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USE OF NATURAL FIBRES IN CLC BRCIKS

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Abstract : Lightweight concrete is concrete having low density due to which it has several other properties like low self-weight, and also it exhibits good thermal and acoustic insulation. Foamed concrete, a type of lightweight concrete is prepared by mixing the preformed stable foam with cement, thus causing cellular structure when hardened. In the modern construction business, lightweight concrete is still a crucial component since it combines the benefits of construction and insulation materials and is distinguished by its rip-roaring thermal qualities, moderate strength, and low density. Foamed concrete is a composite material with a density that is significantly lower than standard concrete. The water-cement (w/c) ratio in foam concrete typically ranges from 0.4 to 1.25. When the ratio is lower, the mixture becomes too stiff and the bubbles break, while when the ratio is higher, the mixture becomes too thin and the bubbles separate from the mixture. In the present study the review of literature on different replacement materials for fine aggregate and different foaming agents were discussed.

I. INTRODUCTION

I.I General

Natural fibers have been used in the production of bricks for centuries, and their use has gained popularity in recent years due to the increasing demand for sustainable and eco-friendly building materials. Natural fibers can be used as a partial replacement for synthetic fibers in the production of bricks, and they have several benefits compared to synthetic fibers. One benefit of using natural fibers in bricks is that they are renewable and biodegradable, which makes them more environmentally friendly than synthetic fibers. Natural fibers also have lower embodied energy compared to synthetic fibers, which means that they require less energy to produce and transport.

In addition to these environmental benefits, natural fibers can also improve the mechanical properties of bricks. For example, the addition of natural fibers can increase the compressive strength, tensile strength, and flexural strength of bricks. This can make bricks made with natural fibers more durable and resistant to cracking and other types of damage.

Overall, the use of natural fibers in bricks is a sustainable and environmentally friendly alternative to synthetic fibers, and it can also improve the mechanical properties of the bricks.

Nowadays the construction industry is the fastest-growing industry in this revolution the new materials such as lightweight brick are used to overcome the overall cost of the house it is essential that we can use materials like foam, banana fiber, fly ash, cement, etc. The banana fiber is the most prominent due to its easy availability and better durability in comparison to other natural fibers. To resist the propagation of cracks and to improve the ductility behavior of brick fibers is distributed randomly in cement mortar. To reduce density as well as improve thermal insulation, as well as sound and vibration insulators foam agents, are to be used. During the development of India electricity was required more and this generation of electricity gives residue like fly ash therefore to reduce this waste we use fly ash in brick.

CLC (Cellular Lightweight Concrete) brick is a type of brick that is made from a mixture of cement, fly ash, sand, and foaming agent. It is a lightweight and porous brick that is commonly used in the construction of walls, floors, and roofs. CLC bricks are known for their high thermal insulation and sound absorption properties, making them an attractive choice for buildings in hot or noisy environments. They are also easy to work with and can be cut, shaped, and molded to fit a variety of different construction needs. In addition, CLC bricks are environmentally friendly and can be made using recycled materials, making them a sustainable building option.

I.II NEED OF THE STUDY.

There are several reasons why the use of natural plant fibers is important and worth studying:

Sustainability: Natural plant fibers are renewable resources, which means that they can be replenished relatively quickly. This makes them a more sustainable choice compared to synthetic fibers, which are derived from non-renewable fossil fuels.
Environmental impact: The production of synthetic fibers can have negative environmental impacts, such as air and water pollution. In contrast, the production of natural plant fibers often has a lower environmental impact.
Comfort and breathability: Natural plant fibers are known for their ability to breathe, which makes them more comfortable to wear in hot or humid conditions.

Hypoallergenic properties: Some natural plant fibers, such as cotton and linen, have hypoallergenic properties that make them less likely to cause allergic reactions.

