

Experimental Study on Use of Strawbale as Future Building Material

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Submitted: 25-05-2021

Revised: 01-06-2021

Accepted: 05-06-2021

ABSTRACT: India is rapidly developing its economy. The economics of the government identify the building industry as a vital engine of economic growth. The rising need of housing for the growing rural and urban population is a pressing issue. To maintain rapid rates of economic growth in the 21st century it is important to put strategy for housing to meet the needs of the rural and urban population. Straw bale construction has considerably good insulation and can be a promising building alternative that meets housing needs and energy efficient goals of India. Also, the use of straw in building will solve the problem of pollution caused by burning of straw, which produces carbon mono oxide CO. Enough straw is already produced in India, it reaches 8 Tones/Acres and its burning produces 4.5 million ton of CO. In addition, that straw bale building has a low impact on the environment. So, choosing straw bale construction has many advantages-for people and the planet.

I. INTRODUCTION

1.1 BACKGROUND & RESEARCH

Due to the exhaustion of natural resources all over the world and due to the effects of global warming and with searching about low-cost material, all of these reflect the importance of searching about alternatives of building materials urgently.

One of these building materials popped up in focus and recently gained popularity throughout the world is straw bale.

1.2 HISTORY OF STRAWBALE IN CONSTRUCTION

As long as human beings have been creating shelter, straw and grasses have been used in conjunction with a variety of building methods to provide safe, dependable, and comfortable housing in many climates and environments.

Walls made from tied bundles of long lengths of straw, stacked in mud mortar, have been constructed for centuries throughout Asia and Europe. Another ancient method, also employed in Asia and Europe, used compacted loose straw coated with a clay slip for walls. Those methods and materials remain in use today, their use declining only where modern construction methods, materials, and codes have become common. In the United States, a new era of building with straw and grasses began in the late 1800s with the development of stationary horse-powered and the steam-powered balers, which made it possible to compress hay and straw into string or wire-tied rectangular units called bales. It took only a slight stretch of the imagination for early homesteaders in the timber-poor region of the Great Plains of North America to think of using bales as oversized bricks. It was in the sand hills of Nebraska, a land that produced magnificent stands of meadow hay, from which the first bale buildings were constructed.

The reasons vary as to why many pioneers chose to build with baled straw or hay. Some seem to have simply been intrigued by the method, while others found building with bales easier than building with sod. Some families decided to replace their original small sod houses with larger bale houses. It was also noted that using baled meadow grasses seemed much more efficient than stripping a large section of productive meadow land for sod.



In some cases, families were in immediate need of housing, and bales were looked upon as the quickest way of getting a roof overhead. Many of those structures were first viewed as temporary, but when it was discovered that they were both durable and comfortable in the extremes of the Nebraska winter and summer, they were soon plastered and adopted as permanent housing.

1.3 CURRENT USE OF STRAWBALE:

Nowadays strawbale construction having walls and foundation made up of strawbale blocks getting popular day by day. We can see strawbale construction in north Europe, northeast Asia, America and in Africa in large quantity.

STRAWBALE

Straw is a natural fibre which we get as a by-product from the agriculture. It is the plant structure between the root crown and the grain head which is composed of cellulose, hemi cellulose, lignans and silica. It is being produced by the process of photosynthesis, a natural and non-polluting process by solar energy. We can get this from wheat, rice, oats, hops, barley. Among this rice straw is the toughest one due to high silica content. It is an annually renewable agricultural residue which is being produce in ample amount in most of the countries. It is also considered as the waste product and is being wasted by burning or any other way which is having impact on the environment directly or indirectly. It is being produced by the collaboration of environment so use of this in construction would be obviously a environmental friendly and would have a lots of merits for our quality life. Burning of the straw lead to black cloud which cause serious chronic cheats diseases and carbon evolved from it would affect the quality of environment. Straw which is produced has become one of the headaches for the

farmers as it won't decay easily. The world largest straw producing countries like China, India and other agricultural country have not been able to utilize it for productive work up till now. In India it is used for paperfactory for production of papers and some other purposes but this is not enough for proper utilization and still these countries are wasting in ample amount. The use of straw for the construction has been commenced long back. Straw bales were first used by the settlers of the sand hills region of Nebraska. In 1890's Nebraska commenced this straw bale for building buildings, churches, schools, officials and grocery stores. In those times they focus in stability of bale wall system, structural stability, plastering and moisture control. So, straw bale construction has been a boom for the economic environmental building alternative.



