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Performance Analysis of Banana Fibreon Soil-Cement-Brick

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***Abstract:** In this project, soil-cement bricks were created by mixing local soil with cement and various amounts of banana fiber. The banana fibers were cleaned, dried, and cut into small pieces before being added to the mixture. Bricks were made both with and without banana fiber to compare their characteristics. After being allowed to cure for a specific period, the bricks were tested for strength, water absorption, and resistance to different conditions, following standard testing methods. The results showed that adding banana fiber increases the strength of soil-cement bricks, but only up to a certain level. Bricks with banana fiber were found to be less prone to cracking and more flexible than regular soil-cement bricks. The study suggests that banana fiber can be a good natural material to improve the strength of bricks, making construction more sustainable and cost-effective.*

I. INTRODUCTION

The construction industry is important because it helps build things like roads, buildings, and homes.Materials like burnt clay bricks and concrete blocks need a lot of natural resources and energy to make.This can harm the environment and use up valuable raw materials.Because of these issues, there is a growing need for building materials that are sustainable, affordable, and kind to the environment.Soil-cement bricks are one example of such materials.They are widely used because they are easy to make, inexpensive, and have less impact on the environment.However, soil-cement bricks can be brittle and not strong enough when pulled apart, which can cause cracks and make them less durable over time.Banana fiber is a natural fiber taken from the stem of the banana plant.After bananas are harvested, the stem is often left as waste.Banana fiber is strong, flexible, breaks down naturally, and is easy to get.Using banana fiber in construction materials not only improves the quality of the materials but also helps use up agricultural waste and supports sustainable development.Natural fibers like banana fiber can be added to soil-cement bricks to make them more resistant to cracking and less brittle.Adding fibers helps control shrinkage cracks and improves the strength of the bricks.Engineers today use natural fibers as reinforcement in construction materials to stop cracks from spreading and make bricks more flexible.These fibers are usually spread randomly in the cement mix.The most common fibers used are banana fiber and jute.Banana fiber is especially popular because it is easy to get and more durable than other natural fibers.This paper looks at how adding untreated banana fibers affects the stress and strain behavior of clay bricks that are reinforced with dry or untreated fibers, arranged randomly, for possible use in building houses in rural India. A few years ago, using fibers as a substitute for some materials became more common because of cost and environmental reasons.Different kinds of agricultural waste,after being processed, have been mixed with common materials like soil, cement, and water to make composite building materials.One big advantage of using natural fibers in soil is that they help prevent cracks that happen when the soil dries out.With the growing population and the need for affordable housing, there is a demand for cheap and eco-friendly building materials.Using banana fiber in soil-cement bricks can help reduce the use of traditional materials and encourage the use of local resources.This study aims to analyze the performance of banana fiber reinforced soil-cement bricks and evaluate their suitability for low-cost and sustainable construction projects.

II. LITERATURE SURVEY

A literature review is an important part of any project because it shows what has already been studied about a particular topic.It helps find out what is still unknown and choose the best materials and methods for the current study.Many researchers have looked into using natural fibers and waste from agriculture in construction to make things stronger and more eco-friendly.Soil-cement bricks are made by mixing soil, cement, and water in the right amounts.These bricks are often used in affordable housing because they are easy to make and use less energy than traditional clay bricks that are fired in a kiln.Some studies say that soil-cement bricks have enough strength to hold up under pressure but are not very flexible and can break easily, which might cause cracks.To improve how well these bricks work, some researchers suggest adding materials like fibers, fly ash, and other by-products from industry.

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Natural fibers such as coconut fiber, jute fiber, sisal fiber, and bamboo fiber have been used in construction materials a lot.From the research, it is clear that using a small amount of banana fiber can help improve the performance of soil-cement bricks.The fibers make the bricks stronger in bending, better at holding tension, and more durable, making them more suitable for affordable and sustainable construction.However, using too much fiber can actually reduce the strength and make the mixing process harder.

III. OBJECTIVES

The following are the work's targets:

1) Use banana fiber as a natural material to strengthen soil-cement bricks.
2) Make soil-cement bricks with various amounts of banana fiber.
3) Check the strength of bricks that have banana fiber and those that don't.
4) Test how much water the bricks can absorb.
5) Find the best amount of banana fiber that makes the bricks perform better.
6) Test the strength of the bricks after 7, 14, and 28 days.