Durability: Some natural plant fibers, such as hemp and jute, are known for their strength and durability.
Cultural significance: In many parts of the world, natural plant fibers are a traditional and important part of the local culture and

economy. The use of natural plant fibers can help to preserve and support these traditions.

Versatility: Natural plant fibers can be used in a wide range of products, including textiles, paper, and building materials. This versatility makes them an important resource for many industries.

I.III RESEARCH GAP

Optimum fiber content and length: Determine the optimal content and length of sisal fiber for achieving the desired mechanical properties in CLC bricks. Further research can focus on identifying the fiber dosage and length that provide the best balance between strength, workability, and cost-effectiveness.

Durability under different environmental conditions: Investigate the long-term durability of sisal fiber-reinforced CLC bricks in various environmental conditions, such as high humidity, aggressive chemical exposure, and freeze-thaw cycles. This research can provide insights into the material's performance and potential degradation mechanisms over time.

Structural behavior and design guidelines: Explore the structural behavior of sisal fiber-reinforced CLC brick elements, such as walls, beams, and columns. Develop design guidelines and recommendations for incorporating these elements into structural systems, considering factors like load capacity, deformation characteristics, and compatibility with other building materials.

Comparative studies with other natural fibers: Conduct comparative studies between sisal fiber and other natural fibers, such as jute, coir, or bamboo, when used as reinforcement in CLC bricks. Assess the mechanical properties, durability, and sustainability aspects of each fiber to determine their suitability and potential advantages over sisal fiber.
Life cycle assessment and environmental impact: Perform a comprehensive life cycle assessment (LCA) of sisal fiber-reinforced CLC bricks, considering their entire life cycle from raw material extraction to end-of-life disposal. Evaluate the environmental impact, including energy consumption, greenhouse gas emissions, and waste generation, to quantify the sustainability benefits of this composite material.
Manufacturing and process optimization: Investigate the manufacturing process of sisal fiber-reinforced CLC bricks and explore ways to optimize the production techniques. This may include studying the effects of mixing methods, curing conditions, and fiber dispersion techniques on the mechanical properties and consistency of the final product.

Cost analysis and market viability: Conduct an in-depth cost analysis of sisal fiber-reinforced CLC bricks compared to conventional CLC bricks and other alternative construction materials. Assess the economic feasibility and market viability of incorporating sisal fiber into CLC brick production, considering factors such as material costs, labor requirements, and potential commercialization challenges.

I.V Objectives of project

1.Use of natural fibers to increase the compressive strength.
2.To increase the properties of brick compared to red clay brick by adding fiber ,fly ash, foam Etc.
3.To make brick light in weight by using foaming agents and fly ash.
4.Foam has the property of sound insulation, fire resistance, thermal insulation.

1.5 Scope of Project.

Research and literature review: Conduct a comprehensive review of existing studies, research papers, and technical literature on the use of sisal fiber in CLC bricks. This will help gather information on the properties, advantages, and challenges associated with this composite material.

Material selection and characterization: Identify suitable sisal fiber types and evaluate their physical and mechanical properties. Determine the optimum fiber length, content, and treatment (if any) for achieving desired performance in CLC bricks

Mix design and optimization: Develop a mix design for CLC incorporating sisal fiber as a reinforcement material. Perform laboratory experiments to optimize the mix proportions, including cement, aggregate, foam, water, and fiber content, to achieve the desired mechanical strength, workability, and density.

Mechanical testing: Conduct a series of mechanical tests on the sisal fiber-reinforced CLC bricks, such as compressive strength, flexural strength, and modulus of elasticity. Compare the results with conventional CLC bricks and evaluate the impact of sisal fiber on their performance.

Durability assessment: Evaluate the durability aspects of sisal fiber-reinforced CLC bricks, including resistance to shrinkage, cracking, and moisture absorption. Perform tests such as freeze-thaw resistance and water absorption to assess their long-term performance.

