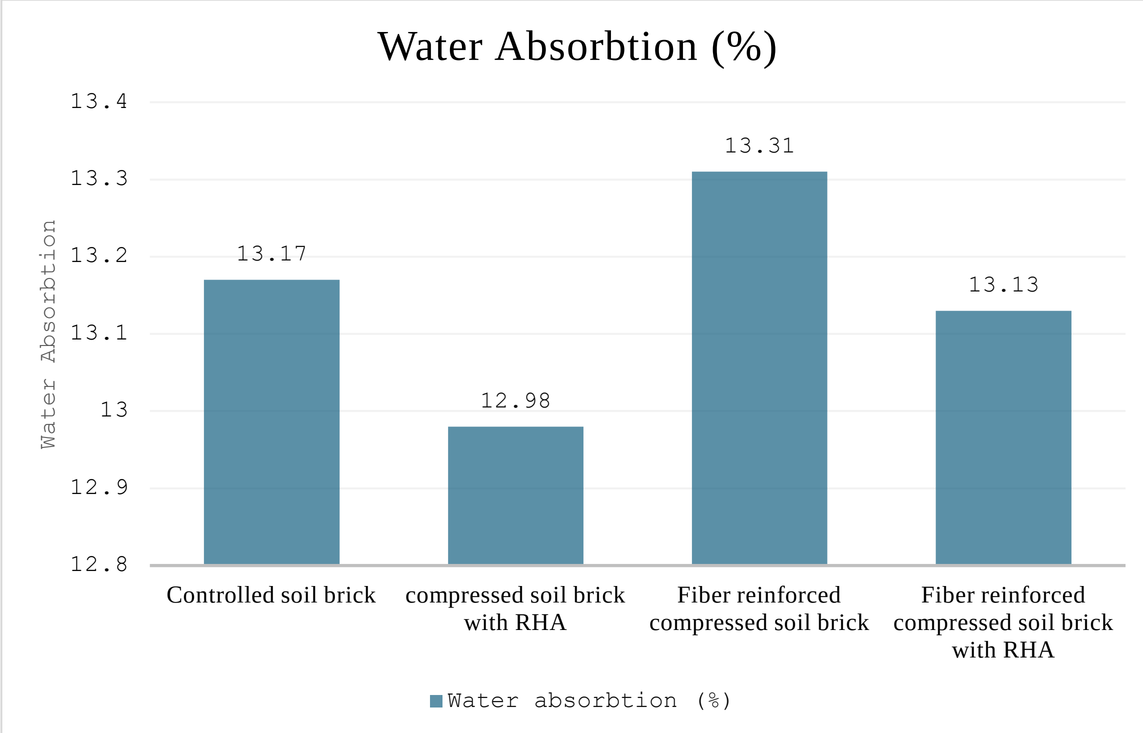


Fig 5. Result Comparison of Water Absorbtion

The following table 2 shows that brick with sugarcane fiber reinforced compressed soil brick with RHA shows

Table 2.Result Comparison

Type	Compressive Strength Test	Water Absorption Test	Drop Test
Controlled soil brick	4.05 N/mm^2	13.17%	Good
Compressed soil brick with RHA	4.71 N/mm^2	12.98%	Good
Sugarcane fiber reinforced compressed soil brick	4.88 N/mm^2	13.31%	Good
Sugarcane fiber reinforced compressed soil brick with RHA	5.11 N/mm^2	13.13%	Good

8. CONCLUSIONS

Fiber-reinforced compressed soil bricks with rice husk ash have proven to be a superior and sustainable alternative to traditional building materials. These bricks shows impressive strength, with a compressive strength of 5.11 N/mm², significantly exceeding the minimum requirement of normal compressed soil brick. Additionally, they demonstrate excellent water resistance, with a water absorption value of 13.125%, making them suitable for construction applications, especially in regions with high rainfall or humidity.The use of sugarcane fibers and rice husk ash in the brick matrix has increased their resistance to brittleness and durability. The fibers produce a positive bridging effect, enhancing the bricks' ductility and corresponding to the improvement in crack resistance.The use of rice husk ash, an agricultural waste product, further amplifies the sustainability profile of these bricks. By repurposing this material, the environmental footprint of construction activities is reduced, aligning with circular economy principles.

REFERENCE

[1] Chantit, F., El Abbassi, F. E., & Kchikach, A. (2024). Performance of compressed earth bricks reinforced with sugar industrial by-products bagasse and molasse: Mechanical, physical and durability properties. Journal of Building Engineering, 90, 109403.

[2] Paul, S., Islam, M. S., & Elahi, T. E. (2023). Potential of waste rice husk ash and cement in making compressed stabilized earth blocks: Strength, durability and life cycle assessment. Journal of Building Engineering, 73, 106727.

[3] Kumar, N., & Barbato, M. (2022). Effects of sugarcane bagasse fibers on the properties of compressed and stabilized earth blocks. Construction and Building Materials, 315, 125552

[4] Das, S. K., Adediran, A., Kaze, C. R., Mustakim, S. M., & Leklou, N. (2022). Production, characteristics, and utilization of rice husk ash in alkali activated materials: An overview of fresh and hardened state properties. Construction and Building Materials, 345, 128341.

[5] Vaz, F. L., da Rocha Lins, J., Alves Alencar, B. R., Silva de Abreu, Í. B., Vidal, E. E., Ribeiro, E., … Dutra, E. D. (2021). Chemical pretreatment of sugarcane bagasse with liquid fraction recycling. Renewable Energy, 174, 666–673. doi:10.1016/j.renene.2021.04.087

[6] Aquino Rocha, J. H., Herrera Rosas, M., Cayo Chileno, N. G., & Cachaca Tapia, G. S. (2021). Physical-mechanical assessment for soil-cement blocks including rice husk ash. Case Studies in Construction Materials, 14, e00548. doi:10.1016/j.cscm.2021.e00548

[7] Hu, L., He, Z., & Zhang, S. (2020). Sustainable use of rice husk ash in cement-based materials: Environmental evaluation and performance improvement. Journal of Cleaner Production, 264, 121744.

[8] Bartos, A., Anggono, J., Farkas, Á. E., Kun, D., Soetaredjo, F. E., Móczó, J., ... & Pukánszky, B. (2020). Alkali treatment of lignocellulosic fibers extracted from sugarcane bagasse: Composition, structure, properties. Polymer Testing, 88, 106549.

[9] Riza, F. V., & Rahman, I. A. (2015). The properties of compressed earth-based (CEB) masonry blocks. Eco-Efficient Masonry Bricks and Blocks, 379–392. doi:10.1016/b978-1-78242-305-8.00017-6

[10] Danso, H., Martinson, D. B., Ali, M., & Williams, J. (2015). Effect of fibre aspect ratio on mechanical properties of soil building blocks. Construction and Building Materials, 83, 314–319. doi:10.1016/j.conbuildmat.2015.03.039

[11] Binici, H., Aksogan, O., Bodur, M. N., Akca, E., & Kapur, S. (2007). Thermal isolation and mechanical properties of fibre reinforced mud bricks as wall materials. Construction and Building Materials, 21(4), 901–906. doi:10.1016/j.conbuildmat.2005.11.004