IV. METHODOLOGY

The methodology adopted for this study to investigate the effect of banana fibre on soil cement brick is described below:

1) *Collection of Materials:* Local red soil was gathered and cleaned to get rid of impurities like stones and plant roots.Ordinary Portland Cement was used to stick things together.Banana fibre was taken out from the banana pseudo-stem.Clean drinking water was used for mixing and making the material strong.



Fig. Cement



Fig. Soil



Fig. Banana Fibre

2) *Preparation of Banana Fibre:*

Banana pseudo-stem was cut and fibres were manually extracted.The fibres were washed to remove impurities and dried under shade for 2–3 days.After drying, fibres were cut into small pieces of 20–30 mm length for proper mixing.

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Fig. Cutting Fibre

3) Testing of soil on sieve analysis (passing in 1.18mm only):

Sieve analysis test was conducted to determine the particle size distribution of the soil used for manufacturing soil-cement bricks. Proper grading of soil is important to achieve good compaction, strength, and bonding in stabilized bricks. In this project, the collected soil sample was first dried in open air to remove moisture. The dried soil was then broken into small lumps and passed through a set of standards IS sieves. Particular attention was given to the 1.18 mm IS sieve, as soil used for soil-cement bricks should mainly pass through this sieve to ensure fine and uniform particles.



Fig. sieve Analysis

4) Mix Proportion:

Soil and cement were mixed in the ratio of 10:10: 0.54 by weight. Banana fibre was added in varying percentages of 0%, 0.5%, 1% and 1.5% by weight of soil.

The density of soil–cement mix was assumed as 1800 kg/m³. The quantity of materials required for one brick (approximately 2.8 kg) was calculated accordingly.

As per standard brick mould size (190mm x 90mm x 90mm)

Volume of one brick – 190 * 90 * 90 = 0.001539m^3.

Assume soil density = 1800 kg/m^3.

Weight of one brick – 0.001539 * 1800 = 2.77 ~ 2.8 kg

Mix proportion Used – 90:10:0.56 = 100.56 (by total weight)

Quantity required for one brick

- Soil

(90/100.535) *2.8 = 2.507 ~ 2.5 kg

- Cement

(10/100.535) *2.8 = 0.278 ~ 0.28 kg

- Banana fibre

(0.535/100.535) *2.8 = 0.01490 ~ 0.015 kg

5) Mixing Process:

Dry mixing of soil and cement was carried out first to obtain uniform colour and consistency. Banana fibre was then added gradually to avoid lump formation. Water was added slowly to achieve workable consistency.



Fig. Mix processFig. Casting of BrickFig. Curing

6) Casting of Bricks:

Brick mould of size 190 mm × 90 mm × 90 mm was used. The mould was cleaned and oiled before casting. The prepared mix was placed in the mould in two layers and compacted properly to remove air voids. The surface was levelled and bricks were kept undisturbed for 24 hours.

7) Curing:

After 24 hours, bricks were removed from the mould and cured by water curing method. Bricks were cured for 7 days, 14 days and 28 days to ensure proper strength development.

V. RESULTS AND DISCUSSIONS

1) Water Absorption test:

The water absorption test was conducted to determine the amount of water absorbed by the soil-cement brick specimens after curing. This test helps in evaluating the durability and porosity of the bricks.After completion of the curing period (7 days and 28 days), the brick specimens were first dried in open air and then placed in a drying oven at a temperature of approximately 105°C to 110°C for 24 hours to remove all moisture. The dried specimens were then cooled to room temperature and weighed. This weight was recorded as the dry weight (W_1).

The specimens were subsequently immersed completely in clean water for a period of 24 hours at room temperature. After immersion, the bricks were removed from water, and surface water was wiped off using a damp cloth. The specimens were immediately weighed again. This weight was recorded as the wet weight (W_2).

The percentage of water absorption was calculated using the following formula.

