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ECOFRIENDLY LIGHT-WEIGHT BRICK

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Abstract - *The most common type of construction material worldwide is brick. Also, we are now having issues with waste that is produced in surrounding regions. So, the goal of our project is to try to find a solution to this issue by creating waste-based brick made up of paper cup and coconut coir. For waste clay is utilized as a binding agent. In addition to making bricks lighter, using coconut coir and paper cup follows best practices for handling solid waste. We tried to lower the percentage of clay in this brick. We try make this brick dam proof for this we are using the banana leaves as a damp proofing agent this method is called as 'Decoction Method.'*

Key Words: Bricks, Banana Leaves, Coconut Coir, Dam proofing, Decoction Method, Paper Cup, Waste Material

1. INTRODUCTION

As it is a common knowledge, bricks are a key component of construction project. Bricks are produced in approximately over 1400 billion unit per year throughout the world, and it is anticipated that demand will continue to increase. Soil and other element make up the majority of conventional bricks, which are created during high-temperature kiln fire. A lack of soil exist in many nations. Since soil is a natural resource, over extraction will have an adverse effect on the environment. Coconut fibre or coir is used in our brick. Coconut is versatile substance with many application. Use waste paper cup that are produced by cafes, restaurants, and hotels. So that we can decrease the percentage of dirt and also offer waste management solutions. We work to reduce manufacturing costs and brick weight at same time. Also we try to make the brick made by such ingredient damp-proof by using liquid solution of banana leaves.

2. OBJECTIVE

- The objectives of this project are as follows :-

1. To compare strength and weight of clay brick with 2nd class conventional brick.
2. To compare cost of clay brick with 2nd class conventional brick.
3. To make dam proof brick by using decoction of banana leaves.

3. STUDY WORK

3.1 What exactly is brick?

The primary building material used to create walls, pavements, and other masonry construction element is the brick, sand, lime, concrete, fly ash, and clay are some of the other element used. The dimensions of normal clay brick vary from country to country, but in India it is roughly 9 inches long, 4 inches wide and 3 inches thick.

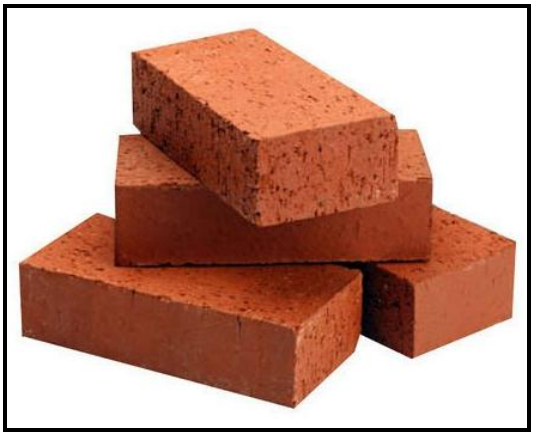

Figure 1:- Bricks

3.2 Materials used in this brick: -

A. Alluvial Soil:-

- Alluvial soil is those that have been dumped along the banks and at the river's bottom. This soil can be found in alluvial fans, floodplains, and near rivers. Because new silt is frequently deposited at the surface by floods, alluvial soil has a distinctive layered appearance. Round gravel particles come in a variety of sizes and dark and light tints.

- Many floodplains create this distinctive layering process, known as stratification. Flooding is the source of alluvial soil. The stream is the source of newly added sediment, which is susceptible to shifts in landscape use.

Figure 2 :- Alluvial Soil

- **Properties of soil:-**

1. River load developed it as it flowed from the upper to lower stream.
2. It is lightweight and porous, making it convenient to use.
3. Soil's consistency refers to both its ability to resist deformation and adhere to other objects as well as to itself.

B. Paper cup: -

- For the purpose of manufacturing bricks, we collect used coffee paper cup from hotels, restaurant, and another establishment. Paper cups are lightweight and easily incorporated into the soil.

Figure 3:- Paper Cups

C. Coconut Coir: -

- The fibrous coconut husk is used to make coconut waste, also known as coir. It is utilized in brick to increase strength of brick.

Figure 4:-Coconut Coir

D. Water: -

- It is a clear fluid. It will be clean and devoid of any dust particles.

➢ **Water's qualities for producing bricks include:**

1) It must be drinkable.

