

Experiment On Papercrete Brick by Partially Replacing Sand with Rubber Shreds

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Abstract: Since the last decade, Due to increasing population and rising demand for building materials. It has become a challenge for civil engineers to produce and use alternate materials. The constant developmental activities in civil engineering and growing industrial activities have created nonstop demand for building materials which satisfy all the strict conditions regarding the short-term and long-term performance of the structure. As the structures of tomorrow become higher and more complex, the materials of construction will be required to meet more demanding standards of performance than those in force today (2006). India's present housing shortage is estimated to be as high as 31 million according to the census and out of these shortages 24 million units are in rural areas and 7 million units in urban areas. Such large housing construction activities require a huge amount of money. Out of this total cost of housing construction, building materials contribute to about 70% of the cost in developing countries like India. The increase in the popularity of using environment-friendly, low-cost and lightweight construction materials in the building industry has brought about the need to investigate how this can be achieved by benefiting the environment as well as maintaining the material.

1. INTRODUCTION

1.1 General Information

This research is aimed to study the effect of paper waste on the strength of concrete and to develop mixture proportions for concrete containing paper waste. Paper waste has been used as a building material for decades, especially in cementation matrices and since then a lot of research has been done to develop the mechanical properties of the composite like compressive, tensile and flexural strength. The use of Paper waste in structural concrete could become an economical and profitable substitute for landfills, incinerators, or other useful options. The research on the use of paper sludge can be further carried out in concrete manufacturing as new recycled material. The

use of paper-mill pulp in concrete formulations was investigated as an alternative to landfill disposal. India is facing a serious challenge in disposing of waste in many landfills throughout the country. The landfill situation is resulting in high disposal costs and potential environmental problems.

1.2 Relevance of work

- 1) To use the waste materials like paper, fly ash etc. in the process of manufacturing a new type of eco-friendly bricks, namely papercrete bricks.
- 2) To manufacture and study the strength and durability of the papercrete bricks to effectively use these papercrete bricks commercially for construction purposes.
- 3) To extend the investigation further to study the structural behaviour of the papercrete brick masonry experimentally and theoretically.
- 4) It is proposed to know the performance of the papercrete bricks. The papercrete brick will be tested to determine its compressive strength, water absorption, and acid resistance then the performance of the papercrete brick will compare with the conventional clay bricks.

1.3 Research objectives:

A set of papercrete mixes were prepared with cement, wastepaper sludge, river sand and manufactured sand. The major objective of this research program is to replace the expensive and scarce conventional building bricks with innovative and alternative building bricks which satisfy the following characteristics:

- i. This type of brick will be lightweight and easy to handle.
- ii. It will have less water absorption compared to conventional bricks.

- iii. Although it's made from the paper, It will be ignitable.
- iv. Since we are using waste material with Abundant availability, thus it is environmental-friendly and cost-effective.

2. LITERATURE SURVEY

2.1 Research details:

The constant developmental activities in civil engineering and growing industrial activities have created continuous demand for building materials which satisfy all the strict conditions regarding the short-term and long-term performance of the structure. As the structures in future will become higher and more complex, the materials of construction will bare required to meet more demanding standards of performance than those in force today (Fuller 2006). Manuel (2002) studied the physical characteristics of papercrete are mainly depending on the relative amount of sand and Portland cement used.

Dunster (2007) said adding 20% calcined paper sludge with cement paste accelerates the setting time by 60 minutes. Workability will be reduced.

Ms.S. Suganya (2012) bricks are relatively lightweight, good sound absorbent and more flexible but has high percentage of water absorption than conventional bricks. It can be easily cut into a desirable shape. And also, it does not expand or contract due to the surrounding environment.

J.N Akhtar et al. (2011) In this study, six different mix proportions were computed by utilizing Paper pulp and industrial by-products like Fly ash, Rice husk ash. And also, due to the addition of paper pulp, the bricks have low thermal conductivity, which reduces the energy requirement for temperature control. While using the paper pulp to make brick, will reduce approximately 50% of the weight of the brick. Therefore, these bricks will reduce the deadweight of the structure by a considerable amount. So, it changes our design and building to an economical one.