Water Absorption (%) =

W_2-W_1/W_1*100

(3.330-3.156)/3.156*100 = 5.513%



Fig. W 1



Fig. W 2

Sample No.	Fibre (%)	Weight of Dry (kg)	Weight of Wet (kg)	Water Absorption (%)
1	0.18	3.156	3.330	5.513
2	0.36	3.150	3.345	6.190
3	0.56	3.175	3.410	4.311
				Average = 5.338

Fig. Water Absorption Test Result

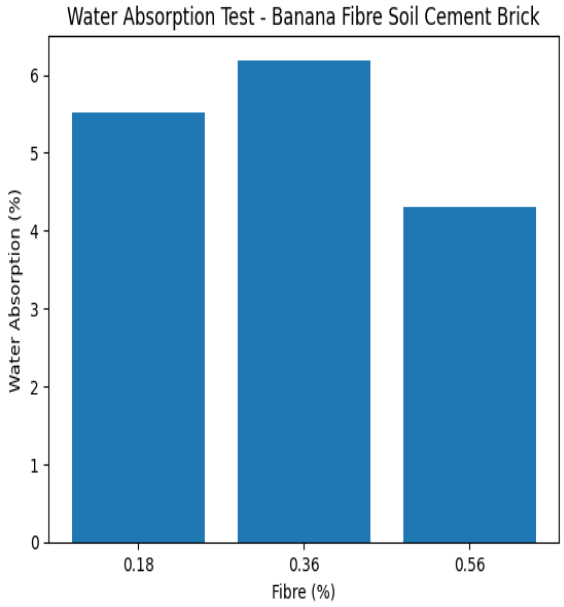


Fig. Water Absorption Graph

2) Testing Conducted on CTM

Compressive Strength of Banana Fibre: The compressive strength test was done to find out how much weight the soil-cement bricks with banana fibre can hold.The test was carried out using a Compression Testing Machine.After the curing time of 7 days and 28 days, the bricks were taken out of the curing process and let dry on the surface.The size of each brick was carefully measured with a scale to find the cross-sectional area.The brick was then placed in the middle of the lower plate of the Compression Testing Machine so the force was evenly spread on the top of the brick.Special care was taken to make sure the brick was aligned properly to avoid any uneven pressure.The force was applied slowly and steadily at a constant speed until the brick broke.The highest force before the brick broke was recorded.

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The compressive strength was calculated using the following formula:
Compressive Strength = Maximum load / cross sectional Area



Fig. Compression Test

Where:

- Load in N (Newton)
- Cross Sectional Area (mm^2)

The average compressive strength was calculated from three specimens for each mix proportion to ensure accuracy of results. The obtained results were compared for different percentages of banana fibre to determine the optimum fibre content that provides maximum strength.

Sample No.	Banana Fibre (%)	Maximum Load (KN)	Compression Strength (N/mm^2)	Average Compression Strength (N/mm^2)
1	0.18	214	5.10	4.875
		157	4.65	
2	0.36	299	10.20	9.935
		284	9.67	
3	0.56	149	7.29	6.330
		136	5.37	