Straw bale is simply a compressed bundle of straw which is arranged in square, rectangular or round shape attached with wire or twines. Straw is the dry stems of cereal grains left after the seed heads have been removed (Austin city code Volume-II, section 3603). Bale density varies according to the type of grains, moisture level and degree of compaction provided by the baler¹. The dimension of straw bale can vary as per circumstance but the standard size can be 900mm x 450mm x 350mm / 584mm x 1168mm x 400mm. Straw bales are light which means a straw bale wall weights 65% less than an equivalent brick wall and 62% less than concrete block wall.

II. OBJECTIVES

The main goal of the team is to produce or Manufacture a something different that Never would have done by anyone else.

Objectives of our project are:

- Understanding the concept of Strawbale concrete.
- Understanding the need of Use of strawbale in construction
- Understanding the properties of Component

- Studying the impact of today's Pollution on future due to current Construction standard
- Utilisation of best alternative raw Material by omitting current high Pollution standards
- Conducts details study about Different factors of tiles and Properties
- Performing detail study about raw Material to be used and procedure For making Strawbaleconcrete blocks.
- Discuss the benefits of products and its shortcoming with remedies
- Conclude the research with Appropriate result and strength Quality and appearance of products

This are the methods of using strawbale as construction material

- 1.Direct method
- 2.Indirect method

1.Direct method

In this method, strawbale is directly used inwalls, slabs andfoundations for G+1 structure. This method is used in Asia, Europe and north America.



2.Indirect method

In this method, strawbale is mixed with concrete to make blocks.

Base materials:

Base material for concrete issand, cement, aggregate, water and admixture.

Base materials give strength to the component. Strawbale is added in gradually increasing percentage to get best percentage which can be used for construction.

1.Sand

The river sand with zone I as per IS 383-2016, passing through 4.75mm sieve confirming IS 460-1962, Good quality river sand, free from silt and

other impurities and which is locally available, was used in this study.

2.Cement

The general cement used for construction is OPC 53 grade cement. OPC 53 grade cement is the most preferred building and construction material for projects that require high tensile strength. You can choose to buy OPC 53 grade cement online as it has the grinding of clinkers to the maximum extent and this cement grade is finer than grade 43.

OPC 43 grade cement is generally used for non-structural works like plastering flooring etc. Whereas OPC 53 grade cement is used in the projects which require higher strength like concrete bridges, runways RCC works etc.

3. Aggregate

The crushed granite, passing through 20 mm and retained on 4.75mm sieve, is used for making concrete mix. Various tests are performed on aggregate to make sure it has good quality as well as good workability and strength.

4.Strawbale

The golden-brown coloured, fully dried strawbales are cut down in 2 to 3 cm length and mixed with other components percentage wisely fin replacement of aggregate.

PROCEDURE

1.All the tested materials are used for making concrete mix of M25 grade. (1:1:2)

M25 grade contains 1part of cement, 1 part of sand, and 2 parts of aggregate. For making 150x150x150 mm concrete block the material required will be 2kg, 2kg and 4kg for cement sand and aggregate respectively.

2. For better workability purpose admixture is added about 1% of the weight of cement.

3.Using strawbale in replacement of aggregate in 5%, 10%, 20%....up to 75% of the weight of aggregate.

4. Mixing sand, cement, aggregate and 5%strawbale with water in pan. Admixture is added in concrete mix.

5.Oiling of 150x150x150 mm mould is done and then mixed concrete having 5% strawbale is poured into mould.

6.Tamping is done with Tamping rod to avoid segregation and bleeding.

7.Mould is left for 24 hours for setting.