2) Water's pH shouldn't be lower than 6.

3) There should be no contaminants in it.

3.3 Proportioning

- Before beginning production, tests should be finished to ensure the greatest quality bricks. The product should be mixed in the proper proportions for best results. Even after conducting extensive research, we still have no notion regarding proportion. So, we made the decision to create a trail sample based on the ratio of dirt to paper cup and coco peat. We conduct three trials for finding Proportion: -

✓ **First Trial: -**

In first trial we continue with the proportion of 1:0.1:0.1. That is 1 part of soil, 0.1 part of coco peat, 0.1 part of paper cup. Main thing that is used in this proportion is coconut peat. But as this proportion give good poor result in compressive strength so it breaks easily. So, we skip this proportion.

Figure 5:- Trial No.1

✓ Second Trial:-

As we use coco peat in first trial we decided to use coconut coir instead of coconut peat by taking same proportion as 1:0.1:0.1. But after casting the brick we seen that the finishing of brick is very poor as compared to conventional brick. This is why we skip this trial also.

Figure 6:- Trail No.2

✓ Third Trial:-

For third trial we decided to take 1 part of soil, 0.0125 part of coconut coir, 0.0125 paper cup. After taking two trial we understand that the % of coconut coir and paper cup is much more so we decided to reduce it. Hence we take only 0.0125 part of both coconut coir and paper cup. After casting a brick we see that the finishing is much better than trial no. 2. Also after taking compressive strength test it gives better result than trial no. 1. So we decided to keep this proportion as our final proportion for our project.

Final Proportion for bricks: - 1:0.0125:0.0125

Figure 7:- Trial No. 3

Figure 8:- Proportioning

3.4 Mixing

- The blending needs to be done correctly. Hand mixing should be used to combine all components. The expense of hand mixing should be reasonable for small volumes. All of the materials we utilized for the experiment are balanced. So, the calculation for our raw material should be made. Three liters of water are used to make one brick. An essential component of mixing is the binding of the materials together; the removal of air gaps must be accomplished through compaction. In order for the brick to reach its maximum strength. When inspecting it, the finishing should be taken into consideration. Keeping the surface flat will reduce the plastering expense.

Figure 9:- Hand Mixing

4. PREPARATION OF BRICK

4.1 Actual Procedure of Brick Casting

1. In order to maintain the best porosity, the brick-making materials stored in the open air. The soil needs to be exposed to air for 24 hours. Then calculate the soil's weight. It is important to examine the water's gravity, which should be roughly equivalent to the soil's moisture content, which was previously calculated through experiment. By taking numerous samples in different ratios, the water's composition should be chosen.

2. We create three bricks for our experiment that have the same proportions of the ingredients as our brick. Use 25g of coco coir, 25gm cups of used paper, approximate water, and 2 Kg amount of soil to make a single brick. To find compressive test we use three brick sample and take the average of them.

3. Ingredients were added to the pan proportionately. The water is added using the sprinkling method after it has been thoroughly mixed. To eliminate voids, prepared materials are put into a mold and compacted. It needs to be pounded with the blows.

4. After the bricks are casted, they stored for up to 3 days of air drying. For first brick we keep the brick more than 7 days in the air. (Note: - It totally depend upon weathering condition). We tested the bricks after they had dried out, first for dry density and then for compressive strength. We took the dry density test for only one set of brick.

5. Proportion used for casting brick is 1:0.0125:0.0125

4.2 Comparison of Finishing

Below is a comparison of traditional bricks and our bricks. Our brick has an identical finish to conventional brick

Figure 10:- Finishing of Eco-friendly Clay Brick

Figure11:- Finishing of Conventional 2nd Class Brick

5.TESTING

A. Name of the test: - Compressive Test:-

- **Procedure of Compressive Test: -**

1. Take the dimension of the specimen to the nearest 0.2m
2. Clean the bearing surface of the testing machine

3. Place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast.
4. Align the specimen centrally on the base plate of the machine.
5. Rotate the movable portion gently by hand so that it touches the top surface of the specimen.
6. Apply the load gradually without shock and continuously till the specimen fails
7. Record the maximum load and note any unusual features in the type of failure.

