

Paper Mash Bricks: An Unconventional Feasible Building Material

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Abstract: *The development business expends a lot of non-sustainable assets. Our study meant to use the waste paper and fly debris to use as a development material comprises a stage towards maintainable turn of events. For this exertion four diverse blend extents are utilized to make blocks. The blocks are made by incomplete substitution of concrete by paper mash. For ordinary blend Portland concrete and quarry dust is utilized. In the event of paper mash block, concrete is supplanted by paper mash by 10%, 20%, 30% separately with consistent % of fly debris to research a few properties like quality, water retention, imperviousness to fire, hardness, adequacy and so forth by leading the various tests on arranged blocks. While utilizing paper mash to make blocks, it diminishes roughly half weight of the block. Consequently these blocks will lessen the dead weight of the structure to significant sum. Additionally utilization of fly debris - condition cordial material so it changes our plan and building cost as in efficient perspective.*

Keywords: *Paper mash, Cellulose, Recycling, Efflorescence Test, Light Weight, Compressive Strength.*

I. INTRODUCTION

Paper mash is another composite material utilizing waste paper as an incomplete substitution of Portland concrete. This expansion in the fame of utilizing natural amicable, minimal effort and light weight development materials in building industry has realized the need to research how this can be accomplished by profiting the earth just as keeping up the material necessities insisted in the norms. As regular wellsprings of totals are getting depleted, it turns out pressing to develop. Most of deserted paper squander is gathered from the nations everywhere throughout the world causes certain genuine ecological issues

Paper is the 3rd largest industrial polluter of air, water and soil. In recent year, paper and paperboard constitute a greater portion of many countries' municipal solid waste generation.

Since the large demand has been placed on the construction industry, especially in the last decade due to increase in pollution which cause a chronic shortage of building resources, the civil engineers have been challenged to convert the industrial waste to useful building and construction materials. One exclusive recycle opportunity is using waste paper as a construction material. Since the construction industry uses up a great

amount of nonrenewable resources, therefore the potential function of waste paper for producing a low cost and light weight composite brick for construction not only delivers the potential use of waste paper recycling but it will likewise bring down the demand pressure on global natural resources.

Paper mash is a complex material involving Portland concrete, squander paper, water and sand. The mix of these materials, which may give an approach to give reasonable lodging for a huge scope. Paper mash have been reported: to be cheap alternative building material; to have good sound absorption and thermal insulation; to be a light weighted and fire- resistant.

1.1 Project Perspective Angle

The reason for present exploration is to use the waste materials like paper and to supplant the exorbitant and uncommon traditional structure block which fulfills the accompanying qualities:

- Essential
- Less weight
- Easily available
- Fire Resistance
- Cost effective
- Environmental friendly

In order to gain the above mentioned, objective project work has been divided into three main parts:

1. Collection of material
2. Validation of hypothesis
3. Results and discussions

1.2 Collection of Material

Material assortment is the fundamental and significant advance in any project. Additionally, the material which is utilized in task not make any harm nature. In this exploration, waste materials were utilized to make building blocks.

1.2.1 Cement

Cement is one of the important materials in this research. Cement is the important binding material in today's construction world 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989 cement used. Properties of cement are as follows:

Description of test	Results obtained	Requirement of IS: 8112-1989
1. Specific gravity	3.15	3.15
2. Initial setting time	75 minutes	Min. 30 minutes
3. Final setting time	270 minutes	Max. 600 minutes
4. Fineness	412.92 m ² /kg	Min. 225 m ² /kg

1.2.2 Sand

Sand particles comprise of little grains of silica (SiO₂). It is framed by the rot of sand stones because of different impacts of climate. As per characteristic assets from which the sand is gotten, it is named as pit sand, stream sand and ocean sand. As per the size of grains, the sand is fine, coarse and rock. The properties were examined according to BIS standard. Properties of sand are as follows:

Sr. No.	Properties	Results obtained
1	Fineness	4.40%
2	Specific gravity	2.60

1.3 Paper

In this investigation, paper is the fundamental constituent material. Various sorts of Papers resemble papers, record sheets, old papers, magazines are utilized. Paper is the principle element of paper mash thus its properties rely upon paper's microstructure. Because of this enormous increment being used of paper, 1600 m³ papers are squandered in India every day. Even however the waste papers are reused in paper industry just 29% of waste paper is reused. It is lower in contrast with the worldwide normal of 36%. Paper is mainly wood cellulose, which is considered as sinewy material. Cellulose is the second most bountiful material on earth after stone. Despite the fact that the synthetic conduct of paper is appropriate for paper blocks, the physical conduct of paper is affecting physical conduct of paper blocks. The rigidity of paper additionally is by all accounts adequate for the quality. Tearing a bit of paper is simpler than pulling it separated. So it indicates the shear quality of paper isn't as extraordinary as its elasticity. However, tearing several pieces of paper isn't a simple undertaking. So it shows that it has more shear quality. Mash is a dialect cellulosic stringy material arranged by synthetically or precisely isolating cellulose strands from squander paper. Numerous sorts of paper are produced using wood with nothing else blended into them.

