

# Study on the Properties of Papercrete Bricks Manufactured Using Fly-Ash

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**ABSTRACT:** Use of raw materials in construction results in depletion of natural resources like river sand. As the civilization is a part of human life. Many efforts are made so far in developing of new substitute materials in construction technology. India has 30% production of the waste during the daily livelihood. From over several decades burnt type of clay bricks have been used in the construction of structures. It has effectively reduces the energy usage of structure like buildings due to its good thermal insulation property.

As a result of this, the usage of clay bricks has been increased which resulted in over exploitation of soil. Disposal of waste papers through land filling & burning leads to pollution. To overcome this several inventions are made in construction industry. The construction industry utilizes enormous amount of non-renewable resources in construction. Our project's main objective is to utilize the waste paper and fly-ash/rice-husk to use as a construction material like eco-friendly brick, constitutes to sustainable development of country.

**KEYWORDS:** Papercrete brick, Compression test, Paper pulp, Light weight brick.

## I. INTRODUCTION

Construction process places an important role in the economic growth of a country. Papercrete brick is a latest developed construction material which consists of pulped paper with ordinary portland cement. Papercrete brick which consists of cement and fine aggregate of prime material. Papercrete is a new type of composite material obtained by use of waste paper as a partial replacement of cement. This recycled brick material is environmental friendly, very low-cost and has less weight construction materials in construction building. About 45% of total waste papers is recycled yearly, 55% have been discharged or goes in to the land filling process. Its leads to the soil pollution also.

Therefore inventions have been carried to use this abandoned waste papers into blocks and made a Papercrete bricks. It is a new construction material which consists of paper pulp and Portland cement and can be used in many applications including Papercrete blocks. It is considered as an environmental friendly material due to its recycled material content, with the addition of cement. It is quite cost-effective, depends on locally available materials. It is free from insect, durable and low carbon emission building material. This experimental study investigates the potential use of waste paper for producing a low-cost and light weight composite brick as a building material.

In the current scenario, the whole world is facing a problem of environmental pollution caused by the industrial waste materials like as they are discarded as landfilling's, to water, to air as fly-ash, micro particles, slag etc., are a few important examples of the waste materials.

## II. OBJECTIVES

1. The main objective of this research work is to make low cost and eco-friendly bricks to maintain environmental balance, and to reduce the problem of waste paper disposals.
2. To use the waste materials like newspaper, fly-ash in the process of producing new type of green bricks.
3. To construct and study the properties of the papercrete bricks in order to use these material commercially for construction purposes in building.
4. The objective of this study is to determine the compressive strength of a light weight brick manufactured using waste paper.
5. To produce light weight and fire-resistant solid blocks which are to be used in partition walls of especially high-rise buildings.