Thermal and acoustic properties: Investigate the thermal conductivity and acoustic insulation properties of sisal fiber-reinforced CLC bricks. Conduct tests to measure their thermal resistance, thermal transmittance, and sound transmission class to evaluate their suitability for insulation applications.

Economic feasibility: Conduct a cost analysis to determine the economic viability of using sisal fiber in CLC brick production. Assess the availability and cost of sisal fiber and compare it with alternative reinforcement materials.

Sustainability assessment: Evaluate the environmental impact of sisal fiber-reinforced CLC bricks compared to conventional bricks. Consider factors such as embodied energy, carbon footprint, and recyclability to determine their sustainability benefits.

Reporting and documentation: Prepare a detailed project report documenting the methodology, experimental results, findings, and conclusions. Present the project outcomes in a clear and concise manner, including any recommendations for further research or practical implementation.

II. STUDY AREA

CLC (Cellular Lightweight Concrete) brick is a type of brick that is made from a mixture of cement, fly ash, sand, and foaming agent. It is a lightweight and porous brick that is commonly used in the construction of walls, floors, and roofs. CLC bricks are known for their high thermal insulation and sound absorption properties, making them an attractive choice for buildings in hot or noisy environments. They are also easy to work with and can be cut, shaped, and molded to fit a variety of different construction needs. In addition, CLC bricks are environmentally friendly and can be made using recycled materials, making them a sustainable building option.

A) Methodology

Procedure of making of CLC bricks with sisal fibre

Phase 1 : Extraction of sisal fibre

1.cutting of upper layer of sisal leaves
2.Remove the wet core of sisal
3.keep the exctracted sisal fibres at some warm temperature to make it dry.
4.Put the dry fibres in some salted water for 24 hours and dry it again

Phase 2: Making the foam by foam agent

1.Remove the lumps if the agent in powder formand Add the foam agent into water as per the proportion 1 :30. And stir it well
2.Fill the container with the agent
3.Start the compressor and then we will get the foam.

Phase 3: Making the bricks.

1.Weigh the cement , fly ash , fibers and foam as per the proportion
2.Make the mesh of weighted fiber
3.Mix the all ingredient in a pan in well manner. Remove the lumps. .
4.Fill the mixture in 3 layers.
5.After filling first layer lay the mesh of a sisal fiber in zig zag manner and repeat this process for 2nd and 3rd layer
6.After filling give it the finishing touch and cure the bricks for 7 , 14 and 28 days

Phase 1- Extraction of sisal fiber.

a. Sisal plant is generally obtained in mountain or road side area. It is a waste plant and it not used for any purposes in industries. So is we use it the environment will not be affected.

b. There are two method to extract the fibers

1) Mechanical method
2) Manual method

c. For our project we occupied the manual method.

a)Procedure :-

1) At first we cut the leaves the of sisal plants as shown in fig 3.1 A-1
2) Then remove the upper green layers of the leaves
3) After that remove the wet part which is on the sisal fiber by sharp objects .the extracted fibers are shown in fig 3.1 A-1
4) At last soak the extracted fibers for 24 hrs in salt water
5) Then dry the fiber.

Fig.3.1.A-1 Sisal plant leaves cutting

Fig.3.1.A-2 Extracted sisal fiber

Phase 2-Foam Generation

Foam is a material which is used for making CLC bricks light in weight.

Procedure :-

1) First we add the foaming agent in some amount of water and remove the lumps and stir it well
2) Fill the mixture in the compressor's container and remove the bubbles.
3) Attach the container to the compressor and start the compressor.
4) By applying a certain amount of pressure we get the foam.
5) Use a bucket or closed container for collecting the foam.

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Fig 3.1 B-1 Foam generated

Phase 3- Mesh

a) Apparatus :- Sisal fiber and weighing machine.

b) Procedure:-

1) Weigh the sisal fiber 20% , 30% , 40% of CLC bricks without sisal fiber.
2) According to size of mould calculate the size of mesh.
3) Make strings of the sisal fiber.
4) Make the mesh by connecting the strings with each other.

