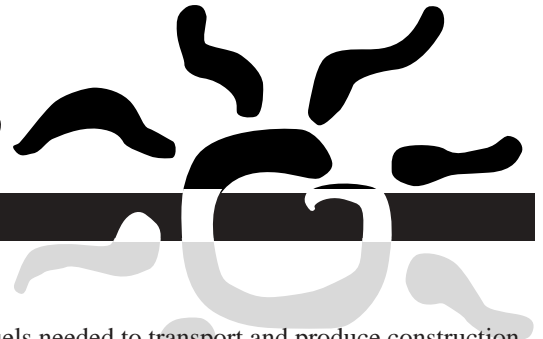


Straw Bale Construction



MIDWEST RENEWABLE ENERGY ASSOCIATION FACT SHEET

History

The first straw bale buildings were constructed in the treeless Sandhills of Nebraska, nearly 100 years ago. They were built out of necessity; straw was readily available and the buildings went up fairly quickly. The people who lived in the straw bale homes found them to be quiet, well insulated, and durable. Some of these homes are still standing today.

In recent years there has been renewed interest in straw bale construction. It has been fueled by growing concern about limited material and energy resources, increasing impacts of developments, and adverse health affects from buildings made with toxic materials.

Why build with straw?

Straw bale homes can be beautiful, comfortable, ecologically sound, and affordable. Bale construction allows for architectural flexibility and aesthetic features such as smoothed corners and rounded edges around doors and windows. When completed the walls resemble the thick stone walls of an old English cottage, or the natural walls of an adobe structure. Buildings can range from very simple structures to highly complex buildings with unique angles and arches.

The natural insulation of straw bale construction allows owners to easily maintain comfortable indoor temperatures year round. Straw bale buildings have significantly higher R-values than conventional construction. Depending on the type of straw used and the thickness of the walls, straw bale walls can range from an R-32 to R-42. That is two to three times better than the walls of most conventional homes. The insulating qualities of the bales also serve to provide a natural sound barrier for the home.

Straw bale construction is also more environmentally friendly than traditional forms of construction. Straw is an annually renewable resource that, in many areas, is readily available. Using locally grown straw reduces the amount

of fossil fuels needed to transport and produce construction materials. It also keeps straw (which is typically considered an unwanted by-product of grain production) out of the waste stream. In many areas of the U.S., straw is disposed of through burning, adding tons of carbon monoxide to the atmosphere.

The affordability of straw bale buildings varies by region, climate, the labor contributed by the owner, and permit costs. Typically, a straw bale home that incorporates owner/builder labor for wall assembly and finish work will cost between \$20 to \$50 a square foot.



MREA Model Home, Amherst, WI, 1999
Non-load bearing wall

Types of Straw Bale Construction

There are two primary forms of straw bale construction, load bearing and non-load bearing.

In load bearing structures, the weight of the roof and lateral shear pressures are actually carried by the bales and the plaster which encases them. This is an easy load for straw bales each of which can withstand up to 15,000 pounds of vertical pressure when laid flat.

In non-load bearing straw bale construction a frame is first built out of wood, and the bales serve as an in-fill insulation. The advantage of this type of structure is that inspection officials recognize and understand this process, and it provides a roof structure under which to build up straw bale walls.

Overview of the Process

Foundation

Most structures begin with some type of foundation, the most common being a poured shallow concrete footing with rigid foam insulation for frost protection. Many other types of footing configurations have also been successfully used.

For a non-load bearing structure, the next step is the framing. Framing options include; post and beam, post and header, and a pole building design. The framing goes up first to support the roof structure. For load bearing structures, this framing step is eliminated and you can get right on to stacking bales.

Bales

As the first step in stacking the bales, a water barrier must be placed between the first course of bales and the foundation or bottom framing structure. Then the bales are stacked. A stagger stacked configuration is most commonly used. Once the bales are all in place, poultry netting is attached to the bales before the plaster coat, to help secure the bales and add rigidity for the plastering process, as well as to add reinforcement to the plaster coat.

Plastering

Several different types of plaster can be used on straw bale buildings. They include a simple earthen plaster consisting of sand and clay, soft plasters which use lime or gypsum, and hard plasters using a portland/sand/lime mix. Typically two to three coats of plaster are applied. Fibers can be added to the plaster coats for strength. While plasters are usually applied by hand, mechanical sprayers can be used.

Frequently Asked Questions

What is straw?

Straw is the stalk of a grain plant, from which the seed head has been harvested. Many different types of grain can be made into straw bales - wheat, rye, rice, oats, or barley, to name a few. The stalk is harvested and tied into bales, with either 2 or 3 strings, or wires. Straw bales are different from hay bales. Straw is higher in silica content and lower in organic matter.

What about fire safety?

Over the past twenty years, fire safety testing of straw bale structures has been done by several different organizations. In these tests, plastered straw bales were found to be better than most conventional building materials for their fire resistance.

Three elements are necessary for fire: oxygen, a combustible material, and something to ignite the combustible material. In this type of construction, the straw is packed densely which greatly reduces the amount of oxygen available. The bales are coated with one inch or more of plaster on both sides keeping any source of ignition away from the straw.



MREA Strawbale Project, Northland College, 1999

Is moisture or humidity a problem?

It is important to keep the moisture in the bales low. In order to achieve this the bales must be kept dry. Bale walls are kept up off the ground by stacking them on top of a foundation. Large overhangs help to drain rain water away from the base of the building. The bales are sealed carefully with plaster to keep out moisture.

What about insects or pests?

As with conventional construction, a properly sealed wall will keep a home pest free. Also, being low in organic matter and high in silica content, straw has no nutritional value.

What about building codes?

It is common for there to be problems obtaining building permits for straw bale structures, especially if there is no history of straw bale buildings in the area. The best process for solving this problem is to learn as much as possible about straw bale construction and make contact with people who have experience building with bales. Then provide the local officials with as much information as possible with respect to straw bale fire and structural testing. It will be easier to secure a permit for a structure that uses straw bales as an in-fill for post and beam construction, rather than a load bearing wall structure.

References

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- Serious Straw Bale*, Lacinski, P. & Bergerson, M. 2000, Chelsea Green Publishing (Available through MREA)
- The Straw Bale House*, Steen, A.S., Steen, B. & Bainbridge, D. 1994, Chelsea Green Publishing. (Available through MREA.)

Workshops & Organizations

- Midwest Renewable Energy Association, 7558 Deer Rd., Custer, WI 54423, 715-592-6595, www.the-mrea.org.
- Solar Energy International. PO Box 715, Carbondale, CO 81623, 970-963-8855, www.solarenergy.org.
- Out On Bale, 1037 E. Linden St., Tucson, AZ 85719.

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