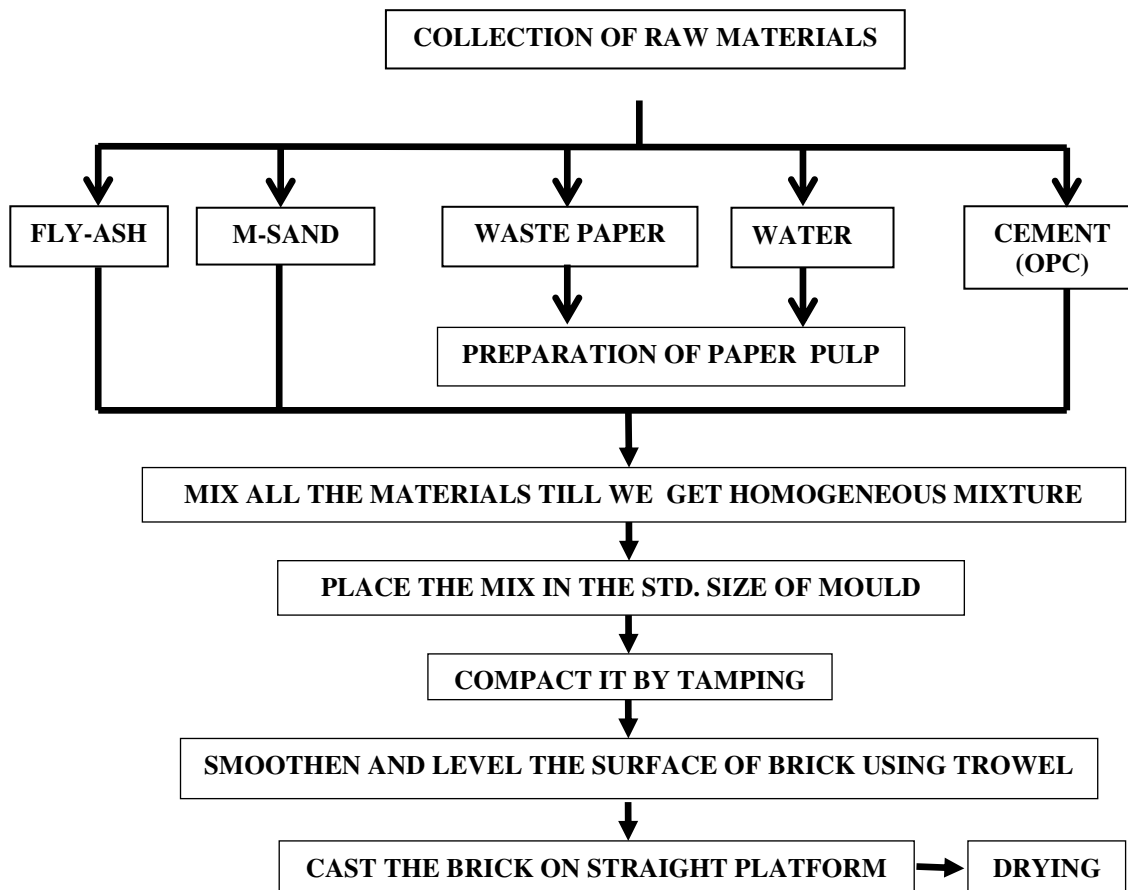
A different sets of papercrete mixes were prepared with Portland cement, paperpulp, flyash and manufactured sand. The major objective of the project is replacement of the high cost building bricks by an eco-friendly building bricks, that fulfils the requirement characteristics of conventional brick like

- Cost effective
- Less weight
- Ignitable
- Low water absorption
- Eco friendly

### III. MATERIALS

1. Cement - Cement is a binder, finely ground composition of minerals. Cement is a substance that hardens and adheres to different materials to bind then each other. In modern several cements are manufactured in that Portland cement is more often used in construction industry.
2. M-Sand - Manufactured sand is a substitute material for river sand used for construction purpose. Manufactured sand is produced from hard granite stone by crushing. The size of aggregate with 4.75 mm and smaller are called as fine aggregate.
3. Fly-ash- Fly-ash is the ash produced during the combustion of coal. Fly-ash can be replaced up to 30% by mass of Portland cement.
4. Water - Potable water is normally considered for mixing concrete and curing. PH shall be between 6 and 7.
5. Waste papers- Different type of papers like newspaper, waste paper, magazines, note book sheet etc. this all can be used for preparing papercrete brick. The discarded papers, which were recollectd, cannot be used directly. This paper should be converted into paperpulp even before mixing with other material.
6. Brick mould- Brick mould of size 190mm X 90mm X 90mm is employed shown in fig 1. The joints of mould were fitted without any gap to avoid any leakage of slurry. Inner of the mould is cleaned and oil is applied.

### IV. METHODOLOGY



The above flow chart represents the brief procedure we have employed in our project.

- At first collection of raw materials consists of cement, M-sand, Fly-ash, Waste paper and water.
- Paperpulp is prepared by soaking water for 24 hours in water. Hence pulp is generated
- Mix the above materials to get homogeneous mixture.
- Place the mixture in mould and compact it by tamping smoothly, level the surface using trowel.
- Demould after 24 hours of setting.
- Allow the brick for drying.

### V. EXPERIMENTAL PROCEDURE

1. **Preparation of paper pulp** - The papers which were collected like newspapers, record sheets etc. were kept in the water for 1 to 2 days, otherwise until the papers degrade in-to a paste-like form as shown in fig 2. It is then ground into a fine paste. Thus the paper pulp was obtained as shown in the fig 3. The density of paper pulp - **1,117 Kg / m<sup>3</sup>** is maintained throughout our project work.
2. **Mixing** - The mix proportion of papercrete brick is given in below table 1.