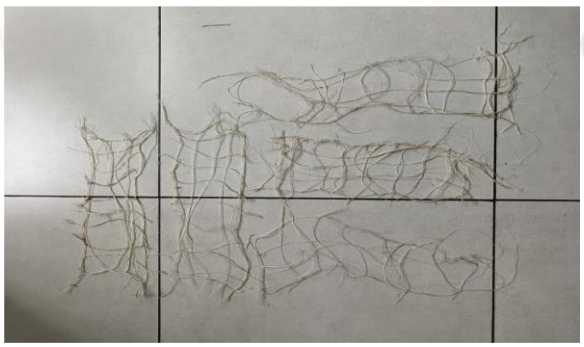

Fig 3.1 C-1 Mesh of sisal fiber

Phase 4-Manufacturing of Sisal fiber bricks-

a)Apparatus:- Cement, Fly Ash , Water , Foam , Sisal fiber mesh, Weighing machine, Mould, oil.

b)Procedure :-

1) Weigh the required quantities for making sisal fiber bricks.
2) Mix the foam , cement and fly ash properly.
3) Oil should be applied inside the mould for easy and safe removal of brick.
4) Put the first layer of the mix in mould then add sisal fiber mesh in the mould
5) Press at point on which the sisal fiber intersects and by this the formation of zigzag mannered sisal fiber in made.(Make Mesh of 20% sisal fiber by weight of clc bricks)
6) Fill the mix in 2 layers and add the mesh at every layer.
7) And for the finishing use thapi.
8) Remove the bricks from mould after 24 hrs.
9) Repeat the procedure for 2 bricks
10) Then put the bricks for curing for 7 days , 14 days and 28 days respectively.
11) Repeat the procedure for 30% and 40 % sisal fiber CLC bricks

Fig 3.1 C-1 Placing of sisal fiber

Fig 3.1 C-2 Placing of sisal fiber in zig zag manner

c)Data Collection

1. The brick size used in this project is 9” x 6” x 4” . The mould is made by us of aluminium sheets.

2. The brick volume is 0.0035 cum
3. The material required for the bricks is cement , fly ash , Foam , Diluted water , Sisal fiber ,weighing machine , Oil.
4. The quantities for 1 brick is 0.875 kg cement, 1.75 kg fly ash , 4.2 x 10-3 kg foam, 0.105 liter water.

III. OBSERVATION

Table No. III.A Comparison of Red clay bricks and CLC bricks with and without sisal fiber

DESCRIPTION	WEIGHT (KG)	COMPRESSIVE STRENGTH (N/MM2)
Red clay bricks	4.5	5.33
CLC bricks without sisal fiber	4.070	3.9
CLC bricks with 20% addition of sisal fiber by weight of bricks	3.650	4.35
CLC bricks with 30% addition of sisal fiber by weight of bricks	3.635	5.5
CLC bricks with 40% addition of sisal fiber by weight of bricks	3.615	6.7

1) Water absorption test – (After 24 Hrs)

The absorption test is the type of test conducted on bricks to determine the moisture absorbed by the bricks when subjected to extreme conditions.

The absorption test can be used as an indicator of the durability properties of bricks such as quality, degree of burning and behaviour of bricks in weathering.

The test can be briefly explained as follows:

a) Apparatus Required

1. A weighing balance with a sensitivity of less than 0.1%
2. Sample of whole bricks

b) Procedure :-

The procedure for the absorption test on bricks includes the following series of steps:

i. The specimen in allow to dry on atmosphere.
ii. The heated specimen is then allowed to cool at room temperature.
iii. The specimen is weighed and its mass is recorded (M1).
iv. Then, the specimen is immersed in water at a temperature of about 27 degrees Celsius for 24 hours.
v. The brick specimen is taken out from the water and wiped with a clean cloth to remove the traces of water that may be present.
vi. The specimen thus obtained is then weighed (M2).