Different type of papers like newspaper, magazines, old invitation cards, paper tickets etc can be used for making paper mash. The papers, which were collected, cannot be used directly. It should be made into paper pulp before mixing with other ingredients.

1.4 Water

Water is a valuable constituent of paper mash as it is involved in the chemical reaction with cement. Potable water should be used for both wetting and mixing of paper mash. It should be free from organic matter and the pH value should be between 6 and 7.

1.5 Paper mash Additives

Cement is added to the paper mash as a binding material. In addition to that, waterproofing admixtures such as Dr. Fixit101 LW⁺ is added to the mix for lowering the percentage of water.

II VALIDATION OF HYPOTHESIS

According to research, up to now, there is no standard rule for formal mix design of paper mash, and in that point of view no hard procedure for casting the bricks. So, in this research, some laboratory experiments were performed to obtain some properties of paper mash..

2.1 Mould Preparation

After gathering all the materials, a mould was prepared. A wooden brick mould was prepared of size 230mm *110mm * 80mm. Joints were made with elimination of any hole or gap to restrict any leakage.

2.2 Mash Generation

The papers, which were gathered, cannot be used immediately. It should be made into paper mash before mixing with other constituents. The papers were kept in the tank for 4 to 5 days, until the papers degrade into a paste form. Then the paper was taken out of the water and taken to the mixer machine to make it as a paper mash.



2.3 Mixing

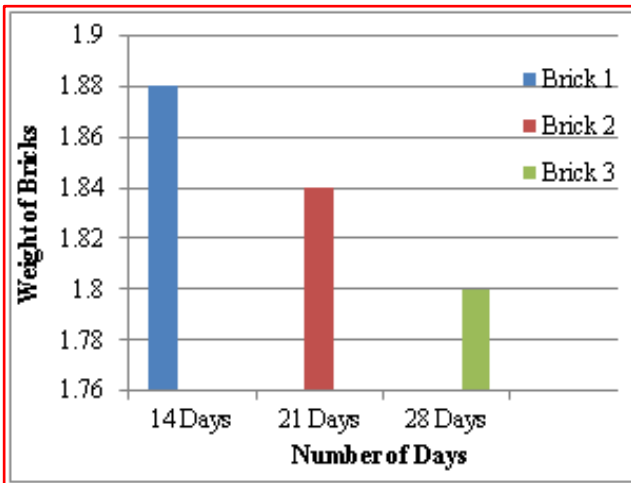
Mixing was done after all the constituents were ready. In

this project, mixing was done manually.

Ratio of cement: sand: paper mash (1:1:3) was used in this project. After the mixing, it should be put in the mould within 30 minutes and ramp with wooden tamper and the surface of the brick should be finished by wooden tamper. The casted paper mash bricks should be allowed for sun drying for 14 days. Curing of bricks is not needed because the paper used in bricks itself hold water for a long time.

III. RESULTS AND DISCUSSION

After casting the bricks they were examined for using as a brick. For this, various tests were performed to confirm the properties of bricks and the results of the test were compared by the existing and standard results. The following tests were performed to check the strength of the brick.



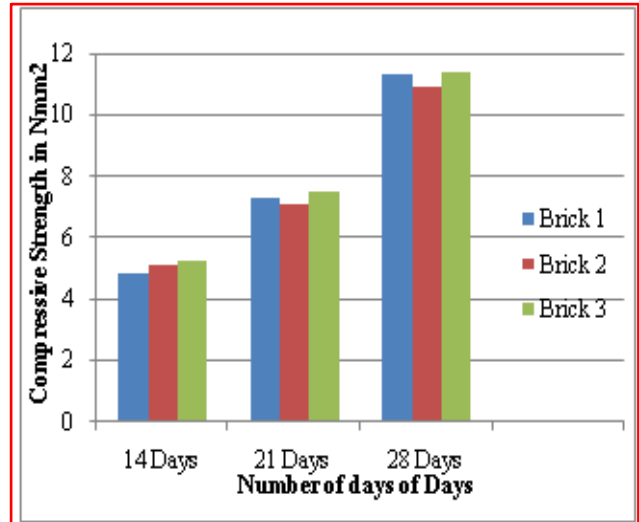
3.1 Compression Test

This test was carried out by Compression Testing Machine after the 14th day from the date of casting paper mash brick. Paper mash bricks never fail instantly, it just compressed like elastic rubber. Therefore great precaution must be considered while testing the paper mash brick because in paper mash load should be applied up to half compression only.