Akinwunmi (2014) The water absorption and fire resistance of papercrete were found to be high and increased with increasing waste paper content while the bulk density and compressive strength of papercrete were low and drops with increasing waste paper content. Papercrete is recommended to be an effective and sustainable material for the production of lightweight and fire-resistant hollow or solid blocks to be used to make partition walls, especially in high-rise

buildings. Mix proportions were recommended for the production of hollow and solid blocks using papercrete

3. METHODOLOGY

3.1 Project Details

This experimental study investigates the implicit use of wastepaper for producing a low-cost and lightweight composite brick as a building material. These alternative bricks were made with papercrete. Papercrete will offer a way to turn wastepaper into affordable houses that are relatively strong, well-isolated and fluently erected. There is no specific goal provision for the mix design of papercrete as it is still developing. Whole World is facing a major problem of environmental pollution due to waste industrial materials as they are dumped in landfills. Fly ash, silica, steel slag, plastic, etc., are a few examples of such waste materials. Hence these materials can be used as alternatives in the construction industry which will help meet sustainable development requirements and reduction of waste.

3.2 Paper.

In this study, paper is the main constituent material. Different types of Papers are newspapers, record waste, old newspapers, and magazines. Paper is nothing but wood cellulose, which is considered a fibrous material. Cellulose is the second most abundant material on earth. Cellulose is a natural polymer with a long chain of linked sugar molecules

3.3 Cement.

The cement used in this study was 53-grade Ordinary Portland Cement (OPC) conforming to IS: 8112 – 1989 cement used.

3.4 Fine Aggregates.

Fine aggregates used were River Sand and Crushed Sand passing a 4.75 mm IS sieve as per the specifications in IS: 383 – 1970 was used.

3.5 Rubber.

The increasing demand for sand for construction purposes and the resulting need for alternative construction materials highlight the importance of this study. However, studies detailing the engineering properties of sand-rubber tire shred mixtures which are essential to assess the strength, stability and

drainage conditions are relatively scarce. Ghazavi (2004) observed the occurrence of peak shear stress for sand–rubber mixtures and also found that the shear strength of sand–rubber mixtures are greater than that of pure sand.



Fig.1 Rubber Shreds

3.6 EXPERIMENTAL PROCEDURE

There is no specific procedure for casting the bricks and the procedure followed in this investigation was our convenience. The mix proportion shall contain [Cement, Fly ash, River Sand, Rubber shreds and paper sludge]. The bricks were cast in ratio and the tests on the bricks were then conducted after 7 and 14 days.

3.6.1 Preparation of Paper Sludge

The papers used were from a variety of sources. Newspapers, record wastes, magazines, etc., These papers were torn into shreds and soaked in water for 3 – 4 days until they started degrading to paste-like form. Then the papers were removed from the water and ground in a mixer to obtain the paper sludge. The sludge is later taken on a non-absorbent plate after having the extra water squeezed out.



Fig.2-Soaked papers and Paper sludge

Sr.no	Sample	Dimension	Weight(gm)	Failure (KN)	Average
A	1	19X9X9cm	1740	27.1	27.05KN
	2		1740	27	
B	1	19X9X9cm	1350	9.3	10.97KN
	2		1525	12.7	
	3		1475	10.9	
C	1	19X9X9cm	1690	19.6	17KN
	2		1513	15.5	
	3		1430	15.9	
D	Burnt brick	23X9.5X7.5cm	2240	78.6	78.6KN

3.6.2 Mixing of dry ingredients

The other constituents of papercrete – cement, sand and Fly ash, were dry mixed until a uniform colour was formed. In this work, mixing was done manually and the paper sludge thus obtained was then mixed with it to get the desired papercrete mix. To make the brick waterproof & fireproof admixtures are added. (Waterproof – Dr Fixit, & fireproof- urea) No additional water was added unless it was essential.



Fig.3 Papercrete Mix

3.6.3 Mould Specifications

Brick mould made of plywood sheets was used. The sheet is extended to the outside for holding the mould while preparing of brick. The dimensions of the mould were that of the modular bricks i.e., 190 mm x 90 mm x 90mm.

3.6.4 Casting of bricks

Firstly, before placing the material, the interior of the mould is properly oiled. The mix should be poured into the mould within 20 minutes of mixing on a table and the material was compacted using a tamping rod manually. The extra mix was removed by a metal strike. Two moulds were used at a time to cast the bricks at a faster rate. A few bricks were then sun-dried

for 14 days and a few others were oven-dried for 3 days and later cured in water for the next 14 days.

4. TESTING OF BRICKS

Various tests were conducted to analyse the properties of the papercrete bricks and compared them with that of the conventional bricks.

4.1 Weight

The results show that the maximum weight of the papercrete bricks is less than 2 kg in both cases. This is less compared to the weight of the conventional bricks which is 2 to 2.5kg. Sun-dried bricks weighed lesser than water-cured bricks.