Calculation of Water Absorption of Bricks

Water absorption by the brick specimen is given by the formula,

W=M2- M1/M1 X 100

The average result shall be reported.
where,
M2 = Wet Weight of brick after immersion of brick in water for 24 hours
M1 = Dry Weight after oven drying of brick

Weight of bricks (M1) :- 3.615 kg

Weight of bricks after 24 hrs deeping in water (M2) :- 3.846 kg

Percentage of water absorption :- 6.5%

2) Drop test :-

A soundness test on bricks is carried out to determine the nature of bricks when subjected to sudden impact.
It is a simple test in which two bricks are taken randomly from the stack of bricks.
The bricks are then struck against each other.
If it emits a clear metallic ringing sound; the brick is of good quality.
The CLC brick with 40% sisal fiber dropped from 4 feet , brick is not broken.

3) Soundness test :-

A soundness test on bricks is carried out to determine the nature of bricks when subjected to sudden impact.
It is a simple test in which two bricks are taken randomly from the stack of bricks.
The bricks are then struck against each other.
If it emits a clear metallic ringing sound; the brick is of good quality.
Bell ringing sound.

4) Hardness test

The hardness of bricks generally implies the resistance of bricks to scratch.
For this test, the brick is scratched with a sharp tool or fingernail.
If the scratching does not leave behind any impression on the brick, it is considered as a hard brick.
After The CLC brick with 40% sisal fiber scratching by nails powder is not formed.

5) Compressive Strength test

Bricks that are used for masonry construction are generally subjected to compressive loads thus it is necessary to determine the compressive strength of bricks.
The compressive strength test is also known as the crushing strength test which is an important type of laboratory test conducted on bricks to determine the load-carrying capacity of bricks when subjected to a compressive load.
This test is performed utilizing a compression testing machine.
The test can be briefly explained as follows:

a) Apparatus & Materials Required
1. Compression Testing Machine
2. Sample of whole bricks
3. Cement, sand, aggregate for specimen preparation

b) Specimen Preparation
The samples of whole bricks are first taken and the unevenness is removed.
The dimensions are duly measured.
The samples are then immersed in water for 24 hours at room temperature. After 24 hours, the specimen is removed and dried. If traces of water are still present, it is wiped with a clean cloth.

Procedure:-

The procedure for the crushing strength test on bricks involves the following series of steps:
1. The specimen with the mortar filled face upwards is placed in the plates of the compression testing machine.
2. The load is then applied axially at a uniform rate of 14N/mm² per minute until failure occurs. The maximum load at failure is recorded.
3. The compressive strength is then calculated using the following formula:
Compressive Strength= Maximum load at failure/ Average Area of Bed Face

IV. RESULT AND DISCUSSION

As we know the red clay bricks are commonly used in the construction work of any structure. But the CLC bricks are not used as load carrying member. But after adding sisal fibers we can get the result better than the red clay bricks in all aspects like weight , water absorption , compressive strength etc.

Results:-

1) Weight of CLC bricks with 40 % sisal fiber is less than the weight of red clay brick and CLC brick without sisal fiber.
2) Compressive strength of CLC bricks with 40 % sisal fiber is more than the of red clay brick and CLC brick without sisal fiber.
3) CLC bricks with 40 % sisal fiber absorb less water than the red clay and CLC brick without sisal fiber.
4) CLC bricks with 40 % sisal fiber doesn't break when we drop it from 4 feet.
5) CLC bricks with 40 % sisal fiber has less price than the red clay bricks and CLC bricks.

V. CONCLUSION

After all the tests we can conclude that the CLC bricks with 40 % sisal fiber are more better than the red clay bricks in economical aspect also. CLC bricks with 40 % sisal fiber can be exchanged with red clay bricks and CLC bricks without sisal fiber.
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