The paper mash bricks show elastic behavior and less brittleness, due to this the structure was not fully collapsed, when the paper mash brick fails at higher load only the outer faces cracked. Brick after testing show like:



Compressive Strength of paper mash brick with no. of days are as follows:



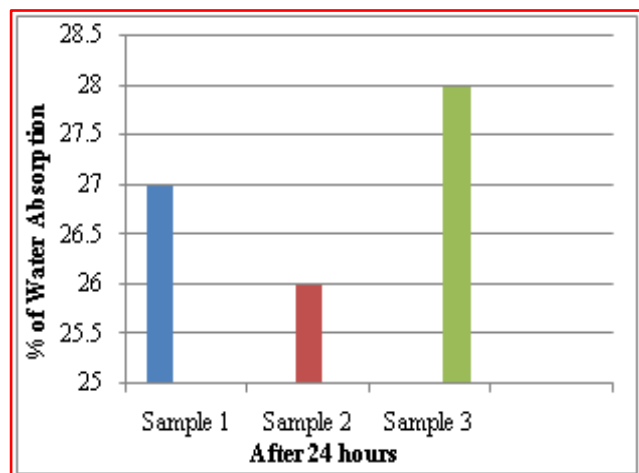
3.2 Weight

The normal conventional clay bricks weight varies from 3 to 4 kg but the paper mash bricks weight varies from 1 to 2 kg. The maximum weight is less than 2.5 kg only. The weight of bricks was measured in a well conditioned electronic weighing machine. Sand based paper mash bricks are having weight 2/3rd of the conventional clay brick only. Thus paper mash bricks are light weight and helpful to reduce dead load of construction.

Weight of paper mash bricks with no. of days are as follow:

3.3 Water Absorption Test

Water absorption test is carried out to check whether the bricks are suitable for water logged areas or not. As per standards the bricks should not consume water more than 20% of its original weight. Water Absorption Test for sample Mix is as follows:



3.4 Hardness Test

In this experiment, a scratch was made on brick surfaces. The scratch was made with the help of finger nail on the bricks; very light impression was left on the paper mash concrete brick surface. Hence, this test results that paper

mash concrete bricks are sufficiently hard.

3.5 Soundness Test

In this test two bricks were taken and they were stuck with each other. The bricks were not broken and a clear ringing sound was produced. Hence the bricks are safe to use.

3.6 Nailing

Paper mash concrete bricks are less hard as compared to conventional clay bricks. Therefore, this test was carried out to find out whether these bricks can hold the nails or not. A nail was hammered in the brick and a screw was also screwed into the brick.

From this test it was examined that paper mash bricks can sufficiently hold the nail.



3.7 Cutting and Glue

Numbers of bricks were wasted on site during the process of cutting only. The labors could not able to cut the bricks exactly what they want. But paper mash bricks can be cut into exactly two parts by using conventional saw blades.

The two paper mash concrete brick pieces can be joint together by putting a medium amount of glue on the bottom piece. Hence paper mash bricks could be used in the application of calling for quick assembly by cutting the parts required to size in advance and letting the user simply glue them together.

3.8. Fire Test

A brick, which is used for construction should be fire resistance in an exposed fire, so that this test was carried out for the bricks.

From the above test, it was examined that the paper mash concrete bricks did not burn with an open flame. They fumed like charcoal. But these brick would be reduced to ashes after burning several hours. If the interior plaster and exterior stucco is provided on the paper mash concrete bricks, the bricks won't burn. The only weak spot is inside the block, near electrical outlets, switches and other situations where wires gives through walls, into boxes etc. Properly wired places never cause a fire. If we apply the plaster without any hole or leakage on the bricks, it won't burn or fume inside because there will be a lack of oxygen

for combustion.

IV. CONCLUSION

From the experimental results obtained, the following conclusions were made:

- Considering the attractive compressive quality appeared by the tried example, it is clear that paper mash bricks is eco-friendly, light weight solid square with the utilization of less number of normal assets. Despite the fact that the outcomes acquired during compression test demonstrated that paper mash blocks are satisfactory for non load bearing dividers walls.
- During experiment we observe that as bricks should not absorb water more than 20%. The water absorption capacity of paper mash brick was found to be more than 20%, which makes it not suitable for water logging and external walls. Although, by providing a waterproof coating (Silicon based waterproofing) it can also be used as external wall.
- The weight of the paper mash brick was $1/3^{\text{rd}}$ to $2/5^{\text{th}}$ lesser than the conventional clay brick. Due to less weight of paper mash bricks, the total dead load of the building will be reduced.
- As these bricks have lesser weight and more flexibility, these bricks are ideal material for earthquake prone regions.
- Paper mash bricks have a high fire resistance, good sound absorbent, good thermal resistance.
- Paper mash Bricks mainly consists of wastes material, it will reduce the landfills and pollution. Hence, the overall cost is very low as compared to conventional Bricks.
- This study helps in converting the non-valuable Paper into Bricks and makes it valuable. These bricks can easily be moulded into any shape, bricks are much easier for someone to lift to any desired height and very good surface finish can be achieved.

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