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RESEARCH ARTICLE **OPEN ACCESS**

TIMBERCRETE BRICK

Kajal Navnath Adlinge[1], Sneha Machindra Sutar[2], Shambhuraje Sharad Ghadage[1], Adarsh Jyotiram Vhatakar[1], Rohan Mahadev Narale[1] and Shivam Ramprit Chouhan[1]

[1]U.G. Student, Department of CIVIL Engineering, SVERI's College of Engineering, Pandharpur Maharashtra, India
[2]U.G. Student, Department of, Computer Science and Engineering, SVERI's College of Engineering, Pandharpur Maharashtra, India

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****Corresponding author:***
Kajal Navnath Adlinge,

ABSTRACT

This project investigates the feasibility and properties of Timbercrete brick, a composite material made from a blend of Saw Dust (sawdust), cement, sand and other additives, as a sustainable alternative to conventional clay and concrete bricks. The research explores the potential of utilizing industrial wood waste to create an environmentally friendly building material with comparable or improved performance characteristics. The study will involve the production of Timbercrete bricks with varying mix proportions of sawdust, cement and sand to determine the optimal composition for structural integrity and other desirable properties. Key characteristics such as compressive strength, water absorption, density, thermal conductivity, and fire resistance will be experimentally evaluated according to relevant Indian standards (IS codes). These properties will be compared with those of traditional clay and concrete bricks to assess the suitability of Timbercrete for various construction applications. Furthermore, the project will analyze the environmental benefits of Timbercrete, focusing on the reduction of Saw Dust sent to landfills, the potential for carbon sequestration within the material, and the lower embodied energy compared to conventional brick manufacturing processes. The economic viability of Timbercrete production, considering the availability of raw materials and manufacturing costs, will also be explored. The findings of this research are expected to provide valuable insights into the potential of Timbercrete brick as a sustainable and cost-effective building material in the Indian context, contributing to greener construction practices and the efficient utilization of industrial waste. The project aims to establish a foundation for further research and development of Timbercrete technology and its wider adoption in the construction industry.

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INTRODUCTION

Timbercrete represents an innovative and increasingly recognized sustainable building material that offers a compelling alternative to conventional options like clay bricks and concrete blocks. At its core, Timbercrete is a composite material ingeniously crafted by blending two seemingly disparate materials: Saw Dust (typically sawdust or wood shavings) and cement, often with the inclusion of other binding agents and additives. This unique combination results in a building block that aims to bridge the gap between structural integrity and environmental responsibility.

Research Gap: It is a sustainable building materials have gained attention, limited research is available on Timbercrete bricks using sawdust as a partial replacement material under Indian conditions. Existing studies mainly focus on conventional bricks or alternative waste materials, with insufficient experimental data comparing Timbercrete bricks to clay and concrete bricks as per Indian Standards (IS codes). There is a lack of standardized mix proportions that balance strength, durability, thermal performance, and fire resistance for Timbercrete bricks. Additionally, environmental and economic assessments specific to India—considering local availability of sawdust, production cost, and practical construction.

Objective

- To determine the optimal mix proportions of timber waste and cement for achieving desired mechanical and physical properties.
- To evaluate the compressive strength, water absorption, density, and of Timbercrete bricks produced under varying mix proportions.

- To compare the properties of Timbercrete bricks with those of conventional clay and concrete bricks as per relevant Indian Standards.
- To assess the economic viability of Timbercrete brick production.

METHODOLOGY

- Timberecrete brick is the mixture of cement, sand, saw dust, dust and water.
- Cement: The ultra tech cement of 43 grade is used by taking the appropriate technique by volume.
- Fine aggregate: The dust used is 20% by volume.
- Sawdust: Saw dust is used by changing the pMaterials❖ Required: ercentage.
- Water: 0.35 to 0.45 water is used as per proper water cement ratio.
- Titanium Dioxide: Titanium is used in the varying proportion as 0%,0.15%, 0.3%.

The varying proportion of all the materials are used to determine the accurate strength, durability, water absorption, and thermal conductivity of timber crete brick of number of samples. From testing of no. of samples we can easily get the results we want and the quality of brick.