4.2 Compressive Strength Test

The test was carried out by a Compression Testing Machine. This test was carried out on the 7th, & 14th day from the date of casting. It was observed while testing the specimens that the bricks did not crush or completely collapse, they just compressed like squeezing a rubber. So, the load was applied to half compression.



Fig.4 Compressive Strength Test

4.3 Fire Resistance Test

A brick which is used for construction should not be flammable in an open flame, so this test was carried out for these bricks. The following are the steps involved in this test,

- First, the brick was wiped with cloths and all the foreign matters were removed.
- Then the flammable sticks were fired. After that, the bricks were held on the flame for 20 minutes.



Fig.5 Fire Resistance Test

4.4 Shape & size

Observe the bricks. It should be uniform in shape (rectangular) & with standard size (19X9X9 cm)

5. ADVANTAGES

- 1) This brick could have considerable economic.
- 2) It has environmental implications as well as being eco-friendly.
- 3) The result is a brick which has low thermal conductivity, i.e., acts as a good insulator. However, its mechanical resistance still requires improvement.
- 4) This could help to reduce fuel consumption and kiln time required for brick production.

6. ENVIRONMENT, ENERGY & ECONOMIC

The aspect of papercrete Brick to Environment

- 1) In manufacturing of conventional clay bricks, a large amount of fuel is needed to burn the bricks. Thus, causes social deforestation and the non-cultivation of land. It may be avoided or reduced by adopting papercrete bricks.
- 2) This type of prefabricated building block may be used for the speedy construction of projects.

7. STUDY PARAMETER

Sr.no.	Name of material	Percentage (%)
1.	Paper Sludge	40
2.	Sand	40-45
3.	Fly ash	10-11
4.	Cement	10-11
5.	Rubber	3-7

8. CONCLUSION

From this investigation, the following conclusions can be derived based on the tests:

From this investigation, the following conclusions can be derived on the basis of the tests:

1. Papercrete brick consists of recycled material and therefore has lower cost than conventional bricks.
2. Papercrete can be easily moulded into any shape, bricks are much easier for someone to lift to any desired height and a very good surface finish can be achieved.
3. Papercrete bricks are suitable for non-load-bearing walls only.
4. Papercrete has good fire resistance.
5. The weight of this brick is less compared to the weight of conventional clay brick. Due to the reduction in weight of these bricks, the total dead load of the building will be reduced.
6. These bricks are not suitable for waterlogging and external walls. Thus, need to be used in inner partition walls. in inner partition walls. This research is just an initiation to a papercrete study. However, further studies are required to be done on the following issues:
7. Modification of mix proportions to achieve optimum properties.
8. Addition of materials like coconut fibres or fly ash to improve the compressive strength of papercrete
9. Colour and texture for better aesthetics and design versatility
10. Addition of silicon, concrete sealer or epoxy compound to help in waterproofing of papercrete
11. Admixtures can also be added to improve setting and bonding properties.

Vinit Sharma, Review on Papercrete, International Journal of Combined Research & Development (IJCRD), 4(6), June 2015.

- [4] T. Subramani, V. Nagappan, Experimental Investigation of using Papercrete, International Journal of Application or Innovation in Engineering & Management (IJAIEEM), 4(5), May 2015.
- [5] M. Scinduja, S. Nathiya, C.V. Shudesamithronn, M. Harshavarthana Balaji, T. Sarathivelan, S. Jaya Pradeep, Innovative Brick Material, International Journal for Research in Applied Science & Engineering Technology (IJRASET), 1, October 2014
- [6] Hemant Sood, Laboratory Manual on Testing of Engineering Materials (New Age International Publisher, Delhi, 1996).
- [7] Jil Tushar Seth, Saransh Joshi, Papercrete: A Sustainable Building Material, CEPT University, Ahmedabad, Gujarat, INDIA

REFERENCE

- [1] G.V.S. Prasad, Study and Behaviour of some Properties of Papercrete Brick with Modular Brick, International Journal of Engineering Research-Online, 3(3), 2015
- [2] K. Anandaraju, B. Jose Ravindra Raj, R. Vijayasathy, Experimental Investigation of Papercrete Brick, International Journal of Machine and Construction Engineering, ISSN (Online): 2394-3025, 2(2), June 2015.
- [3] Shivangini Khandelwal, Kishan Lal Prajapati, Mukul Kumar, Lohit Bhatia, Ashish Sharma,