8. After 24 hours concrete block is removed from mould and curing of block is done for 7 days.

9. Adder 7 days compression test is done on blocks for finding compressive strength of strawbaleconcrete block.

10. Repeat the procedure for other blocks with different % of strawbale

MERITS

1. Waste material is recycled
2. weight of strawbale block is less than standard concrete block.
3. More economical than standard blocks or bricks.
4. It gives fair compression strength so it can be used for load bearing G+1 structure as well as for multi-storey framed structures.
5. Eco friendly.
6. Easy to construct.
7. Longer lifespan up to 100 years.

ENVIRONMENTAL BENEFITS

Sustainability

In contrast to the timber used for building houses, straw can be grown in less than a year in a sustainable production system. Straw can also be grown on saline or low-quality land.

Cool in summer, warm in winter

If you can stop the heat of summer days getting into your house by closing up your home early in the morning while it is still cool, you can keep the inside of the house cool, as long as the heat can't get in through your wall, roof windows etc. That is where a super-insulating strawbale wall comes in handy - it won't let the heat through.

It is just the opposite in winter when you warm your house with sun allowed in through the windows and trapped in the house or with a slow combustion heater, air heaters, radiators etc. You don't want the heat to escape - again the strawbale wall will reduce the movement of that heat.

Insulation against the movement of heat.

Fire resistance

Straw bale buildings are extremely hard to burn. This is because the bales hold enough air for good insulation but because they are compacted tightly, they don't hold enough air to permit combustion.

Increase in pollution, global warming, economy, use of waste material(strawbale) this are some main factors needs to be considered while constructing future houses/buildings. Strawbale is a material which fulfilsthis factorthat's why using it in future construction is great choice.

DEMERITS:

- 1.Strawale blocks having less compressive strength than concrete so it cannot be used for heavy construction work such as bridges, retaining walls etc.
2. Strawbale can be easily found anywhere but the time required for cutting is much more than we imagine.

3. The appearance of strawbaleconcrete is not much aesthetics so plastering is need to be done.

4. Chances of failure if mixing is not properly done.

III. CONCLUSION

1.Strawbales are eco-friendly materials which can be used for construction.

By adding strawbale in concrete gives good compressive strength. It gives compressive less than standard concrete block but more than standard bricks. so it can be used for load bearing structures up to G+1.and strawbale blocks can be used for framed structures as they are:

lightweight

soundproof material

cool in summer, warm in winter

lifespan us upto 100 years

easy to construct

heat resistance

and most importantly they are eco-friendly.

2. It gives structure a longer lifespan as well as better durability as compared standard conventional concrete block. Thus, using this block instead of concrete blocks are more convenient and economical for future aspect.

3.Straw is getting lots of preference in many countries because it is cost effective with high health value, Aesthetics value, thermal performance, Fire resistance, light weight and eco-friendly in nature. It also has good response against earthquake so it can be constructed in earthquake prone areas as well.

4.Straw bales are suitable for use as construction material. The extensive experiments that been done on straw bales shows that: straw bales have many benefits; these are summarized in the following:

Has a good insulation property this mean energy efficiency, which helps in reducing cost of cooling in summer and heating in winter. Has a good sound insulation property. High fire resistance with using plaster. It has ability to withstand the vertical and lateral load in addition to seismic loads. Has ability to balance moisture.

5.Instead of being unwanted and difficult to dispose of, rice straw would become a valuable commodity to be harvested for profit.

6. Plastered straw-bale construction creates long lasting, super insulated (generally R-40 and R-50); fire-resistant housing at per-square-foot costs less than those of traditional methods. The energy savings for space cooling and/or heating continue to accrue for the life of the structure.

7. The emissions from eventual burning or decomposition of the straw are postponed.

8. Straw is produced by photosynthesis, a natural, non-polluting process fuelled by solar energy.
9. Straw is an annually renewable agricultural residue often considered a waste product. So, it is environmentally friendly.
10. In straw bale construction, proper placement of high mass materials like stucco, mud plaster, brick, concrete, tile, adobe or rammed earth in the interior of the structure would provide the thermal mass, while the thick, highly insulative walls would greatly reduce heat loss by conduction. Straw bales on the outside, earth on the inside- we win, the planet wins.

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