PERFORMANCE EVALUATION OF COMPRESSED STABILISED MUD BRICKS MADE WITH RICE HUSK ASH BASED BINDERS

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Introduction

The building sector, responsible for one-third of emissions, hinders SDGs. Compressed Stabilized Earth Blocks (CSEBs) provide a sustainable alternative with lower energy consumption and environmental benefits. rice husk ash (RHA), rich in silica, is abundant in rice-growing nations, offering environmental benefits. The study assesses RHA and cement in CSEB production through various tests, indicating economic and environmental viability compared to traditional bricks. CSEBs, particularly with RHA, align with SDGs and address environmental concerns in construction. Studies demonstrate that incorporating RHA in building materials, such as earthen blocks, can lead to increased compressive strength, contributing to the durability of the construction. Environmental and Economic Benefits: The use of RHA in construction materials not only enhances performance but also reduces CO2 emissions and energy consumption, contributing to sustainable and cost-effective building practices.

Objectives

The project aims to assess the performance of stabilized mud blocks using a binder derived from Rice Husk Ash (RHA). Stabilized mud blocks are eco-friendly and cost-effective building materials, and the incorporation of RHA as a binder has the potential to enhance their structural and thermal properties. It also helps in converting an agricultural waste material into a potential construction material.

The major objectives of the project include:

i. Characterisation of RHA and other test materials
ii. Initial trial mixes to arrive at an optimum mix for making stabilized earth blocks
iii. To evaluate the compressive strength of stabilized mud blocks with varying proportions of RHA-based binder.
iv. Assess the durability and resistance to environmental factors of the blocks over time.

v. Compare the performance of RHA-based stabilized mud blocks with conventional stabilized mud blocks

Methodology

Material Characterization:

a. Collect samples of Rice Husk Ash (RHA) and other materials.
b. Conduct a thorough analysis of the physical and chemical properties of RHA and other materials to understand their characteristics.

Mix Design Optimization:

a. Conduct initial trial mixes with varying proportions of soil and RHA.
b. Evaluate the mixtures for workability, consistency, and basic strength properties.
c. Identify the optimal mix design based on the trials.

Block Production:

a. Prepare stabilized mud blocks using the finalized mix design.
b. Ensure uniformity in block dimensions and compaction during the production process.

Compressive Strength Evaluation:

a. Conduct compressive strength tests on the stabilized mud blocks using a testing apparatus.
b. Vary the proportions of RHA in the binder to assess the impact on compressive strength.
c. Record and analyze the test results.

Durability and Environmental Resistance Testing:

a. Subject stabilized mud blocks to accelerated aging conditions, including exposure to moisture, temperature variations, and other environmental factors.
b. Periodically assess the blocks for changes in structural integrity, weight, and appearance.
c. Record observations and document any notable effects on durability.

Performance Comparison:

a. Produce conventional stabilized mud blocks using a standard mix.
b. Perform compressive strength tests and durability assessments on conventional blocks.
c. Compare the performance metrics of RHA-based stabilized mud blocks with conventional blocks.
d. Analyze and interpret the results to identify any advantages or disadvantages of using RHA.

Data Analysis and Reporting:

a. Compile and analyze all data collected during material characterization, mix design, testing, and comparison phases.
b. Prepare a detailed report summarizing the methodology, findings, and conclusions.
c. Discuss the implications of the results and provide recommendations for potential applications in sustainable construction.

<u>Results and conclusion:</u>

The various test carried out as part of this project is summarized in the table below

Test	Material	Result
Specific Gravity	Soil	2.2
Density	Rice husk ash	1.99
Particle size distribution	Soil	
Particle size distribution	RHA	
Optimum moisture content determination by standard proctor test	Soil	16.67 %
Dry Density	Soil	1.95 kg/m^3
Atterberg limits of soil		
Liquid Limit	Soil	27%
Plastic Limit	Soil	18%
Shrinkage limit	Soil	
Lime reactivity test with RHA	RHA & Lime	1.5 MPa

The following mixes were tried and the compressive strength of the RHA based CSEBs are provided in the table below.

Mix name	Cement (%, by weight)	Lime (%, by weight)	RHA (%, by weight)	Dimension of the brick l x b x h (mm)	Compressive strength at 15 days (N/mm^2)
Mix 1	8	0		230x110x75	1.86
Mix 2	8	0		230x110x75	4.33
Mix 3	4	4	6	230x110x75	Yet to be tested

Innovation in the project:

The project work aims at developing low cost, easy to make RHA based CSEB for application in rural housing. CSEBs are considered as sustainable alternative to burnt clay bricks. Through the addition of RHA the embodied energy of CSEBs can be further reduced, as well as the utilization potential for waste material such as rice husk ash can is increased.

Scope for future work:

The future work includes exploration of higher RHA content to reduce the overall cement and lime content needed to stabilise the clay particles. The other mechanical properties such as stress-strain behaviour of bricks must be performed to compare the performance of RHA based CSEBs with respect to the convention CSEBs. The microstructural evaluation of bricks is needed to understand the reaction mechanism of RHA particles in the soil matrix.

The study of masonry properties such as masonry compressive strength and the flexure bond strength, and stress-strain characteristics of RHA blended CSEBs can provide important insights into the masonry behaviour and the real-time application.

The project is ongoing and the remaining tests will be completed in two weeks and the results will be presented during the review.