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EXPERIMENTAL STUDY AND PERFORMANCE ON PLASTIC BRICK WALLS MADE FROM PLASTIC WASTE

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ABSTRACT

This paper contains the results of strength values of plastic brick wall and compare with normal brick wall by re-bound hammer test, water absorption test and compressive strength test. The parameter under study is compressive strength of waste plastic bricks. The experimental results indicates that the plastic bricks are frequently priced lower than traditional construction materials, making them a desirable choice for low-budget housing.

KEYWORDS – waste plastic, Re-bound hammer, water absorption, compressive strength.

INTRODUCTION

A plastic brick wall, also known as a plastic brick panel or plastic brick facade, is a construction material made primarily from plastic. It is designed to replicate the appearance and texture of traditional brick walls while offering several advantages over conventional brick construction. Plastic brick walls are created by moulding plastic materials into individual brick-shaped units, which are then assembled together to form a wall. The bricks often feature realistic brick patterns, textures, and colour variations, giving them an authentic look. They can be produced in various sizes and shapes, allowing for flexibility in design. One of the key benefits of plastic brick walls is their lightweight nature. Unlike traditional bricks, which are heavy and require substantial structural support, plastic bricks are much lighter, making them easier to handle and install. This lightweight characteristic also contributes to lower transportation

costs and reduced strain on the building's foundation. Another advantage of plastic brick walls is their durability. Plastic materials used in their production are resistant to moisture, corrosion, and pests, making them suitable for both interior and exterior applications. They do not require sealing or regular maintenance, unlike natural bricks that may deteriorate over time. Plastic brick walls are also known for their insulating properties. The plastic material used in their construction often provides thermal and sound insulation, helping to regulate the temperature inside buildings and reduce noise transmission. Additionally, plastic brick walls are considered an environmentally friendly alternative to traditional bricks. They can be made from recycled plastic mate. A plastic brick wall refers to a construction material made from plastic bricks that are assembled together to create a wall or partition. These bricks are typically manufactured using recycled plastics, such as polyethylene terephthalate (PET) bottles or high-density polyethylene (HDPE) containers. The idea behind plastic brick walls is to provide an eco-friendly alternative to traditional construction materials like concrete or clay bricks, while simultaneously addressing the growing concern of plastic waste.

OBJECTIVES OF STUDY

- To compare strength of plastic bricks with normal clay bricks.
- To compare strength of plastic brick wall with normal clay brick wall.
- To compare water absorption of plastic brick wall with normal clay brick wall.

LITERATURE REVIEW

S S Chauhan et.al [1] “Fabrication and testing of Plastic sand bricks” They mixed the river sand and the PET plastic (molten form) in the ratio of 1:2, 1:3, 1:4 for mould size of (230*100*75) mm for which they found maximum compressive strength on the ratio of 1:2 mixture for the same size of the bricks. The water absorption of these bricks was observed less than 5% that is less than conventional clay bricks.

Arvind Singhal, Dr Om Prakash Netula [2] “Utilization of plastic waste in manufacturing of plastic sand bricks.” They used the mixture of plastic and stone dust in the molten form in the ratio of 3:7 in standard brick mould for which stone dust was sieved through 4.75 mm using sieve analysis and conducted test on water absorption to be found as 0%. Compressive strength of plastic sand bricks is 5.6 N/mm2 at the compressive load of 96 KN.

Rajarapu bhushaiah et.al [3]. study of plastic bricks made from waste plastic this study investigates the use of waste plastic to create bricks for building construction. the author conclude that the plastic sand bricks are useful for the construction industry when they compare with fly ash bricks and 3rd class clay bricks.

P. Jayaprakash et al. [4] “Plastic waste converted into bricks” This study investigates the use of plastic waste to create bricks for building construction. The authors find that the use of plastic waste can reduce the amount of waste going to landfills and can result in cost savings in the construction industry. They also note that the mechanical properties of the plastic bricks are comparable to traditional bricks.

Mr. indrajeet et.al [5] “production of plastic bricks” for this project the author used the LDPE for making the plastic brick and compare the normal brick and conclude the using plastic in place of clay and other materials

gives us economic and environmental benefits.They also highlight the importance of ensuring the safety and environmental sustainability of the plastic building materials.

METHODLOGY

- Collection of Materials.
- Batching.
- Melting.
- Mixing
- Molding
- Curing
- Construct A Wall
- Test The Wall For It Is Suitable For Construction Or Not

COLLECTION OF MATERIALS

To make a plastic brick using waste plastic you will need to collect a significant amount of plastic waste. The Collection of waste plastic as shown in Figure 1.

Fig .1 Collection Of Waste plastic

CRUSHING

After collecting the plastic waste materials, the next step in making plastic bricks is to crush and shred the plastic waste into small pieces or particles. Crushing machine as shown in Figure2

Fig . 2 Crushing machine

MELTING AND MOULDING

The plastic waste is melted at a high temperature, typically between 170°C and 230°C, using a heating source such as an electric heater or gas burner. The melted plastic is then poured into a mould to create the desired shape of the plastic brick. Melting the waste plastic as shown in Figure3

Fig.3 Melting the waste plastic

Once the melted plastic has been poured into the mould, it needs to cool and solidify. This process can be accelerated by using a cooling fan or a water bath. Brick Mould with the melted plastic as shown in Figure4

Fig.4 Brick Mould with the melted plastic

PLASTIC BRICK AND PLASTIC BRICK WALL

plastic bricks can be made by using plastic waste. The plastic waste is collected, sorted, cleaned, and then crushed or melted to create a material that can be formed into plastic bricks and as shown in Figure5.

The plastic bricks are then laid in rows, using mortar or an adhesive to hold them together. The wall can be built in a similar way to a traditional brick wall, with alternating courses of bricks and mortar. Plastic brick wall as shown in Figure6.

