LOW COST FARM HOUSE USING STRAW BALE

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ABSTRACT

The price of the material is growing with the faster rate in developing country. The development material plays a vital role in the infrastructural design of the nation. Now a days a lot of activity is going on the development material to reduce the cost of the development. Among the various majority of material comes from the agriculture. And these material losses as a waste heap which leads to the breathing and number of other lungs problem. So in this journal paper straw is being utilize as alternative material.

Straw Bale is used in the form of bricks which reduces the 70% cost of construction and durability for low cost housing.

***Keywords** : Bricks, Straws, Straws Bale*

1. INTRODUCTION

Brick is a material which is the composition of soil, clinker, salt ,sand and water. All these material are nonrenewable source. But the development material are of high cost and straw speak to over 70% of the house hold waste volume. By this way in developing nation like India, these material can utilized as potential material in the field of construction and development

Straw-bale construction is public domains building technology available to anyone there is little to patent, control or sells. Thus there is no large, consolidated industrial or financial interest tha could make enough money from it to invest in the needed research, testing, development and deployment necessary for widespread use.

Straw, an abundant, annually renewable resource that is mostly wasted in the India today, comes with exceptionally low “embodied energy” – that is the amount of energy used in the production, transportation, construction and eventual demolition of a building material

Building from straw is an ancient technique recently rediscovered by environmentalists. The bales are relatively inexpensive and very thermally insulating (about R=2.1 per inch of wall thickness). There are few other uses for straw, since, unlike hay, it cannot be used by animals for feed. Furthermore, because it decomposes very slowly, it isn't often used for composting. Every year, millions of tons of straw are discarded or burned in the India.

2. METHODOLOGY

When building with straw bales, two fundamental types of construction methods can be applied: the load bearing method, and the wrap around method.The load bearing method entails for straw bale walls to support all the loads that a structure encounters (e.g. roof, floors, snow, etc.). Under this method, walls are generally created by stacking bales of straw together so that there are no gaps or spaces between them, and corners are interlocked so that they join together. Advantages in this method include easier construction than conventional building methods and significant reductions in the need of other building materials).

One major disadvantage concerning the load bearing method is the limited size of the structure. The larger a load bearing straw bale structure is, the more difficult it becomes for the structure to stand and resist the loads that are acting upon it. Another negative aspect includes the fact that straw is more prone to settle under this method and thus may require frequent maintenance

Straw bale can also be utilized in the wrap-around method. Under this application, straw bales play the role of an insulator instead of the primary load bearing material. Structural frames within wrap-around straw bale structures do not significantly differ from traditional construction methods; materials can be composed of wood or steel, and frames such as stick, timber and post-and-beam methods can be utilized. As long as a framework is structurally supportive, there are few architectural design limitations to using straw bale as a wrap-around material because it is so malleable. Below are two examples of different architectural scheme used on the same construction method.

3. STRAW BALE CONSTRUCTION

Straw bales can also be used as part of a Spar and Membrane Structure (SMS) wall system in which lightly reinforced 5 - 8 cm (2 - 3") gunite or shotcrete skins are interconnected with extended "X" shaped light rebar in the head joints of the bales. In this wall system the concrete skins provide structure, seismic reinforcing, and fireproofing, while the bales are used as leave-in formwork and insulation.

The pre-fabricated panels consisting of a iron structural frame in filled with straw bales and rendered with a breathable lime-based system - to build 'BaleHouse', a straw bale construction on the college campus. Monitoring work of the structure carried out by architectural researchers at the college has found that as well as reducing the environmental footprint, the construction offers other benefits, including healthier living through higher levels of thermal insulation and regulation of humidity levels.

Typically "field have been used, but recently higher-density "recompressed" bales (or "straw-blocks") are increasing the loads that may be supported.. Field bales might support around 900 kg per linear meter of wall (600 lb./ lin. ft.), but the high density bales bear up to 6000 kg per linear meter of wall (4,000 lb./lin.ft.), and more. The basic bale-building method is now increasingly being extended to bound modules of other oft-recycled materials, including tire-bales, cardboard, paper, plastic, and used carpeting. The technique has also been extended to bags containing "bales" of wood chips or rice hulls.