Materials Required:

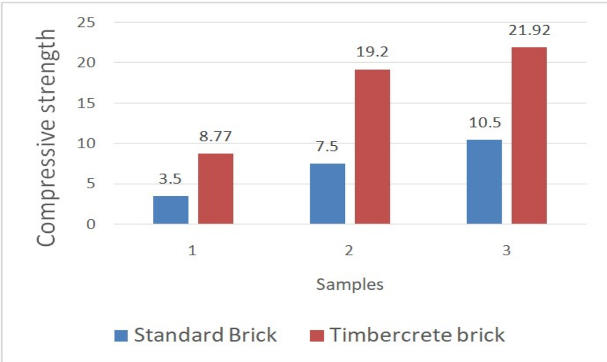
Material	Sample 1 (gm)	Sample 2 (gm)	Sample 3 (gm)	Sample 4 (gm)	Sample 5 (gm)
Cement	1500	1350	1300	1550	1500
Sand	500	600	500	300	400
Saw dust	500	600	700	600	500
Titanium Dioxide	0	0	0	50	25

TEST CARRIED ON MATERIALS

1. Cement - A. Field Tests on Cement
    a. Color Test
    b. Touch Test
  B. Laboratory Tests on cement
    a. Fineness Test
    b. Setting Time Test
    c. Specific Gravity Test
2. Sand - AField Tests on Sand
    a. Sieve Analysis (Grading) Test
    b. Moisture Content Test
    c. Silt Content Test
  B. Laboratory Tests on Sand
    a. Sieve Analysis
    b. Fineness Modulus
3.Saw dust- 1. Field Tests on Sawdust
    a. Moisture Content Test (Field Test)
    b. Visual Inspection for Impurities
  2. Laboratory Tests on Sawdust
    a. Moisture Content Test
    b. Particle Size Distribution (Sieve Analysis)

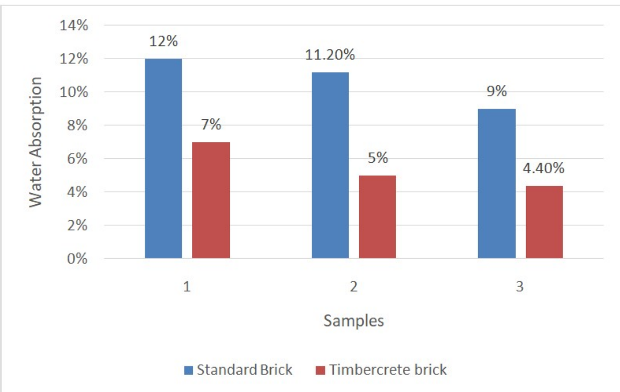
Brick mould size = 19 cm × 9 cm × 9 cm
Volume of one block = 0.19 m × 0.09 m × 0.09 m
= 0.001539m³
Proportion of mix is 1:0.35:0.35
Cement :sand :: 1 : 0.35
1. Volume of cement = 1 × 1.0539 × 10^{-3} m^3
= 1.0539 × 10^{-3} m^3
Density of cement is **1440kg per m³**
Therefore,
Weight of cement for one brick is
= 1.0539 × 10^-3 m³ × 1440 kg/m³
= 1500 gram
2. Volume of Sand = 0.35 × 1.0539 ×10^-3 m³
= 0.36 × 10^{-3} m^3
Density of sand is **1600kg per m³**
Therefore,
Weight of sand for one block is
= 0.36 × 10^{-3} m^3× 1600 kg/m³
= 0.55 kg
= 550 gm
4. Weight of Titanium dioxide powder is 1% of weight of brick
Weight of Ti = 1 % of weight of brick
= (1/100) × 2500 gram
= 25 gm