SL NO.	IDENTIFICATION MARK	PAPER PULP	CEMENT	M - SAND	FLY-ASH % OF WEIGHT OF CEMENT
1	B1	1	1	2	-
2	B2	1	1	2	10%
3	B3	1	1	2	20%

Tbale1 : Mix Proportion of papercrete bricks

- Dry M – Sand of required quantity is weighed and placed on the non-absorbent plate.
- Then the cement and fly - ash which is exactly weighed and placed over the M – Sand.
- All the three ingredients were mixed thoroughly till uniform colour is obtained as shown in fig 4.
- Then the paper pulp is placed on dry ingredients and mixed thoroughly until uniform colour is obtained.
- No additional water was added separately unless it absolutely was essential. The water within the pulp was sufficient for mixing.
- Mixing of dry and wet ingredients is done as shown in the fig 5.

3. **Casting of bricks** - After mixing, it ought to be placed in the mould within half-hour. The bricks were moulded manually by hand over the table.

The following are the steps concerned in moulding :

- The lump of mix was taken and it had been placed within the mould in three layers.
- Each layer is compacted using tamping rod to remove any trapped air from the mix.
- The further or surplus mix on top was removed by trowel.
- Use a trowel to smooth off the top surface to make it level as shown in the fig 6.
- The mould was removed after 24hrs and these bricks were sun dried.



Fig 1 : Brick mould



Fig 2 : Degraded papers



Fig 3 : Paper pulp



Fig 4 :Mixing of dry ingredients



Fig 5 : Mixing of both dry and wet ingredients



Fig 6 : Casting of brick

## VI. TEST RESULTS

### 1. COMPRESSIVE STRENGTH TEST :

- As per **IS 3495:1992**, **3.5 N/mm<sup>2</sup>** is standard compressive strength for conventional brick.
- Compression test is that the main and vital test for bricks.
- This test was dispensed by a Compression Testing Machine (CTM).
- We conducted test for 3 set of bricks for 0%, 10% and 20% fly-ash replacement.
- Instrument is set up for applying load.
- Brick is placed between the plates of testing machine.
- Load is axially applied at uniform rate of 14 N/mm<sup>2</sup> per minute till failure occurs and maximum load at failure is noted. Compressive stress is calculated using equation

$$F = P/A \text{ N/mm}^2$$

Where, P = Load in N

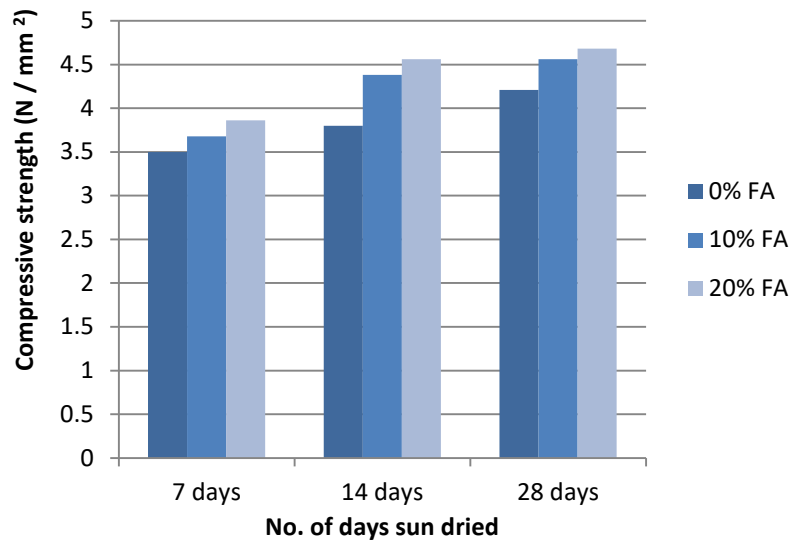
A = Area of the specimen in mm<sup>2</sup>

- The average compressive strength values for 7, 14 and 28 days are noted in the below table 2. and also it is compared in the chart 1.