4. LOADING AND BEARING CAPACITY

In order to evaluate how a plastered-straw bale wall system can withhold compressive, lateral and shear loads, dual-sided plastered bales were placed under such loading conditions in WPI’s laboratory to mimic realistic scenarios of loading conditions that apply to actual straw bale structures.

Configurations of Testing Specimens, three-inch wide by six-inch tall cylinders were prepared to mold the specimen batches for compression testing. This test was intended to provide information on the strength variation of different render recipes, and to control the quality of the mixed renders. However, only 13 specimens were tested because one specimen, 4D, broke. The cylindrical specimens were placed under compressive loads under WPI’s Tinius Olsen hydraulic universal testing machine to evaluate the compressive strength of each plaster composition. This machine can test in either tension or compression mode. The operating software of this machine was Instron Partners software. The maximum loading capacity for this instrument was 400.000lbs. Four, dual-sided plastered bales were made to test the structural strengths of a plastered-straw bale system. Two bale specimens were configured to experience compression loads, while the other two specimens experienced either lateral or shear loading The plastered bales were placed on a supported platform and were vertically and uniformly distributed with a ½ inch steel plate. For the shear load test, the platform only supported half of the specimen while the bale was uniformly loaded. By setting up the test in this way, a shear plane was created, as shown in the figure, and the effect of the load on the shear plane was analyzed. For lateral load test the bale was turned so that the load was directly applied to the plastered side of the bale. An unflustered bale was also tested for compression strength so its results could be used to bench mark against the results from the loaded-plastered specimens. Figure 13 shows the actual specimen configurations for the three loading configurations.

5. THERMAL RESISTIVITY

Two entirely-plastered bales along with six plaster specimens were tested for thermal resistivity capacities. The test involved the specimens to be probed with thermal couples and be exposed to varying temperatures within WPI's environmental chamber. Data software recorded both the temperature within the chamber as well as the internal temperatures within the specimens to gauge how thermally resistant each specimen was under the environmental conditions. The trend of temperature change over time, the overall temperature change and the R-value for each specimen, was collected and analyzed. The R-values were to be calculated by the following equation:

Where:= change in temperature

Heat Flow per Unit Area= power of environmental chamber/ cross-section area of the chamber

A total of thirteen thermal couplings were used for this test; three per each bale, one for each cylindrical specimen, and one for control. For the cylindrical specimens, one thermal coupling was placed halfway in the specimen, which was approximately three inches deep. For the bale specimens, all three thermal couplings were placed half way down from the height of the bale, which was approximately ten inches, and half way in deep from the width of the bale, which was also approximately ten inches. In terms of spacing, one thermal coupling was placed half way in from the side of the bale, which was approximately 20 inches. The second and third thermal couplings were placed eight and three inches from the side of the bale. Figure 14 shows the setup of the test.

The dimensions of the environmental chamber were approximately ten feet long, by three feet high, by three feet wide. It was determined that the energy needed for powering the environmental chamber was 2000 waltz. The chamber was powered by three individual heaters that could be turned on and off manually at any time and. However, the regularity for the chamber to reach a specific range of temperature in a given time period was uncontrollable. Therefore, it was decided that the best approach to test for thermal resistivity was to set the chamber at its maximum temperature of about 40º C for 28 hours. This time frame would ensure that the thermal couplings would be able reach equilibrium as much as possible. After 28 hours, the heaters were turned off within the chamber, yet the data software still recorded the temperature changes within the specimens for an additional 32 hours as the chamber reached room temperature. This range of temperature change within the chamber, specifically within the given time frame of 60 hours, ensured that the specimens would be exposed to two varying temperature conditions. These conditions provided sufficient, qualitative results regarding the thermal resistivity of the specimens.