RESULT DISCUSSION



Sample 1: 3 days
Sample 2: 7 days
Sample 3: 14 days

1) Sample 1
Load on Cement Specimen = 150 KN
Surface area of specimen = 190×90
= 17100 mm²
Strength = Load/Area
= 150 × 1000 / 17100
= 8.77 N/mm²
2) Sample 2
Load on cement specimen = 325 KN
Surface area of specimen = 190×90
= 17100 mm²
Strength = Load/Area
= 325× 1000 / 17100
= 19.20 N/mm²
Water Absorption:
Dry weight of Brick(W1): **2500 gm**
Weight of brick after 24 hour wet in water (W2): **2610 gm**
Water Absorption = (W2-W1 x 100)/ (W1)
=(2610-2500 x 100) / 2500
= 4.4% wt. of brick



Costing of timbercrete brick:

Item	Quantity (gm)	Rate (₹/kg)	Material Cost (₹)	Cost (₹)
Cement	1500	₹5	₹7	₹7
Crushed sand	500	₹1	₹0.50	₹0.50
Titanium Dioxide(0.3%)	25	₹40	₹1	₹1
Saw Dust	500	0	0	0
Material Cost			₹8.50	₹8.50
Labour Cost (10%)			₹0.85	₹0.85
Manufacturing cost(10%)			₹0.85	₹0.85
Total Cost			₹10.20	₹10.20

The compressive strength development of the timbercrete brick over the initial curing period reveals a significant increase in load-bearing capacity. At 3 days of curing, the brick achieved a compressive strength of 8.77 N/mm², indicating an initial level of strength gain as the cementitious matrix begins to hydrate and bind the timber. Extending the curing period to 7 days resulted in a substantial surge in strength, reaching 19.20 N/mm².

Advantages

- Reduces Cost
- Eco Friendly

Applications

- Applied in hospitals, fire stations, temples, industries, colleges, bridges, museums and disaster-response buildings to ensure operational safety during and after earthquakes.
- Air Purification: TiO2 is a photocatalyst. When exposed to sunlight (UV and potentially some visible light), it can break down air pollutants like nitrogen oxides (NOx), volatile organic compounds (VOCs), and particulate matter on the brick's surface, leading to improved air quality around the building.
- Reduced Use of Virgin Resources: By utilizing timber waste, timbercrete reduces the demand for virgin clay and aggregates, conserving natural resources and minimizing the environmental impact associated with their extraction and transportation.
- Potential for Recycling: While end-of-life recycling processes are still developing, the composition of timbercrete offers potential avenues for breaking down and reusing its components in the future.

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Future scope: Growing Demand for Sustainable Construction: As environmental regulations become stricter and awareness about climate change increases in India, including Maharashtra, the demand for eco-friendly building materials like timbercrete is expected to rise significantly. Government initiatives promoting sustainable housing and infrastructure development in regions like Solapur could further boost the adoption of timbercrete.

- Utilization of Local and Waste Materials: Timbercrete's ability to utilize locally sourced timber waste, such as sawdust from the numerous sawmills in India, including those potentially around Solapur, aligns with the principles of a circular economy and reduces transportation costs and environmental impact. This waste-to-resource approach can provide an economically viable and environmentally sound solution for managing timber byproducts. Utilization of Local and Waste Materials: Timbercrete's ability to utilize locally sourced timber waste, such as sawdust from the numerous sawmills in India, including those potentially around Solapur, aligns with the principles of a circular economy and reduces transportation costs and environmental impact. This waste-to-resource approach can provide an economically viable and environmentally sound solution for managing timber byproducts.

CONCLUSION

Based on the provided early strength test results, this timbercrete brick demonstrasa significant gain in compressive strength between 3 and 7 days of curing. The strengthmore than doubled from 8.77 N/mm² to 19.20 N/mm² within this short period. This indicates that the hydration process of the cementitious materials is progressing well, leading to a rapid development of its load-bearing capacity. Significant Strength Gain: The timbercrete brick demonstrates a substantial increase in compressive strength between 3 and 7 days (from 8.77 N/mm² to 19.20 N/mm²). Early Strength Development: The 3-day strength of 8.77 N/mm² suggests a reasonable early strength development, allowing for potentially earlier handling and construction activities compared to materials with slower initial strength gain.

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