Fig. Compression Test Result

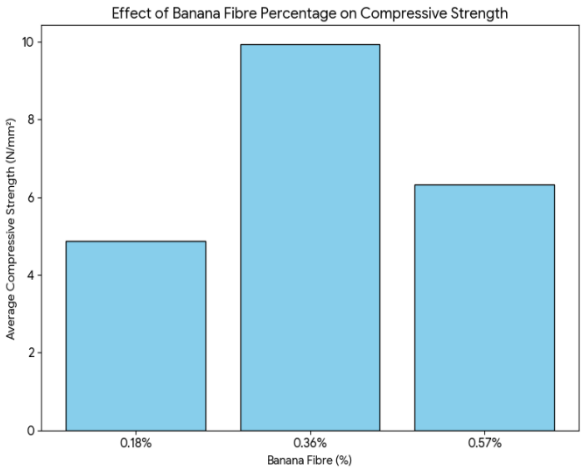


Fig. Compression Test VS Banana Fiber Graph

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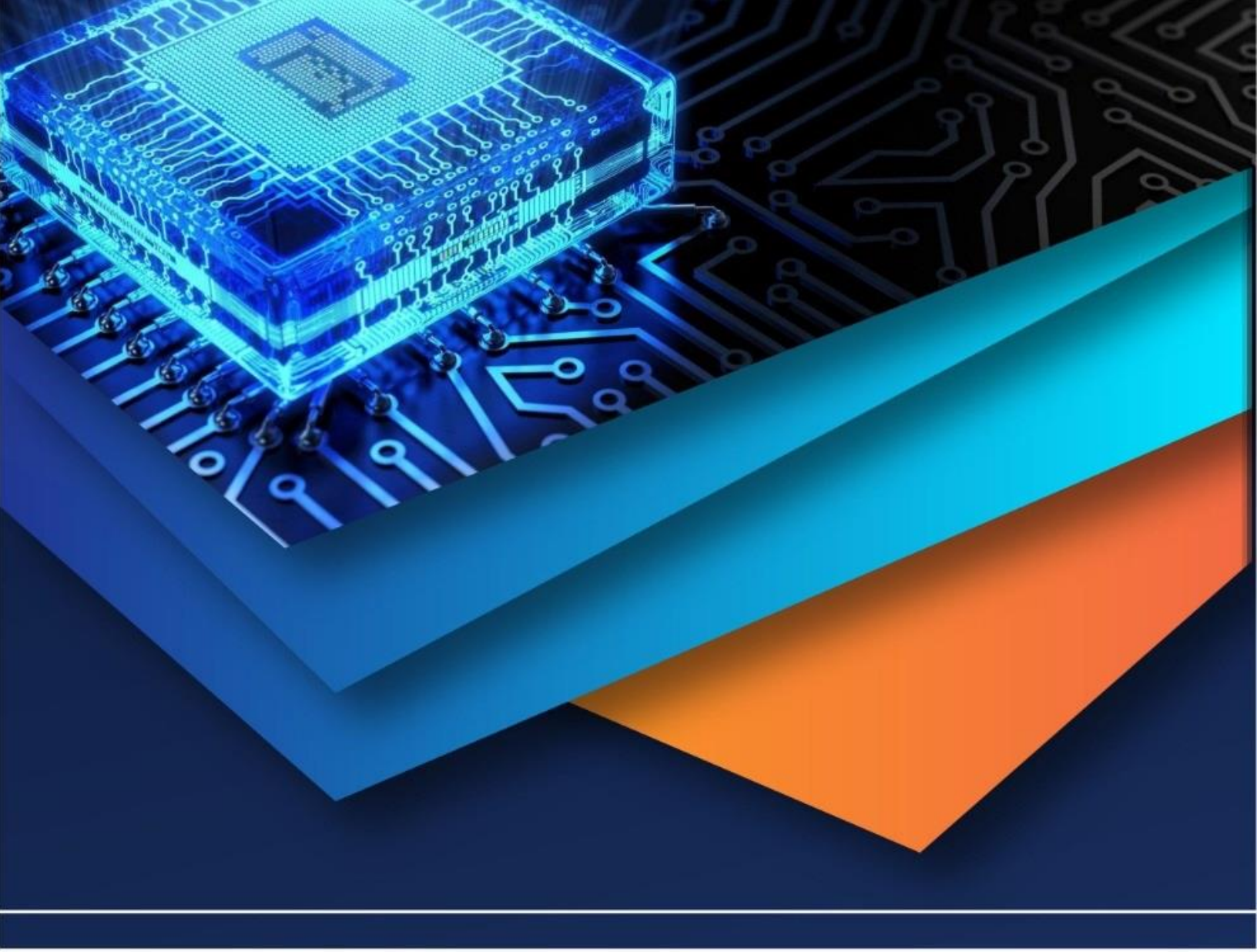
VI. CONCLUSIONS

1) The incorporation of banana fibre improves the mechanical behaviour of soil-cement bricks.
2) Banana fibre, being a natural and locally available material, reduces construction cost.
3) Utilize banana farming waste.
4) From the experimental study on the analysis of performance of banana fiber on soil cement bricks, it is concluded that the addition of banana fiber improves the overall performanceof soil cement bricks when used in optimum quantity.

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