No. of days	IDENTIFICATION MARK	LOAD (KN)	COMPRESSIVE STRENGTH (N/mm <sup>2</sup> )
7 days	B1	60	3.50
	B2	65	3.80
	B3	72	4.21
14 days	B1	63	3.68
	B2	75	4.38
	B3	78	4.56
28 days	B1	66	3.86
	B2	78	4.56
	B3	80	4.68

Tbale2 : Compressive strength results

**Graph 1 : Compressive strength**



From the above graph, observed that the 20% FA i.e., B3 bricks got more compressive strength than B2 and B1. But they are not suitable for load bearing walls. Because, papercrete bricks are having more elastic behavior at failure. So at heavy load, bricks may compress. Due to this compression the roof may be collapsed. So these bricks are suitable only for non-load bearing walls.

**2. WEIGHT TEST :**

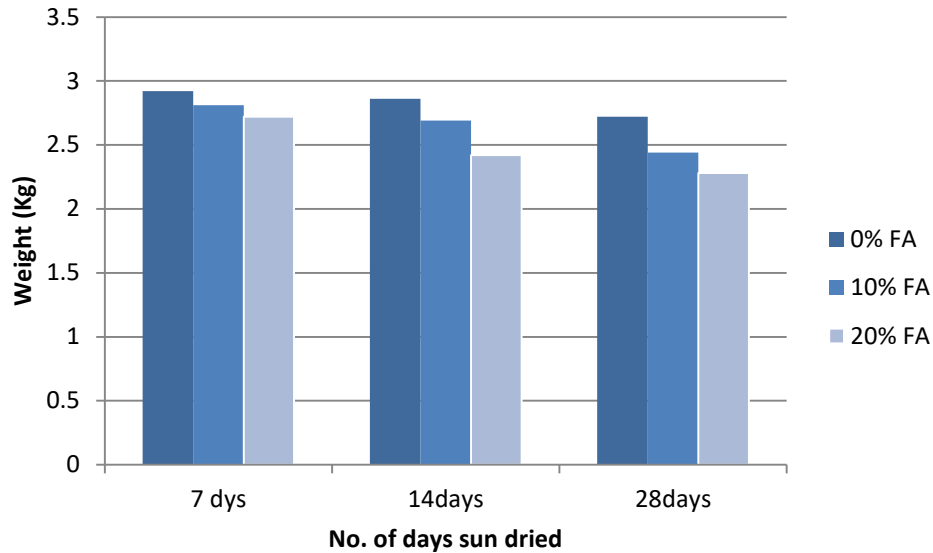
The important objective of this project is to produce lightweight bricks. So, all the bricks were weighed in an electronic weighing machine.

As per IS 1077:1992, the weight of conventional brick is 3 - 3.5 kg. The below table 3 shows the weight of the papercrete bricks and also it is compared in graph 2. By seeing the graph we can conclude that these bricks are light weight and it will reduce the cost of construction due to the reduction in dead load.

No. of days	IDENTIFICATION MARK	WEIGHT (KG)
7 days	B1	2.92
	B2	2.86
	B3	2.72
14 days	B1	2.81
	B2	2.69
	B3	2.44
28 days	B1	2.72
	B2	2.42
	B3	2.28

Table 3 : Weight of the Bricks

**Graph 2 : Weight**



## VI. CONCLUSION

- The compressive strength of the brick is more than 3.5 N/mm<sup>2</sup>. The compressive strength has been increased when the % of fly-ash is increased by 0 % to 20% and also increase in time of drying.
- These bricks are suitable for non-load bearing walls, partition walls and compound walls.
- These bricks are lightweight as compared with conventional bricks. The weight has been reduced about 2/3<sup>rd</sup> lesser, with increase in time of drying.
- A papercrete brick consists of waste materials and therefore cost is very low compared to conventional bricks.
- Good choice to use waste paper as it is economical.
- It can be used for cost effective and energy efficient buildings at earth quake prone areas.
- These bricks are termite proof; hence the paper was mixed with cement in papercrete brick.
- Since, the waste materials are used, it will reduce the landfills and pollution.

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