6. LIGHT-WEIGHT FRAME AND LOAD BEARING

Suitable up to three floors. It is also known as timber framework method in which firstly timber framework is prepared and in those frame only straw is installed. In this timber would be an additional material or any other framework material. In this frame should be provided for doors and windows. In this roof should be constructed at first only. One of the most important design features of a load bearing straw bale house is to distribute the loads as evenly as possible around the whole building. Never use point loads. Timber posts are located at corners and either side of window and door openings only, and are designed such that the timber wall plate at first floor and/or roof level can be slotted down into them once the straw is in place allowing for compression on the bales. Compression of the straw bale infill walls is essential for stability .To increase stability, the bales are pinned externally and the pins are secured onto the base and wall plate of the framework once all the settlement of the walls is complete. It is constructed in such a way that the wall plate and roof are kept 100mm above the finished straw wall height whilst the wall is being built allowing for compressive settlement of the straw wall once the bracing and props are removed.

ADVANTAGES

• The roof can be constructed before the straw is placed providing secure weather protection.

• Framework and posts can be constructed off site.

• Provides greater stability for window and door frames than in the load bearing style.

• Vastly reduces the amount of timber required compared to the more traditional post and beam method.

DISADVANTAGES

• It is more complicated than the Nebraskan style to construct.

• Greater technical ability is required to make the structure stable whilst the straw is being placed.

7. CONCLUSION

Instead of being unwanted and difficult to dispose of, rice straw would become a valuable commodity to be harvested for profit. 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. The emissions from eventual burning or decomposition of the straw are postponed. . Straw is produced by photosynthesis, a natural, non-polluting process fueled by solar energy. Straw is an annually renewable agricultural residue often considered a waste product. So it is environmentally friendly. The major physical components of an ideal passive solar design would include adequate thermal mass (to store and release heat of a 24-hour cycle) and an insulating exterior wrap to reduce heat loss to the outside. 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 isolative walls would greatly reduce heat loss by conduction. Straw bales on the outside, earth on the inside- we win, the planet wins. In this study describes briefly the utilization, applications of agro-wastes in construction industry. Agriculture is the most important economic activity of India and so in other developing countries. There has been a rapidly increase in the agro industrial field in last two decades which has caused substantial increases in the volume of agricultural residues of different types. In current shortage of wood and other building materials for ever rising increased housing requirements have created great interest in those agro-wastes. These agro waste materials reduced building cost. Utilization of agricultural wastes helps in environmental prevention and prevention of agriculture land.

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REFERENCES

1. Ferhat Ozdemir, Alperen Kaymakci, Nadir Ayrilmis "Physical, mechanical, and thermal properties of polypropylene composites filled with walnut shell flour" by in "Journal of Industrial and Engineering Chemistry" year 2012.
2. Amarnath Yerramala Ramachandrudu C, "Properties of Concrete with Coconut Shells as Aggregate Replacement", published in "International Journal of Engineering Inventions", year 2012.
3. Daniel Yaw Osei,"Experimental assessment on coconut shells as aggregate in concrete", in "International Journal of Engineering Science Invention Volume 2 Issue 5 May. 2013
4. Maninder Kaur, Manpreet Kaur, in "A Review on Utilization of Coconut Shell as Coarse Aggregates in Mass Concrete "International Journal of Applied Engineering Research, ISSN 0973-4562 Vol. 7 No.11,2012
5. Abdullah AA. Basic strength properties of lightweight concrete usingagricultural wastes as aggregates. In: Proceedings of international conference on low-cost housing for developing countries, Roorkee, India, 1984
6. Mannan MA, Ganapathy C. Engineering propersties of concrete with oil palmshell as coarse aggregate. Constr Build Mater 2002; 16:29–34.
7. Mannan MA, Ganapathy C. Concrete from an agricultural waste-oil palm shell (OPS). Build Environ 2004; 39:441–8.
8. Prof.Wakchaure M.R., Sapate S.V, Kuwar B.B. And Kulkarni P.S, Ccost Optimization of Reinforced Concrete Chimney. International Journal of Civil Engineering and Technology, 4(2), 2013, pp. 402–414.
9. Alengaram UJ, Jumaat MZ, Mahmud H. Ductility behaviour of reinforced palmkernel shell concrete beams. Eur J Sci Res 2008; 23(3):406–20
10. Mirza Shahab Husain, Anwar Ahmad, Samarul Huda and Mohd Asim, Cost Optimization of Concrete by Replacing Fine Aggregate with Walnut Shell Powder. International Journal of Civil Engineering and Technology, 8(3), 2017, pp. 82-89