Fig.5 Plastic bricks

Fig.6 Plastic brick wall

EXPERIMENTAL PROGRAM

- RE BOUND HAMMER TEST **:** the rebound hammer test is to estimate the compressive strength of concrete or the hardness of a surface in a non-destructive manner. This information is useful for assessing the quality of concrete structures as shown in Table 1, detecting defects, and identifying areas that may need further testing or investigation. The rebound hammer test is commonly used in construction and engineering projects to ensure that the materials being used meet the required standards and specifications. and The Rebound hammer test for plastic brick wall as shown in Table3 , Figure 8.

Table 1 Rebound number with Quality of concrete

Average Rebound Number	Quality of concrete
> 40	Very good hard layer
30 to 40	Good layer
20 to 30	Fair
< 20	Poor concrete
0	Delaminated

REBOUND HAMMER TEST FOR NORMAL BRICK WALL

Table2 rebound hammer test for normal brick wall

S.NO	Rebound Number (**α + 90)**
1	37
2	38
3	36
4	38
5	39
6	37

Average Rebound Number = (37+38+36+38+36+37)/6 = 37.5

According to compressive strength chart in rebound hammer = 260 Kg/cm^2

≈ 26 N/mm^2

Fig.7 Rebound number for normal brick

REBOUND HAMMER TEST FOR PLASTIC BRICK WALL

Table 3 Rebound hammer test for plastic brick wall

S.NO	Rebound Number (**α + 90)**
1	54
2	53
3	54
4	59
5	57
6	56

Average Rebound Number = (54+53+54+59+57+56)/6 = 55.5

According to compressive strength chart in rebound hammer = 550 Kg/cm^2

= 53.9 N/mm^2

≈ 54 N/mm^2

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Fig.8 Rebound number for plastic brick

- COMPRESSIVE STRENGTH TEST the compressive strength test is to determine the maximum load that a material can bear before it fails under compression and the failure point to Normal brick as shown in Figure 9 and the failure point of plastic brick as shown in Figure 10

  This test is commonly used to evaluate the quality and suitability of materials for various applications, including construction. The Compressive strength formula as shown in Table4

Table 4 Compressive strength formula

Compressive strength = Load at failure / Cross-sectional area of the sample

COMPRESSIVE STRENGTH FOR NORMAL BRICK

Compressive strength = Load at failure / Cross-sectional area of the sample

Where f = Load at failure

A = Cross-sectional area of the sample

For the normal brick the load at failure = 80kN

Cross-sectional area of the sample = 190 x 90 = 17100 / 1000 = 17.1

Compressive strength of normal brick = 80 / 17.1 = 4.7N/mm^2 = 47.9 Kg/cm^2

Fig.9 normal brick at failure point

COMPRESSIVE STRENGTH FOR PLASTIC BRICK

Compressive strength = Load at failure / Cross-sectional area of the sample

Where f = Load at failure

A = Cross-sectional area of the sample

For the plastic brick the load at failure = 220KN/mm

Cross-sectional area of the sample = 190 x 90 = 17100 / 1000 = 17.1

Compressive strength of plastic brick= 220/17.1=12.9 N/mm^2 = 131.5 Kg/cm^2

Fig.10 At plastic brick failure point

WATER ABSORPTION TEST In this test at first the bricks are weighed in total dry conditions as shown in figure 11. Then they will be allowed to be dipped in fresh water for about 24 hours in a container. The bricks are taken out of the water after 24 hours and are wiped with a cloth. The wet brick is weighed using a weighing machine as shown in the figure 12 . For the calculation of water absorption the formula for water absorption as shown in table 5. the difference between wet brick and dry brick is done. The difference is the amount of water absorbed by the brick. After that the percentage of water absorption is calculated using the data. Water absorption of bricks tells about the bonding of bricks with mortar.

Table 5 the formula for water absorption

Water Absorption, % = [(W2 - W1) / W1] x 100%

W1 = 1.138

W2 = 1.140

W = [(1.140 – 1.138) / 1.138] x100

W = 0.17

Fig.11 Brick weight before dipped in water

Fig.12 Brick weight after dipped in water

Greater quality bricks absorb less amount of water. For a good quality brick, the water absorption should be less than 20% of its own weight.

RESULTS AND DISSCUSSION

Comparison of plastic brick wall and normal clay brick wall by re-bound hammer test

The Plastic brick wall compressive strength is ≈ 54 N/mm^2 . According to Table 1 , the compressive strength > 40 N/mm^2 the quality of concrete is very good and hard layer.

The Normal clay brick wall compressive strength is ≈ 26N/mm^2 . According to Table 1 , the compressive strength 20 to 30 N/mm^2 the quality of concrete is Fair .

Comparison of plastic brick and normal clay brick by compressive strength test

The Plastic brick compressive strength is 12.9 N/mm^2 = 131.5 Kg/cm^2

The Normal brick compressive strength is 4.7N/mm^2 = 47.9 Kg/cm^2

According to the Indian Standard code IS 1077: 1992, the minimum compressive strength of 1st class bricks should be 100 kg/cm^2. This means that a 1st class brick should be able to withstand a Load of 100kg/cm^2 without breaking or failing load and Common building bricks-35 kg/cm^2.

Water absorption test for plastic brick is 0.17 and the weight of the brick is 1.138 for Greater quality bricks absorb less amount of water. For a good quality brick, the water absorption should be less than 20% of its own weight.

CONCLUSION

From the project it is conclude that the Plastic Bricks and Plastic Brick Walls are Suitable for construction and Further research and development in the field of plastic bricks are essential to improve their fire resistance and overall environmental performance. With continued innovation and responsible use, plastic brick walls can play a significant role in sustainable construction practices.

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