Observation Table (Proportion – 1:0.1:0.1)

(Note: - Coconut Peat is used in this brick)

Table 1:- Compressive Strength

Sr. No.	Sample no	Dimensions of the brick (mm)			C/s area of the brick (A) in mm^2	Failure load (P) in kg	Failure load (P_1)in (N) (1kg = 9.81 N)	Compressive strength $\sigma = P_1/A$ in N/mm^2	Average
		L	W	H					
1	1	230	100	40	23000	7	68.67	2.98	2.98

Conclusion: - After the test we saw that the compressive test of brick that we make in first trial is 2.98 N/mm^2 which is very less than compressive strength of conventional brick.

Observation Table (Proportion – 1:0.1:0.1)

(Note: - Coconut Coir is used in this brick)

Table 2:- Compressive Strength

Sr. No.	Sample no	Dimensions of the brick (mm)			C/s area of the brick (A) in mm^2	Failure load (P) in kg	Failure load (P_1)in (N) (1kg = 9.81 N)	Compressive strength $\sigma = P_1/A$ in N/mm^2	Average
		L	W	H					
1	1	230	100	55	23000	12	117.72	5.11	5.11

Conclusion: - After the test we calculate the compressive strength of brick as 5.11 N/mm^2 this is also less than compressive strength of conventional brick.

Observation Table (Proportion – 1:0.0125:0.0125)

Table 3:- Compressive Strength

Sr. No.	Sample no	Dimensions of the brick (mm)			C/s area of the brick (A) in mm^2	Failure load (P) in kg	Failure load (P_1)in (N) (1kg = 9.81 N)	Compressive strength $\sigma = P_1/A$ in N/mm^2	Average
		L	W	H					
1	1	230	100	60	23000	20	196.2	8.53	8.24
2	2	230	100	60	23000	20	196.2	8.53	
3	3	230	100	58	23000	18	176.58	7.67	

Sample Calculation:-

For Sample 1:- $\sigma = P_1/A$

Result: - The average compressive strength of sample is **8.24 N/mm^2**

Conclusion: - From this we conclude that the compressive strength of eco-friendly brick is 8.24 N/mm^2 and it is very good as compare to conventional brick.

Figure 12:- Compressive Strength Test Apparatus

Figure 13:- Compressive Strength of brick

6. RESULT

6.1 Result of Compressive Strength of Brick

- Average Compressive Strength of Brick Prepared in first trail is 2.98 N/mm^2
- Average Compressive Strength of Brick Prepared in second trail is 5.11 N/mm^2
- Average Compressive Strength of Brick Prepared in third trail is 8.24 N/mm^2
- So the proportion that we fixed after taking test is 0.0125:0.0125:0.0125

7. COST COMPARISON

- Current market conventional brick price: - Rs. 8 to Rs. 9

Table 4:- Cost Comparison

Cost of Waste Clay Brick		
Material Used	Cost (Rs)	Total Cost (Rs)
Paper Cup	0.175	1.6
Coconut Coir	0.25	
Soil	1	
Contractor Profit (10%)	0.1425	
Contingencies Charges (2%)	0.0285	

➢ **Waste Paper Cup:-**

- One labour to collect waste paper cup = Rs. 700/day
- Paper Cup collected in one day = Approximately 100 Kg
- Paper cup require for one brick = 25 gm.
- Cost of paper cup for one brick = Rs. 0.175

Cost of paper cup for 1 brick is Rs.0.175

➢ **Coconut Waste or Coir: -**

- One labour to collect coconut waste = Rs. 800/ day
- Coconut waste collected in one day = Approximately 80 Kg
- Coconut waste require for one brick = 25 gm.
- Cost of coconut waste for one brick = Rs. 0.25

Cost of coconut waste for 1 brick is Rs. 0.25

➢ **Soil :-**

- Soil required for 1 brick = 2 Kg or 2000 gm.
- Cost of soil as per Indian mart = Rs 2000/ tonne (1 tonne = 1000kg)
- Cost of soil for 1 brick = Rs. 1

Cost of soil for 1 brick is Rs. 1

7. CONCLUSION

Through the project we conclude that,

The manufacturing cost of our brick is minimum than conventional brick. Also, it is light in weight and finishing of our brick is equal to conventional brick. The compressive strength of our brick is more than conventional brick. It can be used for low cost as well as ordinary building.

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